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ProMAC 2017

Detailed Program

Wednesday, 29 November 2017

Time	Room	Program	MC
9:30-17:00	Registration Desk at The H4 Hotel München Messe	Registration	
10:00-10:30	Room A-D	**Opening Ceremony**	MC: Ms. Kyoko Mori (Fujitsu Learning Media Limited)
10:30-11:15	Room A-D	**Keynote 1** Acquiring Information Systems in northernSCOPE way **Mr. Pekka Forselius** CEO of 4SUM Partners Ltd, a Senior Advisor of the Finnish Software Measurement Association FiSMA the Immediate Past President of the International Software Benchmarking Standards Group	MC: Ms. Keiko Sakagami (Hitachi Information Academy Co., Ltd.)
11:15-12:00	Room A-D	**Keynote 2** PM4.0 - project management for the next era **Mr. Till H. Balser** Founder of Tiba Managementberatung GmbH	MC: Mr. Masahiro Ueno (FUJITSU LIMITED)
12:00-13:00		**Lunch and Networking**	

	Room A	Room B	Room C	Room D	Room E	Room F	Room G	Room H	Room I
	Ms. Linda Eter (Tiba Managementberatung GmbH)	Mr. Paul Hodgkins (Paul Hodgkins Project Consultancy)	Dr. Ehssan Sakhaee (University of Sydney)	Mr. Alexander Koschke (Tiba Managementberatung GmbH)	Mr. Kazunori Shichida (IBM Japan, Ltd.)	Mr. Reinhard Wagner (IPMA)	Mr. Yoshida Naoto (Hitachi Ltd.)	Ms. Satsuki Shimada (Fujitsu Quality Laboratory ltd.)	Ms. Christine Scholz (IBM Germany)
13:00-13:20	~~A01 Whole life cycle cost analysis and net present value: A case study of residential buildings in Al Ain, UAE Ms. HebatAlla Taha Taha (British University in Dubai)~~	B01 Wagile: Combining Waterfall and Agile Methods, its Advantages and Challenges Mr. Ikufumi Yamazaki (IBM Japan Services Company Ltd.)	C01 Reducing project risks in technical aspects by Technical PMO activities Mr. Yasushi Fukuda (NEC Corporation)	D01 Proposal for Solution business model for JOC(Japan-oriented company) Lease Company in ASEAN Nations Mr. Kazutaka Suzuki (FUJITSU LIMITED)	E01 Managing Environmental Public Policy Project and Integration of Risk Management as a New Paradigm - the Case of South Africa Prof. Pantaleo Mutajwaa Daniel Rwelamila (University of South Africa)	F01 Case Studies of Scope Management for Regional Shared Accounting System Implementation Mr. Koichi Inose (NTT DATA Corporation)	G01 Proposal of quality visualization measures in Agile development Mr. Yasuto Nishiwaki (Hitachi, Ltd.)	H01 Study of Management to Improve R&D Efficiency at the National Level Dr. Akira Yamazaki (Chiba Institute of Technology)	I01 A Case Study of Super-Upstream Process Leading System Development to Success Mr. Shinya Onoda (Hitachi Solutions West Japan, Ltd.)
13:20-13:40	A02 A Consideration of Branching Strategies for Distributed Version Control System Mr. Yusuke Sato (Hitachi, Ltd.)	~~B02 Quantitative risk analysis process of oil and gas upstream service contracts Dr. Reza Dehghan (Islamic Azad University)~~	C02 A Study of Effective Team-Development Activities for a Multinational Virtual Team Mr. Michio Sekido (FUJITSU LIMITED)	D02 Introduction of management method suitable for soil pollution control project Dr.Toshiki Shimoike (Kokusai Kogyo Co., Ltd.)	E02 Consistency among Strategies, Innovation Models and Project Styles Prof. Hiroshi Kubo (Chiba Institute of Technology)	F02 Visualizing Organizational Skill for Managing IT Projects -Capability Maturity Model Targeting to Prevent Serious Problem Projects- Dr. Hiroshi Ohtaka (IT Mieruka Research)	G02 Project Characteristics for Agile Development with the Diamond Framework Mr. Takashi Sato (IBM Japan, Ltd.)	H02 Project Monitoring for Detecting the Changing Tide of Baseline to Prevent the Occurrence of Unprofitable Projects Mr. Katsuhiro Nitta (NEC Corporation)	I02 Applying Multinational PM Knowledge to IT Project Management in Exponential Society Mr. Hiroyuki Endo (NTT DATA Corporation)
13:40-14:00	A03 The Points of Lead Project to Catch Up on Requirement Changes Mr. Kazuto Nakamura (FUJITSU LIMITED)	B03 Process Improvement with Model Based Systems Engineering Framework Mr. Toshinori Ouchi (Hitachi Industory & Control Solutions, Ltd.)	C03 Effect of Power Distance on Project Management Motivation in Thailand Dr. Ehssan Sakhaee (University of Sydney)	D03 A Case on an Activity to Spread a Project Management Tool into a Corporation - Acceleration of Innovation - Mr. Kazutoshi Shimanaka (NTT DATA Corporation)	E03 Proposal of Anti-pattern Utilization Method for Loss-cost Reduction Mr. Ryu Ebisawa (Hitachi, Ltd.)	F03 A Study of Efficient Team Management Configuration for CSIRT Deployment Mr. Hayato Oba (Chiba Institute of Technology)	G03 A New Way of Managing the Unexpected in Projects? Prof. Iris Schirl-Boeck (University of Applied Sciences BFI Vienna)	H03 Project management using CMMI Mr. Tomonori Matsunami (SOMPO systems Inc.)	I03 The Effective Way and the Practice of Program Management Mr. Keiichi Minakawa (IBM Japan, Ltd.)
14:00-14:20	A04 Trend Analysis on Expectation to Project Management Professional School: Based on Text Mining Ms. Kiyomi Miyoshi	B04 Case Study of Educating Software Test Techniques to IT Engineers in Myanmar Mr. Yoshinobu Machida (NTT DATA Corporation)	C04 The Effect about Implementation of the Project Management Case Training Mr. Toru Tsuda (Hitachi Solutions West Japan, Ltd.)	D04 Project Management 4.0, beyond "classic vs. agile" Mr. Sebastian Weber (Tiba Managementberatung GmbH)	E04 A study for apply and consolidate project management skill to PBL in university education Mr. Minoru Kinoshita (IBM Japan, Ltd.)	F04 Project Management Method of Constriction for Large scaled Submarine Telecommunication System Mr. Katsuji Yamaguchi (NEC Corporation)	G04 A Study of the Lessons based on Historical Sub-Leaders from the Point of Project Management Ms. Nana Ueno (Chiba Institute of Technology)	H04 Leadership styles of project management on megaprojects Ms. Sandra Mišić (IPMA)	I04 The Value Creators: a new educational concept to address wicked challenges Dr. Liesbeth Rijsdijk (Windesheim University)
14:20-14:50	Eventcenter	**Coffee Break and Networking**							

	Room C-D	Room E	Room F	Room G	Room H	Room I
	14:50-16:30 **World Cafe** MC: Ms.Linda Eter (Tiba Managementberatung GmbH) MC: Mr. Reinhard Wagner (IPMA)	Mr. Anurag Jain (NEC Technologies India Private Limited)	Mr. Yoshinobu Machida (NTT DATA CORPORATION)	Mr. Makoto Yamasaki (NTT DATA CORPORATION)	Mr. Tetsuro Goto (IBM Japan, Ltd.)	Mr. Phuong Thanh Pham (NEC Vietnam Co., Ltd.)
14:50-15:10		E05 A Case Report of Innovative Human Resource Development by Putting the Skill Map to Practical Use Effectively Ms. Mayuko Torigoe (NTTDATA SYSTEM TECHNOLOGIES INC.)	F05 The method for visualizing variance of software development project in real time Mr. Takeshi Oshima (Fujitsu Quality&Wisdom Limited)	G05 Development of a Lecture in Three Frames Based on an ICE Rubric to Acquire Application Capability Dr. Hironori Takuma (Chiba Institute of Technology)	H05 Is it possible to prevent behavioral complexity in project? A study on prevention of behavioral complexity by authentic leadership approach in creative projects. Mr. Fahri Akdemir (IPMA)	I05 The IT Human Resource Development and Improving Development Efficiency by Improving on the Education in Project Mr. Masakazu Hashizume (Hitachi, Ltd.)
15:10-15:30		E06 Project Management with an Emphasis on Customer Satisfaction Mr. Satoshi Horie (Hitachi, Ltd.)	F06 Project Management Method for Short-term Large-scale and Complex IT Development of Information System for Financial Regulation with Deadline of Compliance Mr. Kazunori Shichida (IBM Japan, Ltd.)	~~G06 Projects diagnosis & performance improvement; Fundamentals & Solutions Mr. Ali Kanaani (Projects Improvement & Development Clinic)~~	H06 Study on Applicability of Project-Behavior Simulation System as a Research Platform for Project Management Prof. Koji Okada (Tokyo City University)	I06 Managing Personal Software Process Education Course Based on Motivation Process Model by Using System-Theoretic Method STAMP/STPA Prof. Shigeru Kusakabe (University of Nagasaki)
15:30-15:50		E07 Ultra short-term development realized by reducing requirement and improving system Introduction training for customers without IT department. Ms. Kazuko Matsumoto (FUJITSU LIMITED)	F07 Lubricate the Team Management with Non-Linear Progress Schedule Ms. Natsumi Takahashi (Hitachi, Ltd.)	G07 Use of CCPM theory for the purpose of optimizing the organization Mr. Tomoki Katayama (FUJITSU LIMITED)	H07 Case Study of Structure of Development System and Operation to Meet a Request of Cost Reduction by 30% Mr. Keisuke Ishigou (NTT DATA SYSTEM TECHNOLOGIES INC.)	~~I07 Proposal to define "Risk Border" as a risk attitude metric to prevent catastrophic situation Mr. Kazuro Haga (IBM Japan, Ltd.)~~
15:50-16:10		E08 Project management technique in the AI project Ms. Naoko Serai (IBM Japan, Ltd.)	~~F08 Project Finance through the Application of Islamic Securitization Mr. Javad Hadadi (Tarbiat Modares University)~~	G08 Necessary Considerations for the Successful System Development Project Mr. Hikaru Furusawa (NTT DATA Corporation)	H08 Risk Management for Long Term Off-shore Outsourcing IT Projects - Introducing the Risk Control Process with Risk Classification - Mr. Toru Hanayama (FUJITSU LIMITED)	I08 Estimation Method of Economic Batch Size in Iterative Development Mr. Kazuyuki Yaguchi (Chiba Institute of Technology)

Time	Room	Program	MC
16:30-17:00	Eventcenter	**Short Break**	
17:00-17:45	Room A-D	**Special Lecture** Project Manager to Project Leader - The Difference that makes the Difference **Mr. Paul Hodgkins** Executive Director of Paul Hodgkins Project Consultancy Former Siemens PM@Siemens Programme Executive for North West Europe	MC: Dr. Akira Yamazaki (Chiba Institute of Technology)
18:00-19:30	Eventcenter	**Welcome Reception**	MC: Mr. Jiro Nonoyama (IBM Japan, Ltd.)

ProMAC 2017

Detailed Program

Thursday, 30 November 2017									
9:00-15:00	Registration Desk at The H4 Hotel München Messe				Registration				
9:20-10:05	Room A-D				**Keynote 3** Business and Digital Transformation by Cognitive Computing **Dr. Kazushi Kuse** VP, CTO of IBM Japan, Ltd.				MC: Mr. Jiro Nonoyama (IBM Japan, Ltd.)
10:05-10:40	Eventcenter				Coffee Break and Networking				
	Room A	Room B	Room C	Room D	Room E	Room F	Room G	Room H	Room I
	Ms. Sandra Mišić (IPMA)	Mr. Hiroki Takei (IBM Japan, Ltd.)	Prof. Lukas Rohr (Bern University of Applied Sciences)	Dr. Vered Holzmann (Tel Aviv yaffo Academic College)	Mr. Laurent Kummer (Six-Sig Management)	Mr. Clément Paul Victor Darfeuille (The Oxford Group)	Prof. Iris Schirl-Boeck (University of Applied Sciences BFI Vienna)	Mr. Toru Hanayama (FUJITSU LIMITED)	Prof. Pantaleo Mutajwaa Daniel Rwelamila (University of South Africa)
10:40-11:00	A10 A Study of Quality Assurance on Applying Package and Building IT Infrastructure Mr. Naoki Tsujikawa (NTTDATA Customer Service corporation)	B10 The problem of missing security functionality Ms. Päivi Brunou (Nixu Oyj Engineering)	C10 The 3-Steps Approach for preventing from the leak of the requirements in system reconstruction Mr. Shingo Asai (FUJITSU LIMITED)	D10 Proposal of improvement about education for younger aged PM used by communication model - Improvement parts of communication which are analyzed by survey to college students - Mr. Takuya Nomoto (Hitachi Solutions West Japan, Ltd.)	E10 Effect of IBM Quality Inspection in project management Mr. Masahiro Sasaki (IBM Japan, Ltd.)	F10 International Project Management Co-operation in the Postal Sector: the example of Deutsche Post/DHL and South African Post (SAPO) Mr. Amin Saidoun (IPMA)	G10 Implementation of the web-based and face-to-face trainings on project risk management for the local subsidiaries Mr. Hidechika Matsumura (NEC Corporation)	H10 Program/Project Management in Higher Education Considering the Self-Management Behaviors of Team Members - Observations from an Educational Approach with a University Student Team - Ms. Haruka Kawahara (Chiba Institute of Technology)	~~I10 Risks Causing Delays in Upstream Construction of Gas Projects: an Australian Perspective Ms. Munmun Basak (Queensland University of Technology)~~
11:00-11:20	A11 Customer-Oriented Approaches to PMO in Southeast Asia JOC Project Ms. Maimi Takahashi (FUJITSU LIMITED)	B11 Research on the Effects of Deliverables Management utilizing Integrated Repository at a Large-scale Project Mr. Tomohiro Akita (IBM Japan, Ltd.)	~~C11 Waste identification and analysis for project management performance improvement Dr. Sherif Mostafa (University of South Australia)~~	D11 Application Example of SCRUM Development Method in the Integration of Intra-company Business Systems Dr. Fumihiro Odaka (NTTDATA INTELLILINK)	E11 A Study of the Management for a large number of Stakeholders Mr. Shinsuke Ohno (Hitachi, Ltd.)	F11 An Effective Way to Use the Process Metrics and the Product Metrics for the Software Quality Control Mr. Hitoshi Furumura (NEC Corporation)	~~G11 Framework for increase empowerment in project training Mr. Ali Kanaani (Projects Improvement & Development Clinic)~~	H11 Effective Resource Planning Method to Mitigate Risk at Project Mr. Kengo Kumagae (IBM Japan, Ltd.)	I11 Analysis of Requirements Elicitation Approaches based on PRINCE Model Mr. Yusuke Makino (Chiba Institute of Technology)
11:20-11:40	A12 Survive with Diversity and Millennial generation Mr. Junji Taguchi (IBM Japan, Ltd.)	B12 Managing Quality by Checking the Completeness of Customer Requirements from Initial Phases to the Test Phase Ms. Saori Kanae (Hitachi, Ltd.)	C12 Rapid UX design process for planning phase in SI projects Ms. Haruka Yoshida (NEC Corporation)	D12 Information Systems Project Managers: Professionals or Managers? Dr. Vered Holzmann (Tel Aviv yaffo Academic College)	E12 Adaptation of Large-scale Scrum Methodology for development of Internet Banking system Mr. Suzuki Yuya (NTT DATA Corporation)	F12 A Study of Project Failure Attribution Analysis based on Morphological Analysis Prof. Shigeaki Tanimoto (Chiba Institute of Technology)	G12 What a player-manager can learn from project management in organizational management Mr. Masahiro Kamiya (Trio System Plans Co., Ltd.)	H12 Challenges for Projects and Project Management in Agrifood Sector Ms. Ana Teresa Herrera Reyes (Polytechnic University of Madrid)	I12 "Monozukuri Dojo" for launching system development project Ms. Haruka Takahashi (Hitachi Systems, Ltd.)
11:40-12:00	~~A13 A Model for Appropriate Allocation of Project Managers to Megaprojects, Case Study: The Iranian Offshore Engineering and Construction (IOEC) Company Dr. Reza Dehghan (Islamic Azad University)~~	B13 Proposal on a Quality Evaluation Method by Data Modeling Method in a Large Project Mr. Hideomi Torii (NTT DATA Corporation)	C13 Construction of Check List for the purpose of Risk Management of Service Business Mr. Yoshinobu Uchida (Hitachi, Ltd.)	D13 A case study for young PM to become the Versatilist on a Small-scale ICT System Development Project Mr. Takeshi Matsubara (IBM Japan, Ltd.)	E13 Immune mechanisms in project management Prof. Sergiy D. Bushuyev (Kiev National University of Construction and Arhitecture)	F13 Integrated Management in Municipal Backbone System Construction Ms. Miyako Nagaoka (Hitachi Systems,Ltd)	G13 Proposal of Resource Management Indicator in EVM Mr. Yuki Konno (Chiba Institute of Technology)	H13 Improving the quality of installation of new client computers utilizing the 'front-loading' approach Ms. Nodoka Sakashita (NEC Nexsolutions, Ltd.)	I13 Role of Customer Orientation in IT Program Management Mr. Akihiko Sekiguchi (FUJITSU LIMITED)
12:00-13:00					Lunch and Networking				
	Room A	Room B	Room C	Room D	Room E	Room F	Room G	Room H	Room I
	Mr. Pekka Forselius (4SUM Partners Ltd)	Ms. Sandra Mišić (IPMA)	Dr. Jesús Martínez-Almela (IPMA)	Mr. Amin Saidoun (IPMA)	Mr. Paul Hodgkins (Paul Hodgkins Project Consultancy)	Ms. Linda Eter (Tiba Managementberatung GmbH)	Dr. Olena Verenych (Kyiv National University of Construction and Architecture)	Dr. Alexandra Tenera (Universidade Nova de Lisboa)	Mr. Reinhard Wagner (IPMA)
13:00-13:20	A14 The Method of using "Carrot-and-Stick" for Projects Recovery role sharing between "PM's Powerful Leadership" and "PMO's Followership and Servant Leadership" Mr. Hideki Unai (Fujitsu Broad Solution & Consulting Inc.)	B14 Organization Attribute Optimization of International Knowledge Transfer —Two-point Comparison of Software Development Organization— Mr. Tetsuro Goto (IBM Japan, Ltd.)	C14 Project Management for ID Projects: Comparative Study on Japan's ODA and ADB Projects in Indonesia Mr. Masatoshi Kaimasu (Kobe Women's University)	D14 Cases of Visualization of Project Situation and Realization of Instant Information Sharing in Large Scale Projects Mr. Satoshi Matsuo (NTT DATA Corporation)	E14 Key to Success of the Project to Streamline and Optimize Mission-Critical IT System Mr. Masahiro Kobayashi (Hitachi Systems, Ltd.)	F14 Project's Time Contingency Estimation Model Using CVaR Dr. Ken-ichi Suzuki (Tohoku University)	G14 Case Study Analysis of Unprofitable Projects - Common Errors in Estimating Productivity - Mr. Taro Harayama (NTT DATA i Corporation)	H14 Competency breakdown structure for managing intercultural issues in international project teams Ms. Olha Mikhieieva (Kyiv National University of Construction and Architecture)	I14 Reverse globalisation -Impacts and opportunities in IT outsourcing industry Mr. Anurag Jain (NEC Technologies India Private Limited)
13:20-13:40	~~A15 Predicting the timing of delivering major project deliverables Dr. Reza Dehghan (Islamic Azad University)~~	B15 Quantitative Risk Management Method for System Development Projects Dr. Akihiro Hayashi (Onosokki)	C15 A Study of Important Points about Operational Design in Information Systems - The Sensible Suggestion Presented from IT Service Manager to Development PM - Mr. Akihiro Mitsuhashi (NTT DATA Corporation)	D15 Application of Enterprise Agile Development to an Insurance Company Mr. Ken Ozawa (FUJITSU LIMITED)	E15 How to systematically Learn Lessons from projects: the paradigm of Project Reviews Mr. Clément Paul Victor Darfeuille (The Oxford Group)	F15 How to control a surmise which is important in appropriate project management Mr. Takayuki Shimojima (IBM Japan, Ltd.)	G15 Proposal of Evaluation and Improvement Method of Presentation Skills Mr. Seiya Kato (Chiba Institute of Technology)	H15 Comparative Study of Description Method for Business Process Visualization Mr. Tetsu Saito (Hitachi Industory & Control Solutions, Ltd.)	~~I15 learning environment design in home education - Report introducing Lessons Learned System design- Mr. Keitaro Hidaka~~
13:40-14:00	A16 A Consideration of Relationship between Team Management Efforts and Performance of Development Members. Mr. Shinya Hirachi (Hitachi, Ltd.)	B16 Secure Mobile Money System for Myanmar Ms. Hnin Mya Mya Moe (Kobe Institute of Computing)	C16 How to exploit the strength of the architect in system development projects - an instruction manual for project managers Mr. Takumin Sugimoto (IBM Japan, Ltd.)	D16 Probabilistic Risk Assessment for Project Plan and Project Manager Dr. Naoki Satoh (Osaka Medical and Pharmaceutical University)	E16 Ukeoi Promotion and its Relation to Employees' Mindset Development and Company's Growth Ms. Taeko Hayashi (NTT DATA SYSTEM TECHNOLOGIES INC.)	F16 Challenges and Measures for Managing Agriculture ICT Project in Global Market Mr. Kohei Kanazawa (NEC Solution Innovators, Ltd.)	G16 Redesigning Datacenter Business Considering the Characteristics of the Business Sites for Smooth Nearshoring Ms. Mizuho Sato (Fujitsu Broad Solution & Consulting Inc.)	H16 Risk Assessment in the Online-Condition Monitoring System Dr. Masahiro Yokoyama (Polytechnic University)	I16 Consideration of the Improvement in a Development Organization Based on CMMI Process Diagnosis Mr. Norihiro Kambara (OMRON Corp)
14:00-14:20	A17 An Improvement Case of the Human Resource Management for Information System Infrastructure by Applying the Rubric Mr. Naohiro Washio (NTT DATA Corporation)	B17 Integration of Agile Development Methodology and Project Management Tool Mr. Teruhide Kusaka (Hitachi, Ltd.)	C17 The Lean Project Manager Mr. Laurent Kummer (Six-Sig Management)	D17 A study on restructuring uncontrolled project as a project manager Mr. Go Onitsuka (IBM Japan, Ltd.)	E17 A Study for Improving Accuracy of Risk Management Education Based on Research of Project Risk Perception. Dr. Chika Yoshida (Kobe Institute of Computing)	F17 A Consideration of Systemization of Change Impact Analysis on Software Maintenance Process Mr. Takaya Morita (Hitachi, Ltd.)	G17 Competencies as an instrument for the blended mental space development of a project Dr. Olena Verenych (Kyiv National University of Construction and Architecture)	H17 Management Support for Stakeholder Engagement Using Wants Chain Analysis Mr. Yuki Takeyama (Chiba Institute of Technology)	I17 Team Building Methodologies in Global Project by Using "Liaison Manager" Mr. Hiromitsu Endo (FUJITSU LIMITED)
14:20-14:50	Eventcenter				Coffee Break and Networking				
14:50-15:35	Room A-D				**Keynote 4** The role of project management in the world of tomorrow (Industry 4.0) **Prof. Dr.-Ing. Helmut Klausing** President of GPM Deusche Gesellschaft für Projektmanagement e.V.				MC: Mr. Katsuhiro Nitta (NEC Corporation)
15:35-16:20	Room A-D				**Keynote 5** Project management across cultures on the example of a multinational EU-Research-Project for "An Open Platform for the Smart City" **Prof. Dr. Lukas Rohr** Director Engineering and Information Technology, Bern University of Applied Sciences				MC: Mr. Kazutoshi Shimanaka (NTT DATA Corporation)
17:00-	Move to "Ratskeller München" by pick-up bus								
18:30-20:30	Ratskeller München				ProMAC Gala Dinner				MC: Ms. Natsuko Sato (Hitachi Ltd.)

ProMAC 2017

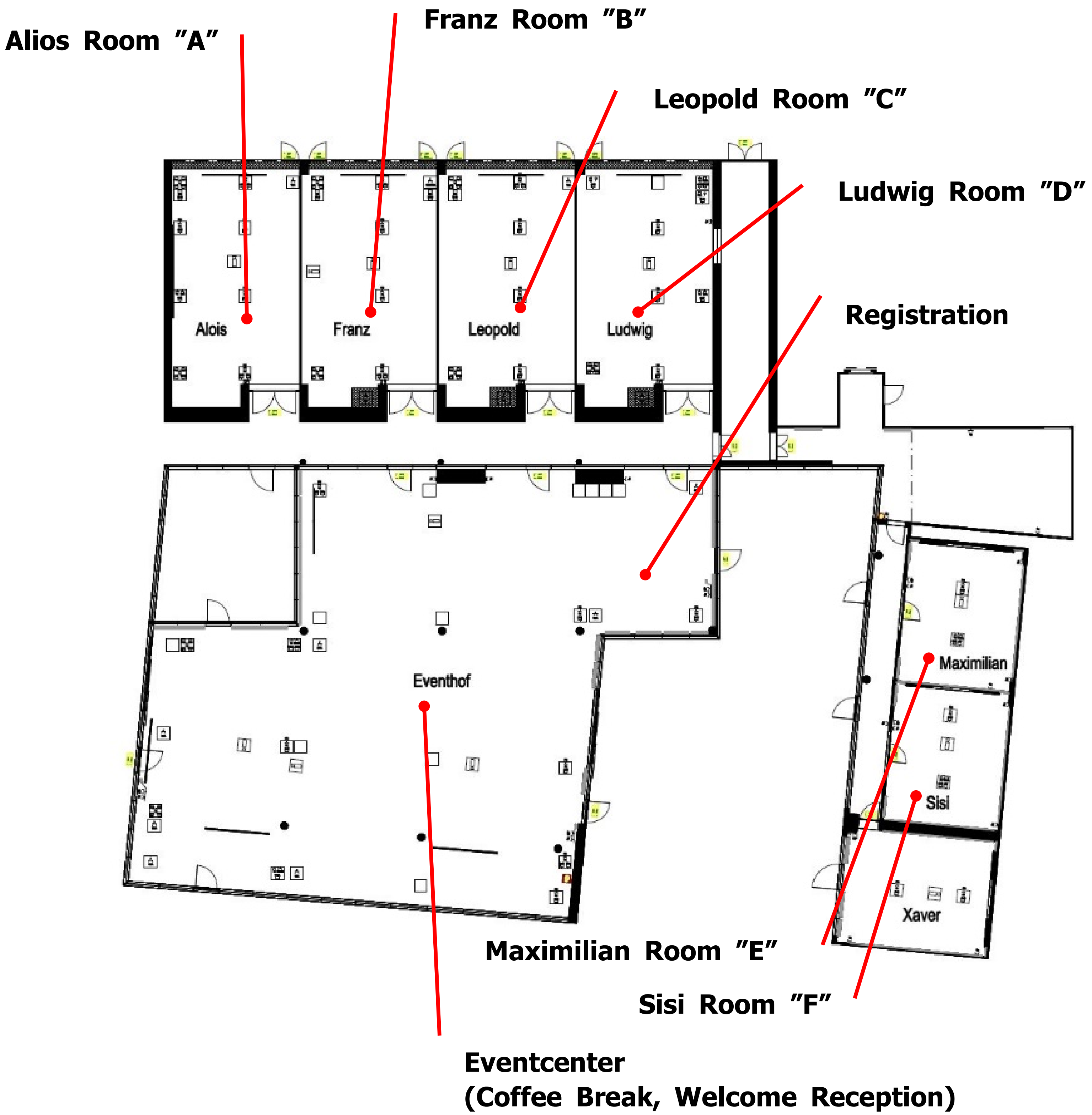
Detailed Program

Friday, 1 December 2017									
9:00-12:00	Registration Desk at The H4 Hotel München Messe				Registration				
	Room A	Room B	Room C	Room D	Room E	Room F	Room G	Room H	Room I
	Mr. Pekka Forselius (4SUM Partners Ltd)	Ms. Päivi Brunou (Nixu Corporation)	Mr. Satoshi Matsuo (NTT DATA CORPORATION)	Dr. Alexandra Tenera (Universidade Nova de Lisboa)	Dr. Jesús Martínez-Almela (IPMA)	Mr. Amin Saidoun (IPMA)	Ms. Natsuko Sato (Hitachi Ltd.)	Prof. Hubertus C. Tuczek (University of Applied Sciences Landshut)	Ms. Chie Ishii (NEC Solution Innovators ,Ltd)
9:10-9:30	A18 The Recommendations for Next Generation Offshore Development Mr. Yuji Osaki (IBM Japan, Ltd.)	B18 A STUDY ON THE RISK MANAGEMENT BY APPLYING TEXT-MINING TECHNIQUE Prof. Nobuyuki Suzuki (Toyo University)	C18 Challenge to nation-wide and ultra-short-term project in a rapid growing market Mr. Phuong Thanh Pham (NEC Vietnam Co., Ltd.)	D18 Would "Few Software Designer and Many Programmer Project" Fail? Mr. Toichiro Susumago (Japan Advanced Institute of Science and Technology)	E18 A Study of Risk Assessment for Supply Chain Model in Industry 4.0 Ms. Waraporn Khunrak (Chiba Institute of Technology)	F18 Lessons Learnt obtained from Process Improvement Activities at Southeast Asian Countries Mr. Masaki Kigure (NTT DATA Corporation)	G18 Understanding Project Culture and its implications on Project Management Ms. Linda Eter (Tiba Managementberatung GmbH)	H18 Work Engagement Research on Information Technology Engineer based on Positive Psychology Ms. Keiko Sakagami (Hitachi Information Academy Co., Ltd.)	I18 Reduction of marine operational cost by mixed loading in a submarine cable project at Western Pacific region Mr. Hiroshi Kawakami (NEC Corporation)
9:30-9:50	A19 Application of Agile Development to Parts of System Development having Complex Data Requirements for the Purpose of Inhibiting Rework Mr. Kouzou Aoyagi (Hitachi Government and Public Sector Systems, Ltd.)	B19 The Effective Approach to Utilize Experts at the Initial Evaluation Mr. Manabu Yamamoto (NTT DATA Corporation)	C19 How Scrum Improves Productivity of System Development Project Mr. Hiroshi Tomita (IBM Japan, Ltd.)	D19 Public Private Partnership Projects Failure Syndrome: The Paradox of Critical Success Factors (CSF) - the case of South Africa Prof. Pantaleo Mutajwaa Daniel Rwelamila (University of South Africa)	E19 Process Improvement Methodology for geographically-distributed development. Mr. Junichi Watanabe (NEC Corporation)	F19 A Case Study on the Measurement and Visualization of the Maturing Process of Team-Approached Medicine Prof. Tomoko Yamamoto (Kawasaki University of Medical Welfare)	G19 Operation method using evaluation models of procurement specifications Dr. Hideki Nakakita (Next Foundation Co., Ltd.)	H19 Theoretical framework for integrated stakeholder and risk management in Indian Smart Cities Mr. Omar Bashir (RICS School of Built Environment)	I19 Practical use of ATA to Understand Member's Characteristic in Team Building Mr. Ryuichi Shimura (FUJITSU SOCIAL SCIENCE LABORATORY LIMITED)
9:50-10:10	A20 The communication challenges for overseas project management in Japanese multinational companies Mr. Mauricio Eigi Tamashiro (NEC Corporation)	B20 A consideration on conflict process based on collectivism Mr. Hidekazu Kondo (University of Tsukuba)	C20 3D Application for Dependability Assessment Based on Three Noisy Models for Cloud Computing Prof. Yoshinobu Tamura (Tokyo City University)	D20 Case Study for Managing Stakeholders in Large Scale System Integration Mr. Hiroyuki Nakamura (NTT DATA Corporation)	E20 Localized household project management: A technology for sustainable municipal development? Dr. Leonid A. Shafirov (Southern Federal University)	F20 Importance of cybersecurity regarding PM Mr. Takeo Funakoshi (NEC Corporation)	G20 On-site Quality Improvement at Multiple Parallel Development Projects Mr. Jiro Nonoyama (IBM Japan, Ltd.)	H20 Fostering nascent intrapreneurs' community Ms. Yuko Hatanaka (Fujitsu Broad Solution & Consulting Inc.)	I20 Predictive Detection of Unprofitable Projects with AI Ms. Ayako Kouno (Hitachi Solutions,Ltd.)
10:10-10:30	A21 Increasing Uncertainty - The Essential Need for Competencies beyond Planning and Controlling Ms. Astrid Kuhlmey (Sicher durch Veranderung)	B21 Speed up and coordinate project's supply chain by using harmonized configuration management system: an application to thermal power plant projects Mr. Mojtaba Tajik Ghaleh (Mapna Group Investment Projects)	C21 Management for the parallel system development in multiple projects Mr. Satoshi Sawada (Hitachi, Ltd.)	D21 A novel framework of the video advertising business and its function Prof. Motoi Iwashita (Chiba Institute of Technology)	E21 Building a migration organization and communication management in large scale overseas SaaS project Mr. Takahiro Tampo (IBM Japan, Ltd.)	F21 The project successes under Northeast Asia corporate governance Mr. Sungwoong Park	G21 Redefining Project Management - A Design Thinking Approach Mr. Arijit Kundu (NEC Technologies India Private Limited)	H21 Applying Service Design Methods in Agile Software Development Projects - Process Framework and Case Examples - Mr. Makoto Yamasaki (NTT DATA Corporation)	I21 Customer-Driven Government: Using Data and Open Source Software to Improve Service Delivery in Rwanda Ms. Maryse Bonhomme (Kobe Institute of Computing)
10:30-11:00	Eventcenter				Coffee Break and Networking				
11:00-11:45	Room A-D				**Keynote 6** Management 4.0, or how digitalization drives the transformation of industries **Prof. Dr. Hubertus C. Tuczek** University of Applied Sciences Landshut, 84036 Landshut TCC-Management - Strategy Consulting, 81247 Munich				MC: Mr. Reinhard Wagner (IPMA)
11:45-12:00	Room A-D				Closing Ceremony				MC: Mr. Takeshi Hojo (NTT DATA Corporation)
12:00-13:00					Lunch and Networking				
13:30-18:00	by pick-up bus	ProMAC Fact Finding Tour visit to (the BMW Museum & World and Christmas Market) or (Deutsches Museum and Christmas Market)							

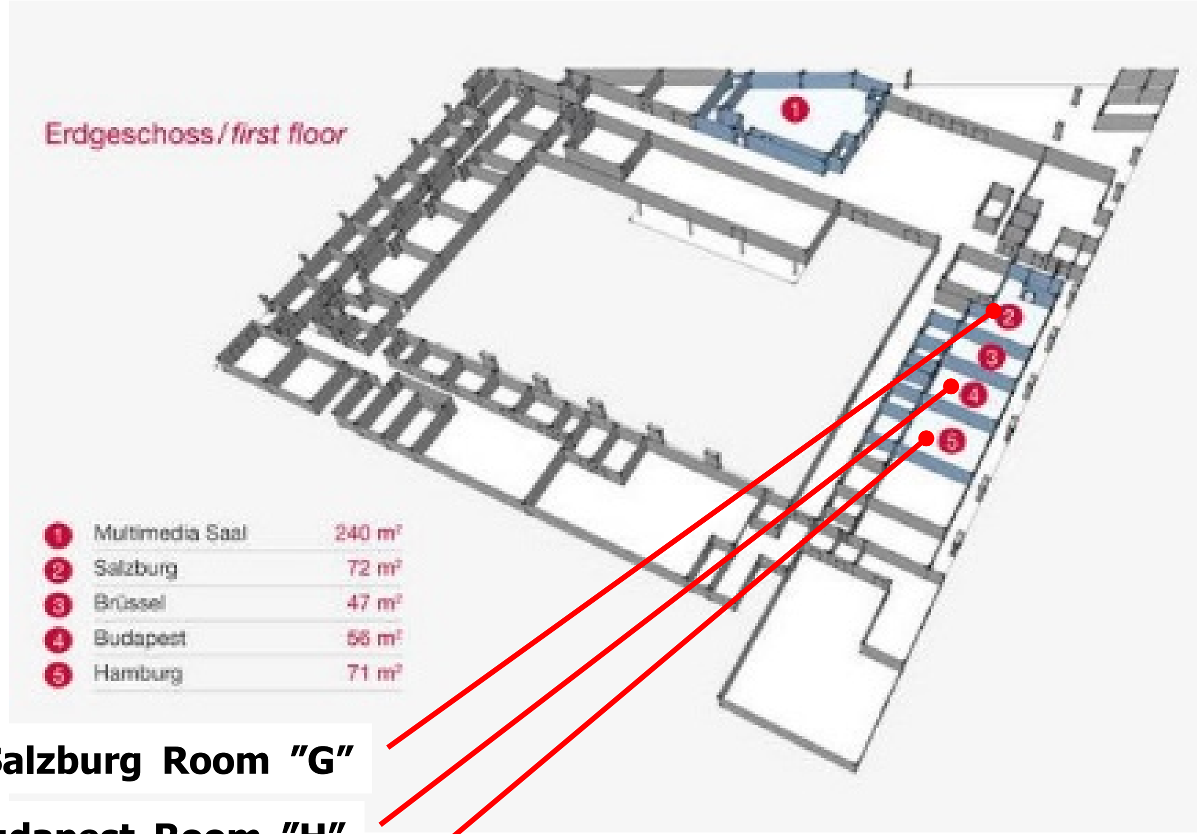
[Note] This program may be changed without previous notice.

■The H4 Hotel München Messe Floor Map

<H4 Hotel Ground Floor>



<Nemetschek (Annex) Ground Floor>



Salzburg Room "G"

Budapest Room "H"

Hamburg Room "I"

■ **Welcome Reception (Nov. 29th)**
>> at Eventcenter of The H4 Hotel München Messe

■ **ProMAC Gala Dinner (Nov. 30th)**
>> at Ratskeller München
(by Pick-up Bus, Dep. Time 17:00)

Proceedings of the 11th International Conference on Project Management ProMAC2017 in Munich

Index

Keynote 1

Acquiring Information Systems in northernSCOPE way

Mr. Pekka Forselius

CEO of 4SUM Partners Ltd, a Senior Advisor of the Finnish Software Measurement Association FiSMA and the Immediate Past President of the International Software Benchmarking Standards Group

Abstract:

Project Scope Management is one of the ten knowledge areas of the Project Management Body of KnowledgeR. Good scope management cannot save a project alone, if there are problems with one or more other areas, but poor scope management can make a project fail, even if all the other knowledge areas were well managed. If you don't know what you should provide, and how much, you will fail for sure. This is true especially in the software intensive IT industry, where the scope definition practices vary too much from case to case, and over time, and where very few people in the world seem to be capable to vision the future system at any point of the system life-cycle. Even more uncommon is the combination of capabilities to vision and quantify the scope of an Information System to be acquired.

The northernSCOPE? concept is one well established and equipped approach for professional scope management for software intensive Information System acquisition. It consists of several methods and tools that can help both the product owner (customer) and the developer team

(supplier) to manage scope over the system life-cycle. Subsets of the same northernSCOPE? methods and tools can assist the decision makers from the early budgeting and tendering phase, through the design, implementation, testing and system installation activities to system maintenance, and finally to prepare the replacement system acquisition. Professional scope management is equally important at all the management levels, not only at the Project Management as introduced in the PMBOKR, but also in Program and Portfolio Management, and software Product Management. The three corner-stones of northernSCOPE? concept are 1) software size measurement in Function Points (FP), 2) realizing and understanding the unit price (money/FP), and use of an independent measurement expert, Certified Scope Manager (CSM).

In his keynote presentation Forselius will introduce the most important methods and tools of the northernSCOPE? concept, and summarize some of the best lessons-learned how to organize and apply the concept in practice. One strength of the concept is that the methods and most of the tools are publicly available, based on International Standards (ISO), and the use of this concept is free of charge, without any license fees. Once people get their certifications for CSM, they can apply the concept as often and as long as they want. Most of the recent experiences come from agile (e.g. SCRUM) world, developing multi-tier service oriented systems, for both public and private sector customers, but the concept itself is independent of technologies, business sectors, and project management approaches.

Biography:

Mr. Pekka Forselius is Master of Science (Information systems), eMBA and Certified Scope Manager. He has almost 40 years of experience in software industry, both on the customer and on the vendor side. His current positions are the CEO of 4SUM Partners Ltd, a Senior Advisor of the Finnish Software Measurement Association FiSMA and the Immediate Past President of the International Software Benchmarking Standards Group. Pekka is also the Chairman of the Job Role Committee, Certified SCOPE Manager at European Certification and Qualification Association (ECQA) and represents Finland in ISO/IEC SC7 standardization for software and systems engineering (editor responsibilities in the areas of Software Size Measurement, IT Project Performance Benchmarking, and Tools and Environments). Over his career Pekka has worked across the fields of Banking, Insurance, Government, Education, and Private Consulting. He has developed and implemented the Experience® data-collection concept and is the product owner of Experience® Service software. He is well-known speaker, researcher and developer of several IT project management methods and concepts, including FiSMA Functional Size Measurement method (ISO/IEC 29881) and the northernSCOPE™ concept. He has published several books and dozens of articles about ICT Program Management and IS Acquisition Management.

Acquiring Information Systems in northernSCOPE way

Pekka Forselius, CSM #1
Munich, Germany, 2017-11-29

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northernSCOPE™

- A scope management concept for systems and software development projects
- A registered trade mark of FiSMA since 2008

- Three corner stones:
  - Functional software size measurement in
  - Cost management through money/FP
  - Independent professional scope manager

- ECQA job role and five days training program for Certified Scope Managers

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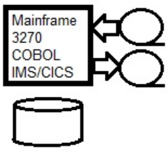
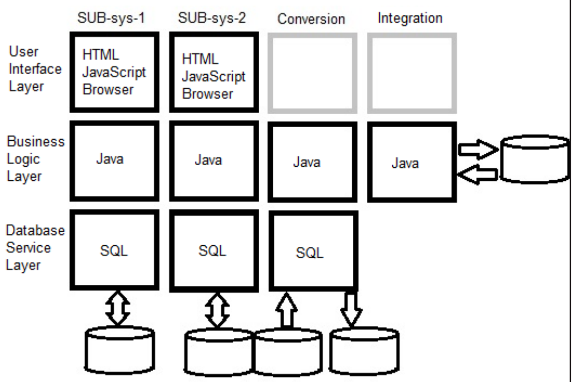
Information systems in 1970s and today

Typical system in 1975



Typical system today



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IS project success criteria

Customer point of view

- Software was delivered on time
- Software was delivered on budget
- Quality of the software meets the expectations
- **Software was delivered as soon as possible**
- **The software was inexpensive compared to competitors**
- Maintenance and support are reliable and effective
- The delivery helped to improve business processes

Supplier point of view

- The customer is satisfied and the feedback positive
- The income from the project exceeded expenses, the project made profit
- The delivery leaded to continuous service contract
- Project team learned new skills
- The delivery process improved
- The image of the supplier as a reliable partner improved

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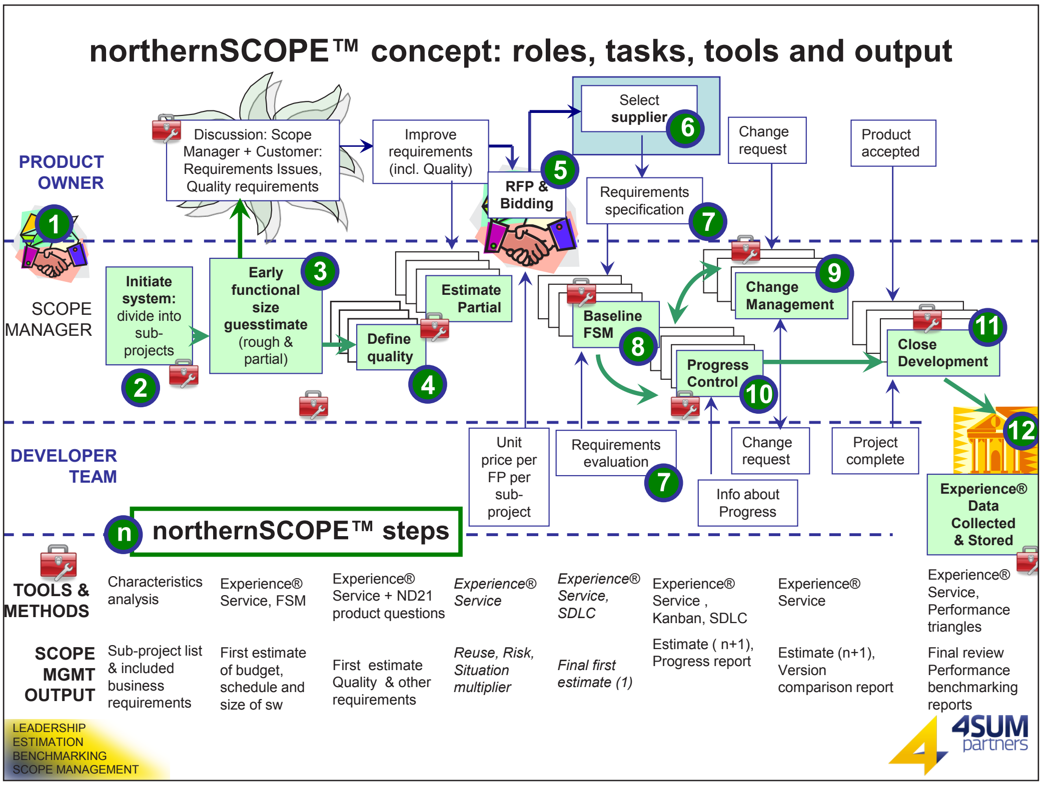
northernSCOPE™ concept: roles, tasks, tools and output
PRODUCT OWNER
SCOPE MANAGER
DEVELOPER TEAM
Discussion: Scope Manager + Customer: Requirements Issues, Quality requirements
Improve requirements (incl. Quality)
Select supplier
6
Change request
Product accepted
RFP & Bidding
5
Requirements specification
7
1
Initiate system: divide into sub-projects
2
Early functional size guesstimate (rough & partial)
3
Define quality
4
Estimate Partial
Baseline FSM
8
Change Management
9
Progress Control
10
Close Development
11
12
Unit price per FP per sub-project
Requirements evaluation
7
Change request
Info about Progress
Project complete
Experience® Data Collected & Stored
n
northernSCOPE™ steps
TOOLS & METHODS
Characteristics analysis
Experience® Service, FSM
Experience® Service + ND21 product questions
Experience® Service
Experience® Service, SDLC
Experience® Service , Kanban, SDLC
Experience® Service
Experience® Service, Performance triangles
SCOPE MGMT OUTPUT
Sub-project list & included business requirements
First estimate of budget, schedule and size of sw
First estimate Quality & other requirements
Reuse, Risk, Situation multiplier
Final first estimate (1)
Estimate (n+1), Progress report
Estimate (n+1), Version comparison report
Final review Performance benchmarking reports
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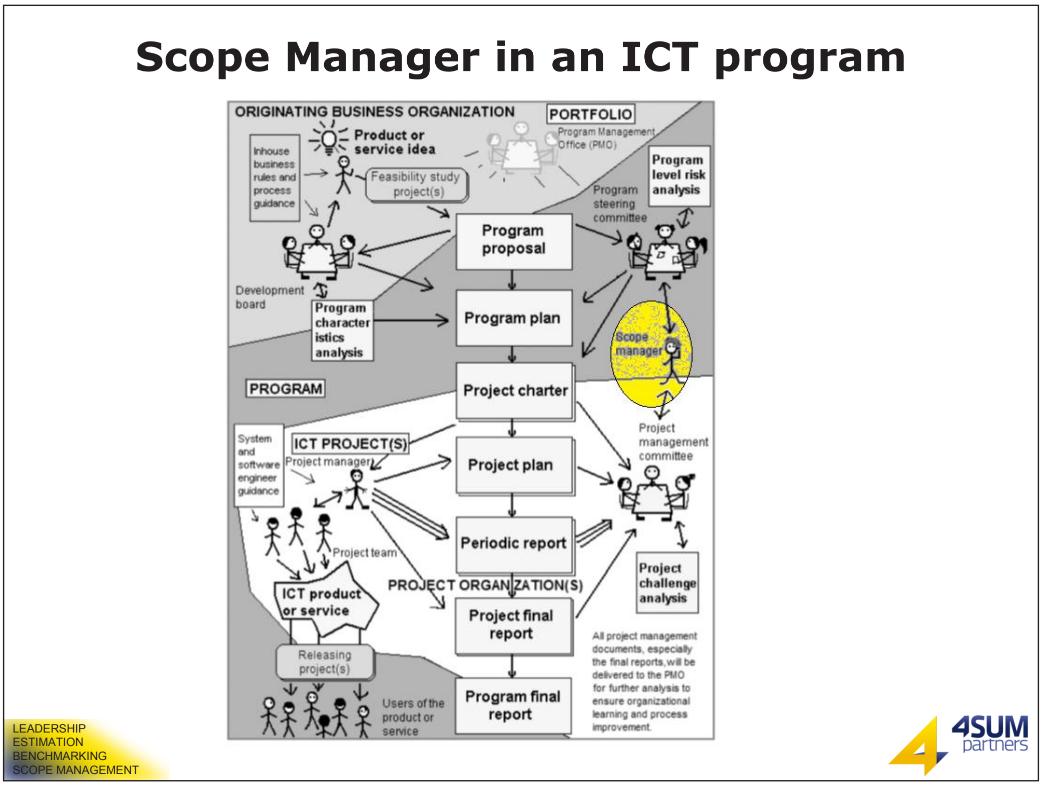
Scope Manager in an ICT program
ORIGINATING BUSINESS ORGANIZATION
PORTFOLIO
Program Management Office (PMO)
Inhouse business rules and process guidance
Product or service idea
Feasibility study project(s)
Program level risk analysis
Program steering committee
Program proposal
Development board
Program characteristics analysis
Program plan
Scope manager
PROGRAM
Project charter
Project management committee
System and software engineer guidance
ICT PROJECT(S)
Project manager
Project plan
Project team
Periodic report
PROJECT ORGANIZATION(S)
Project challenge analysis
ICT product or service
Project final report
Releasing project(s)
All project management documents, especially the final reports, will be delivered to the PMO for further analysis to ensure organizational learning and process improvement.
Users of the product or service
Program final report
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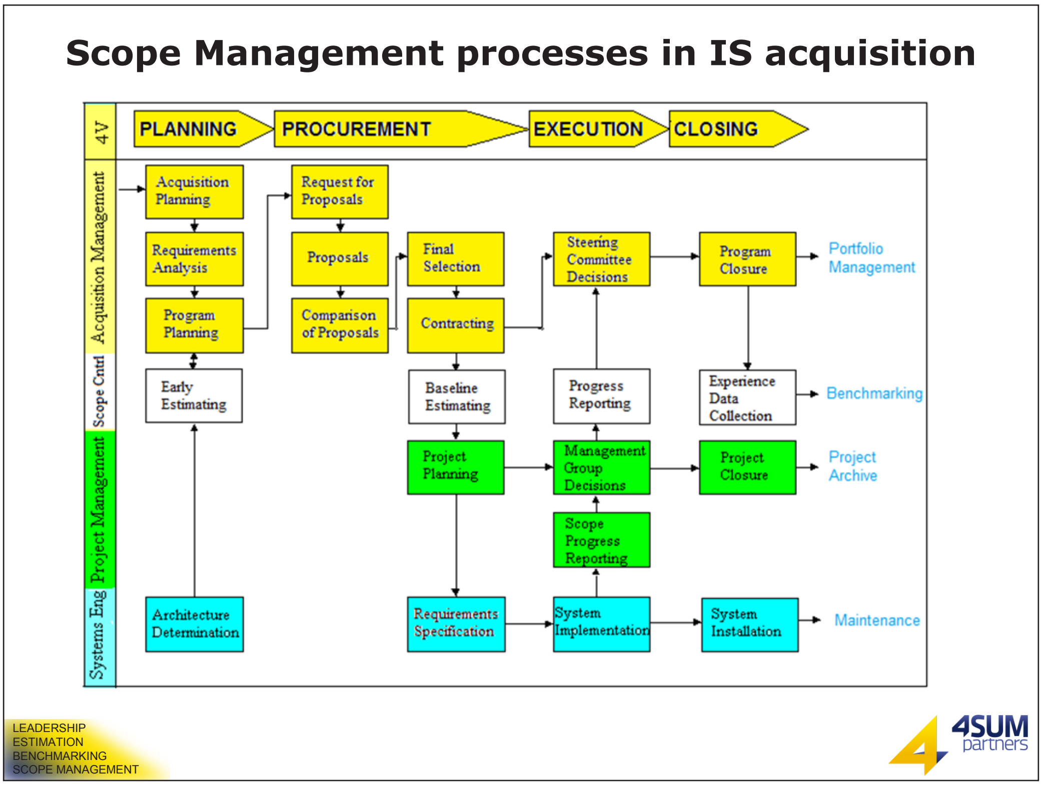
Scope Management processes in IS acquisition
4V
Acquisition Management
Scope Cntrl
Project Management
Systems Eng
PLANNING
PROCUREMENT
EXECUTION
CLOSING
Acquisition Planning
Request for Proposals
Requirements Analysis
Proposals
Final Selection
Steering Committee Decisions
Program Closure
Portfolio Management
Program Planning
Comparison of Proposals
Contracting
Early Estimating
Baseline Estimating
Progress Reporting
Experience Data Collection
Benchmarking
Project Planning
Management Group Decisions
Project Closure
Project Archive
Scope Progress Reporting
Architecture Determination
Requirements Specification
System Implementation
System Installation
Maintenance
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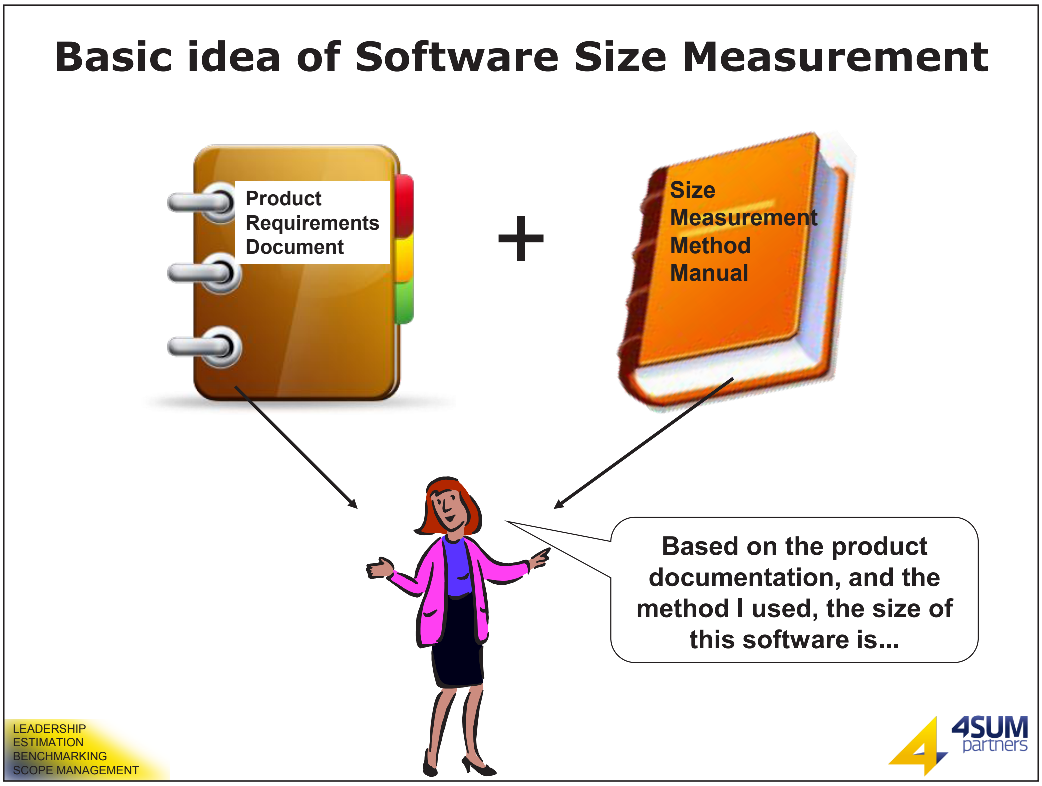
Basic idea of Software Size Measurement
Product Requirements Document
+
Size Measurement Method Manual
Based on the product documentation, and the method I used, the size of this software is...
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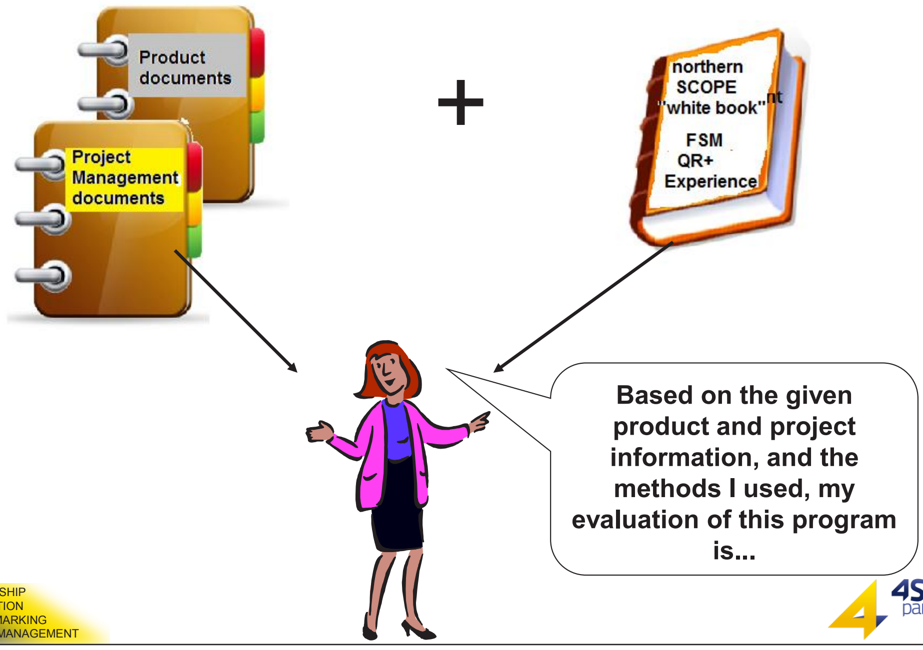
Basic idea of northernSCOPE concept



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Scope Management processes: Estimating effort and cost

Purpose: Rough estimate for budgeting and reality checking, base line estimate for product and project management documentation review.

Methods: Program characteristics analysis, FiSMA Functional Size Measurement, Quality requirements analysis, project classification, experience data repository

Tools: FiSMA FP Fast Calculator, Experience Service

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Scope Management processes: Progress reporting

Purpose: Review and measurement of completed functionality, reality check comparing updated size estimate with remaining time and money (or effort)

Methods: Software Development Life-cycle, FiSMA Functional Size Measurement, Kanban, retrospectives analyzing the achieved delivery speed and cost efficiency

Tools: Experience Service

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Scope Management processes: Experience data collection

Purpose: Objective measurements for benchmarking the achieved delivery speed and cost efficiency, to help rewarding the teams, to prepare the starting maintenance management, and for future process improvement

Methods: FiSMA Functional Size Measurement, Triangle benchmarking, project classification, situation analysysis, experience data repository

Tools: Experience Service

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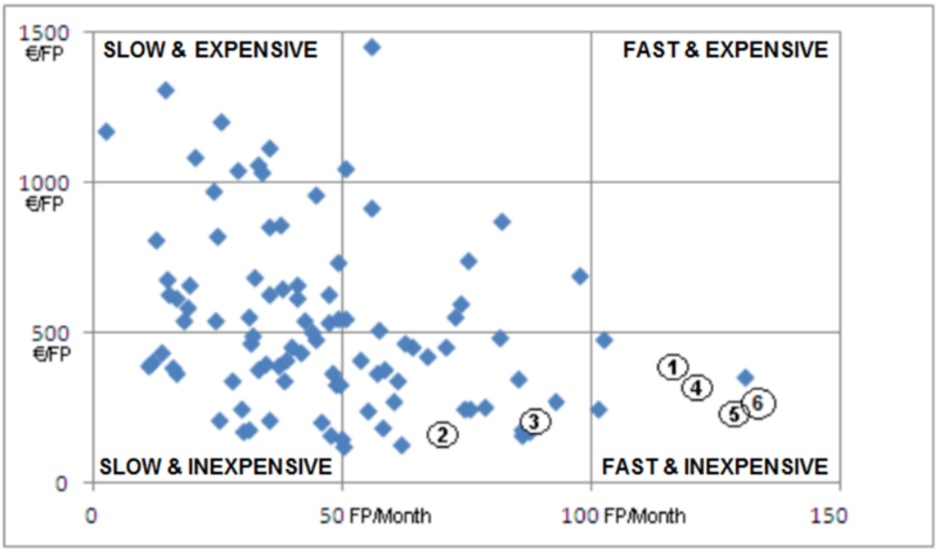
Some results from northernSCOPE



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Lessons learned from northernSCOPE
- "fundamental values" in Agile Manifesto style

- Good speed of delivery in terms of FP/month over accuracy of original estimate of schedule
- Good cost-efficiency in terms of money/FP over delivery on original fixed budget
- Continuous measurement of accepted functionality over continuous effort estimation

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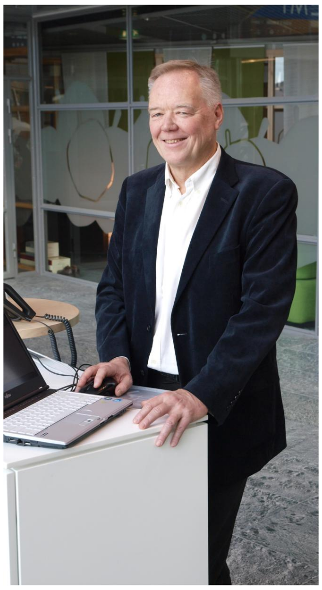
Thank you!



- Pekka Forselius, MSc, MBA, Certified Scope Manager, Immediate Past President of ISBSG, Senior Advisor at FiSMA
- email: pekka.forselius@4sumpartners.com
- see also www.4sumpartners.com, www.fisma.fi and www.isbsg.org

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Keynote 2

PM4.0 - project management for the next era

Mr. Till H. Balser

Founder of Tiba Managementberatung GmbH

Abstract:

The "fourth industrial revolution" is a result of the interaction between intelligent, networked systems and consequently integrated hardware and software development. Work areas and organisational units which have been functionally separate in the past have to be closely and successfully linked in projects and project teams. Thus the different work cultures and structures come into contact. On the one hand, the increasing complexity in projects has to be managed and on the other hand, the demand for agility requires fast, decentralised decisions at the functionally responsible interfaces.

The aim of the project management discipline has always been to manage complexity. With the increasing complexity of projects, the concepts and methods of project management have also evolved over the past 30 years. Whereas 30 years ago, project management was still limited to the use of "critical path analysis", today it is a meta-discipline. Today's often dogmatic conflict between "classic" and "agile" project management contradicts such an evolutionary view and is also ineffective. The discipline of project management is always in a state of flux and in the past five years has been - justifiably - supplemented with agile techniques, especially in research and technology projects. However, agile project management does not guarantee the required planning

security for large projects, particularly for investment projects in industry and in the public sector.

What now? Mr Balser provides guidance in his presentation. Starting with an overview of the evolutionary development steps of project management, next he leads us to a deeper understanding of current methods and concepts of agile project management, in order to guide us into the visionary future of "Project Management 4.0" - also known as "adaptive project management": the clever, situational combination of "classic" and "agile" project management.

Sounds simple at first but is a real challenge for companies, although it is great fun and is successful in every case.

Biography:

Project management already appealed to the economics graduate during his degree studies. "Good project management prevents negative surprises and sleepless nights," says Till H. Balser, who has been a pioneer and campaigner on the topic of project management in Germany for 35 years. Over time he became increasingly aware that PM performance cannot be improved by using software alone.

Considering this he developed his systemic overall approach to PM, known as the "four-axis cross". This approach recognises the introduction/optimisation of PM in companies as an integrative process made up of organisational development, qualification/staff development, method and process standardisation and technological support.

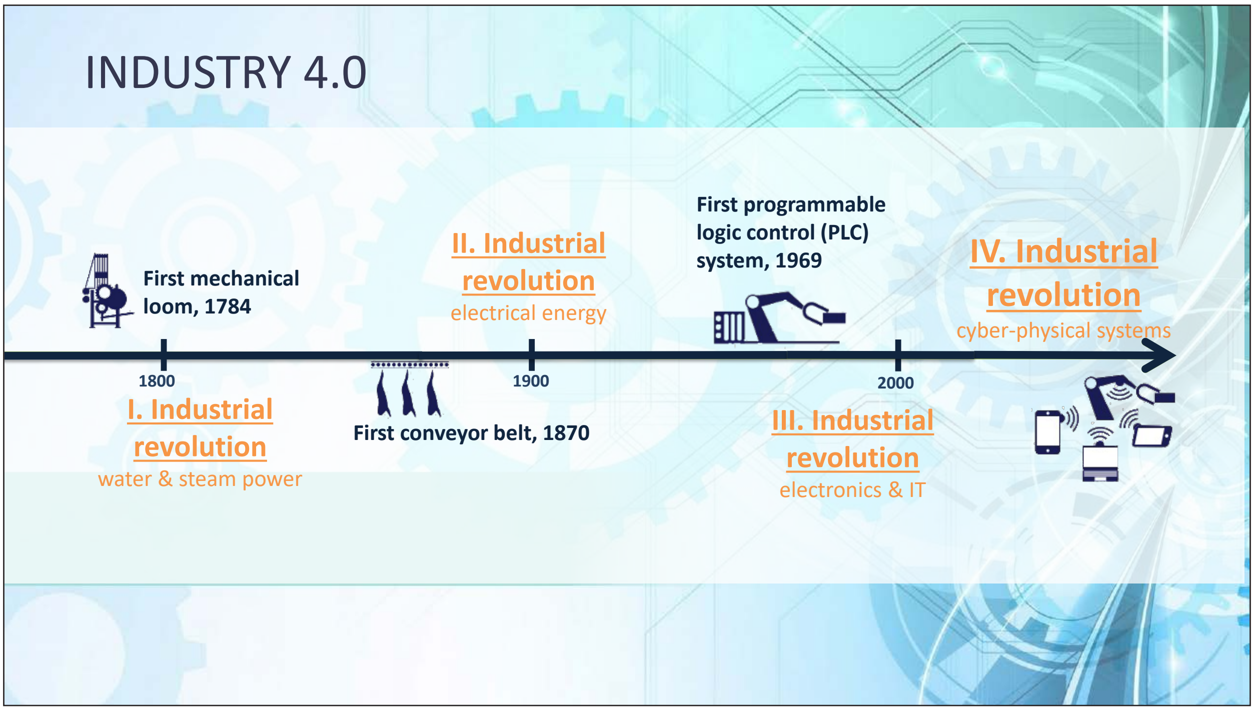
With Tiba, Mr Balser has established an institute that provides expert advice, training and support for all issues relating to project management.


PROJECT MANAGEMENT 4.0
How is the world of project management changing?
Keynote, Till H. Balser


KEY TREND CONCEPT "4.0"
What does it actually mean?

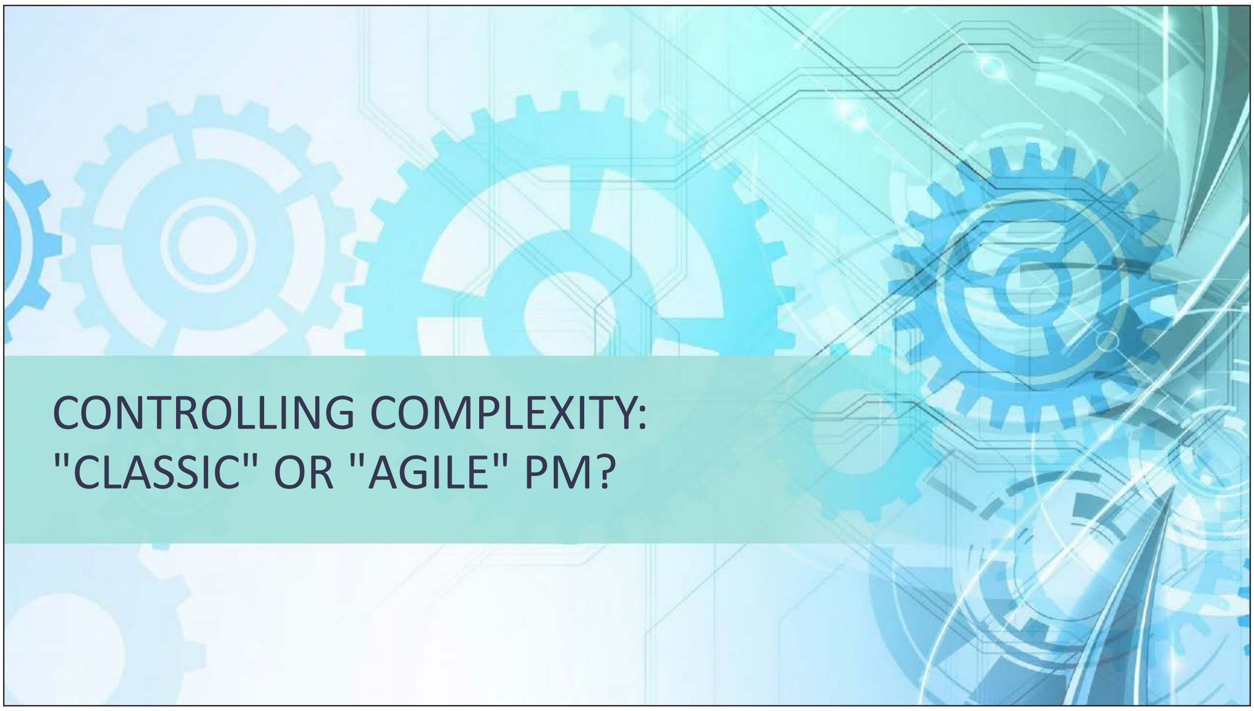

DIGITALIZATION


DIGITAL TRANSFORMATION


INDUSTRY 4.0
First mechanical loom, 1784
1800
I. Industrial revolution
water & steam power
First conveyor belt, 1870
II. Industrial revolution
electrical energy
1900
First programmable logic control (PLC) system, 1969
2000
III. Industrial revolution
electronics & IT
IV. Industrial revolution
cyber-physical systems


INDUSTRY 4.0
Order Pick Time
00:05:15
Order Pick Time
002:09:27


WHAT DOES IT MEAN FOR
PROJECT MANAGEMENT?


CONTROLLING COMPLEXITY:
"CLASSIC" OR "AGILE" PM?

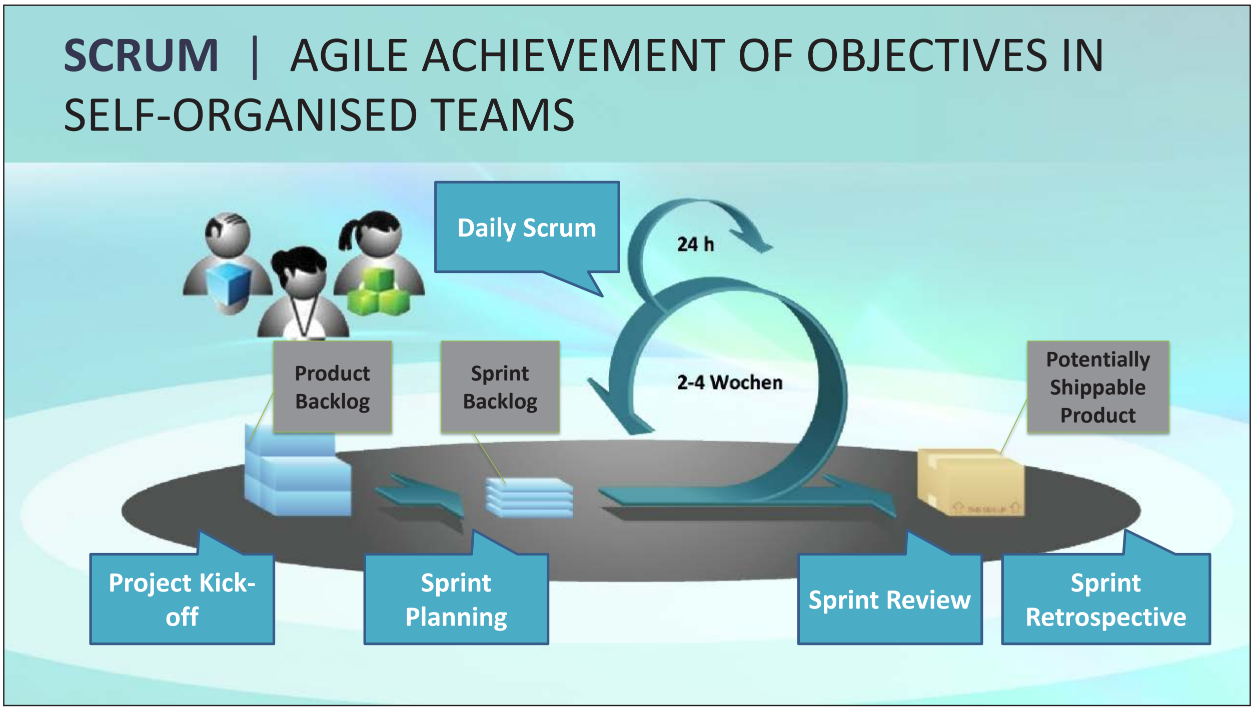

PM – ANSWER TO COMPLEXITY

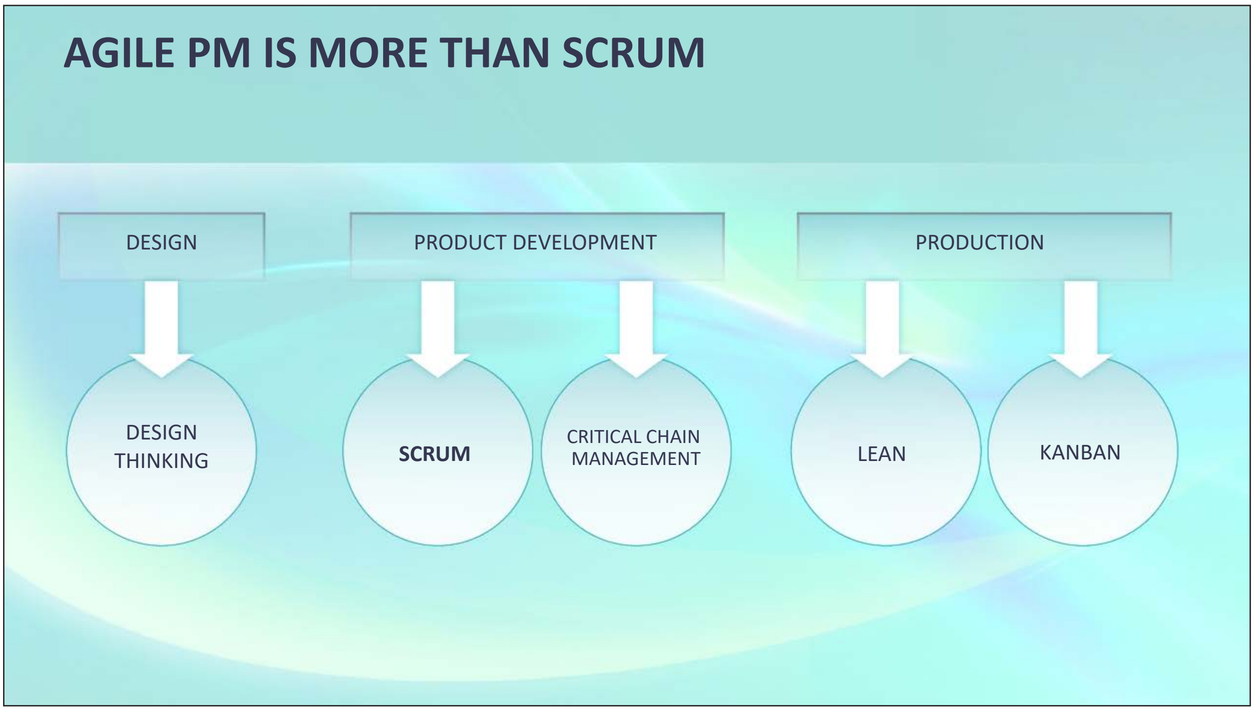

AGILE PROJECT MANAGEMENT –
CONTRADICTION IN TERMS?

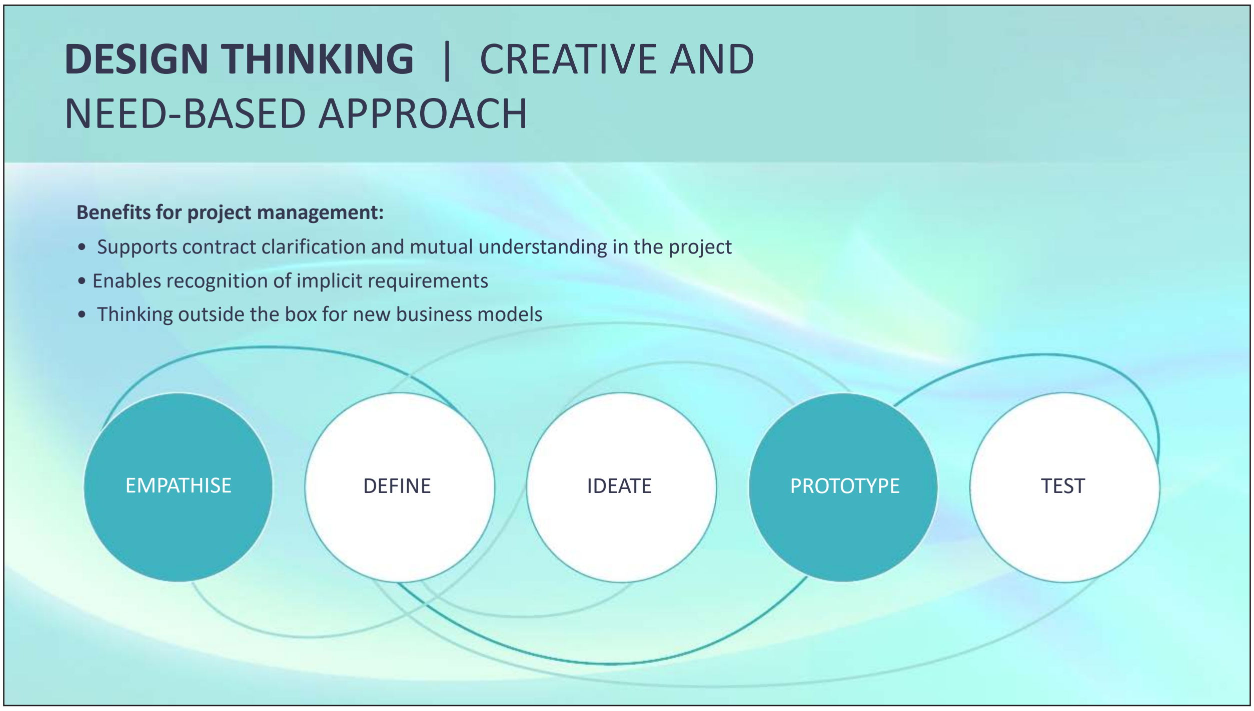

AGILE MANIFESTO, 2001

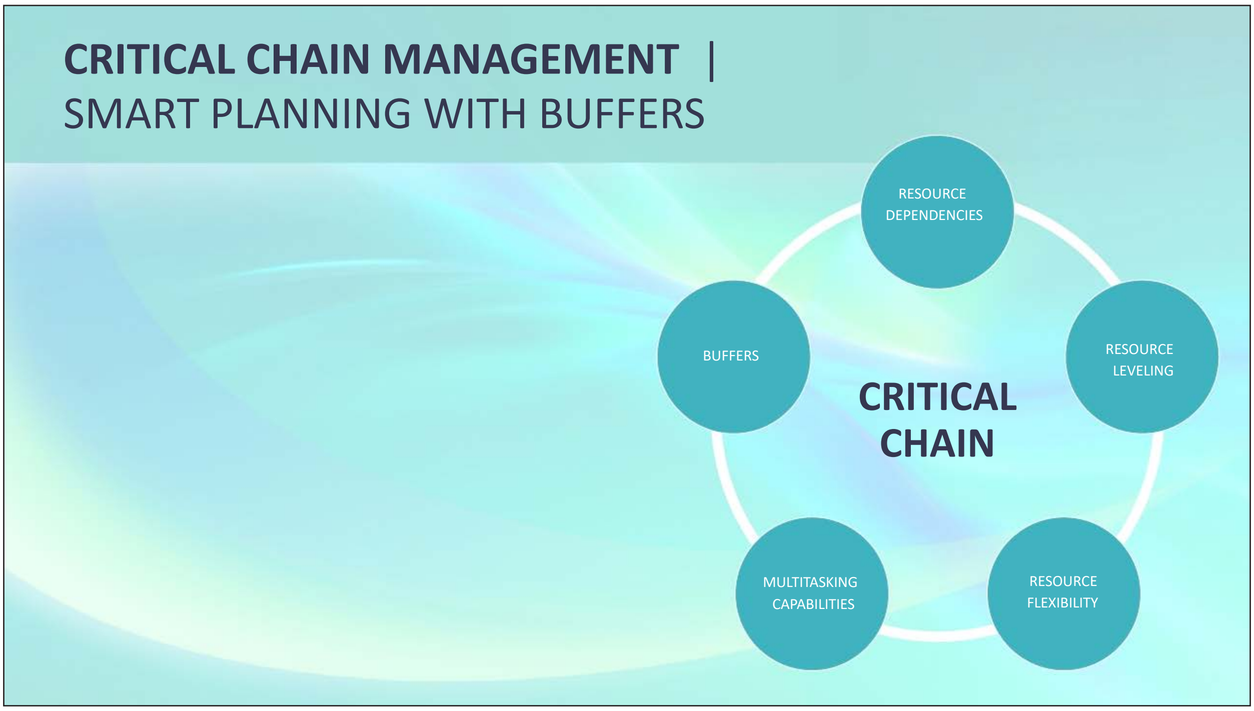

AGILE MANIFESTO, 2001
We value...
Individuals and interactions more than processes and tools
Functional software more than comprehensive documentation
Cooperation with the client more than contract negotiation
Responding to change more than following a plan.


SCRUM


SCRUM | AGILE ACHIEVEMENT OF OBJECTIVES IN SELF-ORGANISED TEAMS
Daily Scrum
24 h
2-4 Wochen
Product Backlog
Sprint Backlog
Potentially Shippable Product
Project Kick-off
Sprint Planning
Sprint Review
Sprint Retrospective

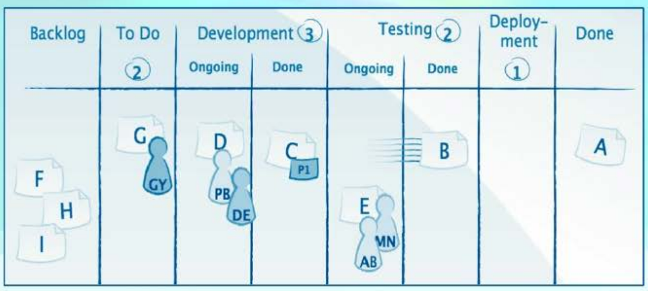

AGILE PM IS MORE THAN SCRUM
DESIGN
PRODUCT DEVELOPMENT
PRODUCTION
DESIGN THINKING
SCRUM
CRITICAL CHAIN MANAGEMENT
LEAN
KANBAN

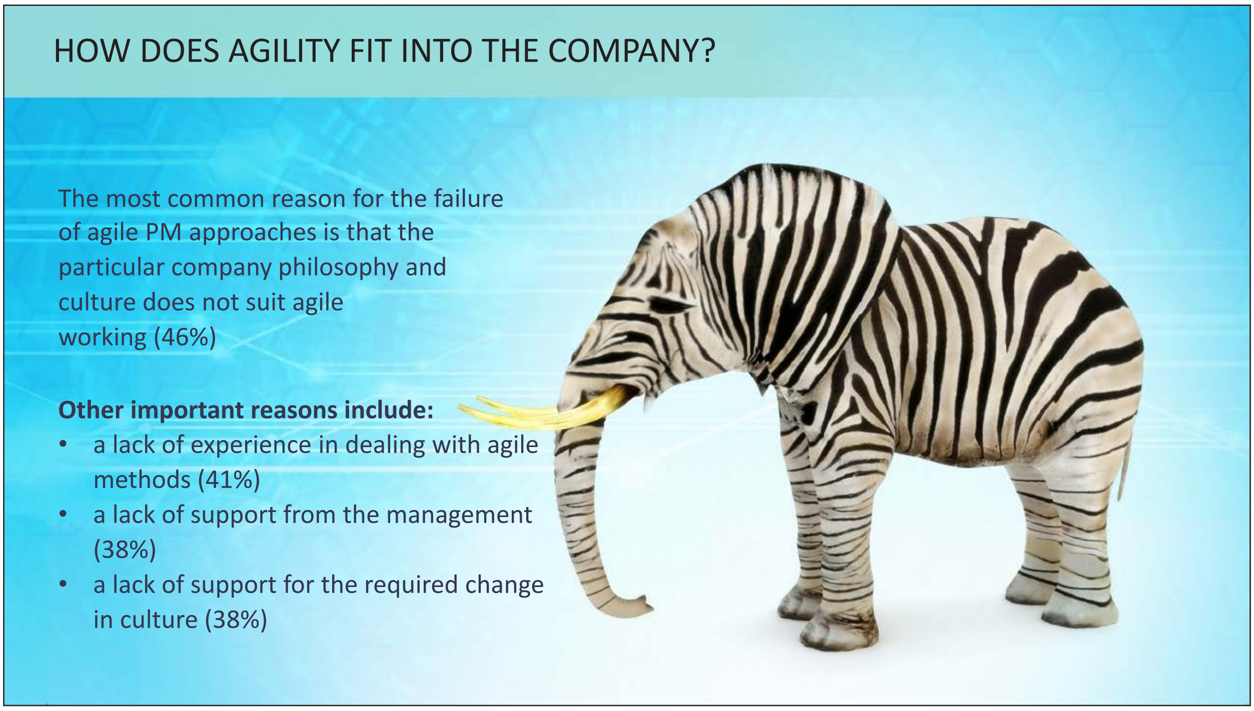

DESIGN THINKING | CREATIVE AND NEED-BASED APPROACH
Benefits for project management:
• Supports contract clarification and mutual understanding in the project
• Enables recognition of implicit requirements
• Thinking outside the box for new business models
EMPATHISE
DEFINE
IDEATE
PROTOTYPE
TEST

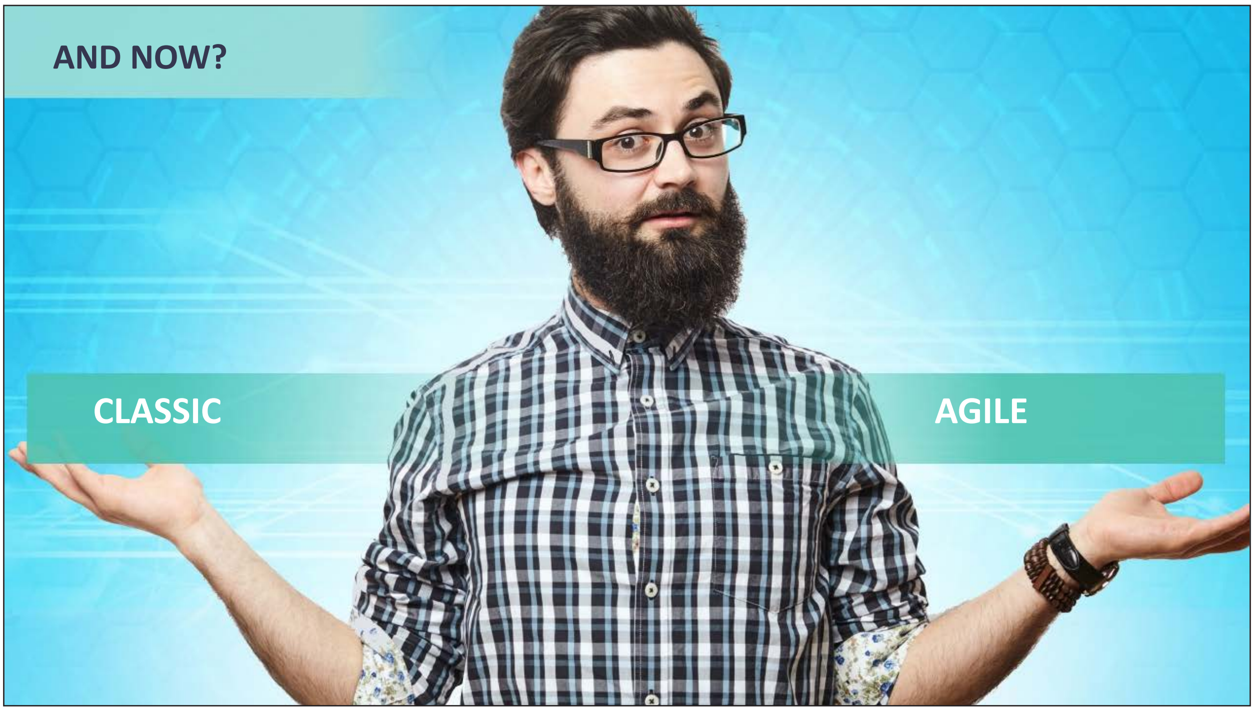

CRITICAL CHAIN MANAGEMENT | SMART PLANNING WITH BUFFERS
RESOURCE DEPENDENCIES
BUFFERS
RESOURCE LEVELING
CRITICAL CHAIN
MULTITASKING CAPABILITIES
RESOURCE FLEXIBILITY

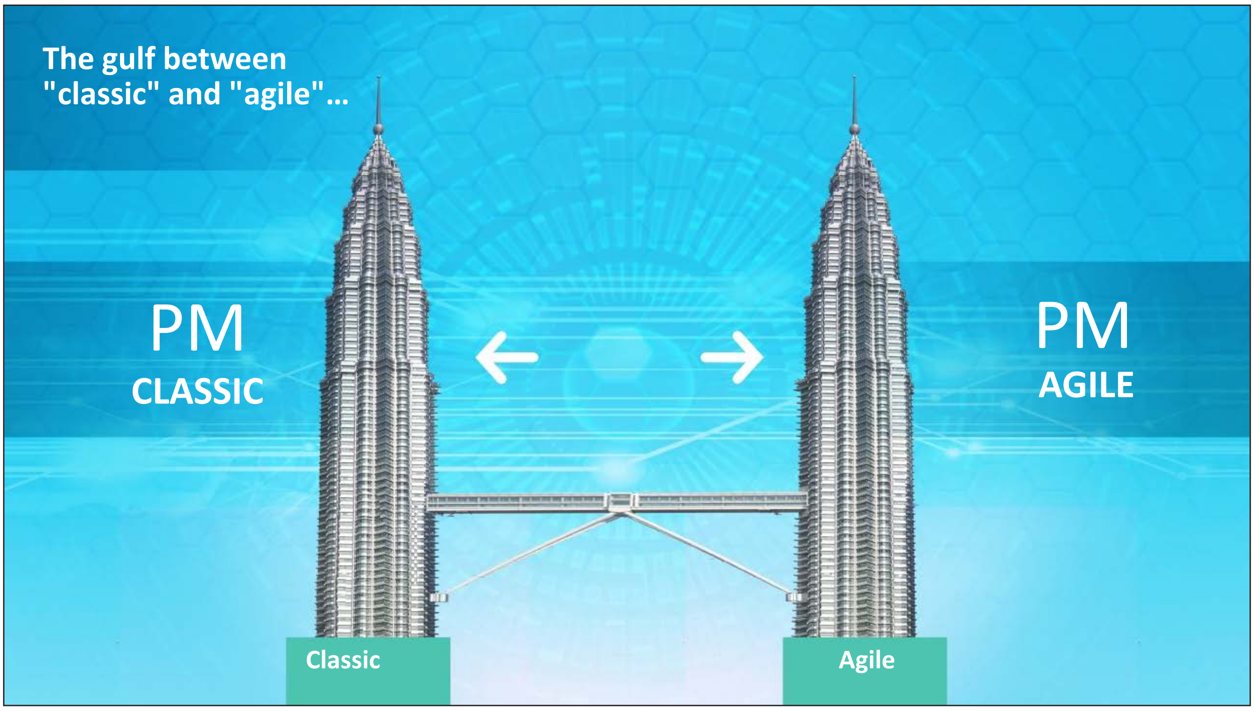
LEAN | LOW WASTEFULNESS DUE TO LONG-TERM AUTOMATION

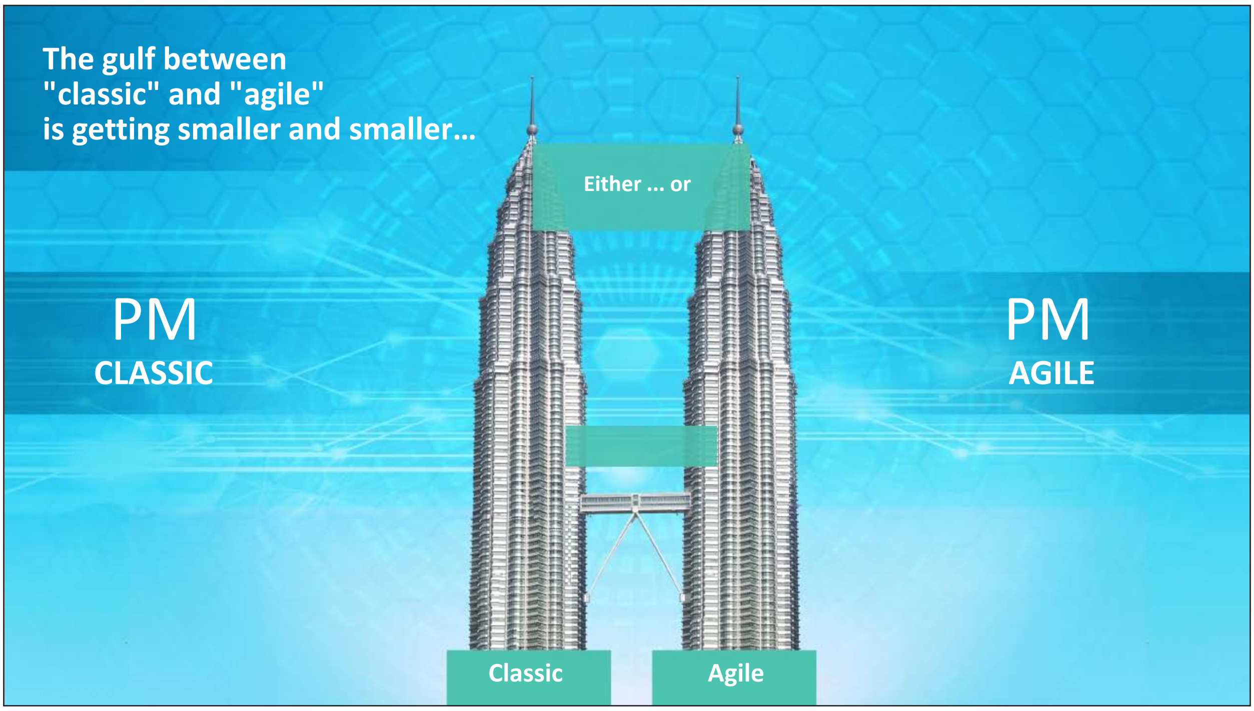
KANBAN | TRANSPARENT AND VOLUNTARY ALLOCATION OF TASKS

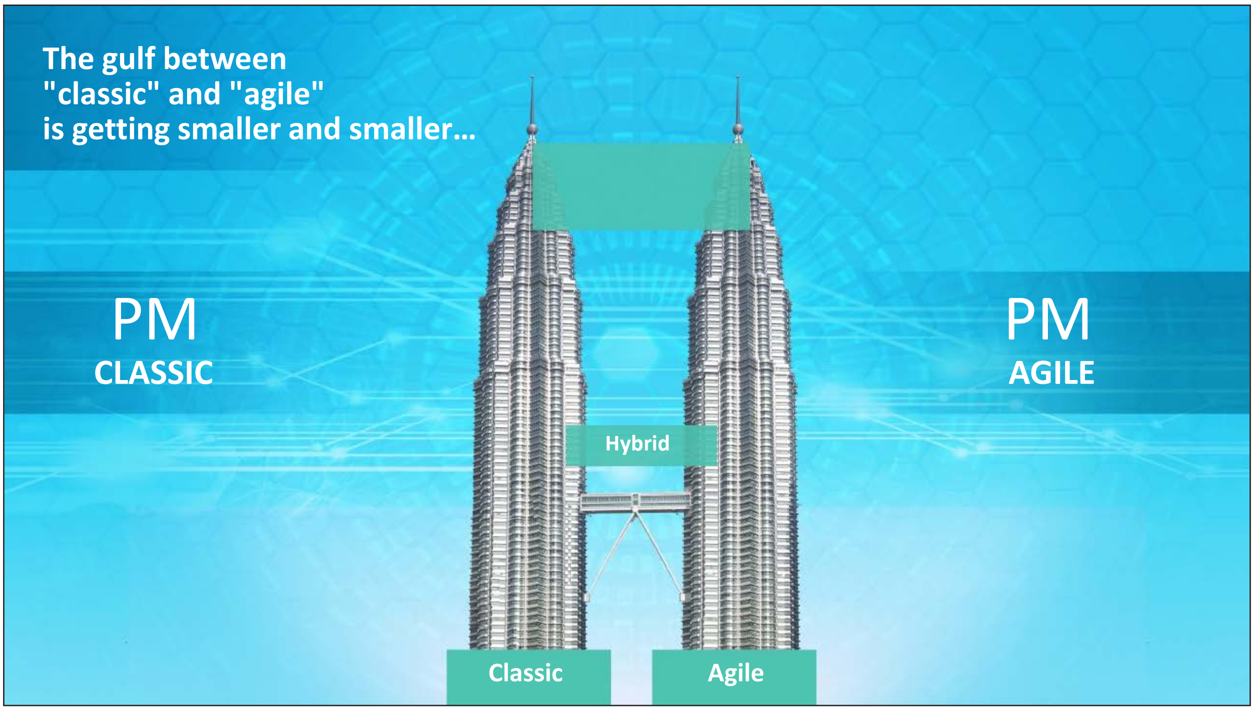



HOW DOES AGILITY FIT INTO THE COMPANY?
The most common reason for the failure of agile PM approaches is that the particular company philosophy and culture does not suit agile working (46%)
Other important reasons include:
• a lack of experience in dealing with agile methods (41%)
• a lack of support from the management (38%)
• a lack of support for the required change in culture (38%)


AND NOW?
CLASSIC
AGILE


The gulf between
"classic" and "agile"…
PM
CLASSIC
PM
AGILE
Classic
Agile

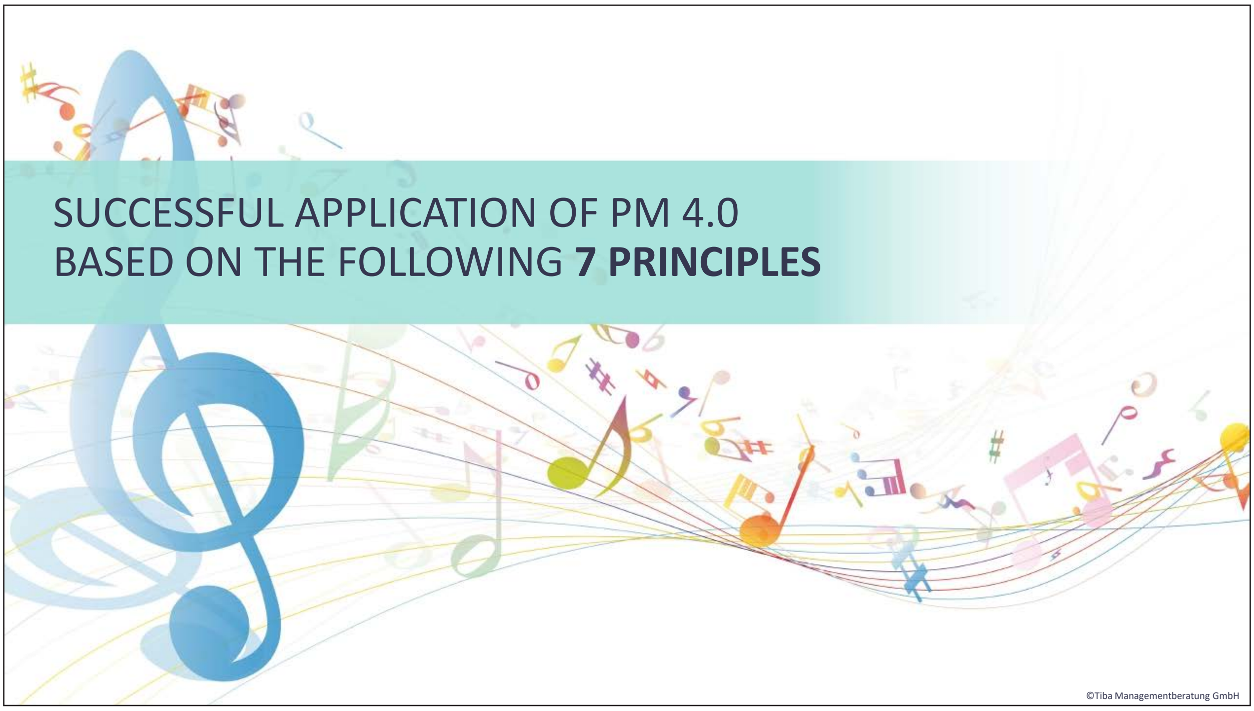

The gulf between
"classic" and "agile"
is getting smaller and smaller…
Either … or
PM
CLASSIC
PM
AGILE
Classic
Agile


The gulf between
"classic" and "agile"
is getting smaller and smaller...
PM
CLASSIC
PM
AGILE
Hybrid
Classic
Agile


...and disappears
in PM 4.0
Adaptive
Project Management
PM 4.0


PROJECT MANAGEMENT 4.0


Project Management 4.0
AGILES PM
KLASSISCHES PM
DESIGN THINKING
SCRUM
CCM
LEAN
KANBAN
ADAPTIVES PM
7 PRINZIPIEN
PM 4.0


SUCCESSFUL APPLICATION OF PM 4.0
BASED ON THE FOLLOWING 7 PRINCIPLES
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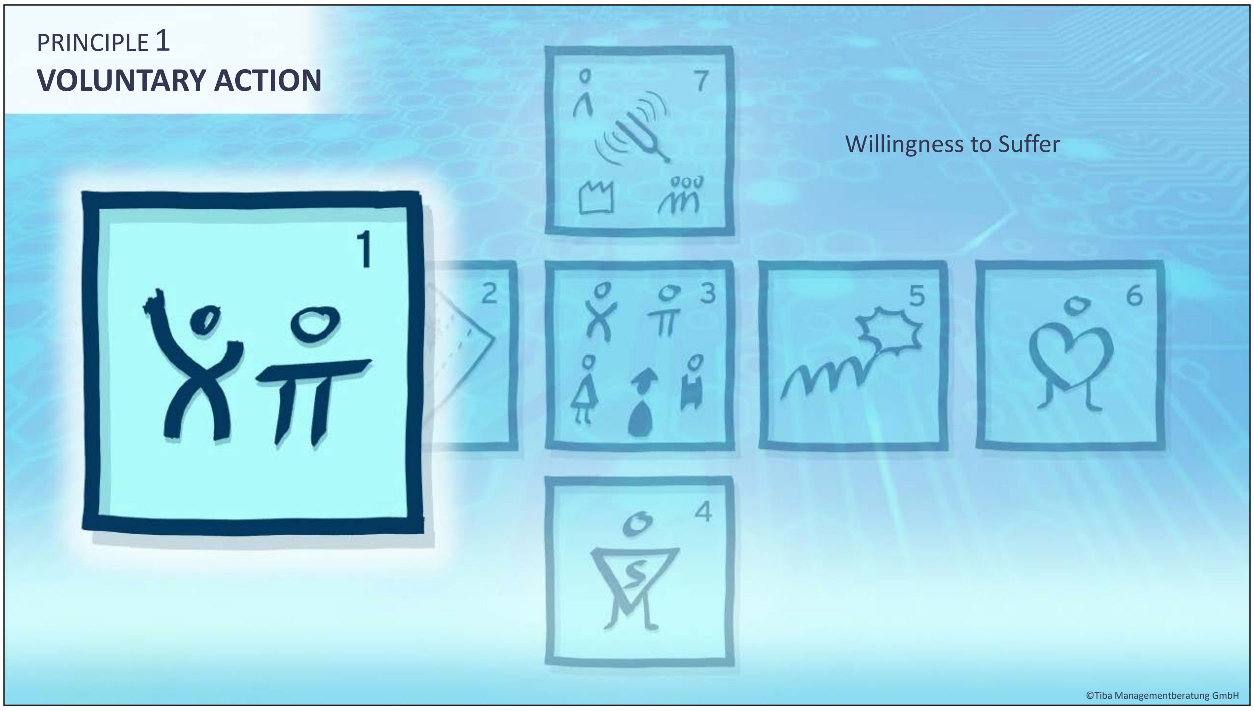
7 PRINCIPLES
FOR THE SUCCESS OF
PROJECT MANAGEMENT 4.0
7
1
2
3
5
6
4


PRINCIPLE 1
VOLUNTARY ACTION
Willingness to Suffer
1
2
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4
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6
7
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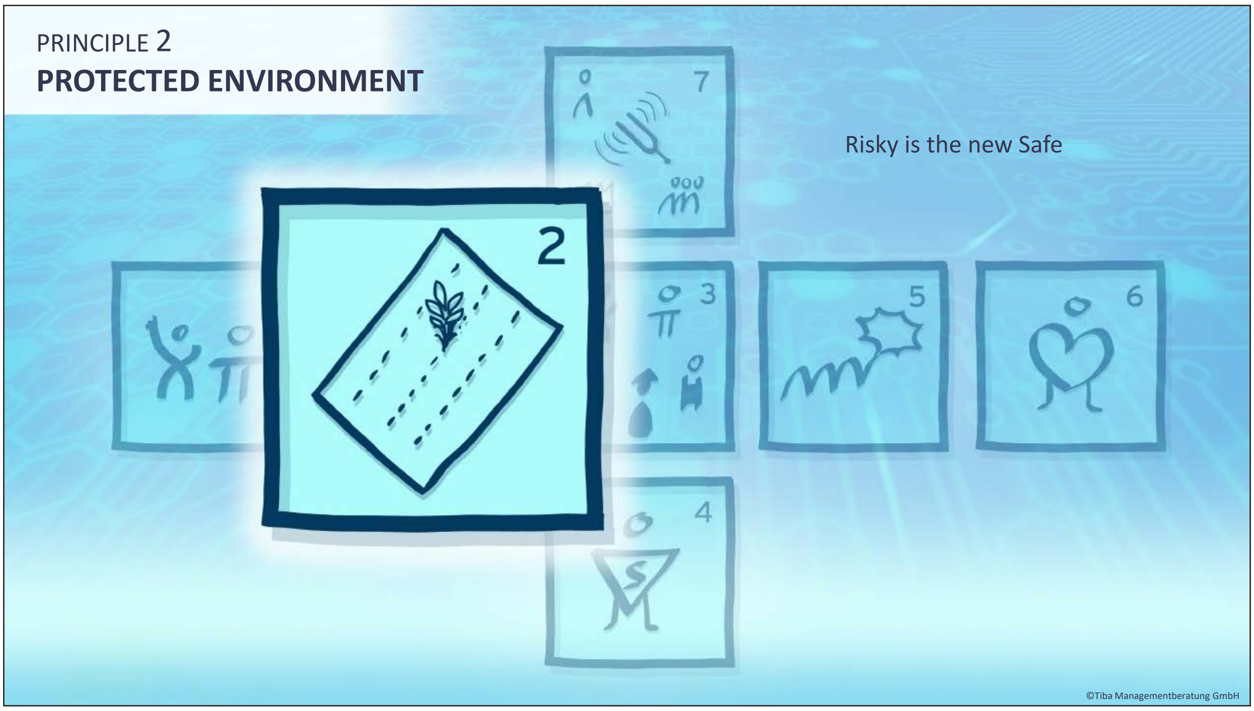
PRINCIPLE 2
PROTECTED ENVIRONMENT
Risky is the new Safe
2
3
4
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7
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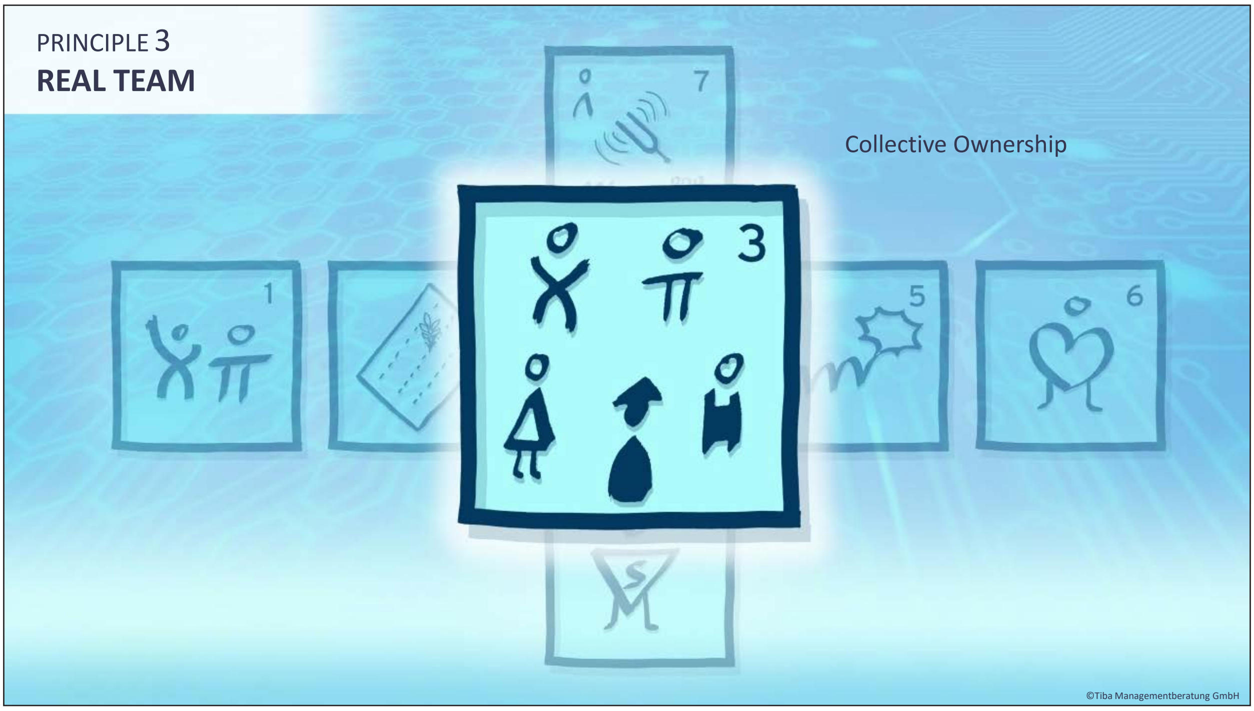
PRINCIPLE 3
REAL TEAM
Collective Ownership
7
3
1
5
6
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PRINCIPLE 4
SUPPORTIVE MANAGEMENT
Support self-organization
7
1
2
3
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4
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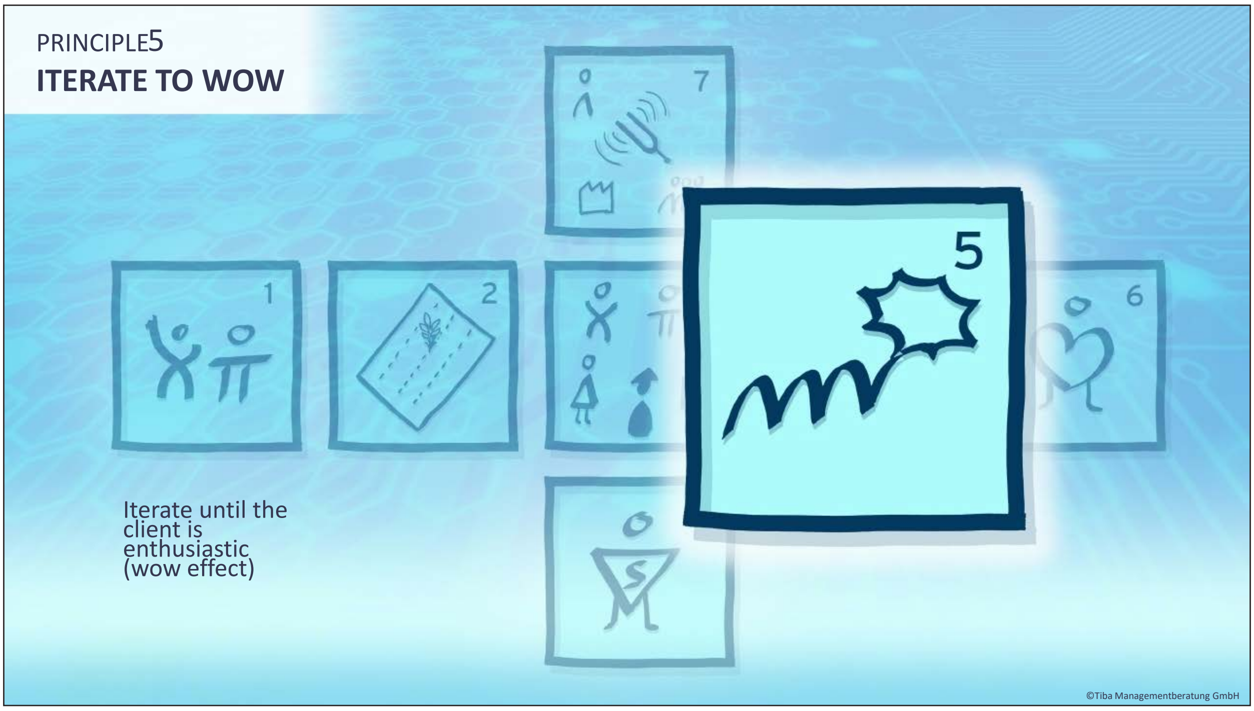
PRINCIPLE5
ITERATE TO WOW
7
1
2
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6
Iterate until the client is enthusiastic (wow effect)
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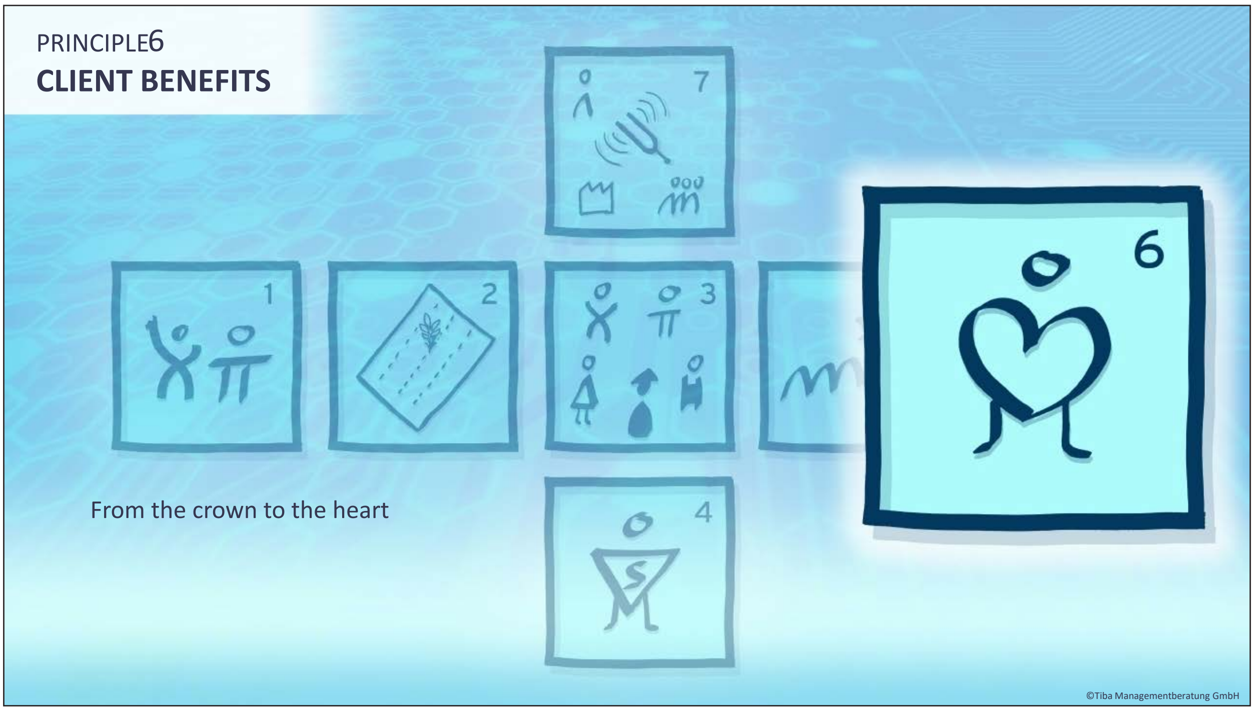
PRINCIPLE6
CLIENT BENEFITS
7
1
2
3
6
4
From the crown to the heart
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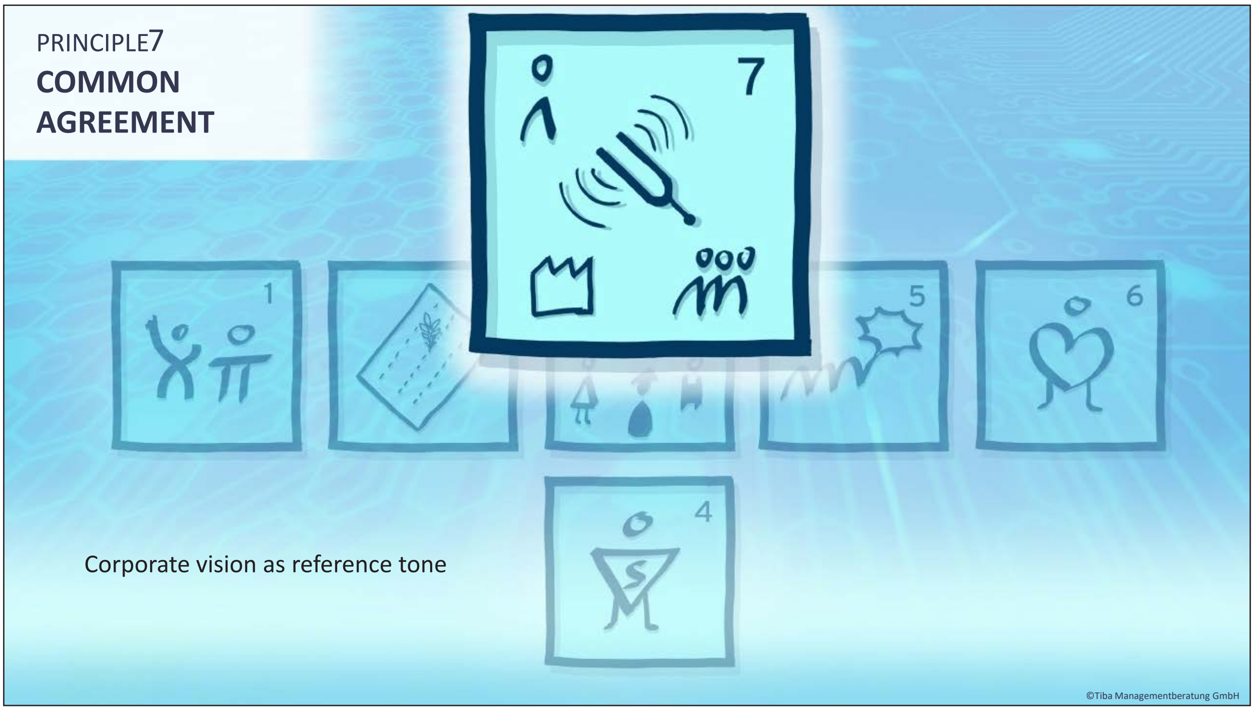
PRINCIPLE7
COMMON
AGREEMENT
7
1
5
6
4
Corporate vision as reference tone
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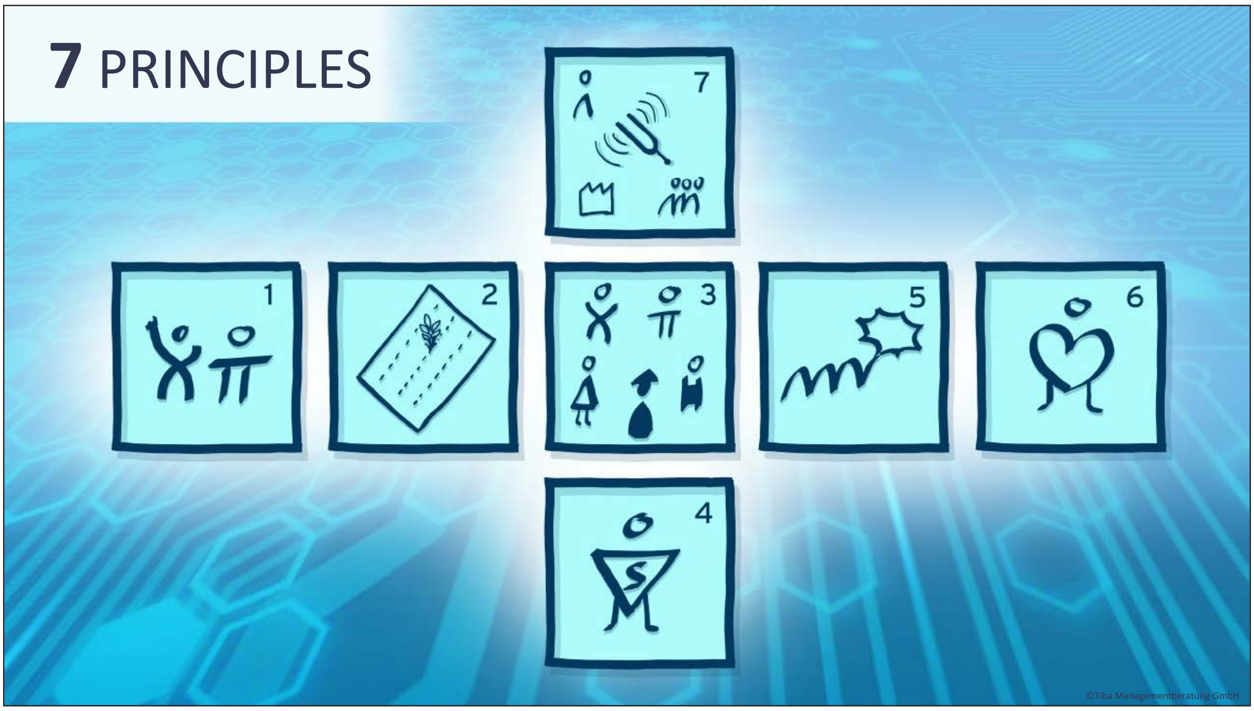
7 PRINCIPLES
7
1
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4
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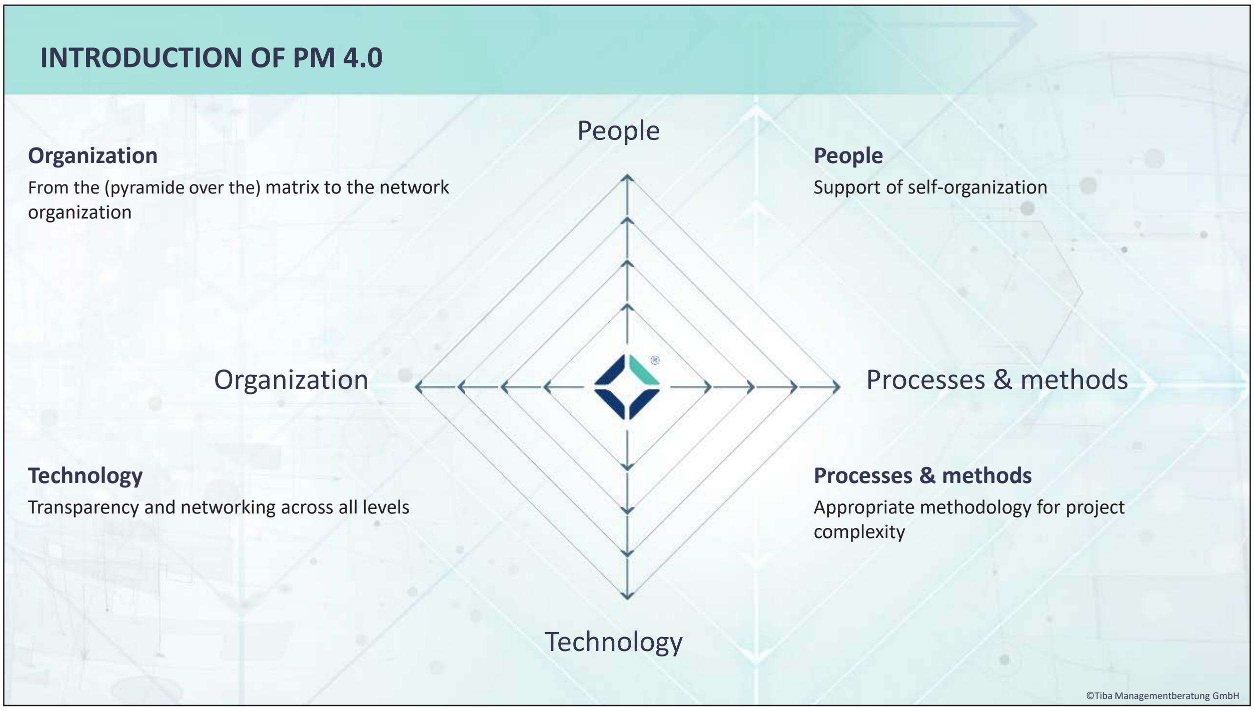
INTRODUCTION OF PM 4.0
People
Organization
From the (pyramide over the) matrix to the network organization
People
Support of self-organization
Organization
Processes & methods
Technology
Transparency and networking across all levels
Processes & methods
Appropriate methodology for project complexity
Technology
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Project management "4.0"

Keynote 3

Business and Digital Transformation by Cognitive Computing

Dr. Kazushi Kuse
VP, CTO of IBM Japan

Abstract:

Enterprises in the worldwide have embraced the concepts of AI (Augmented Intelligence) and Cognitive Computing. Many are already applying these and other intelligent technologies to dramatically improve capability and productivity of their businesses while redefining the ways they engage with customers, partners and others. However, they need a way to prioritize their digital intelligence investments, as cognitive computing presents virtually endless possibilities across business processes and functions. Several cognitive projects will be described with their business challenges. Advanced technologies such as Neuromorphic Computing and Quantum Computing are also explained.

Biography:

Dr. Kazushi Kuse is Vice President, CTO of IBM Japan. He had been leading IBM Tokyo Laboratory as Vice President of IBM Research and Development in Japan from 2009 - 2016. He was driving transformational projects as Vice President of Strategic Value Creation Team - Japan in 2008. He was Director of Service Innovation Laboratory, and Director of Systems Development Laboratory from 2006 - 2007. He was named as Director of IBM Tokyo Research in 2004. He was leading Services & Software department, Pervasive Computing, Object Technology, and

Programming Language in IBM Tokyo Research since he joined IBM in 1987. He received Ph.D. on Computer Science from University of Tsukuba in 1987.

Keynote 4

The role of project management in the world of tomorrow (Industry 4.0)

Prof. Dr.-Ing. Helmut Klausing

President of GPM Deusche Gesellschaft für Projektmanagement e.V.

Abstract:

The rapid digitalization in economy and society changes in a fundamental way our production methods and our working environment.

Introducing new and intelligent ways of creating added-value chains by interlacing production with modern and up-to-date information and communication technology will bring about completely new business models and processes in combination with changed market structures.

Dynamic, real-time optimized and self-organizing value creating networks will come about when people, objects and systems interact with each other. This will create value networks across businesses, companies and enterprises. These could be optimized according to various criteria such as costs, availability and use of resources. Moreover, in the past few years projects have been on the rise across all business sectors in Germany.

Biography:

Prof. Dr.-Ing. Helmut Klausing has been President of GPM Deusche Gesellschaft für Projektmanagement e.V. since January 2016.

He studied electro technology at TU Munich and did his PhD at the University of Karlsruhe in 1989. As a manager of large projects he worked for Siemens and EADS Germany in executive positions and had responsibility for various locations in Europe and South Africa in the fields of science of transport, mobile communication and aviation.

From 2006 to 2015 he was member of the Board of Directors of the association VDE Verband der Elektrotechnik Elektronik Informationstechnik e.V. and in this position responsible for the management of this association.

Prof. Klausing teaches “Innovation Management and Industrial Processes” as honorary professor at the Institute for Technology (KIT) in Karlsruhe.


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GPM Deutsche Gesellschaft für Projektmanagement e. V.
The role of project management in the world of tomorrow (Industry 4.0)
Prof. Dr.-Ing. Helmut Klausing
https://pixabay.com/de/hand-roboter-mensch-maschine-1571847/


World of tomorrow
10 thoughts
1 message
Page 2
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We live in a VUCA-world

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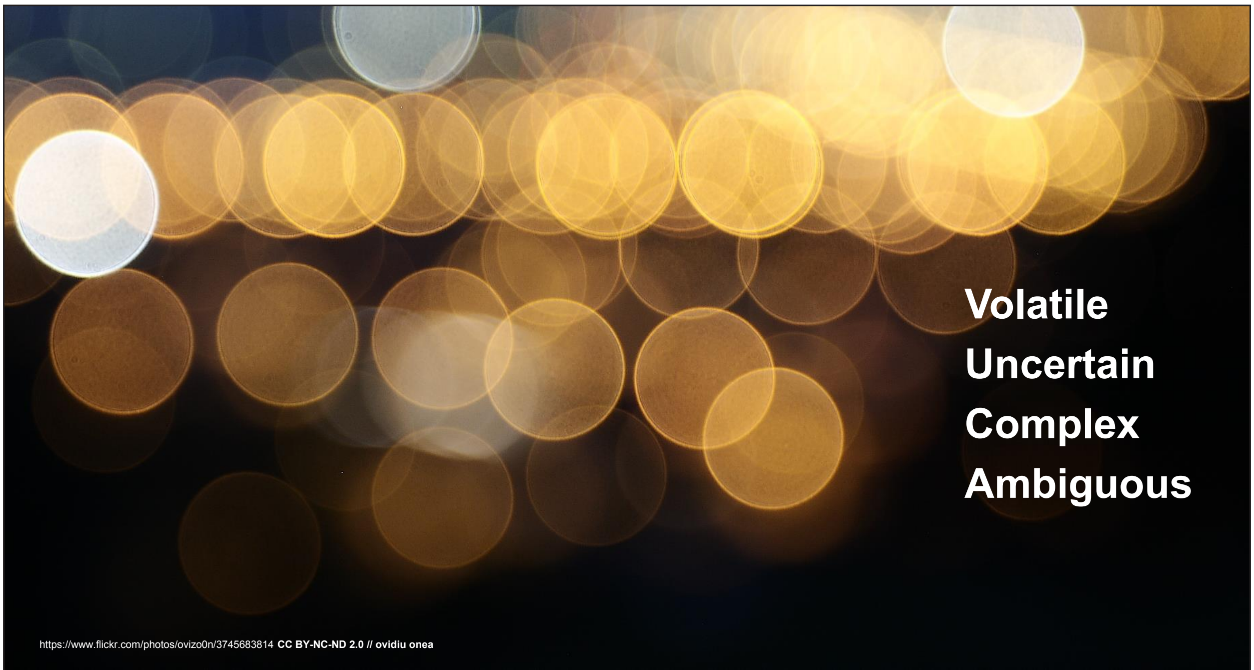

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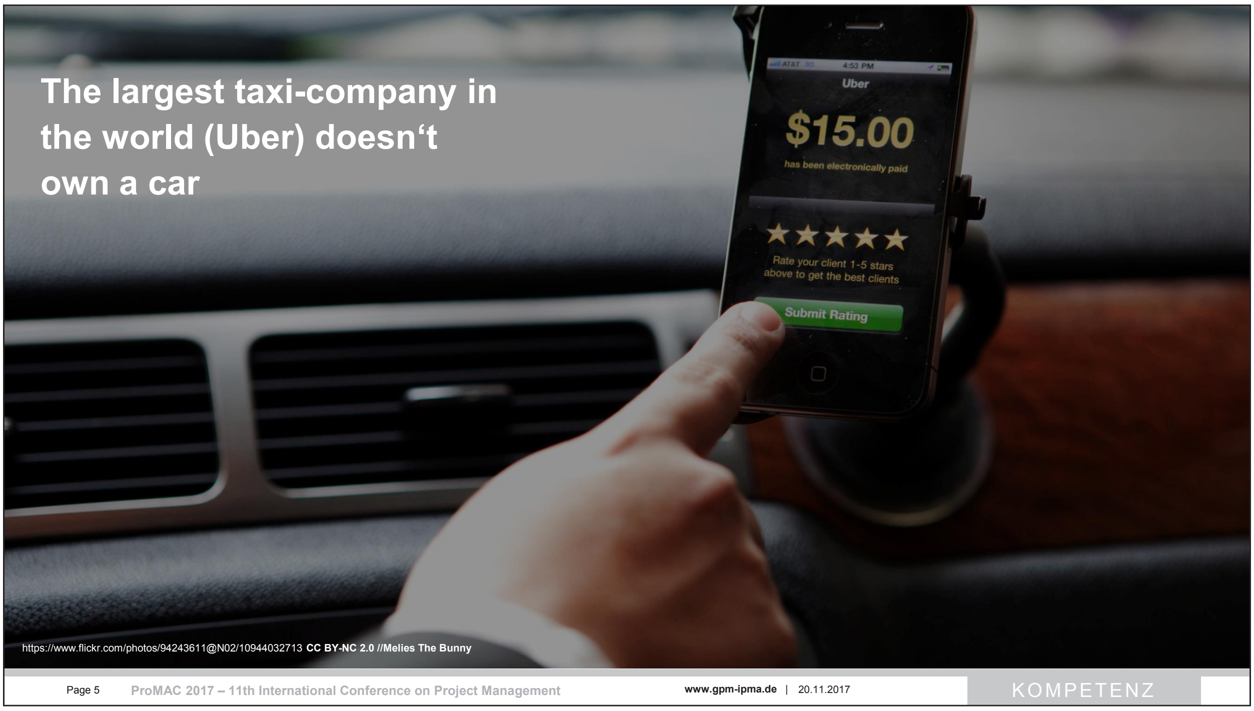
The largest taxi-company in the world (Uber) doesn‘t own a car
Uber
$15.00
has been electronically paid
Rate your client 1-5 stars above to get the best clients
Submit Rating
https://www.flickr.com/photos/94243611@N02/10944032713 CC BY-NC 2.0 //Melies The Bunny
Page 5
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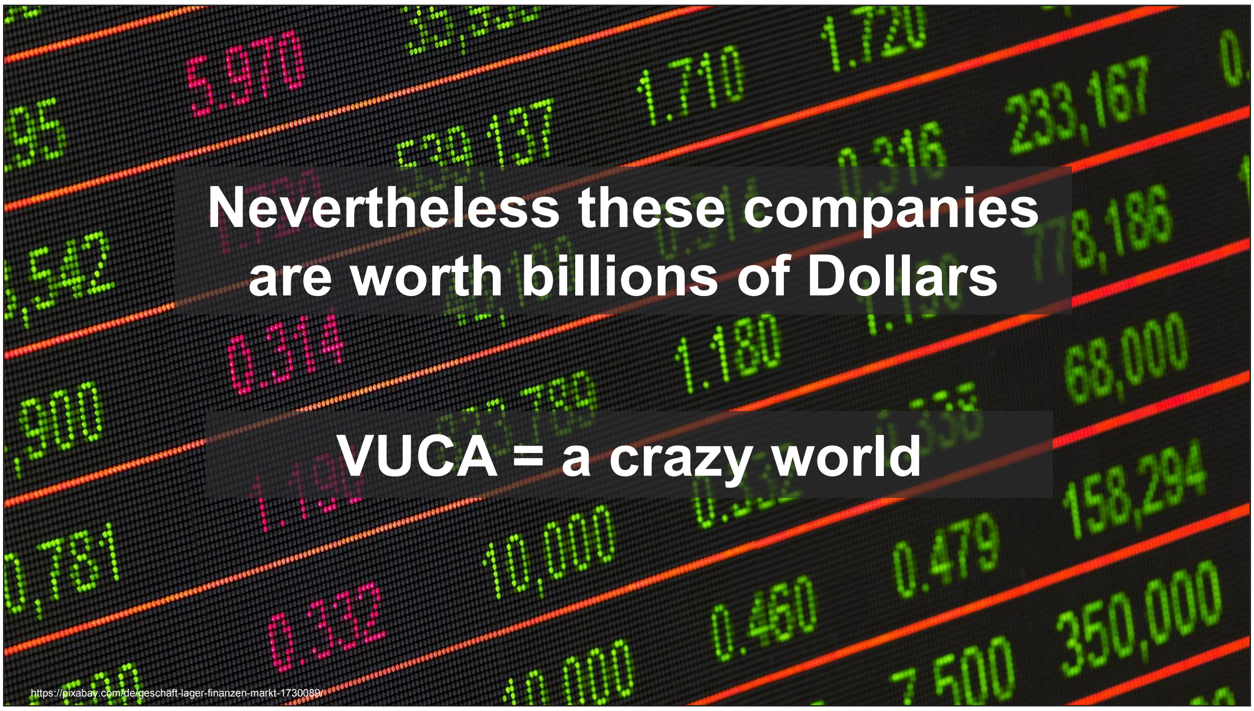
The largest accomodation service (Airbnb) doesn‘t own a single flat
https://pixabay.com/de/großes-haus-wohn-haus-architektur-389271/


The most aggressive dealer
(Alibaba) doesn‘t own a warehouse
itself
https://upload.wikimedia.org/wikipedia/commons/7/79/Wollschläger_Hochregal.jpg


Nevertheless these companies
are worth billions of Dollars
VUCA = a crazy world
https://pixabay.com/de/geschäft-lager-finanzen-markt-1730089/


2
VUCA is driven (amongst others)
by the digital economy
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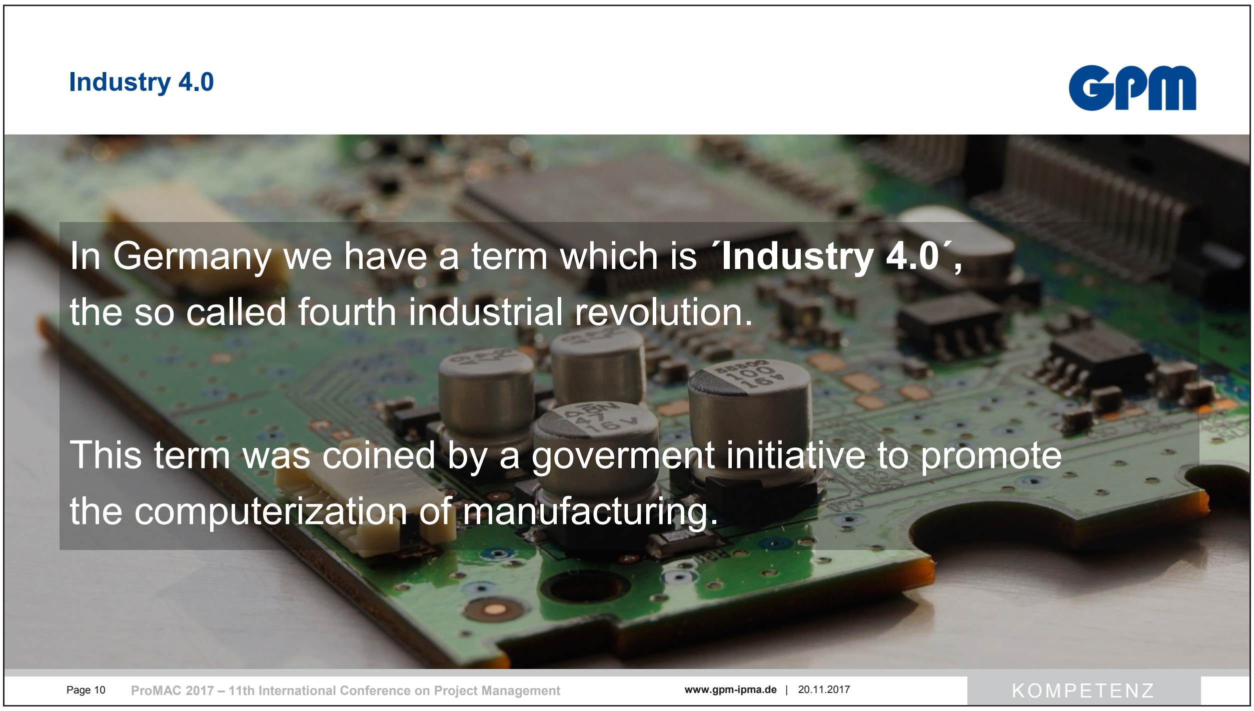
Industry 4.0
GPM
In Germany we have a term which is ´**Industry 4.0**´,
the so called fourth industrial revolution.
This term was coined by a goverment initiative to promote
the computerization of manufacturing.
Page 10
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GPM

Industry 4.0

The fourth industrial revolution: Towards intelligent and flexible production

Industrie 4.0 combines production methods with state-of-the-art information and communication technology. The driving force behind this development is the rapidly increasing digitalisation of the economy and society. It is changing the future of manufacturing and work in Germany: In the tradition of the steam engine, the production line, electronics and IT, smart factories are now determining the fourth industrial revolution.
The technological foundation is provided by intelligent, digitally networked systems that will make largely self-managing production processes possible: In the world of Industrie 4.0, people, machines, equipment, logistics systems and products communicate and cooperate with each other directly. Production and logistics processes are integrated intelligently across company boundaries to make manufacturing more efficient and flexible.

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Industry 4.0 means...

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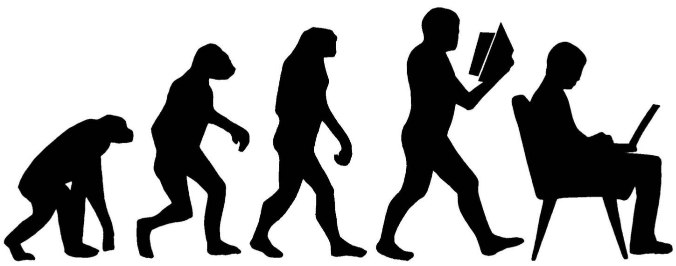
Evolution of Technology by Migration



Cloud, network, sensors, devices connecting to the Internet... all this is already in use

https://upload.wikimedia.org/wikipedia/commons/1/1c/Evolution-des-wissens.jpg

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Industry 4.0 means...

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A revolution concept

but

the implementation will happen by evolution

increased by migration

Quelle: W. Wahlster, DFKI

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With industry 4.0 companies can raise their productivity by up to 30 %
Bild: https://pixabay.com/de/leistung-stimme-zulassung-schöne-1238472/


Conventional business models come under pressure
New, agile and innovative players will appear
Bild: https://pixabay.com/de/maschine-alt-presse-handarbeit-709588/


Processes, production, products und services will change radically.
We will see traditional beliefs cracking
Bild: https://pixabay.com/de/bleistift-bruch-zerbrochen-kaputt-1203977/


GPM
GPM Deutsche Gesellschaft für Projektmanagement e. V.
„These changes will affect almost every industry, every company and every worker in Germany.“
BDA
BUNDESVEREINIGUNG
der Deutschen Arbeitgeberverbände
Page 18
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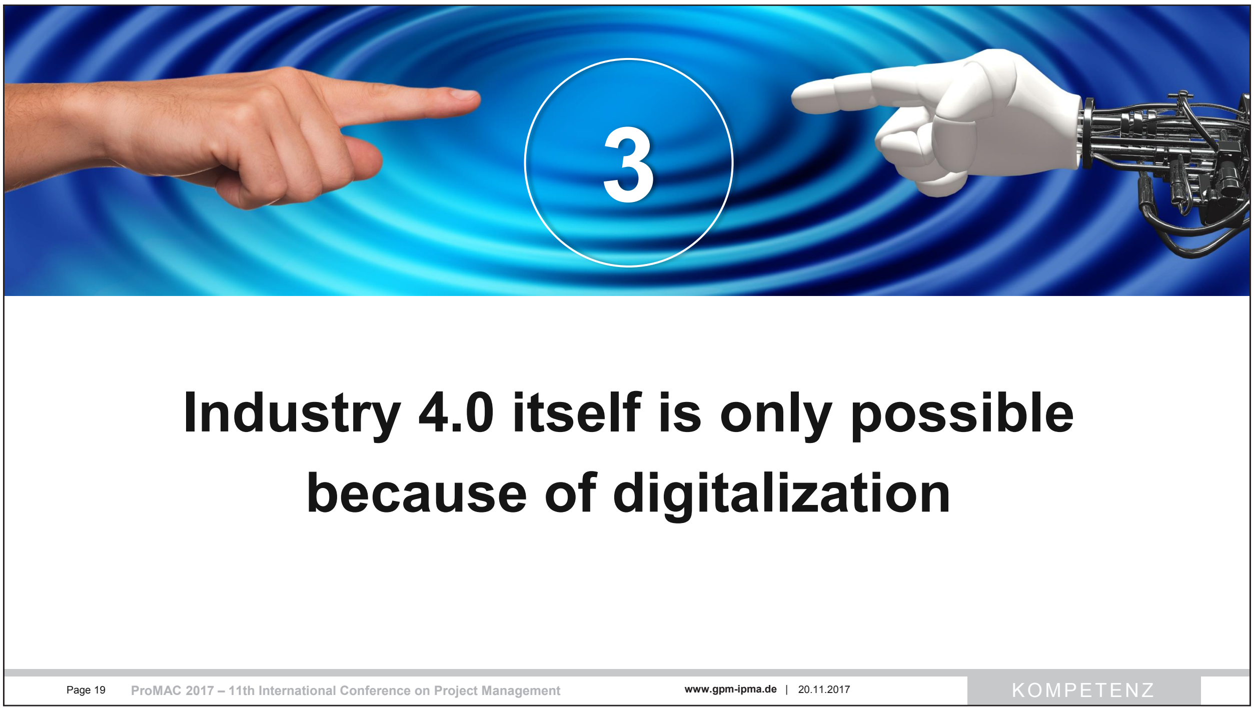
3
Industry 4.0 itself is only possible because of digitalization
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Digitalization has just about started
Bild: https://pixabay.com/de/superhelden-mädchen-geschwindigkeit-534120/


4
Digitalization won‘t only effect the physical world – the way we work together will radically change too
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We will see ...
more cooperation across companies and industries
+
thinking in systems (networks)
+
new working and business models
=
https://www.flickr.com/photos/29898978@N02/9946035604

In this new work-world the importance of projects will grow

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Industry 4.0

The combination of the physical and the virtual world will be a turning point for **Industry.**

Processes, production, products and services will change tremendously.

There will be a deep-rooted system change with dramatic and far-reaching implications.

Bild: https://pixabay.com/de/erdbeben-bruch-asphalt-riss-1665892/

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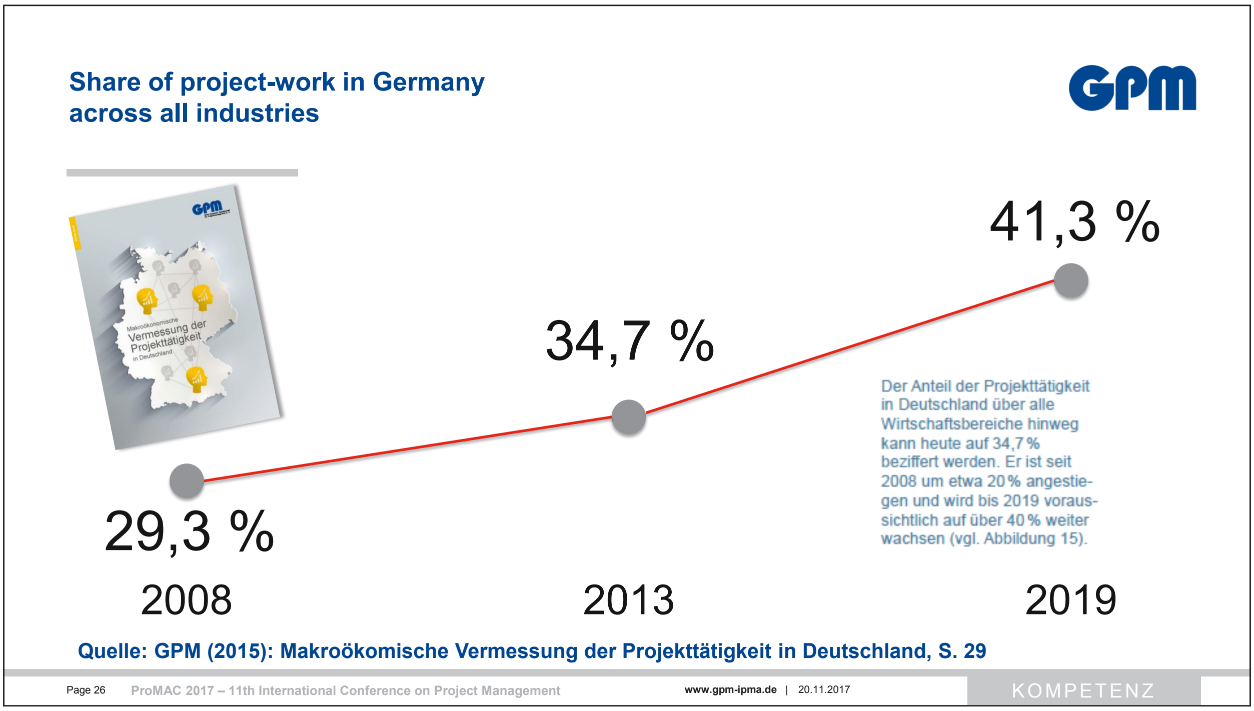
more cooperation across companies and industries
+
thinking in systems (networks)
+
new working and business models
=
more work will be done in projects
https://www.flickr.com/photos/29898978@N02/9946035604


Share of project-work in Germany across all industries
GPM
41,3 %
34,7 %
29,3 %
Der Anteil der Projekttätigkeit in Deutschland über alle Wirtschaftsbereiche hinweg kann heute auf 34,7 % beziffert werden. Er ist seit 2008 um etwa 20 % angestiegen und wird bis 2019 voraussichtlich auf über 40 % weiter wachsen (vgl. Abbildung 15).
2008
2013
2019
Quelle: GPM (2015): Makroökomische Vermessung der Projekttätigkeit in Deutschland, S. 29
Page 26
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6
As projects grow, the management of
projects will become a factor of success –
for companies and individuals alike
Page 27
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Almost everyone will need
project management skills –
not only managers, but also
employees and freelancers –
and will have to understand
their role in the whole process

The way we plan, decide, organize and operate will be in many ways different from the way we do it today

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Industrie 4.0 changes the working world

GPM

- New employment and working models
- Higher demands on complexity: Thinking in terms of systems and general contexts, of processes and creating value networks
- Increased expectations concerning responsible decisions taken by executives and flexible working processes with real and virtual tasks in dynamic structures and procedures
- New professional qualification requirements: universal engineering, workflow-management, digital competency
- Better qualification during working processes: as needed, in a formal, non-formal or informal way

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First results concerning Industry 4.0

GPM

Industry 4.0 mainly focusses on production with little change-over time, decentralized production steering and customized products as well as working processes in the future. However, the future role of Project Management in connection with digitalisation respectively Industry 4.0, has not yet been discussed.

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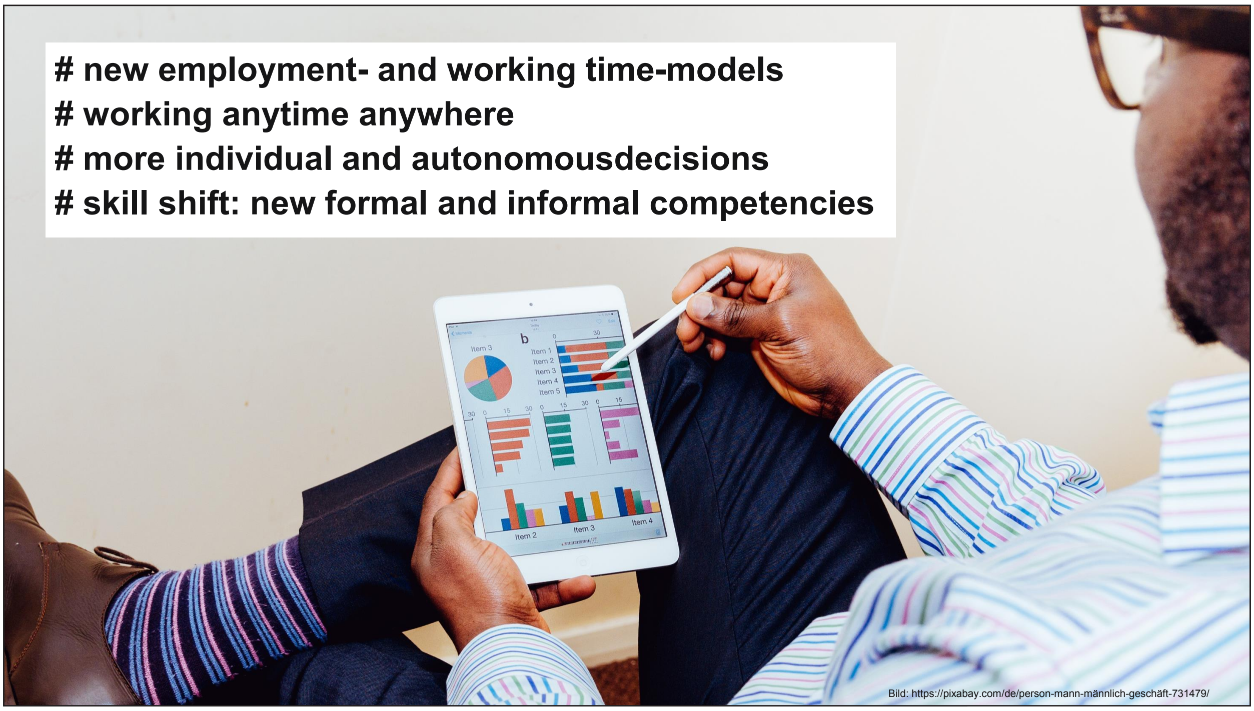

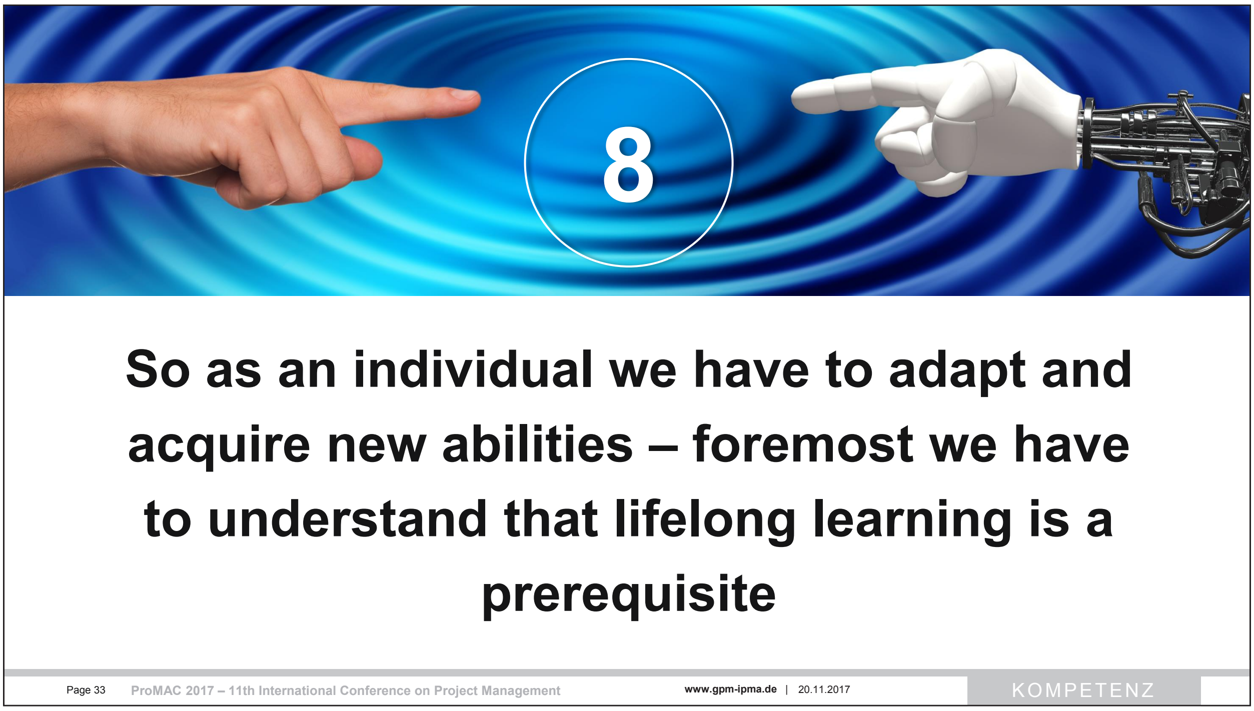
8
So as an individual we have to adapt and acquire new abilities – foremost we have to understand that lifelong learning is a prerequisite
Page 33
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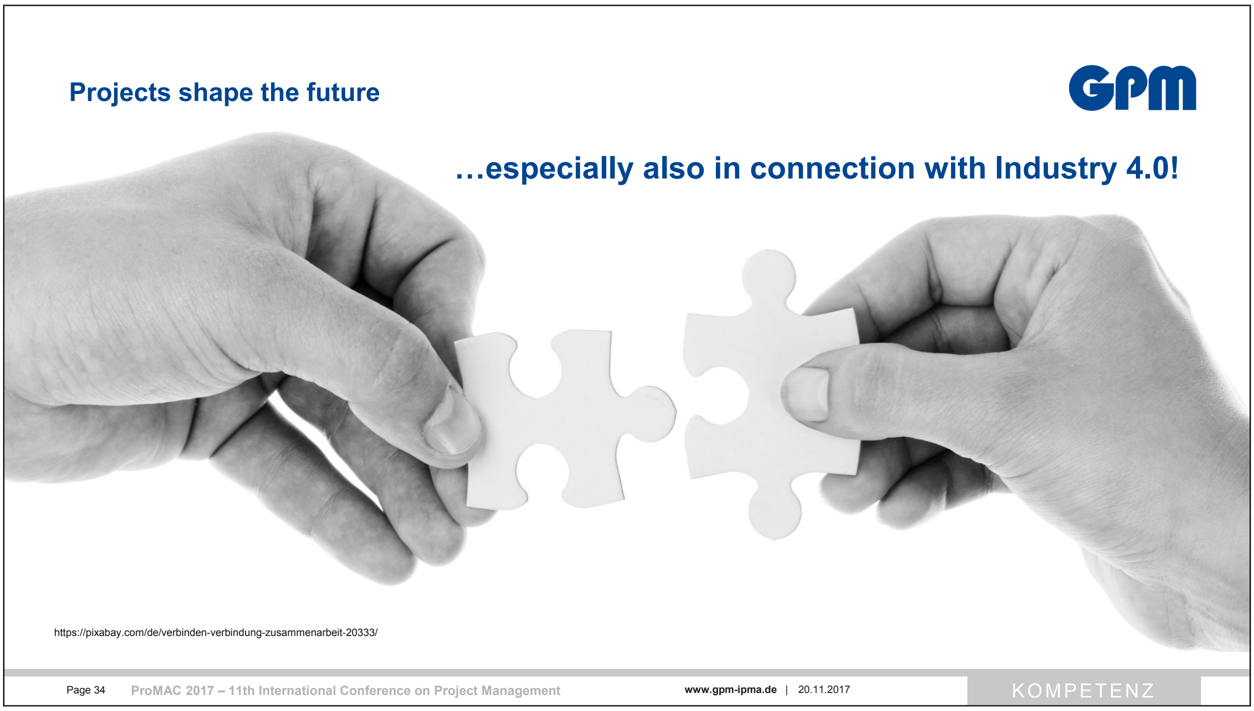
Projects shape the future
GPM
…especially also in connection with Industry 4.0!
https://pixabay.com/de/verbinden-verbindung-zusammenarbeit-20333/
Page 34
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Digitalisation in context with Project Management

GPM

New employment and working models

Higher demands on complexity: Thinking in terms of systems and general contexts, in processes and in creating value networks

Increased expectations concerning responsible decisions taken by executives and flexible working processes with real and virtual tasks in dynamic structures and procedures

New professional qualification requirements: universal engineering, workflow-management, digital competency

Better qualification during working processes: as needed, in a formal, non-formal or informal way

Project management offers the best opportunities for tackling these challenges with its team-orientated organisational structure.

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Bild: tps://upload.wikimedia.org/wikipedia/commons/6/65/Team_Work.jpg

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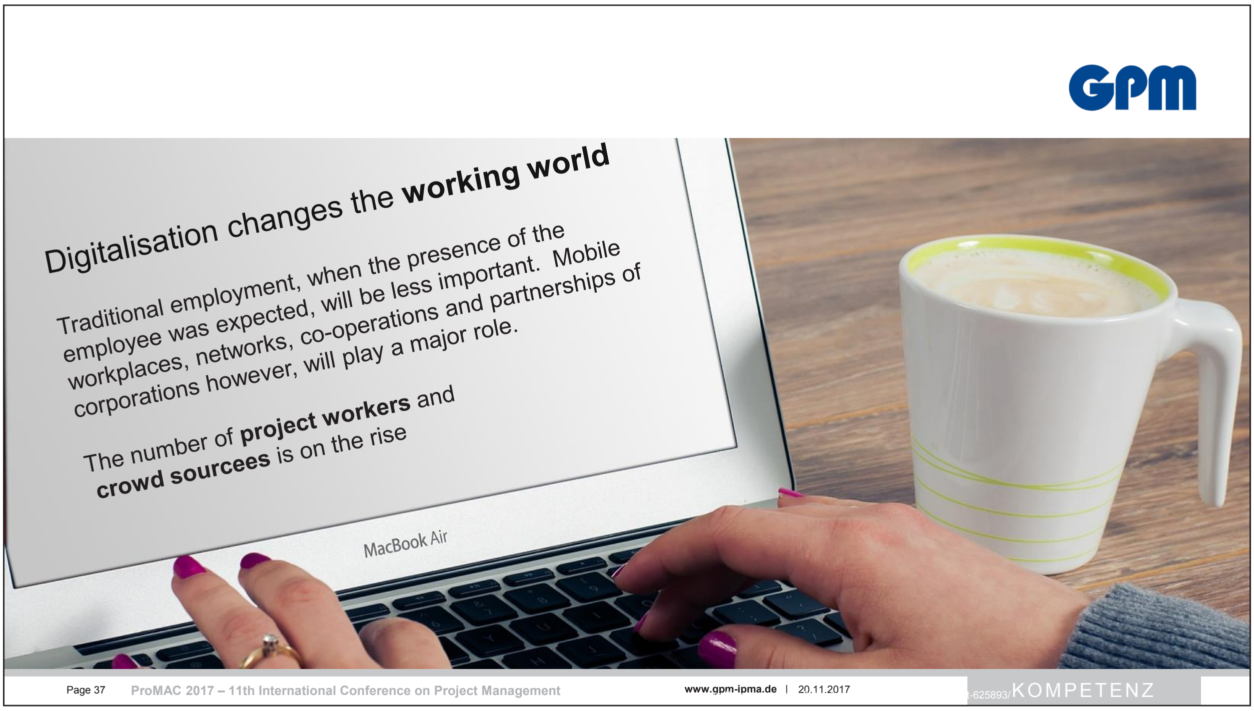
GPM
Digitalisation changes the working world
Traditional employment, when the presence of the employee was expected, will be less important. Mobile workplaces, networks, co-operations and partnerships of corporations however, will play a major role.
The number of project workers and crowd sourcees is on the rise
MacBook Air
Page 37
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Everyone involved in projects will have to learn
GPM
to work together with internal and external partners
…in a trusting way
https://pixabay.com/de/hand-hände-händeschütteln-861275/
Page 38
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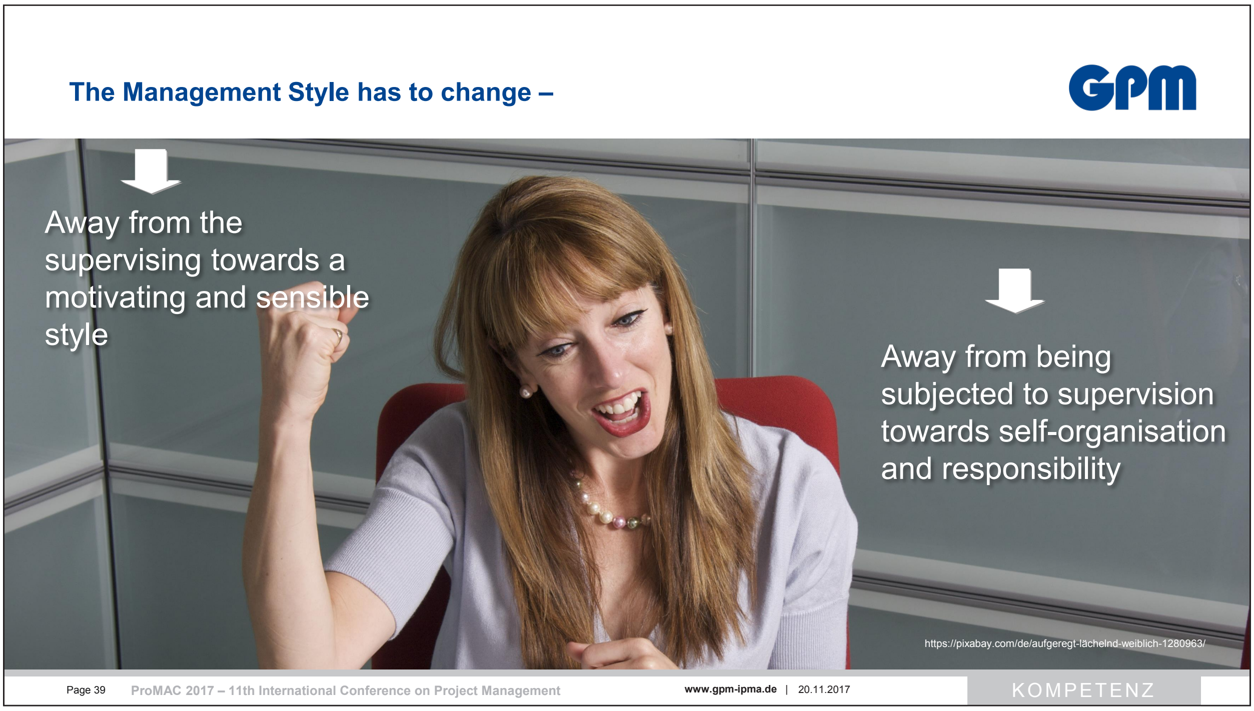
The Management Style has to change –
Away from the supervising towards a motivating and sensible style
Away from being subjected to supervision towards self-organisation and responsibility
https://pixabay.com/de/aufgeregt-lächelnd-weiblich-1280963/
Page 39
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We have to learn that social and communicative skills are as important as vocational skills
https://pixabay.com/de/abenteuer-höhe-arm-hilfe-sportler-1807524/
Page 40
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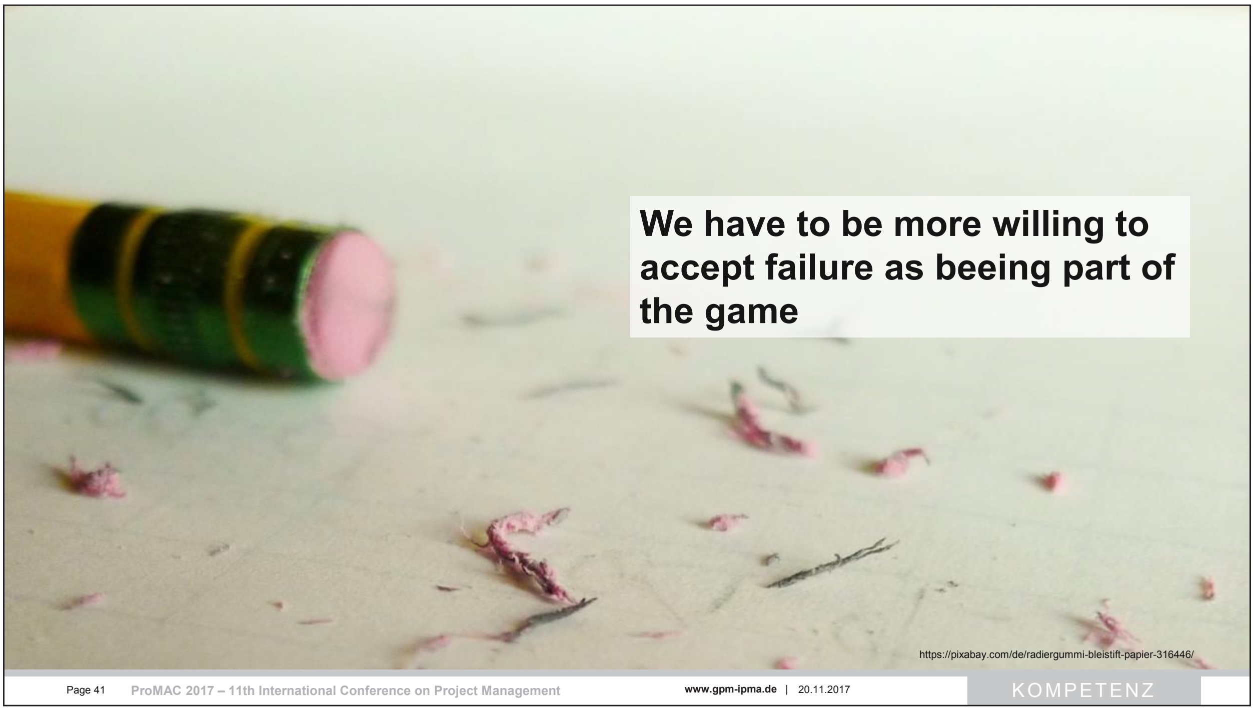
We have to be more willing to accept failure as beeing part of the game
https://pixabay.com/de/radiergummi-bleistift-papier-316446/
Page 41
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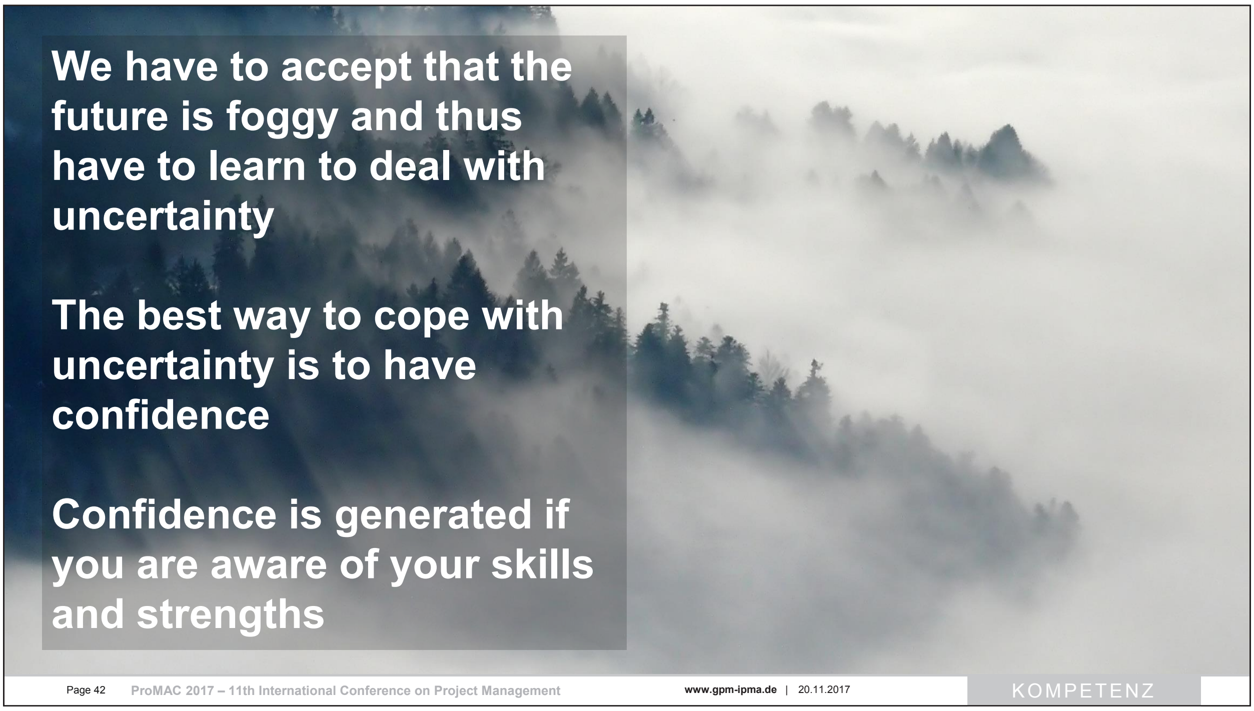
We have to accept that the future is foggy and thus have to learn to deal with uncertainty
The best way to cope with uncertainty is to have confidence
Confidence is generated if you are aware of your skills and strengths
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IPMA and GPM offer the opportunity for lifelong learning in the field of project management

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IPMA

GPM

- A Certified Projects Director
- B Certified Senior Project Manager
- C Certified Project Manager
- D Certified Project Management Associate

IPMA international project management association

The IPMA four-level certification program is designed as an ongoing competence development process.

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10
It is GPM‘s mission to provide fundamental PM-knowledge – starting at elementary school to university and professional training
Page 45
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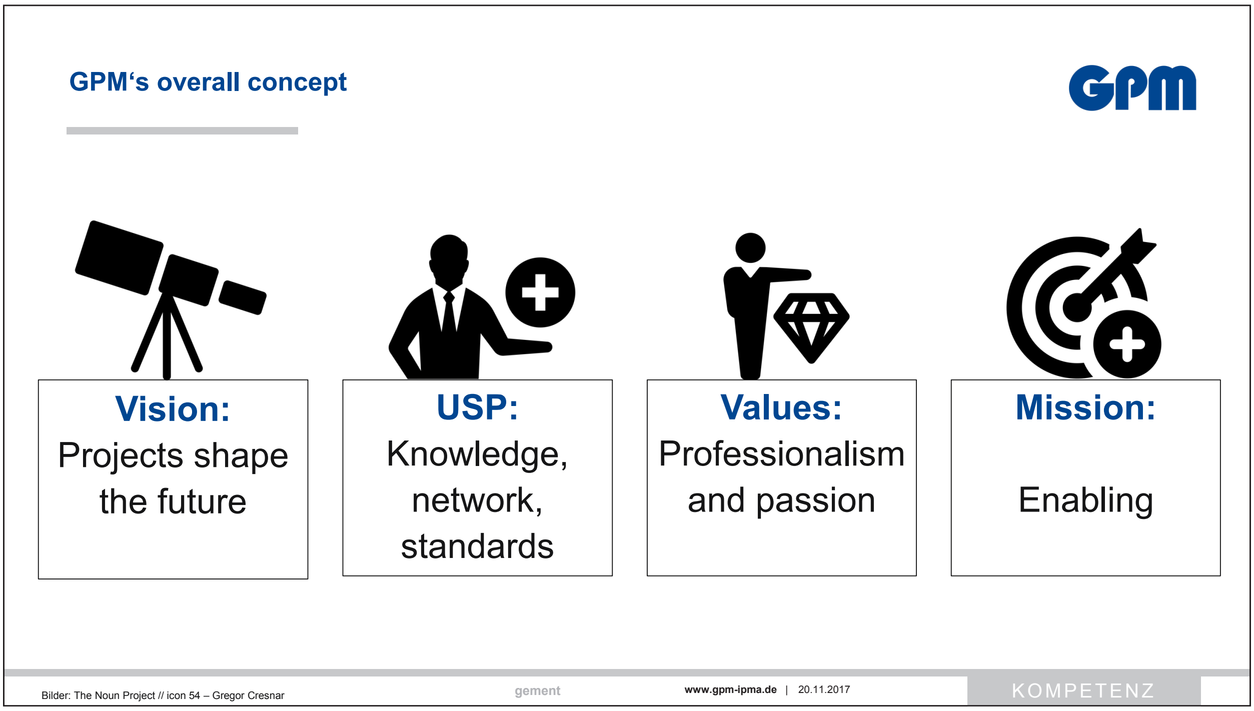
GPM‘s overall concept
GPM
Vision:
Projects shape the future
USP:
Knowledge, network, standards
Values:
Professionalism and passion
Mission:
Enabling
Bilder: The Noun Project // icon 54 – Gregor Cresnar
gement
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GPM

My message

Projects will be the future – especially with the Digital Revolution ahead

We at IPMA and GPM have the answers for future challenges!

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About us

GPM

GPM German Association for Project Management

- National member association of IPMA International Project Management Association
- Largest network of project management experts on the European continent (over 7,800 members)
- Legal form: non-profit organization
- Founded: 1979
- Headquarters: Nuremberg
- Capital office: Berlin

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Aims of GPM

GPM German Association for Project Management

- Professionalization of project management: participation in national and international development of project management standards (DIN, ISO)
- Development of project management: 39 professional groups
- Platform for project management topics: central and regional events
- Comprehensive programs for education and training, seminars and conferences
- Certification of project personnel according to the IPMA 4-level-certification system
- Ceremony of awards: for outstanding achievements in project management

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Thank you very much

Prof. Dr.-Ing. Helmut Klausing
h.klausing@gpm-ipma.de
0911 433369-80

Page 50 ProMAC 2017 – 11th International Conference on Project Management www.gpm-ipma.de | 20.11.2017 KOMPETENZ

Keynote 5

Project management across cultures on the example of a multinational EU-Research-Project for "An Open Platform for the Smart City"

Prof. Dr. Lukas Rohr

Director Engineering and Information Technology, Bern University of Applied Sciences

Abstract:

In august 2016 Bern University of applied science has won an important EU-funded project together with partners in Japan and Europe. The goal is to develop a platform on which open government data combined with the internet of things is provided to a variety of users.

We will discuss general project management guidelines based on theories of Hofstede, Hall and Trompenaars and focus and highlight on experiences and investigations found on this special project [1].

We will analyze what project managers must consider in such an international and intercultural project. We will explain how conflicts can arise and be resolved in an international project, and examined communication in an intercultural environment always with the goal to maintain a smooth working relationship.

1. Project management across cultures 2017, Bachelor Thesis by Patric Jenni, Bern university of Applied Sciences

Biography:

Lukas Rohr holds a PhD in Physics of the University of Basel and a MBA of ETH Zürich.

His career began in an industrial R&D section before he became in 1993 head of the new founded materials technology department at EMPA (Swiss federal laboratories for materials testing and research) in Thun. There he was responsible for several international research projects in the framework of EU and many R&D contracts with industry.

2007 he was elected as a director of Bern University of Applied Sciences in Engineering and Information Technology.

He is involved in many activities fostering start-ups and transfer of R&D results to the industry. He serves therefore in several boards as for example as President of the Board of the Foundation for technological Innovations.

He served for almost 10 years as a Swiss delegate in a technical committee of COST (European Cooperation in the field of Scientific Research)

He was always convinced of the innovation potential of multicultural teams and interested in leading such research teams. Therefor he did 1996/1997 an Europreneurial-Education at the Centre Européen de Management in Colmar (F) in collaboration with University of St. Gallen and INSEAD at Fontainebleau

Lukas is married to Mayumi Yoshida and they have 3 adult children.

They live in Thun (Switzerland) for almost 30 years.

Project Management Across Cultures

on the example of a multinational EU-Research-Project for “An Open Platform for the Smart City”

Prof. Dr. Lukas Rohr
Bern University of Applied Sciences

Layout

- The Project: City Platform as a Service – Integrated and Open
- Project Management Structure
- Intercultural Sensitivty
- Challenges and Obstacles
- Conclusions

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City Platform as a Service – Integrated and Open

[siːpaːsdɒtaɪəʊ]

シーパース・ドット・アイオー

Horizon 2020
European Union Funding
for Research & Innovation

Project Data

Joint Research and Innovation Action (RIA) between Europe and Japan

Funding Institutions & Programmes	H2020 EUJ-02-2016 NICT (高度通信・放送研究開発委託事業)
Project Volume	3.2 Mio. € 304.5 PM
Duration	July 1, 2016 – December 31, 2018 (2.5 years)

Horizon 2020
European Union Funding
for Research & Innovation

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What is a Smart City?

„A city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"
Caragliu et al., 2011

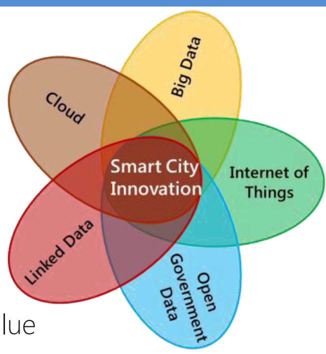
„A smart city is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development"
Dameri, 2013

„A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operations and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects."
ITU-T, 2016

5

Project Objectives

1. Develop an Open Social City Platform
2. Deploy the City Platform as a Service Solution
3. Empower the citizen to her data
4. Validate the platform with use cases providing public value
5. Develop blue prints for the adaptation and transfer of solutions to other cities
6. Create impact in cities



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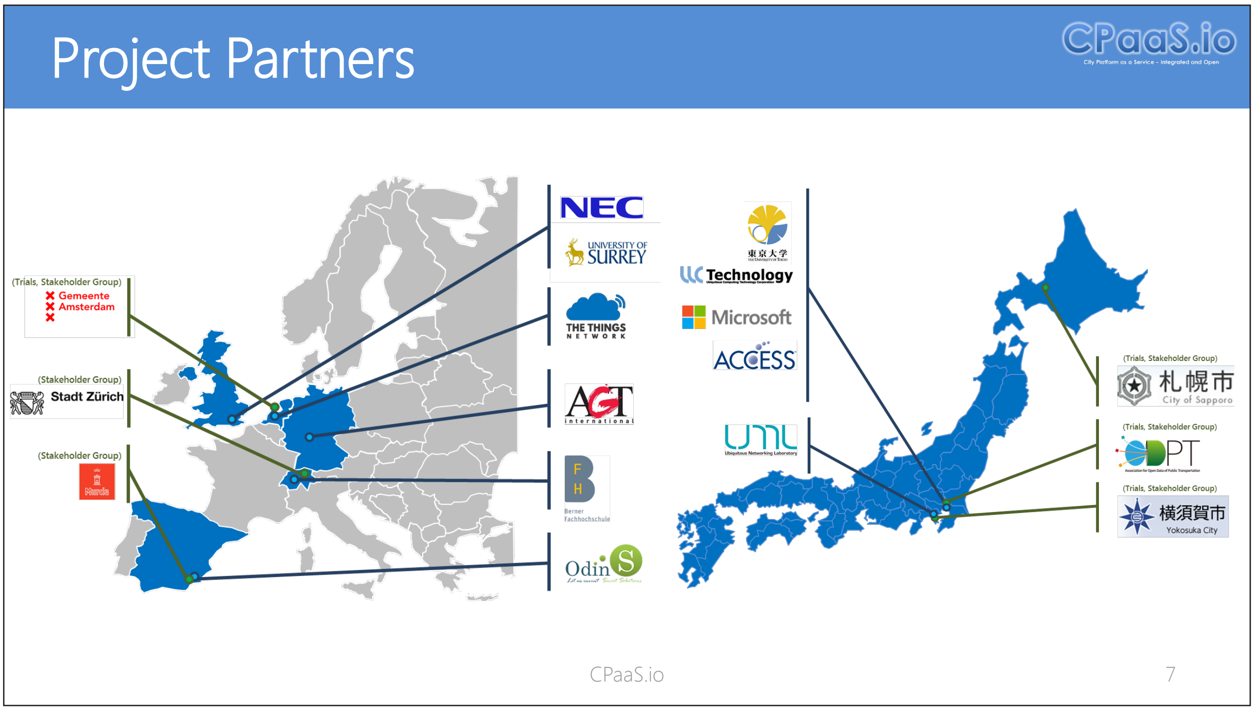
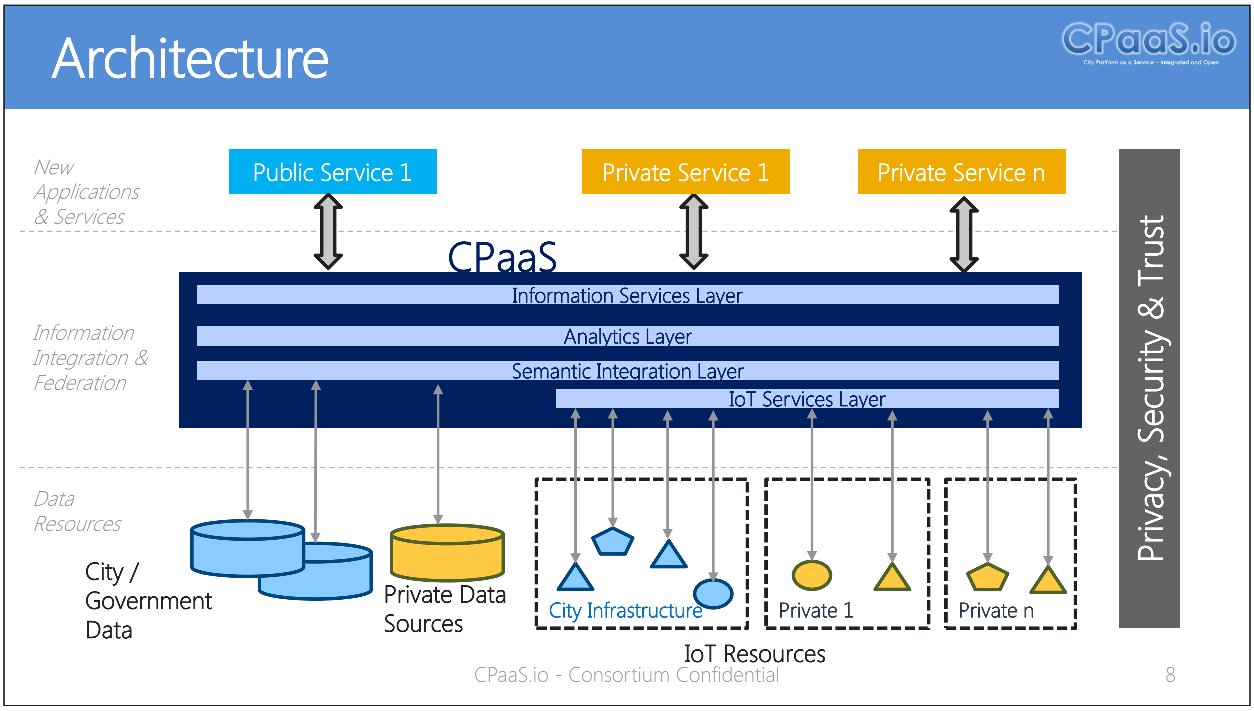

Project Partners
CPaaS.io
(Trials, Stakeholder Group)
Gemeente Amsterdam
(Stakeholder Group)
Stadt Zürich
(Stakeholder Group)
NEC
UNIVERSITY OF SURREY
THE THINGS NETWORK
AGT international
F H
Berner Fachhochschule
Odin S
東京大学
Technology
Microsoft
ACCESS
UNL
(Trials, Stakeholder Group)
札幌市
City of Sapporo
(Trials, Stakeholder Group)
PT
(Trials, Stakeholder Group)
横須賀市
Yokosuka City
CPaaS.io
7


Architecture
CPaaS.io
New Applications & Services
Public Service 1
Private Service 1
Private Service n
CPaaS
Information Services Layer
Analytics Layer
Semantic Integration Layer
IoT Services Layer
Information Integration & Federation
Data Resources
City / Government Data
Private Data Sources
City Infrastructure
Private 1
Private n
IoT Resources
Privacy, Security & Trust
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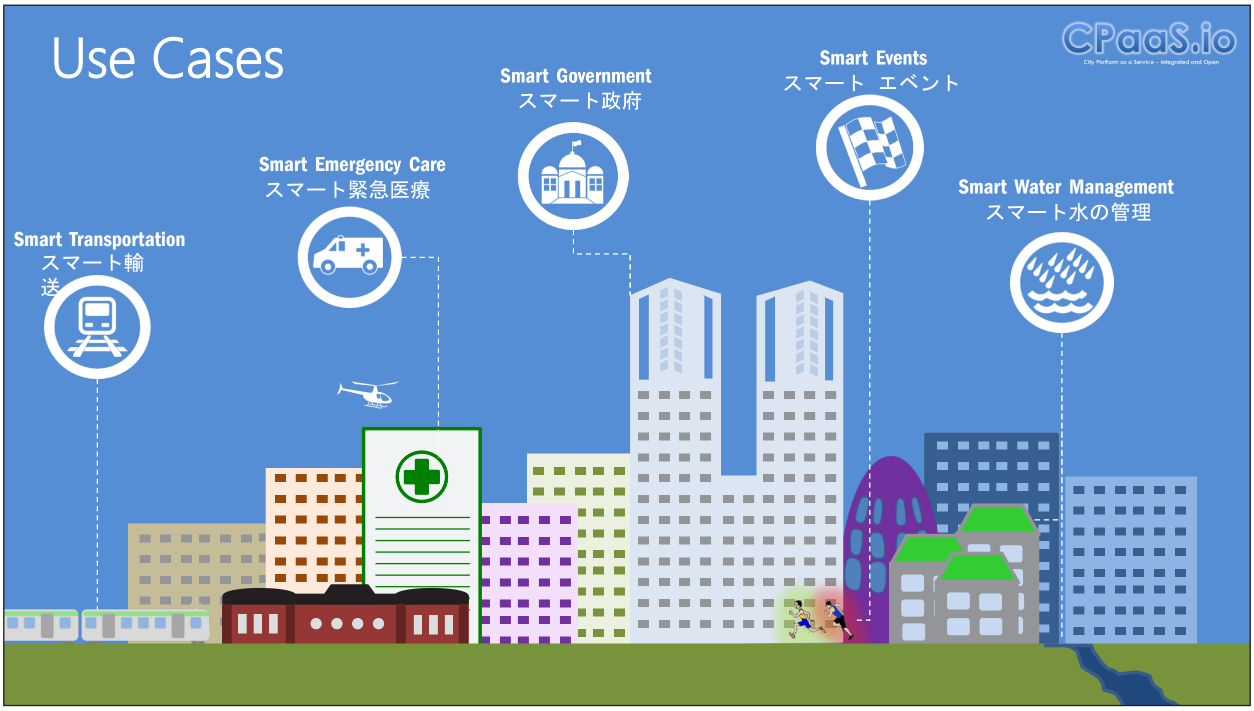
8



Use Case - Events

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Event Experience

- More fun and excitement for participants at events like the "colour run"
- Increased number of participants
- Better information for international visitors (e.g., Asian Winter Games 2017 in Sapporo)
- Better logistics for organizers, participants and visitors

Transportation

- Aggregated real-time information about public transport operations from multiple providers
- Scalability

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Use Case - Waterproof Amsterdam

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City Platform as a Service - Integrated and Open

Goals
- Early detection of high water levels / floods
- Safety of citizens

Approach
- Citizens install water and water level sensors, connected via a LoRaWAN network
- Data is collected, aggregated and analysed in the CPaaS.io platform
- Automatic triggering of governmental services
- Data available to third parties for additional usage and services

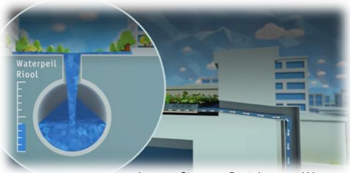

Image: Stowa - Bert-Jan van Weeren (https://youtu.be/7OeNDSepbUY)

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Use Case - Waterproof Amsterdam

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City Platform as a Service - Integrated and Open

Users
- Waternet
- Buidling Owners

Data
- Weather
- Sensors and Devices
- Water Infrastructure
- Ground Water
- Realtime Sewage Data
- Historical Data about Bottlenecks
- Geodata

Pictures: Rainproof Amsterdam (Merlijn Michon), Retentiedak Smart Flow Control (https://youtu.be/JJ7hQWv5-eU)

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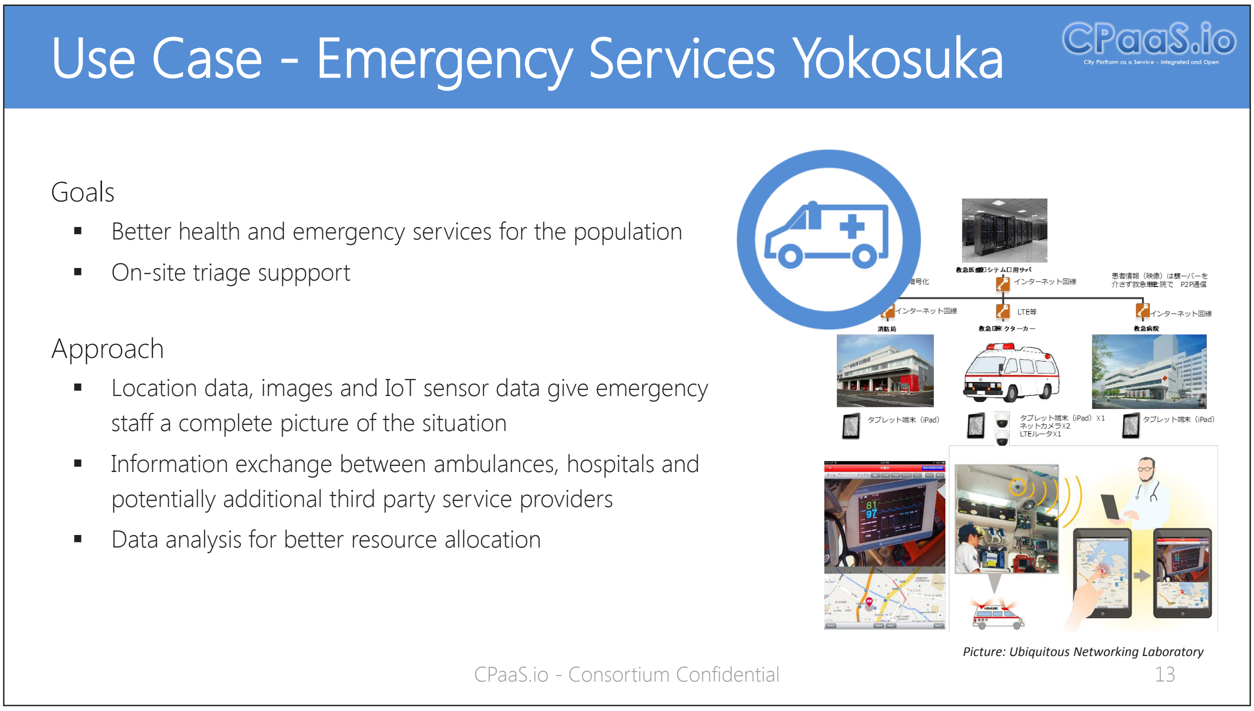
Use Case - Emergency Services Yokosuka
CPaaS.io
Goals
Better health and emergency services for the population
On-site triage suppport
Approach
Location data, images and IoT sensor data give emergency staff a complete picture of the situation
Information exchange between ambulances, hospitals and potentially additional third party service providers
Data analysis for better resource allocation
Picture: Ubiquitous Networking Laboratory
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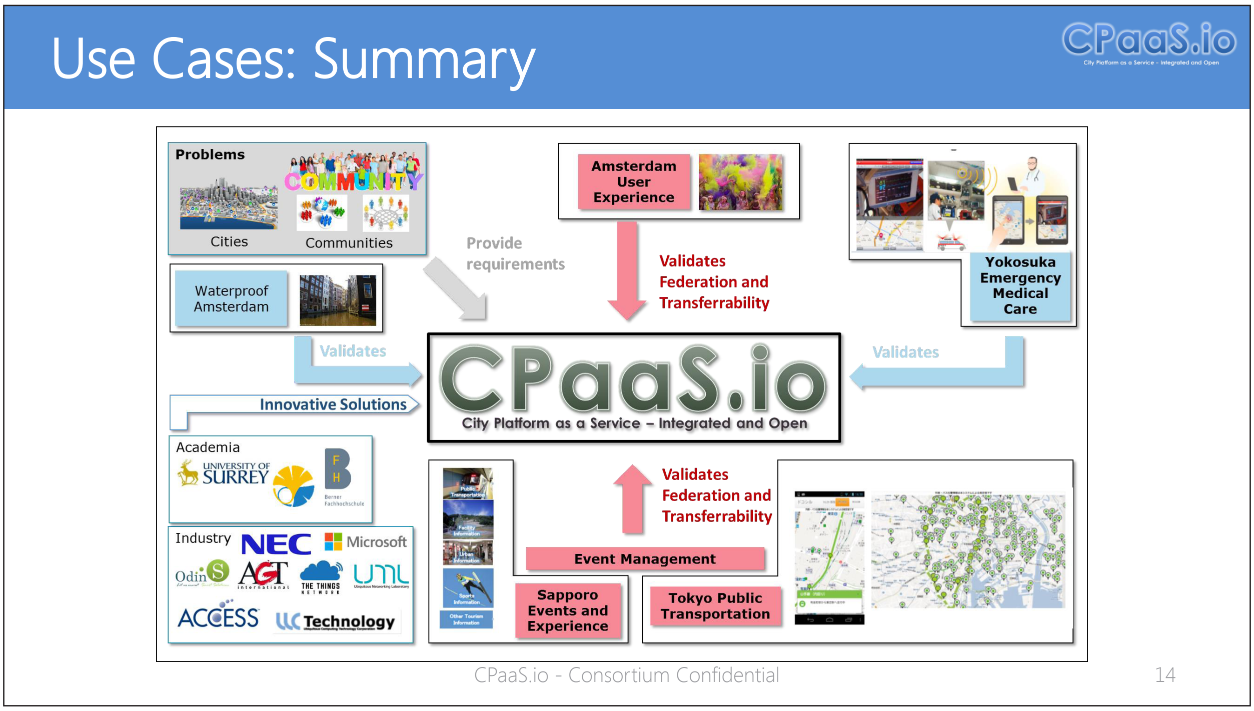
13


Use Cases: Summary
CPaaS.io
Problems
Cities
Communities
Waterproof Amsterdam
Provide requirements
Amsterdam User Experience
Validates Federation and Transferrability
Yokosuka Emergency Medical Care
Validates
Validates
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City Platform as a Service – Integrated and Open
Innovative Solutions
Academia
Industry
NEC
Microsoft
ACCESS
Technology
Validates Federation and Transferrability
Event Management
Sapporo Events and Experience
Tokyo Public Transportation
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14

Summary

The project …

- … combines different, but complementary technologies
- … develops a platform as a foundation for an urban data infrastructure
- … shows the value based on concrete use cases defined by the cities

In addition to the technical and scientific innovation, it is an explicit goal to foster an innovative economic environment in cities.

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Project Management – 4 Key documents

- 1. The Grant Agreements
- 2. The Coordination Agreement
- 3. The Consortium Agreement (Europe) and Subcontractor agreement (欧州との連携による公共ビッグデータの利活用基盤に関する研究開発再委託契約書– Japan)
- 4. The Project Handbook

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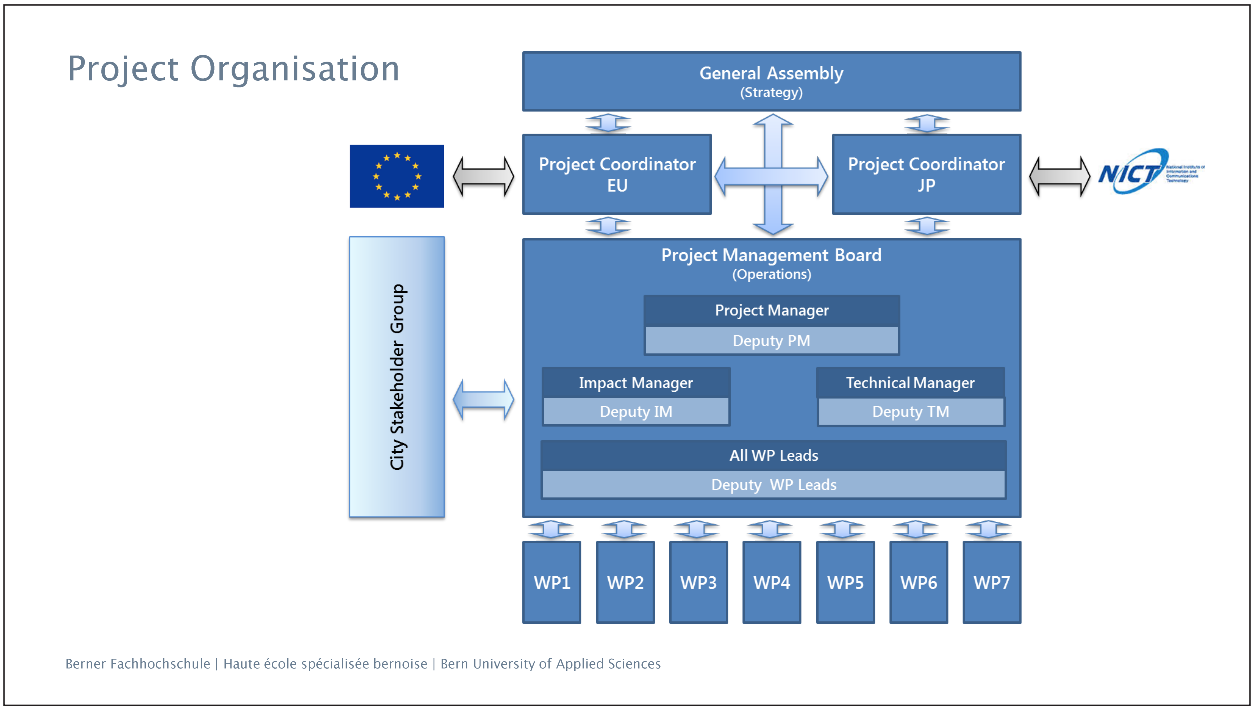
Project Organisation
General Assembly
(Strategy)
Project Coordinator
EU
Project Coordinator
JP
NICT
City Stakeholder Group
Project Management Board
(Operations)
Project Manager
Deputy PM
Impact Manager
Deputy IM
Technical Manager
Deputy TM
All WP Leads
Deputy WP Leads
WP1
WP2
WP3
WP4
WP5
WP6
WP7
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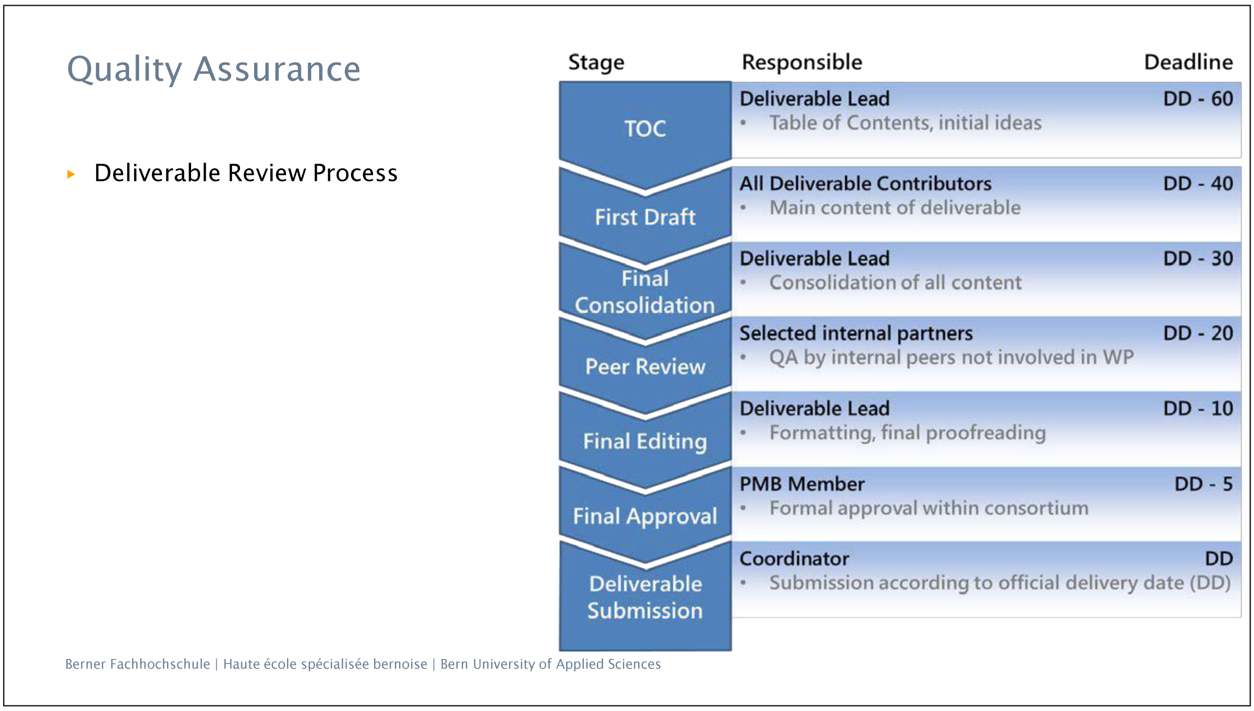
Quality Assurance
Deliverable Review Process
Stage
Responsible
Deadline
TOC
Deliverable Lead
DD - 60
Table of Contents, initial ideas
First Draft
All Deliverable Contributors
DD - 40
Main content of deliverable
Final Consolidation
Deliverable Lead
DD - 30
Consolidation of all content
Peer Review
Selected internal partners
DD - 20
QA by internal peers not involved in WP
Final Editing
Deliverable Lead
DD - 10
Formatting, final proofreading
Final Approval
PMB Member
DD - 5
Formal approval within consortium
Deliverable Submission
Coordinator
DD
Submission according to official delivery date (DD)
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Operational Challenges

Financial Reporting and Payments

- Coordination of the Japanese and European funding agencies
  - e.g. Different funding requirements
- Different fiscal years and appropriate reports
  - Budget organisation
- Different Processes in EU and in Japan
  - Different holidays should be in line with deadlines
- Mailing list should be kept to essential things

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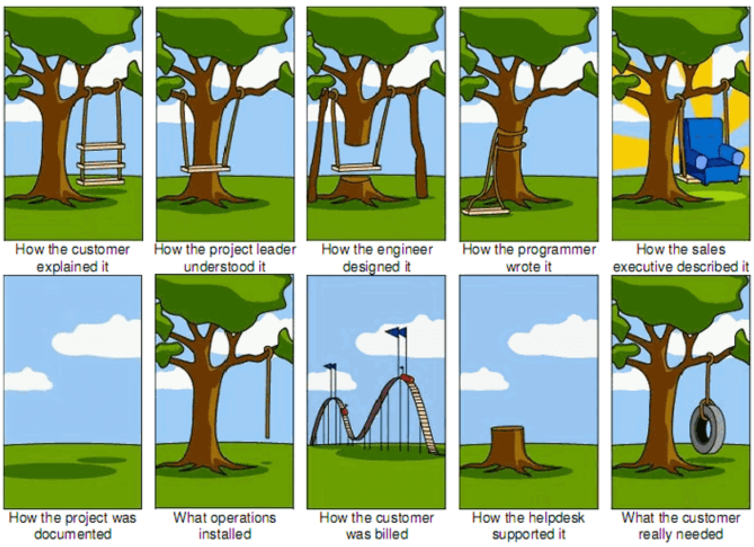
Project Management is „almost“ all about Communication

- Communication Process
- Para verbal communication
- Non-verbal communication
- Means of communication



https://www.tamingdata.com

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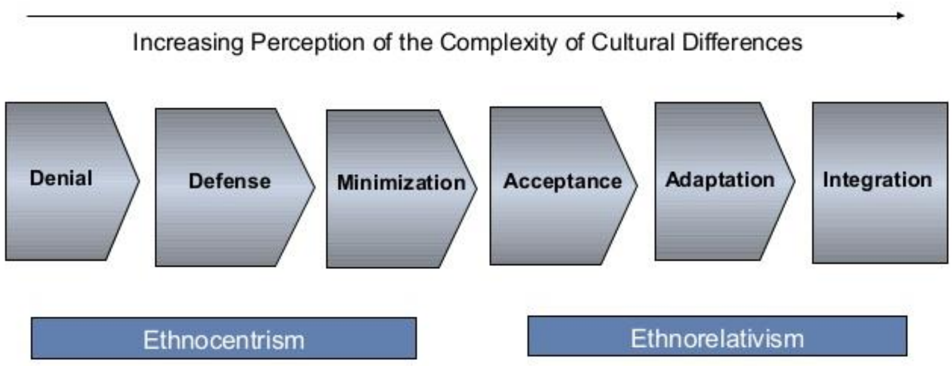
DMIS – Development Model of Intercultural Sensitivity



Source: Milton Bennett

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Culture and intercultural dimension

Dimension Model by Hofstede

- Power Distance
- Individualism/Collectivism
- Masculinity
- Uncertainty Avoidance

Cultural characteristics all nations Frameworks	Japan	Switzerland	Germany	Netherlands	France	Spain
Power Distance	Medium	Low	Low	Low	High	Medium to High
Individualism vs Collectivism	Rather Collectivistic	Individualistic	Individualistic	Individualistic	Individualistic	Medium
Masculinity	Very Masculine	Masculine	Masculine	Feminine	Medium	Medium to low
Uncertainty Avoidance	Very High	Medium to high	High	Medium	Very high	Very high

Source: Patric Jenni

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Communication Plan

- Kick off Meeting in Japan
- Internal collaboration room based on Sharepoint 2013
- General Assembly (one physical meeting/year and online meetings on demand
- Project coordinators EU & JP (Bi-weekly)
- WebMeetings: Adobe Connect Room
- Public Website: http://www.cpaas.io
- One mailing list for all members used for general project information
- Newsletter at important project milestones

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Challenges for the project

- Different Expectations for one big project
- In Europe might the project last 30 months and in Japan 36 months
- Learning: If you don‘t hear anything, the project is probably sleepy
- If possible don‘t chat, don‘t email – talk face to face
- Challenge the cultural differences – respect and understand
- Handling of different funding requirements and funding rules
- Find the advantage of multicultural teams
- Don‘t be to serious, let‘s lough together!
- Doing things right or doing the right thing

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Conclusions

- 24h Project work, needs well organised teams and flexibility
- Manage expectations especially by the project leader(s) to be predictable
- Language tools: Language competencies are still important. Computer tools like (translation or speech recognition) are helpful
- Culture – Diversity: Openness for other culture and a minimal knowledge is very helpful to avoid misunderstandings
- Face to face meetings in the beginning very important (kick off)
- Soft and Communication skills of the Project leader is very important
- Culture adapts the team through the work
- Requirements/Motivation of the team member and their surrounding should be understood

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Thank You

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City Platform as a Service – Integrated and Open

Gracias Mulțumesc 謝謝 Paldies Eskerrik asko Dziękuję Mahalo תודה Go raibh maith agat спасибо Grazzi आभारी
Xin cảm ơn 감사합니다 நன்றி Köszönöm مرسي Ndiyabulela Grazia Tak Благодаря Aitäh Terima kasih Děkuji
Asante Diolch شكرا Takk Ďakujem Gràcies Kiitos Obrigado Teşekkür ederim Ngiyabonga Þakka þér Grazas
Tapadh leibh ขอบคุณ Faleminderit Ačiū Danke Merci Grazie Hvala Ευχαριστώ Dankon Tack Dank je Grazcha

With special thank to the CPaaS.io Team especially
Prof. Stephan Haller
Patric Jenni

ありがとう

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Keynote 6

Management 4.0: How Digitalization Drives the Transformation of Industries

Prof. Dr. Hubertus C. Tuczek
University of Applied Sciences Landshut, 84036 Landshut
TCC-Management - Strategy Consulting, 81247 Munich

Biography:

Prof. Dr. Hubertus C. Tuczek earned his doctorate at the Technical University Munich (TUM), Prof. Milberg in engineering. He has gained more than 30 years of management experience in the machinery and equipment, aerospace and automotive industries. For 17 years he held the position of a group vice president on the board of the Dräxlmaier Group, a worldwide operating automotive supplier, with responsibility for international business development, quality and project management as well as global procurement. At the beginning of 2015 he was appointed as a Professor for Management and Leadership at the University of Applied Sciences at Landshut, near Munich. His research is focused on the changing requirements for leadership in the digital age.


Management 4.0: How Digitization
Drives the Transformation of Industries
GPM Deutsche Gesellschaft für Projektmanagement e. V.
Prof. Dr. Hubertus C. Tuczek
PROJEKT
MANAGEMENT
EFFEKTIV
Page 1
Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management
Agile Management 4.0


Management 4.0: How Digitization
Drives the Transformation of Industries
GPM Deutsche Gesellschaft für Projektmanagement e. V.
Agile Management 4.0
Editors: Alfred Oswald, Wolfram Müller
Management 4.0
Handbook for Agile Practices
Release 1.0
PROJEKT
EFFEKTIV
Page 2
Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management
Agile Management 4.0

Complexity is Our Way of Being!

GPM

Complexity is a gift.

Complexity has been always there.

For the first time in human history, natural complexity interlinks with social and technical complexity in a unique way as never seen before.

Complexity generates uncertainty (it feels unpredictible and unmanageable).

Page 3 Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management Agile Management 4.0

Management in the Course of Time …

GPM

Management 1.0
Command and Control
„Scientific“

Management 2.0
Market strategy
add-on tools

Management 3.0
Complexity
Scientifc analogy

Management 4.0
Complexity as gift
Network of theories

~1975 ~1995 ~2015

Boom of tools:
- Balance Scorecard
- Six Sigma
- Theory of Constraints
- Total Quality Management
- ….

2/2001
Agile Manifesto

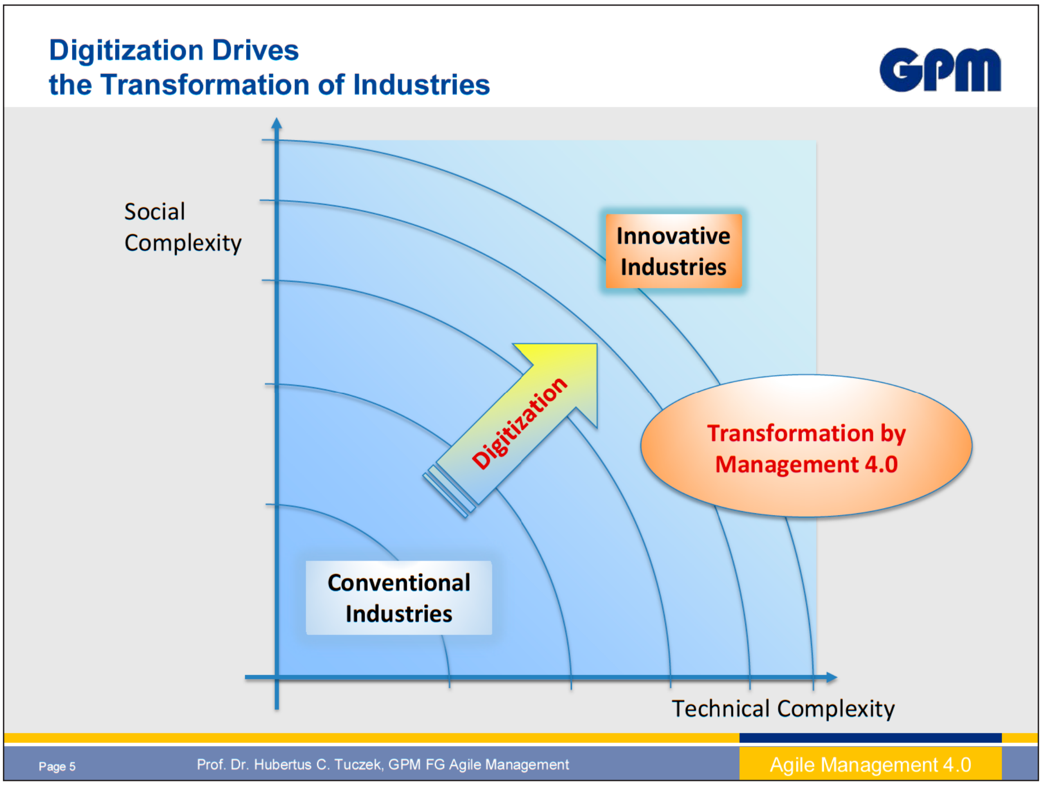
Cybernetics:
Viable System Model
(1959)

Complexity research:
Foundation (1960 -1980)
Synergetics (~ 1980)

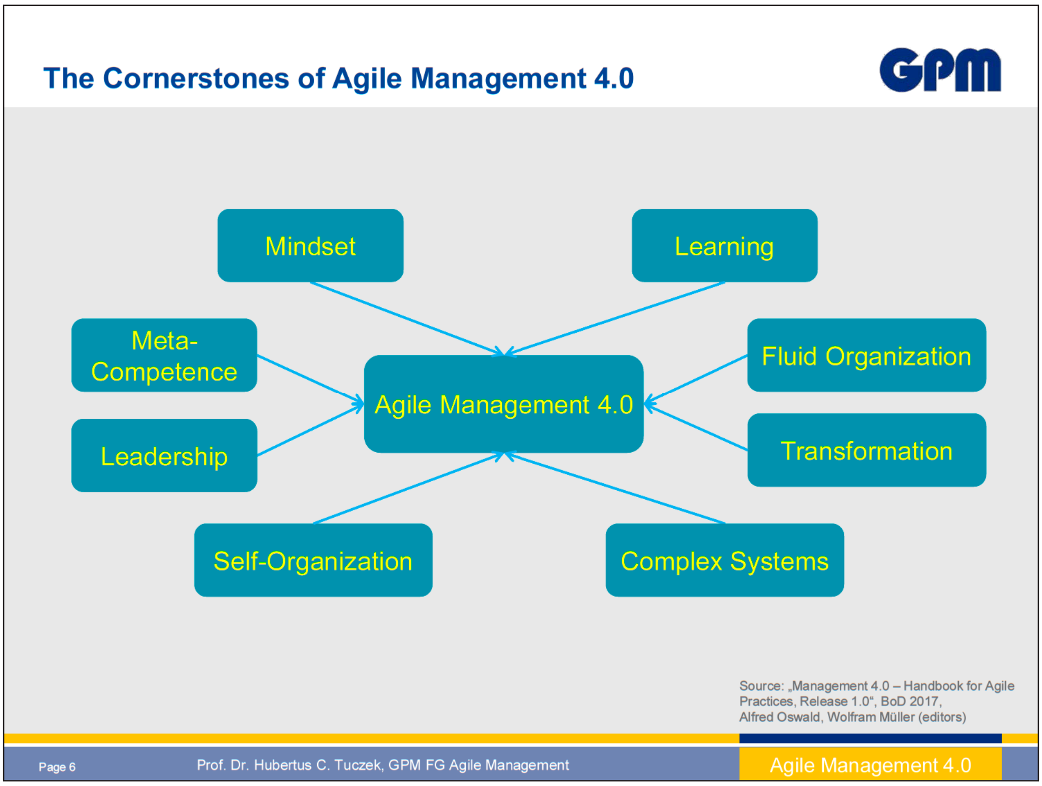
Agile Manifesto:
- Individuals and interactions *over Processes and tools*
- Working software *over Comprehensive documentation*
- Customer collaboration *over Contract negotiation*
- Responding to change *over Following a plan*

Source: „Management 4.0 – Handbook for Agile Practices, Release 1.0“, BoD 2017, Alfred Oswald, Wolfram Müller (editors)

Page 4 Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management Agile Management 4.0



Digitization Drives
the Transformation of Industries
Social
Complexity
Innovative
Industries
Digitization
Transformation by
Management 4.0
Conventional
Industries
Technical Complexity
Page 5
Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management
Agile Management 4.0



The Cornerstones of Agile Management 4.0
Mindset
Learning
Meta-
Competence
Fluid Organization
Agile Management 4.0
Leadership
Transformation
Self-Organization
Complex Systems
Source: „Management 4.0 – Handbook for Agile
Practices, Release 1.0", BoD 2017,
Alfred Oswald, Wolfram Müller (editors)
Page 6
Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management
Agile Management 4.0

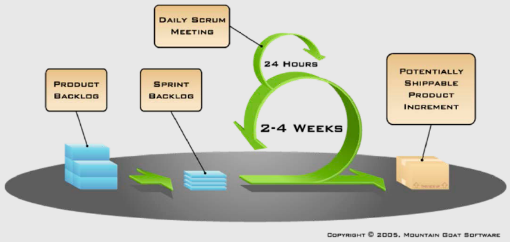
The Credo of GPM FG AM – not „either… or“, but „ … as well as …“

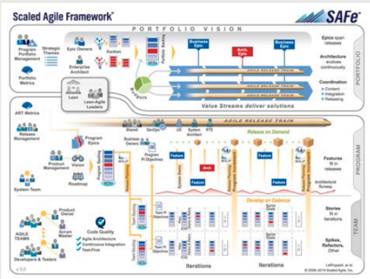

Manifesto for Agile Software Development

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

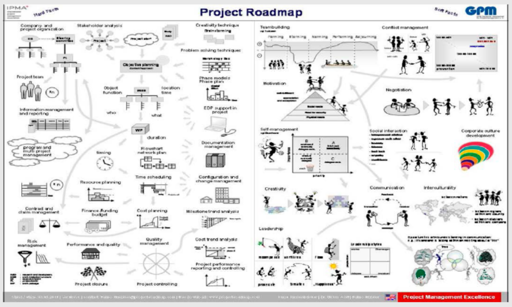
Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.





SAFe à la Dean Leffingwell



Page 7 Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management Agile Management 4.0

Agile Management 4.0…

… generates Agility (Flexibility * Speed)

= Mindset ∘ Governance ∘ Techniques

Mindset	Governance	Techniques
Inward Attitude	Framework Safety Fence	Scope of Action
	Systemwide Thinking, Networks	Case to case Technique (agile, classical)
	Decentralized Steering Self-Organized	

Page 8 Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management Agile Management 4.0

Hybrid Project Management

GPM

- The Hybrid Project Management is determined by an Agile Mindset, using Agile Management 4.0 and complementing it with methods and models of the classical project management.

Source: „Management 4.0 – Handbook for Agile Practices, Release 1.0“, BoD 2017, Alfred Oswald, Wolfram Müller (editors)

Page 9 Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management Agile Management 4.0

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hubertus.tuczek@haw-landshut.de

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GPM Deutsche Gesellschaft für Projektmanagement e. V.

www.gpm-ipma.de

Page 10 Prof. Dr. Hubertus C. Tuczek, GPM FG Agile Management Agile Management 4.0

Special Lecture

Project Manager to Project Leader - The Difference that makes the Difference

Mr. Paul Hodgkins

Executive Director of Paul Hodgkins Project Consultancy

Former Siemens PM@Siemens Programme Executive for North West Europe

Abstract:

Our projects today are more challenging, complex and ambiguous than ever before.

The only thing as project managers we can be certain of is uncertainty and if we are not comfortable with the uncomfortable, then perhaps project management is not for us.

In a world of project uncertainty, Paul explains why he believes it is project leadership that will be the critical factor between project success and projec failure and therefore, the ability of the project manager to transition to project leader, is not only required, it is crucial.

In this special lecture, Paul Hodgkins shares his 'story' from when he joined Siemens at 17 as a trainee, to the time that he left Siemens at aged 47, of seven leadership lessons he learned that made the difference to him, and his projects.

This is an interactive, light hearted though thought provoking presentation and it begins with the hardest interview Paul ever had; one where he was only asked three very simple questions.

Biography:

Paul joined Siemens in 1984 as a graduate trainee and within two years entered the world of Project Management.

His enthusiastic approach and project business success was recognised in his project management of some key projects; most notably in the then government owned British Rail; the implementation of communications infrastructure programme for London Undergrounds' Jubilee Line Extension and a major telecommunications refresh programme across the Government Department of Social Security as well as in leading the communications implementation project for the Channel Tunnel Rail Link.

Paul was promoted to Head of Project Management and then Head of Sales Support for Siemens Communications; reporting to the Managing Director.

Responsible for a team of over 100 pre and post sales support staff and supporting a £250M UK sales business, he assisted the sales force to consistently exceed all sales order, turnover and profit targets and through his positioning of Project Management as a value creating profession, was able to add over £2Million of incremental profit to that business.

His achievements were recognized when he won, against some very stiff competition from across all of UK industry, (not Siemens specific), the prestigious UK National Sales Award for "Sales Support Team of the Year".

From February 2006 until June 2013, he was responsible for leading the PM@Siemens programme (Siemens global programme addressing project business) across the UK and North West Europe where his motivational and inspirational leadership style led to even greater levels of project and programme business success.

His efforts led Siemens UK plc in 2008 to become the first corporate organisation in the UK to receive accreditation from the Association for Project Management. This was in recognition of Siemens UK plc's commitment to professional project and programme management development.

In April 2009, Paul was nominated by 'Project Magazine' as one of ten 'key influencers' in the UK in relation to the profession of project and programme management. This recognition placed him in the company of the then Mayor of London, Ken Livingstone and Sir David Normington, the then Permanent Secretary to the UK Government Home Office.

In July 2013 he established his own business, Paul Hodgkins Project Consultancy, where he has already begun to help businesses "unleash the power of projects and programmes". He continues to be recognised for his contribution in developing the project management profession and has written articles for and appeared in numerous project management publications.

Paul was appointed as a Fellow of the Association for Project Management (FAPM) in October 2009 and represented Siemens as part of the PMI Global Executive Council and APM Corporate Leaders Advisory Group.

He is also guest present as part of University College London's MSc on the Strategic Management of Projects.

Project Manager to Project Leader

'The difference that makes the difference'

ProMAC 2017
H4 Hotel München Messe
Munich

29th November to 1st December 2017

Paul Hodgkins
Executive Director
Paul Hodgkins Project Consultancy Limited

Paul Hodgkins
Project Consultancy

Leadership – some questions to think about

- **Who do we think of as being a great leader?**

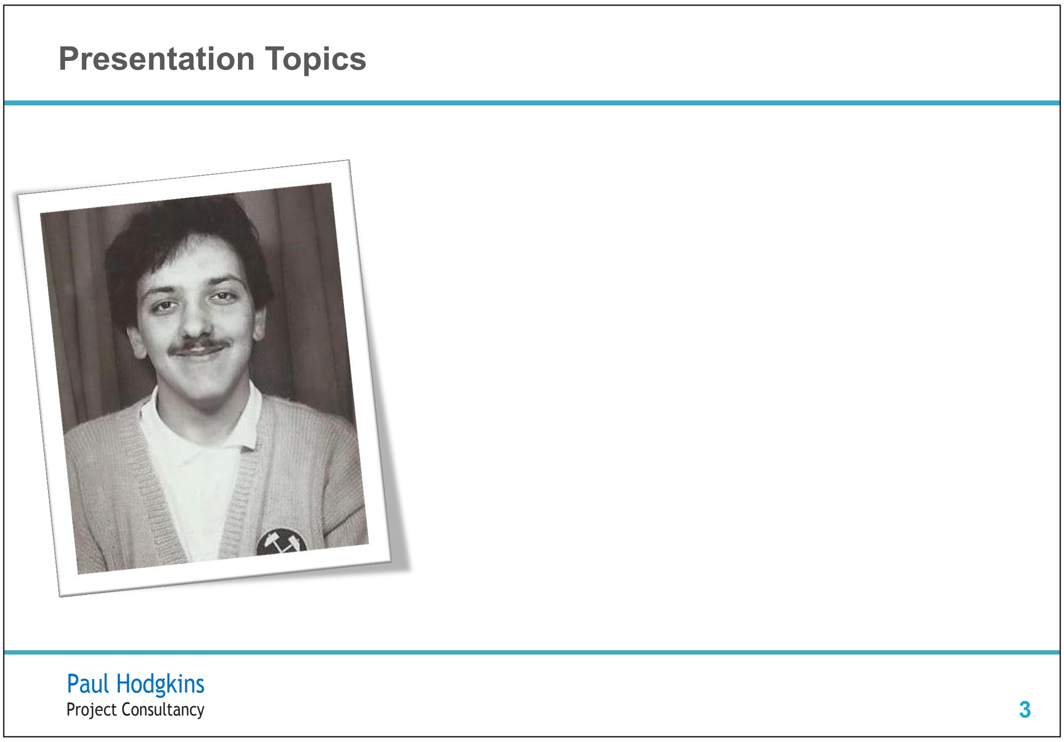
- **What qualities do we believe great leaders demonstrate?**

- **Are leaders born or are leaders made?**

Paul Hodgkins
Project Consultancy

1


Project Manager to Project Leader
Paul Hodgkins
Project Consultancy
2


Presentation Topics
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Presentation Topics

34 years

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Project Manager to Project Leader
'The difference that makes the difference' Lesson No.1

Computer training scheme gets government approval

"Reliance is well-equipped to prosper"

BUPA scheme is improved

1984

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Project Manager to Project Leader
'The difference that makes the difference"

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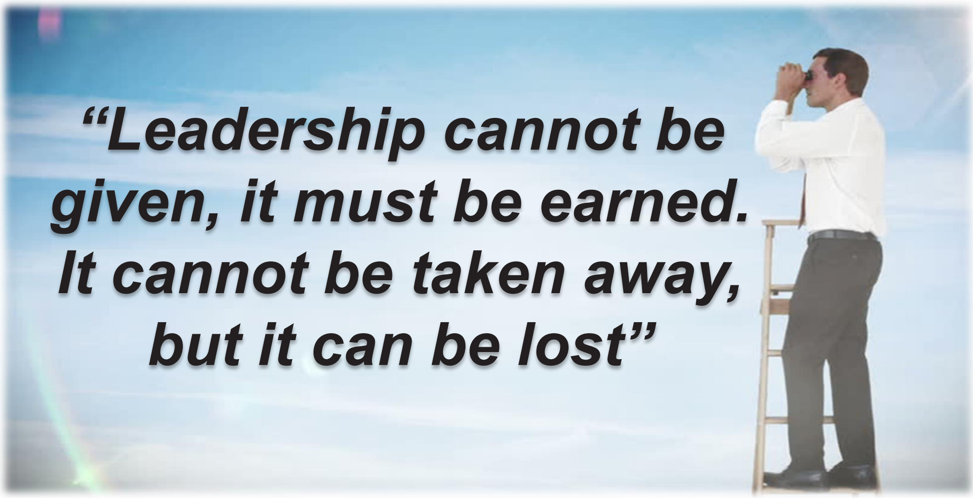
Project Manager to Project Leader
'The difference that makes the difference"



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Project Manager to Project Leader
'The difference that makes the difference' Lesson No.2

2. Be Authentic

- *When what you think, feel, say and do are in harmony*
- *Be yourself, be true to your values, know your purpose and the project's purpose – ask why, not what*
- *If you try to be someone you are not, you may find you end up being dressed for the wrong occasion*

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8

Project Manager to Project Leader
'The difference that makes the difference' Lesson No.3

3. Vision

- *Creating a vision of what you and the project can become*
- *Help your team to see the bigger goal and the importance of their role*
- *Show the way, lead the way and then get out of the way*

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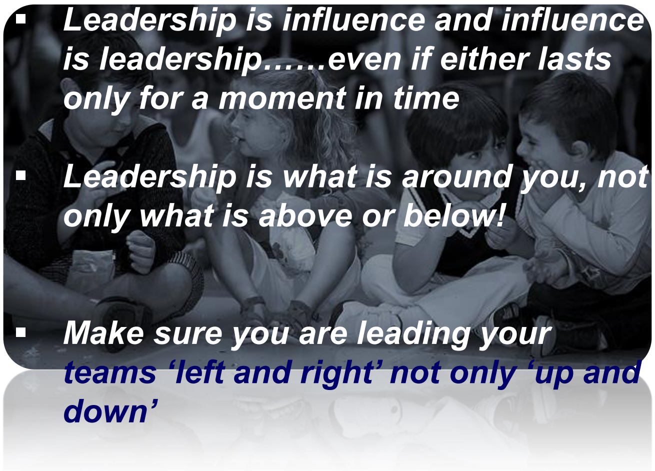
Project Manager to Project Leader
***'The difference that makes the difference'* Lesson No.4**

4. Leading 'left and right'



- *Leadership is influence and influence is leadership……even if either lasts only for a moment in time*
- *Leadership is what is around you, not only what is above or below!*
- *Make sure you are leading your teams 'left and right' not only 'up and down'*

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10

Project Manager to Project Leader
***'The difference that makes the difference'* Lesson No.5**

5. Passion

- *Work with intent and enjoyment; if you don't enjoy what you do, or the responsibility you have, then why are you doing it?*

- *You can not be passionate about something you don't care about*

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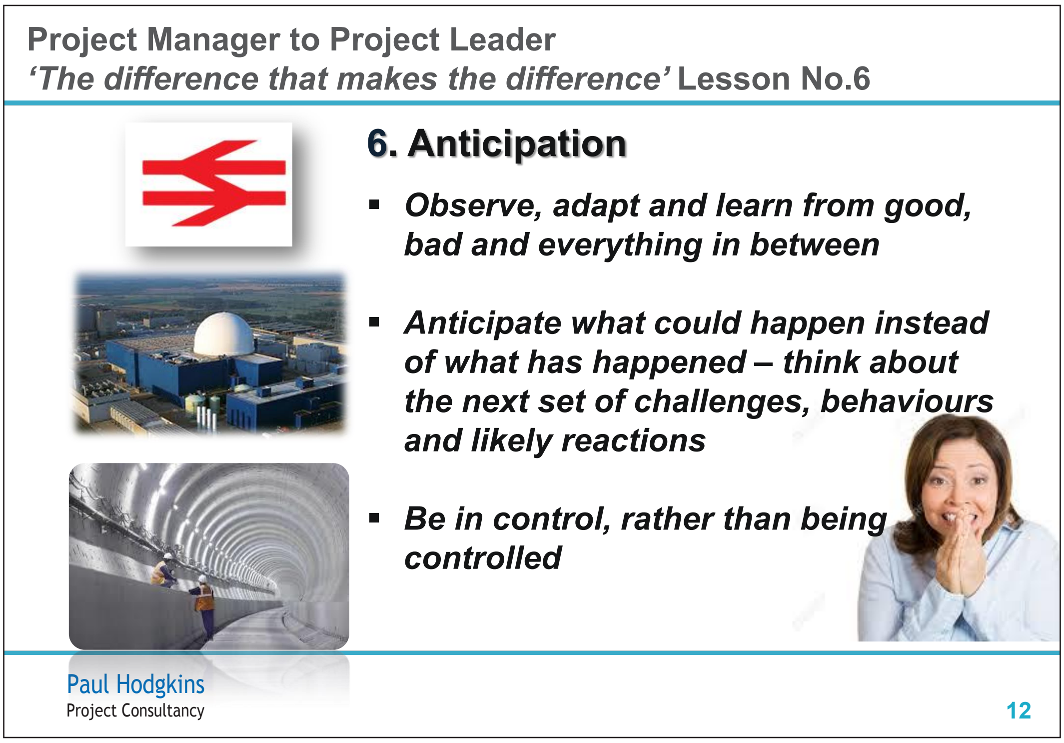
11


Project Manager to Project Leader
'The difference that makes the difference' Lesson No.6
6. Anticipation
Observe, adapt and learn from good, bad and everything in between
Anticipate what could happen instead of what has happened – think about the next set of challenges, behaviours and likely reactions
Be in control, rather than being controlled
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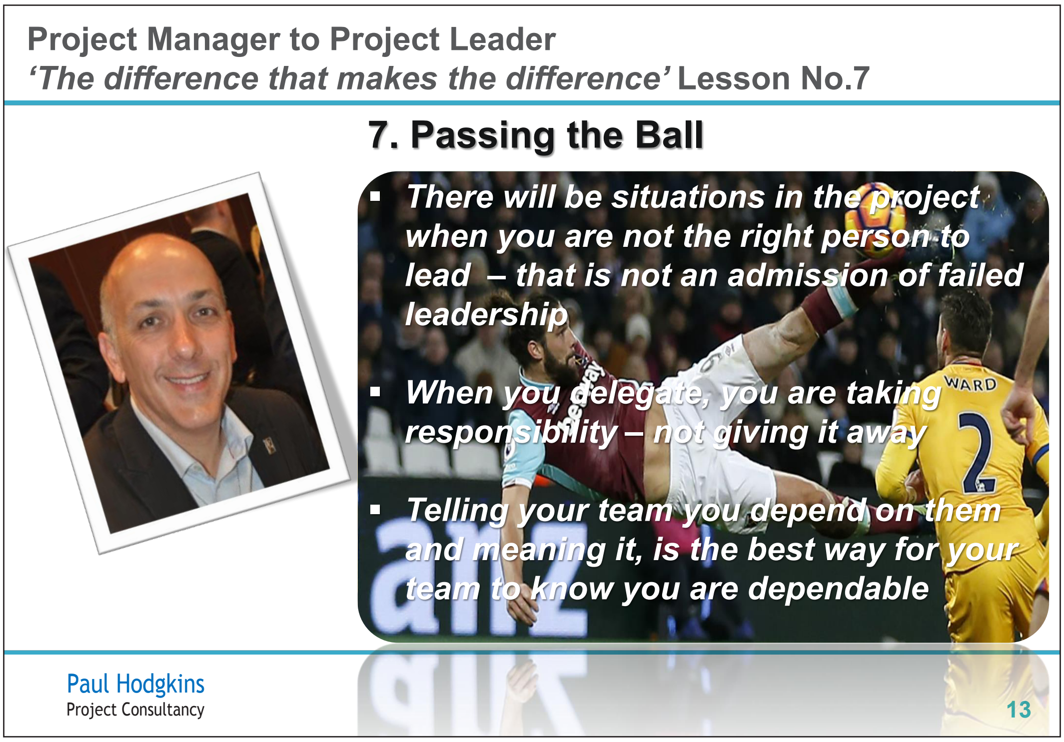
Project Manager to Project Leader
'The difference that makes the difference' Lesson No.7
7. Passing the Ball
There will be situations in the project when you are not the right person to lead – that is not an admission of failed leadership
When you delegate, you are taking responsibility – not giving it away
Telling your team you depend on them and meaning it, is the best way for your team to know you are dependable
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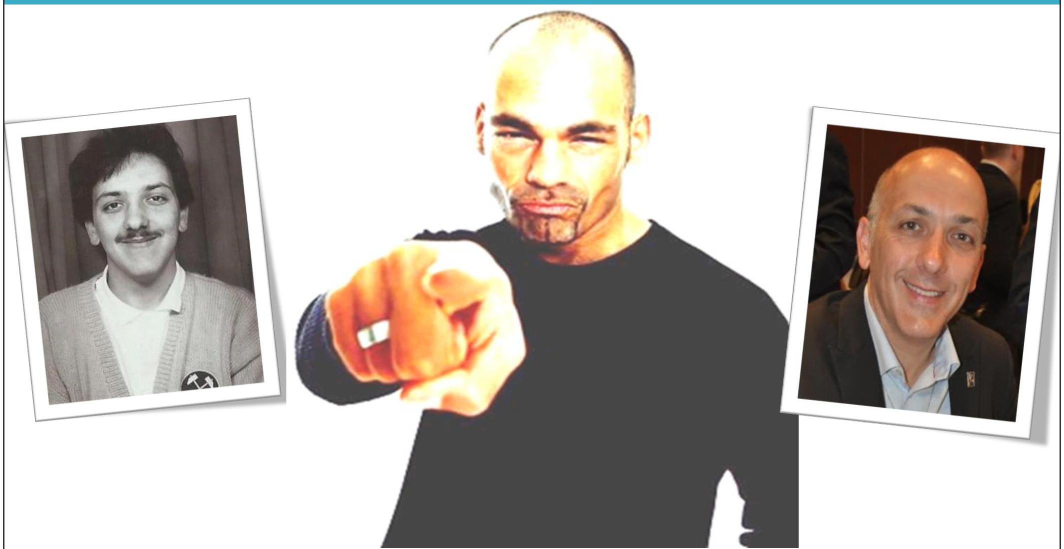
Project Manager to Project Leader
'The difference that makes the difference'



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14

Project Manager to Project Leader
The difference that makes the difference

Thank you for listening
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Whole life cycle cost analysis and net present value

- A case study of residential buildings in Al Ain,UAE -

Hebatalla Taha Prof. Abid Abu-Tair
British University in Dubai

Life cycle cost analysis and net present value are fundamental financial techniques which evaluates the project and assists decision makers in financial decisions. Life cycle cost analysis allow analysts to evaluate various economical scenarios and its effects. It assisting in choosing between different alternatives and comparing between different financial decisions and its effects and implications. It helps in estimating future costs. This paper computes the Life cycle cost analysis by applying net present value technique upon residential buildings in Al Ain, in the UAE from owner perspective. A sample of 60 residential buildings was tested. Life cycle cost analysis was evaluated through a life cycle of 35 years. Life cycle cost analysis includes initial cost, operation cost and demolition cost. Operation cost includes electricity cost, water cost, maintenance cost and replacement cost. Results show that the net present value is converted from negative to positive value at a certain year during the life cycle of the building. Results of net present value reflected the rate of investment values which shows that the highest rate of investment was for the lowest height buildings and increases along with the building height increase. Life cycle cost analysis is a useful financial technique that assists decision makers such as owner properties to determine exactly the profitability of each project. Net present value shows clearly the stages of expenses and benefits during the life cycle of the buildings.

Keywords and phrases: life cycle cost analysis (LCCA); net present value (NPV); return of investment (ROI); residential buildings; Al Ain, United Arab Emirates (UAE).

1. Introduction

Although life cycle cost analysis (LCCA) has been used since mid of the 20th century, it seemed to be new technique for some organizations and companies. The ambiguity of applying LCCA was the reason of not-practicing LCCA in most companies. LCCA as a financial technique is assisting decision makers to judge economically issues. Therefore, the aim of this paper is to compute the LCCA by applying net present value (NPV) technique upon residential buildings in Al Ain, the United Arab Emirates from owner perspective.

2. Literature review

2.1. Life cycle cost analysis (LCCA)

There are two complementarities abbreviations, which are life cycle cost (LCC), and lifecycle costing as referred in ISO/DIS 15686-5.2 (2016). ISO/DIS 15686-5.2 (2016) defined LCC as “cost of an asset or its parts throughout its life cycle, while fulfilling the performance requirements”. Whilst, lifecycle costing is the “methodology for systematic economic evaluation of lifecycle costs over a period of analysis” ISO/DIS 15686-5.2 (2016). Therefore, LCCA is a comprehensive financial technique that allows engineers, project managers, and cost analysts to study and evaluate all pertinent costs to a project during its lifetime. This project might be a product, system, building or any sequence processes through a period with considering possible changes in economic factors over time.

2.2 Net present value (NPV)

Tupper, Bendewald and Buys (2011), defined NPV as a tool to measure “the value in today’s dollars of its implementation over the specified timeframe”. Positive NPV means preference economic choices Shtub, Bard and Globerson (2005).

It is however, important to note some NPV features. Computing NPV facilitates understanding life cycle cost/benefits for each alternative Martin, Nikolopoulou and Afshari (2014). It used as a tool to compare between different alternatives Abdelhamid, El‐Gafy and Kshirsagar (2010) and Ates (2015). NPV is the best convenient method in construction industry when applying LCCA approach Martin, Nikolopoulou and Afshari (2014).

ASTM International (2013) illustrated the method of calculating LCC in present value terms (PVLCC) as shown in (1):

$$PVLCC = \sum_{t=0}^{N} \frac{C_t}{(1+i)^t} \quad (1)$$

where:

C_t = relevant costs occurring in year t,

N = length of study period, years, and

i = the discount rate.

2.3 Return of investment (ROI)

ROI called also, internal rate of return (IRR) (Tupper, Bendewald and Buys 2011). ROI is a tool to express cash flow and investment analysis in a monetary invested unit. Productive investment shows high ROI (Markarand Hastak 2015). The ROI is a rate of return used to compare profitability of investments. If the ROI is greater than the owner's stated discount rate, the measure is beneficial (Tupper, Bendewald and Buys 2011). ROI can be computed from (2) Hastak (2015);

$$ROI = \frac{[\,(Profit=(Project\ Output)-Project\ Costs\ (Input)]}{Project\ Costs\ (Inputs)} = x\% \quad (2)$$

2.4 LCCA application and importance

A consensus is forming among experts Eisenberger and Lorden (1977), Shtub, Bard and Globerson (2005) and Moselhi, Zayed and Ammar (2013) that LCCA technique is the best technique to assist in making-decision. LCCA is a successful tool to support managers to measure the financial impact of their judgment. Whilst, LCCA makes outstanding differences if, decisions will be been taken at early stages.

Eisenberger and Lorden (1977), Shtub, Bard and Globerson (2005) and ASTM International (2013) applied LCCA as a measurable tool to compare between different alternatives by trading off between different materials or systems to find the best economic design during the lifetime of the project. On the other hand, Bozdağ and Seçer (2011) differentiated between different seismic structural solution in respect to financial and technical sides. Contrast built by accounting the entire cost estimate and base shear values in order to find the optimum earthquake damage cost compatible with the lowest initial costs during the designed life cycle.

2.5 LCCA drawbacks and limitation

The main confrontation of LCCA as mentioned by Ciroth 2009 and cited in Pagan and etc (2011) and agreed by Seo, Oh and Choi (2012) is cost databases. LCC pursues all associated costs through a life cycle, which needs a robust and detailed database. Furthermore, some of cost data are considered sensitive to some organizations. As well, data related to costs are affected particularly to market's rates, currency and time value.

3. Methodology

Researcher applied LCCA and NPV upon residential buildings in Al Ain, UAE that are built for the commercial or investment use. That means the owner of the property will not live in the same property and it will be completely offered for leasing purposes. The selected buildings have ten years old or less, so buildings are almost new. Buildings databases were collected from Abu Dhabi Commercial Engineering Services L.L.C. (ADCE) and Abu Dhabi Commercial Properties L.L.C. (ADCP) the partners of Abu Dhabi Commercial Bank (ADCB). The researched could access the databases easily after obtaining permissions from both departments because the Researcher works in the same organisation.

A sample of 60 residential buildings was tested. Based on the city height typology, which consist of buildings with ground and first floor (G+1), ground and second floors (G+2), ground floor and third floors (G+3) and ground floor and four floors (G+4). Unequal number of samples was distributed for each category, 30, 4, 7 and 19 buildings for each category in order. The economic life cycle for residential buildings in Al Ain equals 35 years.

The aim of this paper is to gather all associated costs that will occur during the buildings lifecycle to compute LCCA and NPV. The main required input data for LCCA are fundamental costs for building during its lifecycle such as initial cost (IC), operation cost (OC), and demolition cost (DC).

IC includes all costs required in design and construction phases. OC is associated with any cost required to operate the building. OC in our study is divided into utility cost (UC) and maintenance and replacement cost (M&RC). UC consists of electricity cost (EC) and water cost (WC). DC contains any costs correlated to demolition stage. Figure (1) and (3) illustrate the distribution of costs during the LCC.

$$LCC = IC + OC + DC \quad (3)$$

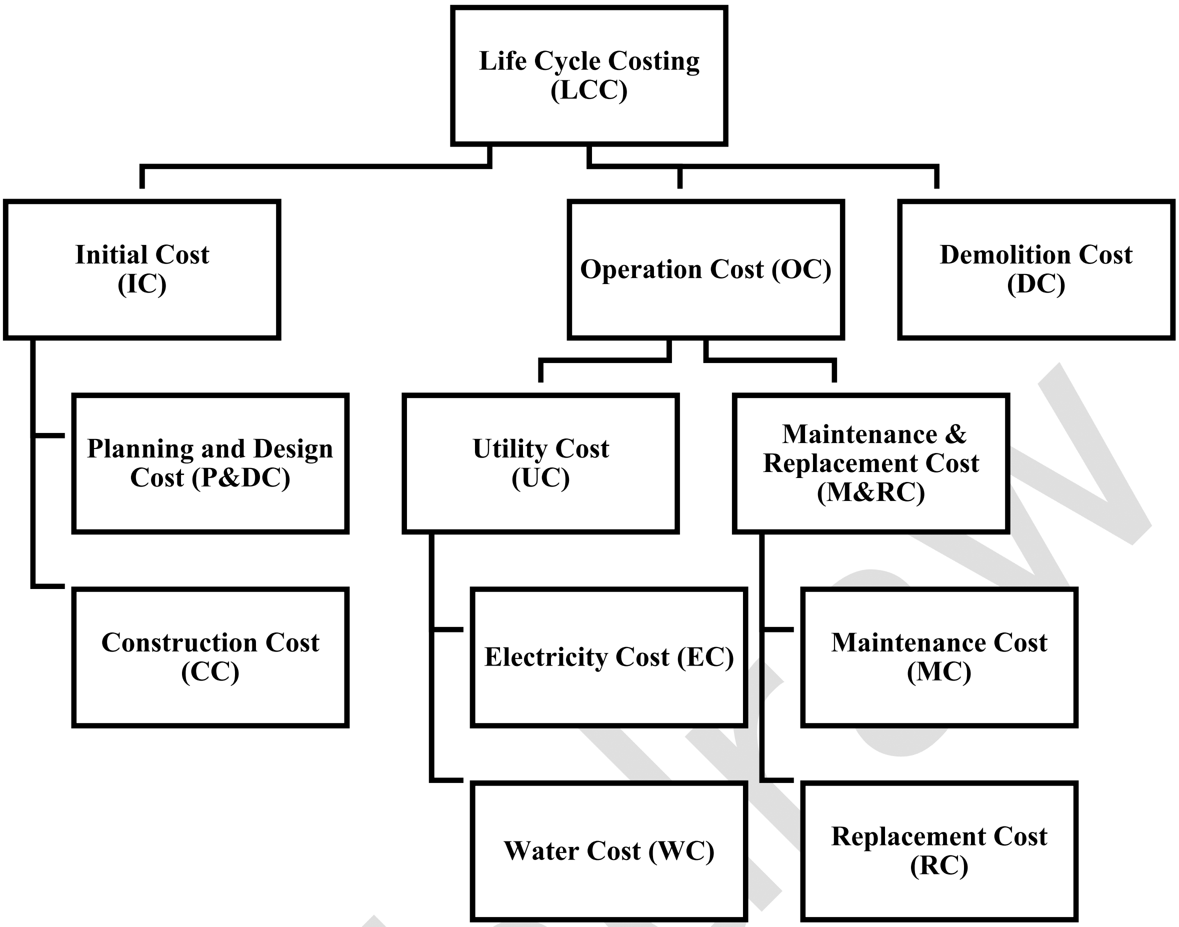

Figure 1 LCC organizational structure

IC and DC were available costs from the databases, while we estimated OC. Since, this research studies LCCA from owner or investor perspective, we assumed that OC for the building is 10% of the total OC for the building.

4. Results

Table 1. illustrates the LCCA and NPV for (G+1) buildings. Dashed line in the table refers to the hidden years in between. LCCA is the summation of a, b and c. Equation (1) applied on the net cash flow. Net cash flow refers to the income subtracted from the expenses (LCCA). All units are per unit rate of AED/m^2. Same calculations were computed for the other types of buildings. Fig. (2) shows the cumulative present value for all types of buildings.

Results show that the net present value is converted from negative value to positive value at a certain year during the life cycle of the building. For (G+1) buildings, NPV became positive at year 11. This indicates that after 10 years, all expenses were covered and profit has been started. For (G+2) buildings, NPV became profitable at year 15 and for (G+3) and (G+4), NPV converted to positive at year 16. NPV values for (G+1), (G+2), (G+3) and (G+4) buildings are AED/m^2 (9,062), (5,296), (4,999) and (5,937) respectively. Therefore, (G+1) buildings are the most profitable type of buildings during the 35 years of lifecycle.

Results of NPV reflected the ROI values which shows that the highest ROI was for (G+1) buildings, then (G+2), (G+3) and (G+4) buildings respectively.

Table 1. LCCA & NPV for (G+1) buildings

Time (years)	0	1	2	10	20	30	35	Total
IC (a)	- 3,108	-	-	-				-3,108
OC (b)		- 8	- 21	- 88	- 125	- 301	- 131	-2,212
-MC	-	0	12	15	25	42	53	1,006
-RC	-	-		59	80	228	39	514
-UC		84	88	125	194	305	383	6,915
-DC (c)							89	89
Income (d)		303	318	470	765	1,247	1,592	27,377
Net cash flow (e=a+b+c+d)	- 3,108	294	296	382	640	946	1,460	22,056
PV (f)	- 3,108	284	277	270	321	337	438	9,062
∑PV (g)	- 3,108	- 2,824	- 2,546	- 221	3,077	6,896	9,062	

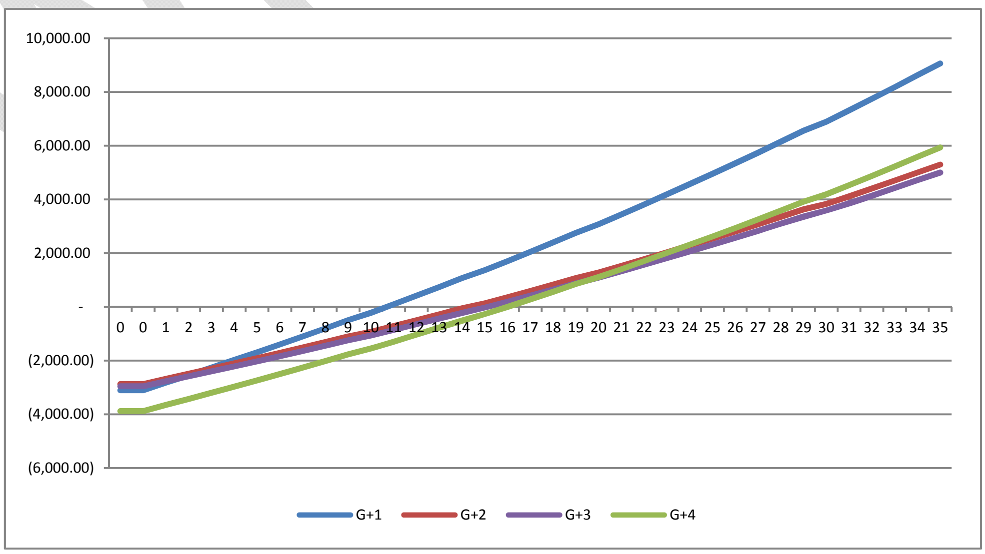

Figure 2 Cumulative PV for all types of buildings

5. Conclusion

Life cycle cost analysis is a useful financial technique that assists decision makers such as owner properties and investors to determine exactly the profitability of each project. NPV shows clearly the stages of expenses and benefits during the life cycle of the buildings.

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A Consideration of Branching Strategies for Distributed Version Control System

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In software development projects, version control systems (VCS) are commonly used for software configuration management. Nowadays, distributed version control systems (DVCS) are widely adopted due to its flexibility for creating and merging branches. Widely used branching strategies for DVCS include the git-flow and GitHub Flow. These branching strategies focus on the changes in existing, single codebase. On the other hand, in enterprise application development, source codes are developed by teams that have separated area of responsibility and from scratch. In such a case, appropriate tailoring is required for branching strategies. In this paper, we describe two enterprise application development projects that adopted DVCS for software configuration management. We tailored git-flow branching strategy in two patterns for the enterprise application development, and adopted the tailored branching strategies to each project. As a result, we had finished the development with the tailored branching strategies in each project successfully; however, workload of project members is different between the projects. As a result of comparison between the branching strategy that has "reviewed" branches and the one that does not have "reviewed" branches, we found that the branching strategy that does not have "reviewed" branches can distribute workloads to the project members more widely.

Keywords and Phrases : Configuration Management, Version Control, Distributed Version Control System, Branching

1. Introduction

The software configuration management process in ISO/IEC 12207 requires to record and manage modifications and releases of deliverables in software development project. In software management projects, version control systems (VCS) are commonly used for software configuration management to fulfil this requirement.

In the development of open source software (OSS), distributed version control systems (DVCS) are widely adopted due to its flexibility for creating and merging branches (Alwis and Sillito(2009)). Nowadays, DVCS are adopted even in proprietary software development (Muslu, K. et al.(2014)).

To use DVCS in software development, a suitable branching strategy should be considered for each project.

In this paper, we consider branching strategies for DVCS that targeted to enterprise application development. We included measures to commonly occurring problems in enterprise application development into the branching strategies. Additionally, we describe the result of adoption of these branching strategies to enterprise application development projects we were working on.

2. Preceding Study

When more than one development team member shares a single repository, it is important to set up layers of version control, according to the phase of development or the extent of change impact (Nojiri and Imaizumi(2004)).

git-flow (Driessen(2010)) and GitHub Flow (GitHub, Inc.(2013)) are widely known branching strategies, which implement layered version control in DVCS.

However, when the waterfall style enterprise application development project adopts git-flow or GitHub Flow, there are some problems listed below.

(a) Limit Development Scope for Each Developer

git-flow and GitHub Flow do not state about limitation of development scope for each developer, because these branching strategies have originated as a branching strategy for OSS. On the other hand, in enterprise application development, prime constructors commonly subcontract a part of application development to their subcontractors. In this situation, to clarify the boundary of responsibility, it is required to limit development scope for each developer. Additionally, the deliverables shared to the whole application (hereinafter referred to as the *shared deliverables*) should be able to refer from the developers regardless of development scope.

(b) Handle Auto-generated Template Codes

OSS development projects which targeted by git-flow and GitHub Flow do not assume the existence of auto-generated template codes. On the other hand, in enterprise application development, template code generation is commonly used to make program structure coherent. In this situation, it is required to consider how to distribute the auto-generated template codes to each developer, or how to handle modification of the auto-generated template codes.

(c) Manage Work-in-progress Deliverables

In git-flow and GitHub Flow, work-in-progress deliverables are not supposed to be registered in a central repository. On the other hand, in enterprise application development, is desirable to be able to manage reviewed deliverables according to the progress of the review. For this purpose, it is required to manage work-in-progress deliverables which under review separately from completed deliverables.

3. Consideration of Branching Strategy

To solve the problems described in chapter 2, we considered a branching strategy for DVCS targeted to enterprise application development.

3.1. Structure of Branches

With the backgrounds described in chapter 2, we started from git-flow and changed the structure of the branches listed below.

3.1.1 Set Main Branch for Each Development Team

To enable more than one team to develop an application simultaneously, it is required to manage the deliverables from each team separately.

To fulfil this requirement, we set main branches correspond one-to-one with each team (hereinafter referred to as the *develop branch*). The deliverables from each team are managed in the develop branch of each team.

The role of develop branch is the same as the one in git-flow excepting there is more than one develop branch in a repository. To develop a new feature, a developer creates a branch corresponding to developed feature from a develop branch, and implementation and unit testing of the feature are held in that branch. After finishing the unit testing, the developed deliverables will be merged into the develop branch.

3.1.2 Set a Branch for Managing the Shared Deliverables

The shared deliverables should be managed separately from the other deliverables, and should be able to refer from each team.

To fulfil this requirement, we set a branch for managing the shared deliverables (hereinafter referred to as the *ground branch*). We presumed that the shared deliverables contain the utility libraries shared from the whole application and the auto-generated template codes.

To develop a shared deliverable, a developer creates a branch from the ground branch, and implement and unit test the shared deliverable in that branch. After finishing the unit testing, the developed deliverable are merged into the ground branch. The shared deliverables are merged from a parent branch to a child branch starting from the ground branch. This process makes the developers do not have to pick up the modified files that affect to their own development scope from the whole shared deliverables, and prevent omitting to merge the modification.

3.1.3 Set Branches for Managing Reviewed Deliverables

To manage the deliverables according to the phase of development, reviewed deliverables should be managed separately from other deliverables.

To fulfil this requirement, we set branches for managing reviewed deliverables (hereinafter referred to as *reviewed branch*). A reviewed branch will be a child branch of a develop branch, and a parent of a feature branch in git-flow. A reviewed branch corresponds one-to-one with a feature branch. After finishing the unit testing of the feature developed in the feature branch, the reviewed branch will be merged into the develop branch.

3.2. Formulated Branching Strategy

Based on the consideration described in 3.1, we formulated the branching strategy shown in Figure 1.

In case of a merge conflict, we resolved the conflict in child branch. We use the pull request in GitHub Enterprise for code review. We performed the code reviews on the pull request from feature branch to reviewed branch.

4. Evaluation of Formulated Branching Strategy

We applied the formulated branching strategy to an enterprise application development project we were working on (hereinafter referred to as the *project A*), and evaluated the result.

4.1. Organization of the Project A

Figure 2 shows the project organization chart of the project A. The business function development

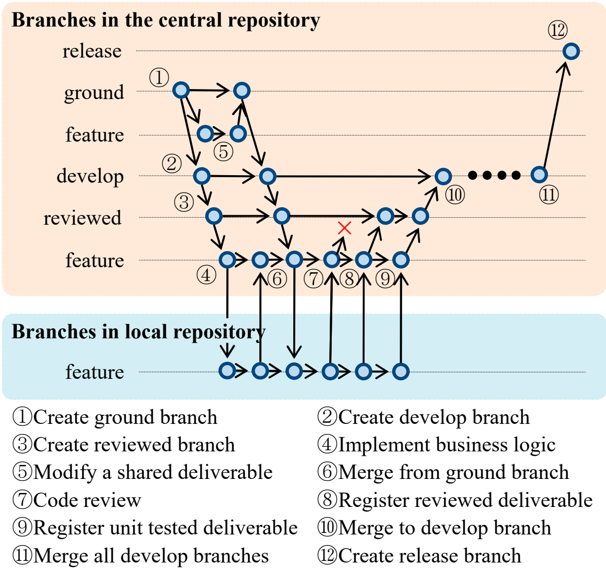

Figure 1 Formulated Branching Strategy

group consisted of four development teams. A development team is consisted of one leader, one or two assistant leaders, and three to nine developers.

The developers implement business logics. The leader and assistant leaders have charge of reviews for deliverables implemented by the developers, and management of work progress of development. All the members in a development team use the version control system for software configuration management.

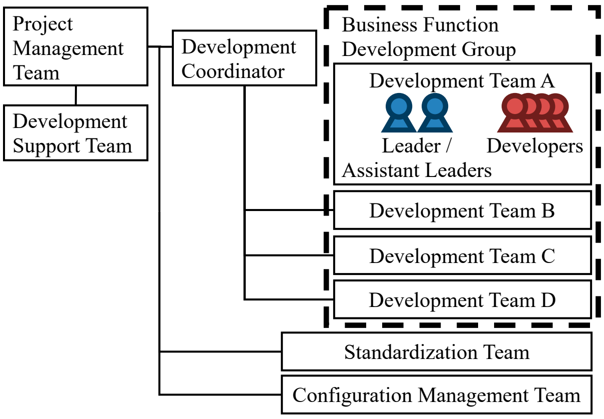

Figure 2 Project Organization Chart of the Project A

Each branch has a branch owner. The branch owner has charge of modifications and merges on their own branch. Table 1 shows a role and a branch owner for each branch which used to develop business functions in the project A.

Table 1 Role and Branch Owner in the Project A

#	Branch	Role	Owner
1	develop	Store unit tested deliverables	Leader / Assistant Leader
2	reviewed	Store reviewed deliverables	
3	feature	Store work-in-progress deliverables	Developer

4.2. Characteristics of the Project A

The characteristics of the deliverables in the project A which related to branching strategy and software configuration management are as follows.

- More than one development team, which has the individual boundary of responsibility, develops assigned business functions simultaneously.
- Development tools are used to generate template codes.
- The standardization team unifies management of the shared deliverables.
- All the deliverables from each team are stored into a single repository.

4.3. Evaluation of the Formulated Branching Strategy on the Project A

We evaluated the formulated branching strategy described in 3.2 with the software configuration management work performed on the project A.

In the project A, we have finished the software construction process with the formulated branching strategy successfully. Table 2 shows the number of developed functions, created branches and commits in the software construction process of the project A.

Table 2 Results Related to Branching Strategy in the Software Construction Process of the Project A

#	Items	Numbers
1	Developed Functions	95
2	Created Branches	207
3	Created Commits	1636

The evaluations of the topics described in 3.1 are detailed below.

(a) Contribution of develop Branch

Modifications had been able to track with respect to each team. Deliverables from each team had managed properly, and there are no commits which make the boundary of responsibility ambiguous. These results suggest that the develop branches fulfilled the role we had planned.

(b) Contribution of ground Branch

Operations which merge the modifications of the shared deliverables from the ground branch to the develop branches performed properly. Through the operations which make branches for development of the shared deliverables from the ground branch, work-in-progress shared deliverables did not slip into the develop branches. These results suggest that the ground branch fulfilled the role we had planned.

(c) Contribution of reviewed Branch

reviewed branches stored the reviewed deliverables and did not store work-in-progress deliverables. This result suggests that the reviewed branches fulfilled the role we had planned.

We also interviewed with the members of the development teams in the project A about the software configuration management work performed with the formulated branching strategy. We received the feedbacks listed below.

- The merges in the reviewed branches make the workload of the leaders and the assistant leaders heavier.
- The progress of reviews was not managed with the reviewed branches, but managed with other documents because of the reporting.

According to the results of the interview, it was discovered that the reviewed branches cause an increase in the workload of leaders and assistant leaders for merging.

In the project A, the leaders and the assistant leaders have charge of management of work progress of the developers as well as operations with the version control system. Therefore, from a perspective of project human resource management, we consider that the workload for software configuration management should not depend on leaders or assistant leaders.

According to Phillips et al.(2011), the workload for merging could be a significant problem in the use of version control systems. We therefore considered the workload of leaders and assistant leaders related to the reviewed branches.

4.4. Distribution of Workload for Merging in the Project A

Figure 3 shows the distribution of workload for merging in the project A. The vertical axis represents the number of merges, and the horizontal axis represents the member of the development teams. The upper part of the stacked bar graph represents the number of the merges which caused conflicts, and the lower part represents the number of the merges which did not cause conflicts. The bars in boxes indicate the merges which performed by the leaders and the assistant leaders. Figure 3 suggests the workload for merging concentrated on the leaders and the assistant leaders in the project A.

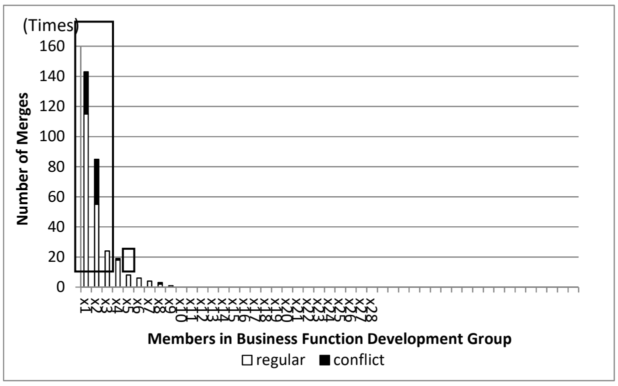

Figure 3 Distribution of Workload for Merging in the Project A

Table 3 shows the breakdown of merges performed by the members of the development teams in the project A. In the formulated branching strategy, reviewed branches are placed between a develop branch and a feature branch. The reviewed branches have to merge the modification from the both branches and thus the workload for merging concentrates on the branch owner of the reviewed branches. As described in 4.1, merging from the reviewed branches to the develop branch and resolution of merge conflicts are performed by the leaders and the assistant leaders in the project A. We considered it is the cause of the concentration of workload.

Table 3 Breakdown of Merges in the Project A

#	Assignee	Merges		Conflict?	
		From	To	No	Yes
1	Leader / Assistant Leader	ground	develop	9	0
2		reviewed	develop	74	24
3		develop	reviewed	9	0
4		feature	reviewed	124	35
5		Subtotal		275	
6	Developer	reviewed	feature	8	1
7		Subtotal		9	
8	Total			284	

5. Refinement of Formulated Branching Strategy

Based on the evaluation, we refined the formulated branching strategy.

As described in 4.3, the ground branch and the develop branches had no problem. On the other hand, the reviewed branches had the problems about the workload for merging. We found it is less necessary to manage the progress of reviews by using branches. We also found that assignment of management of the reviewed branches to the leaders and the assistant leaders causes the concentration of workload.

Based on those findings, we removed the reviewed branches from the branching strategy described in 3.2.

Figure 4 shows the refined branching strategy. The feature branch comes from the develop branch directly, whereas it comes from the reviewed branch in Figure 1.

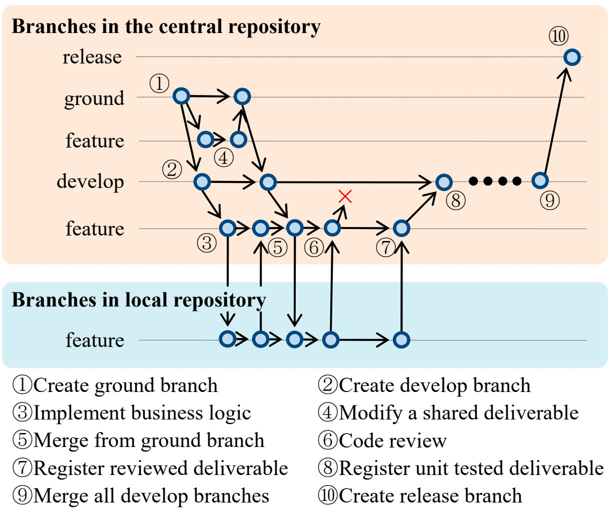

Figure 4 Refined Branching Strategy

6. Evaluation of the Refined Branching Strategy

We applied the refined branching strategy to another enterprise application development project we were working on (hereinafter referred to as the *project B*), and evaluated the result.

6.1. Organization of the Project B

Figure 5 B shows the project organization chart of the project B.

The team structure related to project management differed from the one of the project A. The business function development group consisted of more than one development team the same as the project A. The role of the leaders, the assistant leaders, and the developers is same as the project A.

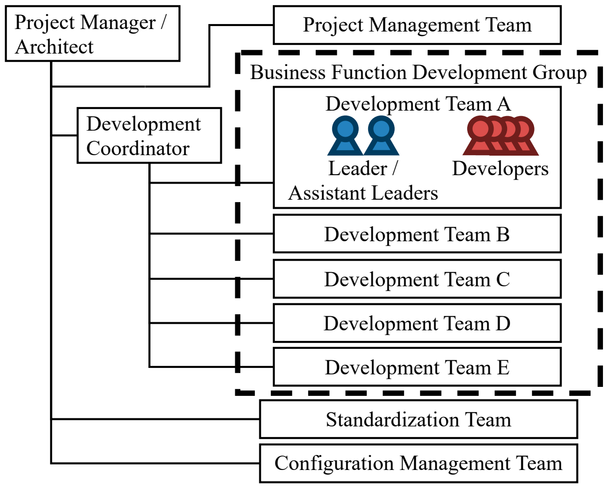

Figure 5 Project Organization Chart of the Project B

Table 4 shows a role and a branch owner of develop branch and feature branch in the project B. The branches which owned by the leaders or the assistant leaders are less than the ones in the project A because of the omission of the reviewed branches.

Table 4 Role and Branch Owner in the Project B

#	Branch	Role	Owner
1	develop	Store reviewed and unit tested deliverables	Leader / Assistant Leader
2	feature	Store work-in-progress deliverables	Developer

6.2. Evaluation of the Refined Branching Strategy on the Project B

In the project B, we have finished the software construction process with the refined branching strategy successfully. Table 5 shows the number of developed functions, created branches and commits in the software construction process in the project B.

Table 5 Results Related to Branching Strategy in the Software Construction Process of the Project B

#	Items	Numbers
1	Developed Functions	92
2	Created Branches	260
3	Created Commits	2156

The develop branches and the ground branch fulfilled the role we had planned. Progress of reviews was able to manage with separated documents. We performed code reviews on the pull request from feature branch to develop branch.

6.3. Distribution of Workload for Merging in the Project B

We examined workload for merging, which became a problem on the project A. We also inspected for newly arose problems on the project B. Figure 6 shows the distribution of workload for merging in the project B. Figure 6 suggests the workload for merging on the leaders and the assistant leaders is less concentrated than the one in the project A. Figure 6 also suggests the workload for merging on the developers is increased compared to the project A.

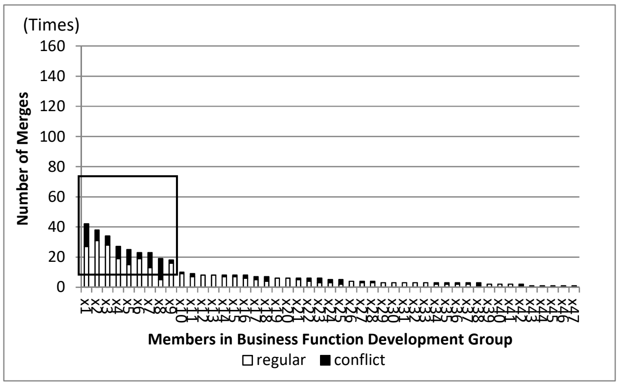

Figure 6 Distribution of Workload for Merging in the Project B

Table 6 shows the breakdown of merges performed by the members of the development teams in the project B. Table 2, 3, 5, and 6 suggest the number of the functions are approximately same as the project A and the project B, whereas the number of merges performed by the members of the development teams is decreased compared to the project A. Additionally, the number of merges performed by the leaders and assistant leaders is decreased whereas the number of merges performed by the developers is increased compared to the project A. These result suggest the omission of the reviewed branches causes a transfer of workloads of merging with develop branches to the developers. According the result, we conclude that the concentration of workload was resolved.

6.4. Workload Caused by Merge of Modifications in Auto-generated Template Code

From the comparison of Table 3 with Table 6, the number of merges from ground branch to develop branch in the project B is larger the one in the Project A. According to the inspection of the merging work, we found that the merge of modifications in auto-generated template causes merge conflicts. We also found that the resolution of those merge conflicts increased the workload for merging. Measures for this problem remain to be seen.

Table 6 Breakdown of Merges in the Project B

#	Assignee	Merges		Conflict?	
		From	To	No	Yes
1	Leader / Assistant Leader	ground	develop	27	20
2		feature	develop	71	33
3		Subtotal		151	
4	Developer	develop	feature	24	27
5		Subtotal		51	
6	Total			202	

7. Conclusion

We formulated branching strategies for DVCS targeted to enterprise application development, and adopted the branching strategies into the two projects.

There were no problems in the adoption for the first project from a perspective of software configuration management; however, the workload for merging concentrated to the leaders and the assistant leaders. We refined the branching strategy and adopted the second project. We found that the refined branching strategy resolved the concentration of workload for merging.

From these results, we found that we can handle problems caused in the adoption of DVCS for enterprise application development project such as limitation of development scope for each developer, distribution of auto-generated template codes, and management of work-in-progress deliverables by adding develop branches for each development team and a ground branch to git-flow.

Additionally, from the result of the adoption for two projects, modification in auto-generated template code could be a cause of merge conflicts. Measure to reduce these merge conflicts is an issue in the future. Furthermore, the effect to the man-hours for software configuration management caused by the adoption of this branching strategy is an issue in the future.

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Techniques for Project Leaders to Keep Pace with Requirement Changes

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There are a lot of system restructuring projects that take one year or more from the start of requirement definition to go live. However, a customer's business changes every day, and changes cannot be stopped while developing a new system for the future. Therefore, it’s difficult in the ordinary development process of a waterfall model to fix all requirements for a system go-live during the requirement definition phase, so it’s necessary to continue system development while managing changing requirements. To solve this challenge, it’s important that the number, kind, size, and fixed time of the requirement changes that are generated in system development are investigated as thoroughly as possible, because the project plan is set up according to the conditions at the start of the project. Next, confirming the gap between these initial conditions and reality is important. This paper proposes 6 points of project planning to enable projects to manage requirements that cannot be decided during the requirement definition phase. We applied these 6 points for a system restructuring project that included 7 requirement changes. The project was finished on schedule and its quality was ensured.

Key Words & Phrases: Requirement change, Project planning, concurrent development and legal system support

1. Introduction

Customers’ information systems are restructured regularly about every 3 to 5 years. There are a lot of large scale restructuring projects in Fujitsu. To restructure a large system, a project may need more than one year from start of the RD (Requirement Definition) to the system cut over. However, a customer’s business environment changes every day, and the requirements for an information system could be changed by the business environment. So it’s difficult for customers to define all of the requirements in the RD phase.

In particular, in a system based on laws of government, system revisions corresponding to the laws are unavoidable. But laws cannot normally be decided more than one year before enforcement. Therefore, no one can define all of the requirements in the RD phase (Nakamura, 2016).

Today, the agile development process is popular. However, the data analysis report 2014-2015 from IPA (Information-technology Promotion Agency) in Japan shows that the rate of using Agile in projects is only 2.3 %. Agile is not popular for business systems in Japan (IPA, 2009a and IPA, 2014). And the Agile process doesn’t have many management methods or techniques compared to waterfall process. So, the risk is high, if Agile is applied for Type 3(high reliability) systems (IPA, 2011) like a large scale financial system.

Therefore, for large scale high reliability systems, it’s necessary to ensure quality using a waterfall process covering all of the system and additional requirements which were not defined in RD phase (IPA, 2009b).

There are some case studies where a project could not progress according to schedule because of requirement changes. In these projects, the project manager made local and informal correspondence for requirement changes, and the manager could not consider the quality for the complete system and the impacts on the project schedule.

There are a few good reference books and white papers about techniques for leading projects and managing requirement changes for project manager. As related research, there is a study by K. Iwata that proposed some management techniques for ambiguous requirements in the RD phase from the project owner’s viewpoint(Iwata, 2013), but those techniques are not applicable to system develop methods.

This paper proposes some techniques for project management planning to enable projects to keep pace with requirements which were not defined in RD phase. And we used and evaluated the effect of these techniques in a large scale restructuring project.

2. Background and target project

2.1 Outline of the system under development

The target system is for the largest financial company in Japan. The system is very important for the stock exchange in Japan. If the system stopped, the stock exchange market would close. The system is based on legislation in investment law, company law, and accounting regulations. The system must be updated to comply with those laws twice a year. And also, the new laws which come in to force BEFORE cut over to the new system must be applied to current (old) system. The laws must be applied to new system despite not being defined in the RD phase.

2.2 Outline of target project

The target project was a restructuring project for the above system. The project size was 400 man-months, and program size was 300,000 steps. The project started in Sep. 2013 and the system was cut over in Mar. 2015. The project schedule was shown in Figure 1. There are 4 month RD phase, 4 month design phase (BD and DD), 2 month developing phase (PG and PT), 6 month testing phase and 2.5 month trial phase.

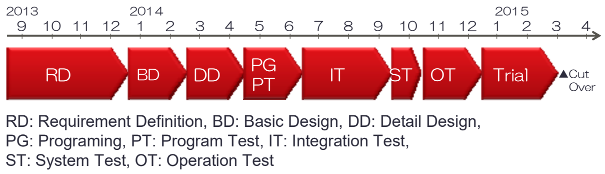

Figure 1 Project schedule

The project followed three principles aimed at reducing cost and ensuring quality:

- -Develop a high quality system, with low costs and short schedule by reusing the current system's resources (documents and source code) which are already quality assured in current system.
- -Discriminate between high reliability functions and medium reliability functions, and apply different system development methods for reliability.
- -Organize a project team which has many engineers who have good experience about developing and maintaining the current system to reduce the cost of researching the specification of the current system.

3. Challenges

At the end of RD phase, we found that there are many requirement changes from changing laws occurring before the system cut over.

To keep pace with requirement changes, the two projects (one project is the new system development project and the other project is updating the current (old) system) were run in parallel, and the new system reused the current system's source code, which were updated for the requirement changes. So it was ambiguous how much source code would be reused from the current system and how much source code would be developed in the new system project.

To make project plan, we checked with the customers about new requirements that were not defined in the current requirement definition documentation but had to be completed before cutover.

Then, the requirements were categorized into three types according to implementation timing and formulated an implementation policy (Figure 2).

Type 1: Update both current and new system
  Update both the current and the new system's resources.

Type 2: Update only new system
  When the requirement was clarified, implement the requirement only in the new system before cut over.

Type 3: Update only new system after cutover
  Manage and test two source code repositories (one is a version at cut over and the other includes the new requirement).

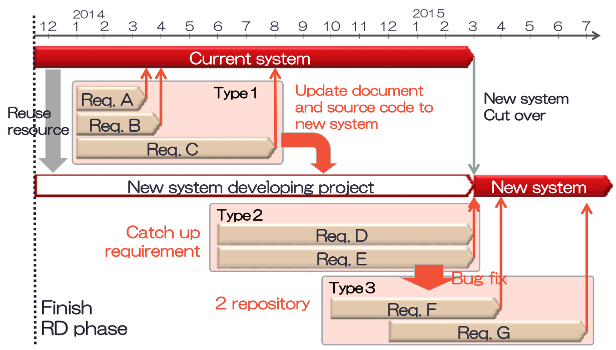

Figure 2 Requirements changes and catch up types

We found 3 challenges from the point of project management related to reusing the current system's source code and developing the new system efficiently, while also ensuring quality by arranging implementation types.

Challenge 1: Clear project scope

In this project, the policy of developing the new system is to reuse source code from the current system. But the source code of the current system was constantly changing from new requirements. So the source code reused depends on the timing. Poor choice of timing could have a big impact on the project scope and schedule. For example, if we defined the reused timing as before changing in current system, we have to change two systems as one requirement change.

In the waterfall model, project scope is defined by the contents of the RD documents. In this project, a requirement change is dealt with by creating another project with separate budget and schedule as a requirement change project on the current system. But those two projects would update same resources, so the responsibility of writing documents and testing could be ambiguous.

For example, in type1, when we need to update both the current and new system's documents, the task to update new system's documents could be in the new project's scope or the current project's scope. And in the IT (Integration Test) phase of new system, a task of test a function arising from a requirement change could be in the new project's scope or the current project scope.

Further, if we want to reuse documents that include requirement change, a task of writing a document may have to wait for a writing documentation about requirement changes in current system.

Challenges 2: Ensuring quality of the entire new system

When two projects (the new system project and a requirement change project for the current system) progress in parallel, there are many changes to source code which are already quality assured through each phase of new system project. So we have to re-confirm quality from two aspects. One aspect is regression testing of code and documents, and the other is alignment between the new system's function and the modified function of the current system.

In particular for type 1, the tendency is to reuse functions that are changed in current system for the new system. But the new system could be changed by a user requirement. So the new system may not work due to interference between functions which are changed in new system and functions which are reused from the current system. So we have to ensure quality of the new system by adding tasks like reviewing the functions which were changed in the current system.

Challenges 3: Rework from requirement change

There were a lot of reworks from requirements change. In the waterfall model, basically the quality of document or system is assured in each phase, and when the quality is assured, we can go to the next phase. If the requirements change, we have to return to the previous phase and rework some tasks in the previous phase. So, as might be expected, we spent some time and cost in rework. The effect of requirements change can be large for project schedule and cost. So we have to plan to implement those requirements which are expected to change in the near future during the planning phase of the project. Questions might be asked about how much rework will be needed, how many staffs will be needed to implement those requirements, what is the implementation schedule, and so on.

4. Solution of those challenges

4.1 Points for project planning

To solve these three challenges, it is important to allow for the generation of new requirements and include the necessary countermeasures in a project management plan. We propose the following 6 points for planning:

Point 1: Gather information about requirement change

To solve challenge 1 and 2, it is necessary to gather as much information as possible about requirement changes and make plans to implement any as-yet undefined requirements.

There may be a few requirements which are not fixed. However, most are known with about 80% precision, and the customer likely understands the outline of the final requirement. However, the detail could be dependent upon new laws from the national legislature.

Therefore, it is effective to gather information based on the customer understanding. For example, listening to the customer, and checking the meeting minutes from the advisory committee of the Ministry that discusses legislation.

Point 2: Define artifact baseline

To solve challenge 1 relating to documents and source code which are developed in each phase, it's important to choose the timing of taking baseline documents from the current system project to the new system. By defining the artifact baselines, we can identify potential duplication of updates to documents and source code, and we can clarify tasks and define the responsibility of both projects.

For example, in type 1, if we define a baseline from documents that were not updated for requirements changed in current system as input to the basic design phase for the new system project, then we can define tasks about writing and reviewing documents for the requirement changes. Moreover, we can define which project's scope those tasks are in.

Point 3: Plan quality assurance tasks for the entire system

To solve challenge 2, we need to plan tasks to ensure quality for the entire system after implementing requirement changes. The plan has to include timing and human resources.

We also have to research the impact of requirement changes based on information which is gathered in point 1, on functions in other related systems that are also impacted by requirement changes, and we have to define scope of review and test and plan tasks to ensure quality.

In particular, if functions which were changed in the new system and functions which were changed in the requirement change project overlap, we need to include tasks for regression testing of the overlapped part, and rework IT for requirement change functions and the new system's functions.

Moreover, if the new system development and requirement change project are done in parallel, we need two test environments. One environment is for testing of requirement changes, the other one is for testing of the new system. So we need to plan for developing two test environments and test data.

In addition, if there are requirement changes that should be implemented immediately after the cutover to the new system, such as type 3, again, two test environments are necessary. One is for investigating bugs arising from incidents occurred in the operation environment which has the same version of application installed. The other one is for testing of requirement changes. So we need to include development of two test environments in project planning phase.

Point 4: Planning work flow to minimize rework

To solve challenge 3, it's effective to plan work flow to minimize rework by carefully arranging tasks between the new system project and requirement change project. Especially when we know that there will be big requirement changes for a function, we can change the schedule for tasks for designing the function to be carried out after the requirement is fixed. Or avoid reviewing and testing before requirements are fixed, and review and test afterwards. These steps help the project to reduce wasted man-hours.

For example, in type 2, if we set the project schedule so that the requirement change project joins at IT phase, we can prevent double execution of the test by planning those tests to be executed after the requirement is changed.

Considering that points 2 to 4 are based on non-fixed requirements, we have to agree with customer the following 2 things from the start of the project:

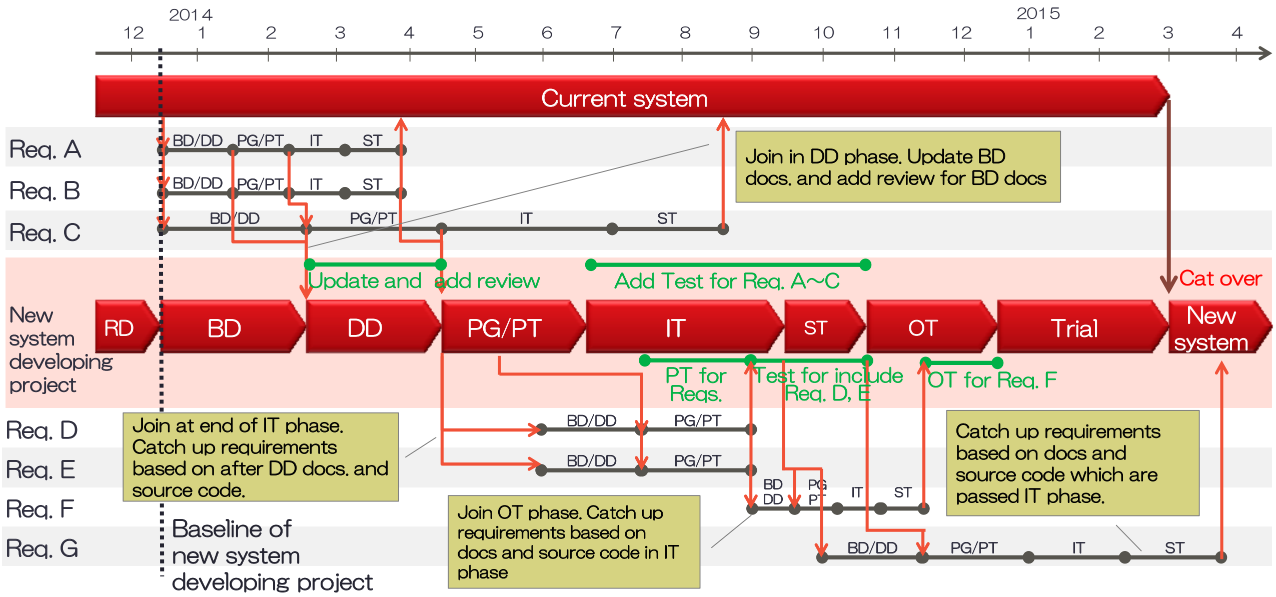

Figure 3 Project plan to catch up requirement changes

Point 5: Agree change control procedure for the plan with the customer

It is important to clarify the content of the requirements that are assumed within the project plan, and agree with customer the change control of the project plan if the assumption is changed.

The project plan following from points 2 to 4 will include both the new system development project and requirement change project, so the plan should be the best possible for the entirety of the new system and current system. Therefore, there is a possibility that the plan of the new system development is impacted by requirement changes.

Point 6: Define milestones for reviewing requirements contents

It's important to define and agree with customer about milestones for checking whether the content of requirements has changed.

The project plan will be based on unclear requirements. Therefore, if the contents of the requirements change from the initial assumption, the project plan may have to be changed. The review milestones must be scheduled as early as possible to allow sufficient time to recover from the effects of a requirement change.

4.2 Plan for the actual project

In the actual project, we had to manage 7 changing requirements A to G, so we planned the project based on points 1 to 6 (Figure 3).

Req. A, B, C: Doing basic design in parallel and then join

The baseline for documents and source code were defined in December 2013. The basic design phases were done in parallel for both new system project and requirement change project.

So, we added 3 tasks (copy contents of requirement from the requirement change project, reinforced review, and reinforced IT) in the project plan. They preceded the new system development detail design and coding from the requirement change project. And the resources which included requirement changes are reused for new system.

Req. D, E: Implement development and join at end of IT phase

The baseline of documents was defined at the end of detail design phase and the baseline of source code was defined at the end of coding phase. The two change projects are joined in IT phase after development phase of requirement change project.

So, we added module tests to cover the impact of requirement change. The sequence of test cases for the IT of the new system development was planned to start with cases which were not impacted by the requirement change. The test case covering the source code of the requirement change is executed after joining. This planning enabled an efficient IT.

Req. F: Implement development and join in Operation Test phase

Requirement F was needed at the time of the cut over to the new system. The baseline of documents was the latest document in IT phase and the baseline of source code was defined at the end of IT phase. And the two projects were joined in Operation Test phase.

So, we added some tasks for test cases of the source code of the requirement change, and all of the regulatory testing. We added tasks to review the things being reflected for all the bags generated while changing the requirement.

Req. G: Join after cut over to the new system

The baseline of documentation was defined at the end of IT and the baseline of source code was taken from the ST (system test) phase. The task to ensure quality is same thing as matter after cut over.

But we had to test requirement G before cut over. Therefore we needed to develop two test environments (one is for testing for requirement G, the other is for operational bug fixing).

4.4 Effects of points 1 to 6

4.4.1 Effect on schedule

There was no major change from the requirements which were defined at end of the RD phase except for items D and E. These requirements were able to be accommodated because it was planned within the schedule. The timing of the joins, the tasks to implement the requirement changes, and to quality assurance could be planned at the outset of the project. This avoids any schedule delay from requirement changes.

4.4.2 Effect on quality

By planning tasks for ensuring quality beforehand, there were no bugs and system failure after cut over arising from alignment and regression testing between new system and requirement changes.

The planning of quality tasks helped project members understand that we need different tasks to ensure quality for two systems And so, we were able to ensure quality.

4.4.3 Effect from viewpoint of cost

By creating the project plan with consideration of the order of test cases and rework from requirement changes, the project could be optimized for efficiency of the new system development and requirement changes. So the project cost was able to remain within the range of the original estimates.

5. Future works

5.1 Communication plan

The requirement change is done as a different project of new system developing project. So, the member of requirement change project can't understand the new definition of new system and the situation of new project.

In this target project, in Req. D, there was one work leakage of test by indefinitely of the roles between projects. To solve this problem, the members of two projects have to communicate about system definition and sharing problems. So, to communicate each other, the project manager have to make a communication plan between two projects like having weekly meeting and information sharing environment(etc. wiki and share folder).

5.2 Considering other business applications

We needed to migrate data from the current system to the new system in the restructuring project. So, where there were changes to current system or new system from requirement change, we also had to change the data migration tool to maintain data integrity.

In the actual project, we needed to change the design of the data migration tool from requirement C and D. But this aspect was omitted from the new system project. So we had to change the tool design and source code to implement those requirements.

Therefore, when we implement requirement changes in restructuring projects, we need to consider the following aspects in addition to the business application:

- Data migration and transformation
- Operational tools and manuals
- Non-functional requirements (performance)

6. Conclusion

In many manuals about project management techniques, the methods aim to avoid requirement change. But in a real project, due to legislation and other external factors, the customer cannot define all the requirements in the RD phase. So, the project manager should assume in the plan that requirement changes will occur. The point is "How do you prepare your plan for requirement change?" This paper explained these points.

Experienced project managers already understand how to manage requirement changes. But project management techniques have succeeded empirically and have not always been formalized clearly as documents. We think it is important to capture knowledge from actual project practice in books or papers to pass on to younger project managers.

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Trends in Expectations from a Project Management Professional School : A Text-mining Analysis

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At the Advanced Institute of Industrial Technology, a Project Management Professional School was opened in 2010 as one of the course certification programs. The purpose of this school is to practice real life project management in order to impart skills in a variety of perspectives. This study considers the attributes of applicants during the fiscal years from 2010 to 2015 along with an analysis of the courses they applied for. Further, it provides the results of the analysis by text mining the applicants' aspired motives; aspired motive is a field on the application form asking applicants to provide a reason they chose those specific courses. Initially, a large proportion of students wished to learn the basics of project management, and the desire to acquire knowledge systematically was followed by an attempt to learn skills through practical exercises.

Keywords and phrases: Course Design, Course Certification Program, Text Mining

1. Introduction

This study introduces the course design and purpose of the Project Management Professional School opened as a credential certification program at the Advanced Institute of Industrial Technology (AIIT). The attributes of applicants from the fiscal year (FY) 2010 to FY 2015 along with an analysis of the courses they applied for are explored. Further, this paper includes the results of the analysis by text mining students' aspiring motives.

The main purpose of this study is to obtain suggestions for the future direction of the Project Management Professional School. To accomplish this, a hypothesis search-type approach with text mining analysis method was utilized to improve the matching of the course contents with applicants' aspirations by identifying trends from the obtained data and applying them to the course design.

Section 2 describes project management professional schools that have been established as coursework certification programs; the following sections oversee the application status to this program. First, in section 3, we describe the application situation over the span of six years since FY 2010. In section 4, an analysis of the applicants' motivations to apply for the courses using a text mining analysis method is provided. Finally, section 5 summarizes the trend of the applicants' motivations from FY 2010 to FY 2015, and the analysis' adaptation to the 2017 course design.

2. Course Certification Program: Project Management Professional School

This section introduces the offerings of the Project Management Professional School, and specifically its course certification program.

2.1 Course Certification Program

This course certification program is based on the credit certification system which was newly established by the revision of the School Education Act in 2007 (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2009). One can receive a certificate of completion by taking a specific educational program and completing the requirements specified by proccelum, such as obtaining units of recommended classes. A person who has received the certificate can list it on the job-card specified by the Ministry of Health, Labor and Welfare. At the AIIT, we offer diverse learning opportunities by utilizing the AIIT Credit Banking System and the Open Institute, etc. This course certification program is one of them. The course has established programs such as Human Centered Design, Information Security, and Project Management Professional School Program (AIIT, 2010).

2.2 Project Management Professional School

The School opened its doors in FY 2010 as one of the course certification programs. Classes are offered on weekday evenings and Saturdays. It consists of a wide range of subjects from basic knowledge on project management to human strengths as a project manager. The program is designed as follows (AIIT, 2017):

1) Purpose

The purpose of this school is to provide opportunities for people practicing project management in real life to learn project management skills from various perspectives. For those who do not have experience or knowledge of project management, they are taught the basics. For those who have knowledge but no experience, they are provided a virtual project implementation environment to train for practical use. For those with expertise in project management, the school produces an overview by organizing the project management systematically so that it will lead to self-improvement and provide guidance for successors. In addition, coaching to take Project Management Professional (PMP) of the international certification of project management and Project Manager of Information-technology Promotion Agency, Japan (IPA) examinations is also available.

2) Target

This course covers a wide range of students, including those who are planning to work as project leaders and project managers as well as veteran project managers who have already completed many projects. In addition, staff of the Project Management Office (PMO) department is trained to support multiple projects and upper management to supervise multiple projects.

3) UNIT and Class

The Project Management Professional School in FY 2017 is divided into three UNITs in accordance with the regular graduate school students who would like to take advantage of the classes offered.

UNIT 1 has 6 classes, totaling 67 hours. The lecture titles are PMBOK® Guide Navigation, Project Management Basic, PMP® Examination Preparation, Risk Management, Basic Agile Project Management for Innovation, and PM Practice by the Simulation Tool. The classes are offered from summer vacation until the start of the last half of the school year. UNIT 1 consists primarily of basic classes of project management (PMI, 2013).

UNIT 2 has 6 classes, totaling 62.5 hours. The lecture titles are Project Management for Supplier Point of View, System Development Project, and Project Management Practice. UNIT 2 consists of classes for practicing project management.

UNIT 3 has 7 classes, totaling 78 hours. The lecture titles are Project Management Tools and Techniques, IT Management Project, IPA PM Examination Preparation, Project Management Case Study, Interpersonal Skills (Coaching & Mentoring), Interpersonal Skills (Communication & Negotiation), and Career Design for Project Manager. As a conclusion of the course, UNIT 3 is composed of classes to learn the application of skills necessary for veteran project managers.

In FY 2017, 15 classes totaling of 207.5 hours are being offered. Most of these classes are ongoing from 2010 when the course started. As a course certification program, it is necessary to pass 120 or more credit hours, and one can divide classes according to individual plans of study. The course also includes regular graduate classes, and when one enrolls in the graduate school in the future, you can receive credits as a vested unit. For some classes, lectures are designed to be completed in a day, such as on holidays or Saturdays, so that one does not need to attend school for a long period of time and it will not interfere with work schedules. The opening classes for FY 2017 are shown in Table 1.

Table 1 Class for 2017

	Class	Level	Hours
UNIT1	PMBOK® Guide Navigation	Basic	14.0
	Project Management Basic	Basic	14.0
	PMP® Examination Preparation	For Exam.	21.0
	Risk Management	Intermediate	6.0
	Basic Agile Project Management	Intermediate	6.0
		Sub Total	67.0
UNIT2	Project Management for Supplier Point of View	Intermediate	12.0
	System Development Project	Intermediate	22.5
	Project Management Practice	Advanced	28.0
		Sub Total	62.5
UNIT3	Project Management Tools and Techniques	Intermediate	24.0
	IT Management Project	Advance	18.0
	IPA PM Examination preparation	For Exam.	12.0
	Project Management Case Study	Advanced	6.0
	Interpersonal Skills (Coaching & Mentoring)	Human	6.0
	Interpersonal Skills (Communication & Negotiation)	Human	6.0
	Career Design for Project Manager.	Human	6.0
		Sub Total	78.0
		Total	207.5

3. Status of Application for the Course

In this section, the attributes of applicants, courses applied for, and classes from FY 2010 to FY 2015 are described.

3.1 Applicant, Course Applied

Throughout FY 2010 to FY 2015, a total of 121 people applied for the program. The gender ratio (male:female) is 117:4, indicating that 97% of the applicants are men. The applicants' age groups are shown in Table 2. The majority of the applicants are in their thirties or forties.

Table 2 Age of the Applicants

Age (in years)	2010	2011	2012	2013	2014	2015	Total
≧20	1		3	4	2		**10**
≧30	11	5	8	9	6	8	**47**
≧40	4	5	5	8	6	15	**43**
≧50	2	2	2	4	3	7	**20**
≧60	1						**1**
Total	**19**	**12**	**18**	**25**	**17**	**30**	**121**

The details of affiliation are shown in Table 3.There are 32 active students, which is 26% of the total applicants, including 4 who have already graduated and 7 who later enrolled in the graduate school. In some cases, this program was used as company training; the breakdowns in this category are 4 in 2012, 8 in 2013, 2 in 2014, and 12 in 2015, totaling 26 applicants.

Table 3 Affiliations of the Applicants

Affiliation	2010	2011	2012	2013	2014	2015	**Total**
General	10	7	11	23	15	23	**89**
(Company Training)			(4)	(8)	(2)	(12)	**(26)**
(Admission to AIIT after attendance)	(2)		(1)	(4)			**(7)**
(AIIT graduates)				(1)		(3)	**(4)**
AIIT Student	9	5	7	2	2	7	**32**
Total	**19**	**12**	**18**	**25**	**17**	**30**	**121**

During FY 2010 and FY 2015, there were 438 applications for the classes offered (including multiple classes per application). The number of classes contained in one application ranged from 1 to 12, with an average of 3. 6 classes, and a mode of 31 cases of one-class application and 25 cases of two-class applications.

Table 4 shows the number of applications classified by each course. The courses referred to here are basic, intermediate, examination preparation, advanced, and human, depending on the content of the classes.

Table 4 Number of Applications per Level

Level	2010	2011	2012	2013	2014	2015	Total
Basic	19	15	23	36	12	5	**111**
Intermediate	14	12	24	44	19	16	**129**
Advanced	11	6	9	15	6	22	**69**
Examination Preparation	—	0	0	6	3	13	**22**
Human	21	9	33	25	12	7	**107**
Total	**65**	**42**	**89**	**126**	**52**	**64**	**438**

3.2 Discussion

From the attributes of the applicants, there is a trend that a consistent number of regular students seek further learning while taking regular classes. Additionally, some applicants have already graduated. On the other hand, there are seven students who enrolled in the graduate school as regular students after attending this program. These results suggest that some applicants developed a desire to learn more expansively and more in depth on the subject. For those who entered through company training, their companies actively encouraged employees to communicate with other students in addition to acquiring skills. There is a report that the program led to a widening perspective of the students (Miyoshi, 2015). Year after year, the number of applicants for the Basic Course has decreased, and higher numbers have been documented in the Intermediate and Advanced Courses. In FY 2015, the Examination Preparation Course enrolment started to increase. This indicates that there is an expectation on the part of the students that the Project Management Professional School can be a step to prepare for the PMP and IPA examinations.

4. Correspondent Analysis Aspiring Motives

This section describes the analysis method of applicants' aspiring motives and the trend analysis results for each year.

4.1 Procedure

A field in application documents from 121 applicants during FY 2010 to FY 2015, which describes the aspiring motive for classes, was analyzed. This field typically reveals the problems that applicants have in their daily work and motivation for learning. The analysis of the gathered data was done through text mining, using KH Coder (Higuchi, 2004). It is necessary to model the event data in accordance with fixed rules; however, these rules enabled the researchers to perform the analysis in a comparatively easy manner. Moreover, the rules have been frequently used in surveys and research in a wide variety of fields, including management. When performing the corresponding analysis and co-occurrence network analysis, the researchers utilized R to provide statistical computation and graphic environments. It should be noted that in the co-occurrence network analysis, the magnitude of the strength of the Jaccard (Romesburg, 1992) coefficient is determined by the co-occurrence relationship between one word and another.

4.2 Correspondence Analysis

4.2.1 Trend Analysis of Frequently Occurring Words

First, a trend analysis was executed based on an overall image of the data used for analysis. The researchers counted the words that appear in the sentences written as aspired motives. There are words counted more than once in one motive. Additionally, items such as proper nouns, organization names, person names, and place names, are excluded. The top 60 frequently occurring words are shown in Table 5. Since some word counts were a tie, 61 words are posted. Of the 121 cases, for example, 674 cases of "project" and 316 cases of "management" appeared.

4.2.2 Analysis Considering Compound Words and Unknown Words

As mentioned in 4.2.1, "project" and "management" appeared at a high among motives. Upon further investigation, the researchers confirmed how these words appear in the actual sentences and discovered that "projects" are often used in different contexts, such as "project management" and "project manager."

During the analysis, in order to distinguish between these words as much as possible, it was decided to use a morphological analysis system and analyze in a way that distinguished and filtered compound words such as "project manager" and "change management." For morphological analysis, ChaSen (Matsumoto, 2000) was utilized. There were 1,254 compound words extracted from the target summary papers.

Table 5 List of Frequently Occurring Words (Top 60)

Word	Times	Word	Times
project	674	feel	44
management	316	technique	42
knowledge	243	work	39
control	228	self	38
attend	204	credential	37
experience	166	basic	36
business	157	utilize	35
learn	145	management(keiei)	35
think	142	study	33
program	100	internal company	32
skill	95	information	32
system	94	understand	32
development	90	utilization	31
imagine	86	wish	31
system(taikei)	84	engage	31
do	83	schedule	30
foundation	81	lecture	30
desire	77	responsible	29
affairs	74	class	28
unit	68	test	28
manager	66	career	27
take	66	improvement	26
practice	64	use	26
get	63	examination	26
acquisition	63	workplace	26
technical	58	many	26
company	54	earn	26
need	54	service	25
me	50	enterprise	25
proof	48	training	25
learning	45		

Text mining was performed on the 34 words that are considered compound words. These words appeared more than 10 times, and they included technical project management terms. Examples of compound words are listed below.

Compound Words:

project management, project manager, Project Management Professional School, project leader, the course certification program, class student, progress management, risk management, schedule management, system engineer, career up, and level up.

Further, acronyms and abbreviations were identified as unknown words and are not considered frequent words. Hence, the following words were extracted.

Forced Extraction Words:

MS-Project, IT, PMBOK, PMI, PMO, PMP, PDU, PBL, WBS, OJT, SIer, SE, WEB

Furthermore, from the verbs and nouns, the following words that are commonly used, appearing in any sentences, and not related to motives were excluded.

Excluded Words:

think, do, feel, engage, wish, hope, attendance, course, lecture, class, UNIT

After the words described above were extracted, the text mining analysis was carried out again. The top 60 frequently occurring words are listed in Table 6. As we mentioned before, 61 words are posted for some tie counts on words.

Table 6 List of Frequently Occurring Words Considered Compound Words (Top 60)

Word	Times	Word	Times
project management	231	credential	34
knowledge	219	management(keiei)	33
Project	196	internal company	31
Experience	148	understand	31
Business	140	information	30
Learn	138	study	30
Skill	87	utilization	29
system(taikei)	82	MS-project	26
fundamental	78	earn	26
project control	75	workplace	25
development	75	responsible	25
PMBOK	73	enterprise	24
IT	72	opportunity	24
Affairs	71	improvement	24
System	68	examination	24
Program	62	tool	23
Control	60	install	23
Practice	60	ability	22
Acquisition	59	service	21
Get	56	short	21
project manager	53	customer	20
Need	53	built	20
Company	52	organization	20
PMP	51	method	20
management	46	member	19
Learning	41	risk control	19
Technique	40	efficiency	19
Basic	36	operation	19
Technical	36	know	19
Work	36	section	19
Utilize	35		

4.2.3 Co-Occurrence Networks

Co-occurrence networks are generally used to provide a graphic visualization of potential relationships among people, organizations, concepts, and other entities represented within written material. Co-occurrence networks are defined as the collective interconnection of terms based on their paired presence within a specified unit of text. In this context, networks are generated by connecting pairs of terms, using a set of criteria that defines co-occurrence.

The results of the analysis of frequently occurring words are displayed in Figure 1. Larger nodes represent higher frequency words. Thicker lines represent stronger edges.

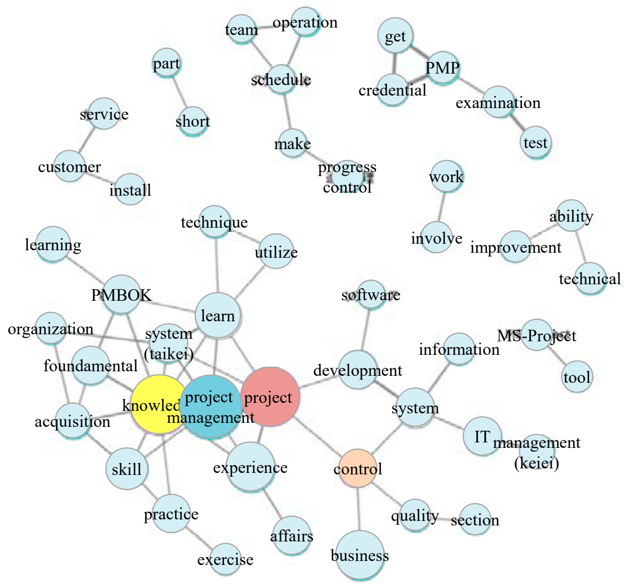

Figure 1 Co-Occurrence Networks

4.3 Characteristics by Year

4.3.1 Analysis Based on Year

Table 7 presents the distinctive words that most often appeared. The values within Table 7 are those of the Jaccard index.

The two most frequently appeared words by fiscal years are as follows; For FY 2010, the words were “business” and “project management.” The other years had different words: “project” and “MS-Project” in FY 2011; “fundamental” and “knowledge” in FY 2012; “experience” and “project” in FY 2013; “project management” and “learning” in FY 2014; and lastly, in FY 2015, the words were “IT” and “system.”

In Table 7, it is difficult to see which words characteristically appear in a certain year at first glance. For example, some words appear frequently in 2011 but not in other years or words occurring commonly. Therefore, the researchers created the co-occurrence relationship among the years, which is shown in Figure 2. It appears that “project management,” “project,” and “business” were frequently utilized every year. Characteristic words by year are "MS-Project" and "turn" in 2011; "management" and "learning" in 2012; "practice" in 2013; "program" and "company" in 2014; and "method" and "IT" in 2015. In addition, in FY 2010, 2012, and 2013, commonly featured characteristic words are "PMBOK," "knowledge," "system (taikei)," "experience," and "learn."

Table 7 List of Distinctive Words (By FY)

2010		2011	
Business	.111	project	.089
project management	.104	MS-project	.087
Knowledge	.102	project management	.075
project control	.092	skill	.063
system(taikei)	.079	business	.062
Learn	.079	responsible	.060
PMBOK	.072	PMBOK	.055
Practice	.066	project control	.055
management (keiei)	.058	acquisition	.053
Affairs	.057	practice	.053
2012		**2013**	
fundamental	.119	experience	.199
Knowledge	.115	project	.161
Learning	.104	project management	.156
Business	.089	knowledge	.152
PMBOK	.086	learn	.117
Experience	.078	system(taikei)	.092
management	.074	affairs	.092
system(taikei)	.066	skill	.091
project control	.063	system	.082
progress control	.058	fundamental	.080
2014		**2015**	
project management	.086	IT	.101
Learn	.079	system	.073
development	.077	technique	.065
Skill	.072	development	.061
Program	.064	practice	.060
environment	.055	internal company	.059
Company	.055	utilize	.054
project manager	.048	program	.053
Get	.041	information	.052
management(keiei)	.041	PMP	.051

4.3.2 Correspondence Analysis

Figure 3 presents the results of the correspondence analysis and visualizes the relationship between the year and aspiring motive of previous section.

In this figure, words that are not distinctive when collected by frequency patterns are plotted around the point of origin (0, 0). When seen from the

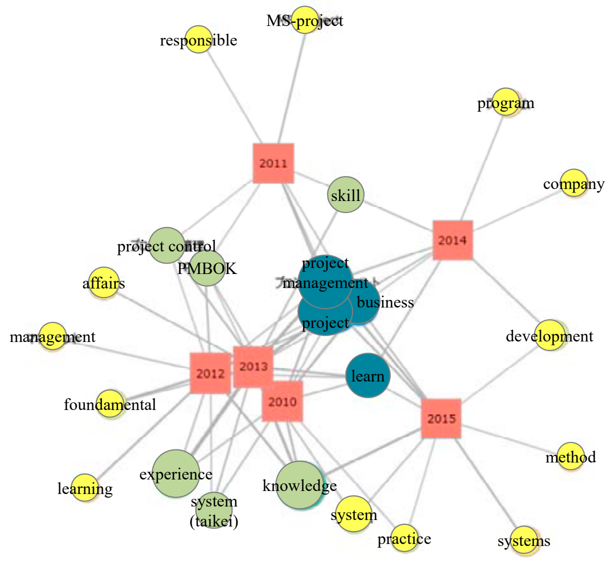

Figure 2 Co-occurrence Relationships between FY 2010 and FY 2015 (Top 60)

point of origin, for example, the more a word is plotted in the direction of "2010" and the further away from the point of origin it is, the more it can be interpreted as a word that is characteristic of "2010."

The contribution ratio shows the volume of information that has been collected by each of the main dimensions in relation to the total volume of data. Here, the cumulative contribution ratio (total value) for the two dimensions is 100%; thus, all of the 60 most frequently occurring words with a significant difference that are presented in Figure 1 can be explained by these two dimensions.

First, if one concentrates on "Dimension 1" with a high contribution ratio, namely the right/left positional relationship within Figure 3, one can see that "2012" and "2013" are positioned in a negative area and that "2014" and "2015" are positioned in a positive area. Here, we can see the features are opposite. However, if we focus on "Dimension 2" with a high contribution ratio, namely the up/down positional relationship within Figure 3, we also see that "2011" and "2015" are close to the base point and has no visible features.

As described above, "2012," "2015," "2013," and "2014" have characteristics relatively comparable to each other, and "2010," "2013," and "2014" have opposite polarities.

Focusing on the distribution of each word, we can see the words that characterize "know" in FY 2010; "PMBOK" in FY 2012; "skill" in FY 2013; "program" in FY 2013; and "IT" and "plan" in FY 2015.

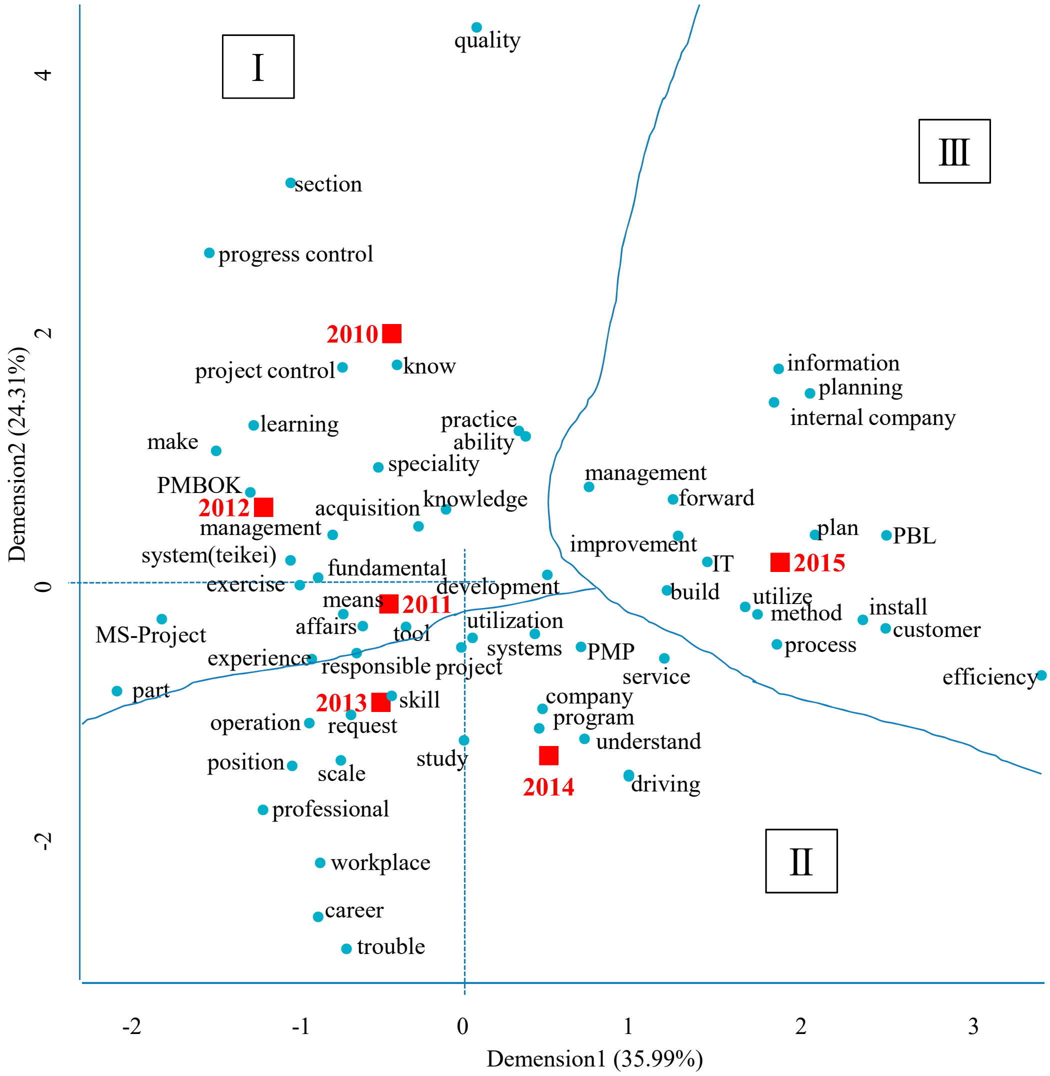

Figure 3 Characteristics of FY Revealed by the Correspondence Analysis (Top 60)

Based on the arrangement for each year, three groups are identified: Group I (2010, 2011, 2012), Group II (2013, 2014), and Group III (2015). This grouping is considered an index in understanding the characteristic changes of the year. In other words, each group becomes a measure of grasping the progress of the year, and by analyzing the words placed there, you can grasp the transition of motivation desires. Figure 3 includes a subjective judgment by the analyst.

Furthermore, we examine the constituent elements arranged for each group and examine the transition of desire motivation. For Group I, we can see the words “know” “learning” “acquisition.” In Group II, we can see the words “utilization” “understand,” and “driving”. In Group III, we can see the words “customer” and “efficiency.”

5. Conclusions

This report introduces the course design and the purpose of the Project Management Professional School opened as a credential certification program at the AIIT. The researchers analyzed the attributes of applicants from FY 2010 to FY 2015 and investigated current trends by text mining the aspiring motives of course applicants. The results indicate that the preference of the applicants’ desired classes transitioned from basic to advanced ones. In FY 2010, the proportion of applicants who wished to learn “fundamental project management” through the course was high. There was a tendency of trying to acquire systematic knowledge from the analysis of aspiring motives. As each successive year passed, the proportion of applications who desired to learn the basics decreased and the percentage of exam preparation measures and applications to practical exercise classes increased. In addition, a characteristic of FY 2015 was a tendency to learn methods and apply them for practical use. On the other hand, 40% of the total participants in FY 2015 were taking the courses as mandatory company training, so this point needs to be taken into account.

In FY 2017, as introduced in Section 2, a new "project manager career design" for UNIT 3 was implemented. It is a one-day class of this course, and the purpose of this class is to enable students to acquire knowledge about careers and to design for themselves a path to grow as project managers. With this class, students understand typical career theory and the competence necessary for project managers. Students can also identify knowledge and characteristics that they are missing themselves; then, the students will clarify exactly what they want to realize as project managers as well as the process needed in order to achieve such a goal. Furthermore, the students will be also be utilized by the school in order to enhance the development of young people. Opening this class is a response to the fact that the aspirations of applicants are shifting to a more advanced course. In addition, the school wants to encourage students to think about career self-reliance.

From this point forward, the institution plans on using the results of this analysis to create a program designed for a project management vocational school at a graduate school for professionals.

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A Study of Quality Assurance on Applying Package and Building IT Infrastructure

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A tendency to develop system without an application development, and a development not to make codes has been seen. Because high quality, cost reduction, and shortening of delivery date can be expected, by applying a package. However, the problem of the quality occurs in such a project. And it is necessary to establish the way of thinking and policy about the guarantee of quality for the service to provide bases system (IT infrastructure) such as a middle package, OS, hardware. In the both case of applying the package and IT infrastructure, it is required for customer to confirm and clarify the condition of vague parts as much as possible. As for applying the package from the viewpoint of usability, an achievement of the end user would be expected as result of a training. A condition and the consensus building of the process completion becomes important. It is necessary to visualize demand of customer and win customer's satisfaction. Therefor the traceability is important in order to chase a series of flows until a demand, requirements, a design, a realization method, examination. For quality assurance, at least perform the following. Accurately grasp the purpose of the customer, obtain approval through User Acceptance Test (UAT), and make sure the requirements definitions are visible and definitely realize and verify the agreement contents. As with non-functional requirements, the metrics has document error rates, test densities, etc. However, metrics equivalent to software development scale is a subject to be studied in the future.

Keywords and phrases: Quality Assurance, Traceability, Visibility, User Acceptance Test, Consensus Building

1. Introduction

High quality, short delivery time, cost savings can be expected by applying packages with quality assured. For this reason, there is a tendency towards development that does not involve application development and development that does not make application. However, quality problems also occur in such projects. Meanwhile, in the service that provides the infrastructure such as middle package, OS, hardware, etc., the concept and policy of quality assurance are not sufficiently established. Both the package and the base service confirm and clarify the customer's request, set the conditions after assuming the ambiguous part as much as possible, and agree with the customer. Based on this agreement, the requirements will be decided for realizing the request. In the package, from the viewpoint of usability, the customer may expect that the proficiency level of the end user is high as the result of the training. Conditions of process completion and consensus formation become important. If this agreement formation is insufficient, customers' satisfaction cannot be obtained, which becomes a problem at the time of acceptance. Therefore, it is indispensable to clarify customers and inspection conditions. Verifying the items promised with the customer and the confirmation items considered necessary by the customer will guarantee the promised quality. In the upstream process, validation is the main and important. Also, consensus formation may include acceptance confirmation (UAT: User Acceptance Test) and user proficiency degree. This paper focuses on the application of packages and the construction and provision of infrastructure as a service form of a project without software development and consider the actual condition and problems of quality assurance. It also refers to the provision of services such as on-site migration and deployment of hardware, and also the form of service of construction.

2. Basic Concept of Quality Assurance

As for considering quality assurance, it is first necessary to clarify what quality to be satisfied in the project. Quality management systems requirements are defined in JIS Q9001:2015. Quality characteristics to be considered are not only functional requirements (see Table 1). There are projects that are not enough to deal with non-functional requirements such as reliability and performance, and they are problematic. In addition, in order to guarantee the quality, scope making, detailed designing, work breakdown structure (WBS) and verification are required, and correspondence between design and test is represented by V letter.

Table 1 Quality Characteristics

#	Main Quality Characteristics	Subcharacteristics
1	Functionality	Suitability, Accurateness, Interoperability, Compliance,Security
2	Reliability	Maturity, Fault tolerance, Recoverability
3	Usability	Understandability, Learnability, Operability
4	Efficiency	Time behavior, Resource behavior
5	Maintainability	Analyzability, Changeability, Stability, Testability
6	Portability	Adaptability, Installability, Conformance, Replaceability

2.1 V model

From the viewpoint of quality assurance, the correspondence between design and test is expressed as "V-shaped model" (see Figure 1). The direction of systemization, from systemization planning to requirement definition, development (from system design to system test), operation test, operation and evaluation is divided into four stages: business, application, IT system, software.

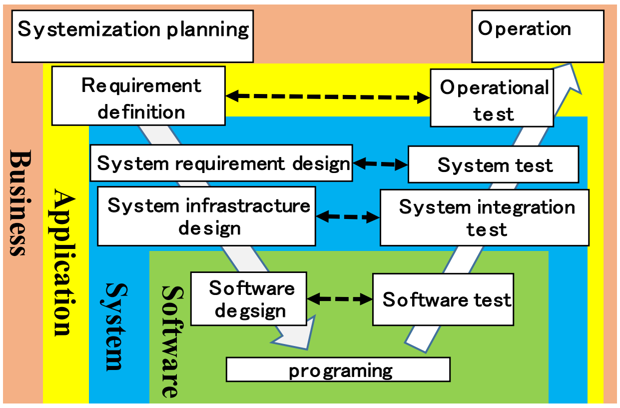

Figure 1 Correspondence between Design and Test

In the requirement definition of the upstream process, requests are sorted out as requirements, but this requirement is ambiguous, that deeply indicated by Shimizu (2012), and it is changed to conform changes in the external environment and conditions. Therefore, it is necessary to recognize that uncertainty is high.

Management evaluates that the IT system contributes to the project, and the business department is responsible for confirming the operational requirements and the requirements that have been defined by operational test. Therefore, active involvement in IT system development, role and responsibility sharing are required, in which common frame is described by IPA SEC BOOKS (2007). "Visualization" is indicated by IPA SEC BOOKS (2006), and is the first step in problem solving. "Invisible software development" is the root of the difficulty among the IT project issues.

2.2 Project without AP development

In this paper, this article assumes two services as a configuration model of a system without AP development to be studied, a service that applies packages and a service that constructs and provides infrastructure. In addition to this, services to be offered in service is assumed (for example, construction carried out locally, such as migration and transition support, hardware equipment construction: network wiring work, terminal installation work, rack installation work, station construction work such as free access cutting etc.). The target service provided image for the hierarchical structure from the hardware to the business AP is shown below (see Figure 2).

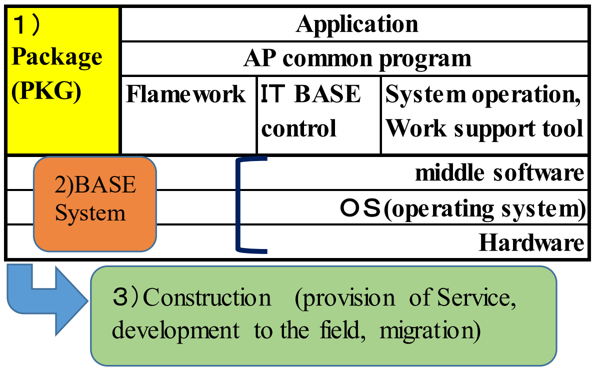

Figure 2 Image of Target Service

2.3 Concept of Quality Control

In order to guarantee the quality, it is necessary to design and build quality. It is necessary to plan the process, confirm the review and results, ensure the problem management and not to carry over the problem to the next process (see Figure 3). That is, it is quality control.

In package provision, operation checks the confirmation as to whether the content defined in the requirement as the business is sufficient, that is, the validity (validation). Also, as necessary, for parts involved in additional development, verify the same as software development. Since these add-on developments are derivative development to packages, the degree of freedom is small, and the basic quality depends on the quality of the package is large.

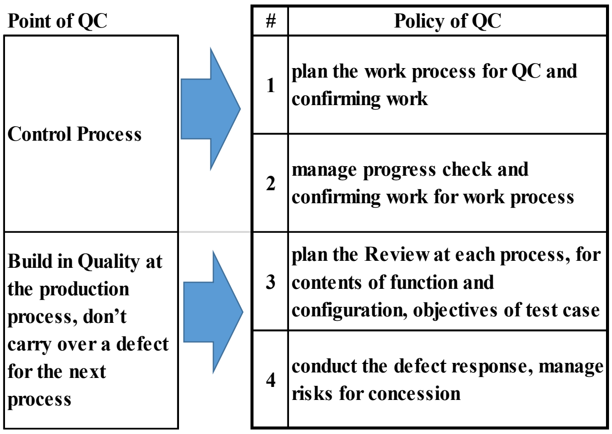

Figure 3 Concept of Quality Control

For the infrastructure, system requirement definition -> method design -> product setting -> environment construction, refinement and realization are promoted. It is important to confirm (MECE: Mutually Exclusive Collectively Exhaustive) that development does not overlap. In addition, verification of each process is confirmed by the corresponding test process to ensure traceability. These series of traceability assurance are quality assurance in the infrastructure (see Figure 4).

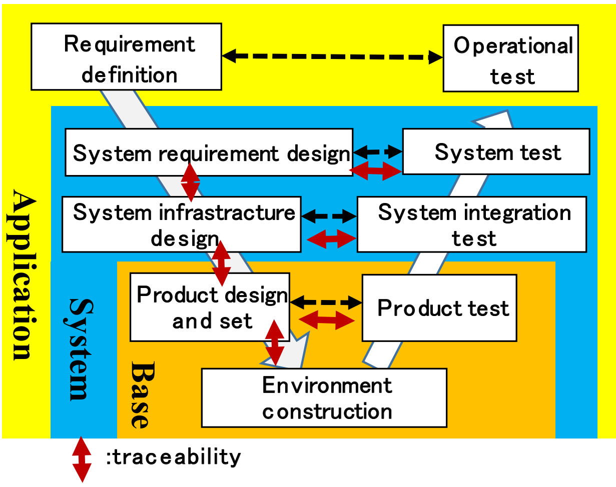

Figure 4 Traceability of IT Infrastructure

3. Quality Assurance Issue

3.1 Package Application

In applying the package, it is desirable to orient as follows: conduct FIT & GAP analysis with the current operation, review the business itself as necessary, change the operation, make excessive creation, make the best possible to be compatible with packages that are considered practice. Then develop only essential parts of additional development (add on). Dynamics to suppress additional development is working to high quality, at introduction of short term, in low cost.

The trade-off with low usability is a prerequisite. Unless the balance between the premise and quality is accurately checked, the evaluation on quality will be different. Therefore, it is necessary to preset the expected level of quality in the V-shaped model. It is easy to problem if there aren't mandatory documents. The correspondence to the request is visualized, and the discrepancy of recognition is reduced. An example is shown below. (See Table 2, Table 3)

Table 2 Response Policy to requirements (example)

Functional Requirements	Priority	Possibility of correspondence	Package Correspondence with	Response policy
1 User authentication				
(1)Capture staff information and organization				
① Capturing staff information and organization information provided by the city.	A	○	○	
② Fo… and or…	B			
③ Th… registe…	A			
④ Besides registering by collective importation of staff information and	A	○	○	
(2) Editing and authority management of staff				
① Register usage rights for registered staff	A	○	○	
② Exclusive control on data being updated	B	△	○	
(3) Setting authentication information				
① To be able to register ID and password	A	○	○	
② The user can change the password at any	A	○	○	
③ It is possible to set the expiration date of	B	○	○	
④ Be able to check the user's most recent pa…	B	○	○	
⑤ The condition of the password such as th…				

Adoption or non-adoption

Package treatment

Table 3 Requests for items (example)

Item name	Draft document	Shelf document	Remarks
Affiliation department	○	○	By user authentication information default
Affiliation section	○	○	By user authentication information default
Affiliation group	○	○	By user authentication information default
Person in charge	○	○	By user authentication information default
job title	○	○	By user authentication information default
phone number	○		Enter extension number
Year belonging to	○	○	Year to which the document belongs. The display on the Japanese calendar
Document symbol	○	○	
Document number	○	○	In principle automatic numbering. Manual input possible (including branch number)
System control number	○	○	Unique number on the system of the document
Document sharing range	○	○	The ability to set sharing level such as "section", "group" etc
Drafting subject	○		
Drafting date	○		On the default day, you can enter calendar on the same day
Decision type	○		Select from the selection items such as "mayor" "deputy mayor"
Inquiry	○		
Draft content	○		Secure at least 1,100 letters
Enforcement document subject	○		

In a case of problem project, the project was interrupted. It was attributed to a complaint from the project owner (PO) that the quality was not secured. Case studies are described by Tsujikawa (2016a, 2016b, 2015).

Problem in this case is one of the reasons it was not possible to agree in advance how to evaluate the scenario test of the UAT (User Acceptance Test).

Originally, it is necessary to prepare a scenario test by examining what to check in advance (pass / fail judgment). In addition, it is required to decide in advance what measurement items can be quantitatively evaluated by what kind of metrics.

If the granularity of the description of the document to be created is unclear, it is impossible to confirm validity or agree. Regard to the particle size, there is a need for objective criteria.

For approval rules such as additional development, it is also necessary to set the rules agreed upon. Also, as for additional development (add-on) by specification addition (CR: Change Request), it is necessary to consider the application of the quality control level similar to AP development, the scope and release time, and risks.

3.2 Base System

In the case of contracting a service to build a foundation system (for example: split bidding / order placement), it is a matter to what extent the examination of the foundation is enough, and it is required to set the level. It is also important to grasp the coverage of the test. It is necessary to confirm the requirements, and breakdown requirement to implementation status of the design (Traceability secured image shown in Figure 5).

Further, not only the confirmation of a single level in implementing multiple software, confirmation of the ability to cooperate with each other, but the confirmation that no mutual interference becomes a problem. Although the case where the test point of view can be identified can perform tests that focus object, otherwise, be evaluated from the whole operation in the form of stabilized test envisaged (comps, overall operating test).

When verifying according to the test plan, it actually happens to notice the test viewpoint and missing points of the test, and additional tests are carried out. This is because it can be recognized when realizing and refining.

In the analysis of errors, the minimum unit to be managed is analyzed as equipment or packaged software, from the viewpoints of failure cause, mixing process, difficulty level, and person in charge. For example, from the viewpoint of troubled parts, the bug detection density is quantitatively evaluated for each apparatus, and devices deviating from the target level are extracted. In addition, analyzed by taking into account the qualitative evaluation, such as the complexity of the degree of difficulty and equipment specifications of the instrument settings, measures of quality improvement.

Moreover, by focusing on the person in charge to quantitatively evaluate the error detection density separately, if deviates from the target level is conducted also to the qualitative assessment. If it is found out that it is caused by insufficient understanding of the product of the person in charge, strengthening of the support system can be studied.

It is also necessary to confirm that the commercial products satisfy the required quality. From this point of view, it is necessary to make software (package software) that realizes the common functions of the foundation, subject to traceability.

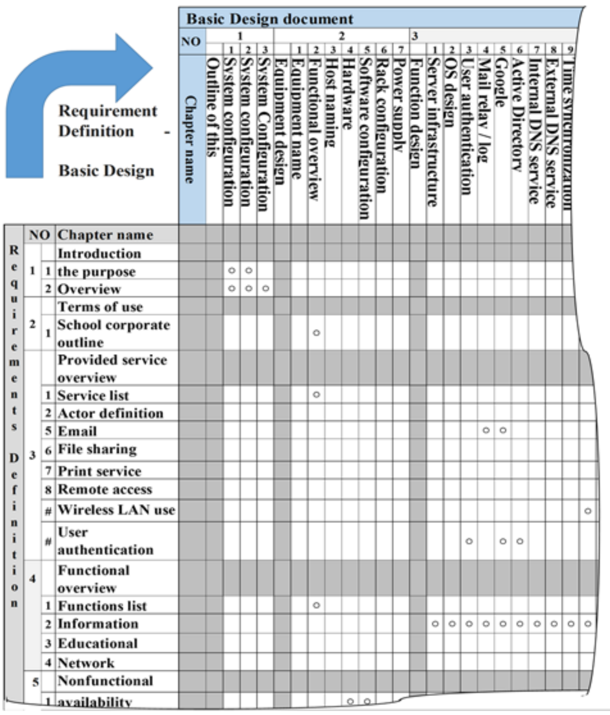

Figure 5 Image of Traceability (example)

Although there is a problem of setting criteria for judging that the test is sufficient, the following points can be considered as a viewpoint of quality improvement.

1) Failure than the failure to be extracted originally in each step is detected

2) Failure according to the process progress is not in decline

3) The number of leakage occurred has exceeded the expected number

3.3 Construction (development to the site)

In a service (such as hardware construction) that develops designed and tested on schedule as planned, designing and planning its development and implementing it as assumed is a quality factor. In addition to reliability, promptness, local customer correspondence also occurs, so human quality for customer satisfaction is also required.

Corrective action is required for troubles at the work site, and for occurrence events, it is required to improve by dividing into the following categories to prevent reoccurrence.

An example of cause analysis of problems are shown below.

1) Insufficient preparation
2) Mistake (LAN loop, verification error, design inconsistency, power off, material management mistake / loss, environmental check unexpected, lazy judgment, report ignored)
3) Management absence
4) Insufficient safety management
5) Breach of manners

4. Measures and Considerations

4.1 Package Application

Since it is a prerequisite that the quality of the package itself is secured, it is primary to clarify the scope and aim of the UAT and to make recognition with the customer (consensus building/formation).

In other words, it is one of countermeasures to prepare test scenarios assuming processing procedures and operation according to the level of proficiency of end user's actual operation. This will confirm and resolve the difference between actual operation and scenario test. However, the subject of the validation is the customer.

It is a part that differs depending on the proficiency level of the user (key user, end user, part-time job etc.) used. In addition, individual skill evaluation is necessary, but it is not easy to measure. In a project, the validity of the UAT is evaluated by grasping the trail of the execution content for each user for the assumed scenario.

However, since the number of testing man-hours and period increases, the cost and the user's restraint time also become long, so it is necessary to set in advance the criteria to form a consensus beforehand on how far it is judged to be appropriate if implemented. Examples are shown below (see Table 4, 5).

Table 4 Test Check List (example1)

Classification	Major classification	Small classification	Precondition	SCL NO					
ST(System Test)	Functional test	Disposal / transfer		21					
No	Test items	Test condition & check confirmation condition	Confirmation item (result) & confirmation method	Test results			Correction Confirmer	Remarks Fault handling form ID	Functional requirement
				Date confirmed	Confirmer	Judgment			
2	Confirmation of tabs subject to transfer	Click the discard transfer button on the menu screen	To display the tab of the waste transfer destination						2－(6)
3			Display extended tab, disposal transfer application completed tab, waste transferred						
4	Display of migration data	Select the affiliation year, jurisdiction affiliation and click "Search" button	Migrated data is displayed						2－(6)
5		Specify creation affiliation and click	Migrated data is displayed						
6		Specify the retention limit and click	Migrated data is displayed						
7		Specify the action after the work end	Migrated data is displayed						
8	Changing the retention period of	Select file criteria and click "Save period change" button	Changing the retention term of						2－(6)
9			The file criterion for which the retention						
11	Extension of	Select file criteria and click "Extension"	To extend the retention term of						2－(6)
13	Detailed information	Select file criteria and click "Detailed	Display detailed information on the						

Table 5 Test Check List (example2)

Classification	Major classification	Small classification	Precondition	SCL NO					
ST(System Test)	Functional test	menu		9					
No	Test items	Test condition (environment) & check confirmation condition	Confirmation item (result) & confirmation method	Test results			Correction Confirmer	Remarks Fault handling form ID	Functional requirement
				Date confirmed	Confirmer	Judgment			
2	Login (document management system)	Enter a valid user ID and password and click "Login"	Display the menu screen and display the login user's name						1－(3)
3		Enter a nonexistent user ID or an incorrect password and click "Login"	Display an error message and stay on the login screen						
4	Login (Single sign-on)	After logging in to the portal site, click on the document management system link	Display the menu screen and display the login user's						1－(4)
5			Activate the browser screen of the document						
6	Menu display	Log in as a general user (user of information management	The tab of the processing menu is displayed, the book management menu						1－(2)
7		Log in as an administrator user	In addition to the processing menu						

4.2 Base System

It is conceivable to organize the concept of visualization and traceability, and prepare a project plan to proceed. Although 100% full path verification on the actual machine is ideal for each product combination constituting the foundation, but it is difficult in terms of time and cost. It is necessary to consider how far it is to implement in real environments and whether it is realistic. Also, it is realistic to limit tests based on accumulated quality results based on historical achievements. However, the validity of the scope of the test is largely dependent on the characteristics of the project (high reliability, securing responsiveness, high security, 24-7, SLA) and required specifications.

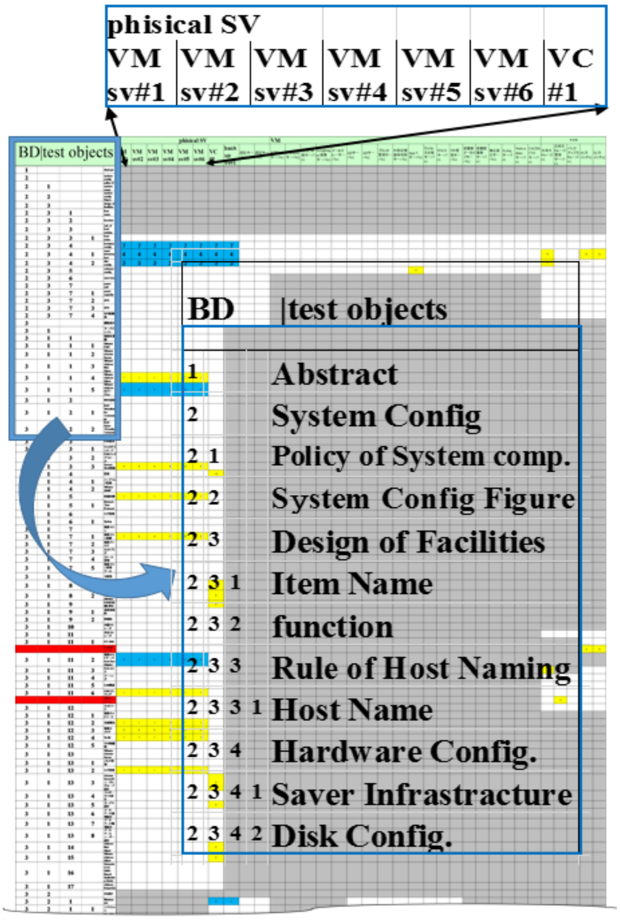

Figure 6 Visualization of test coverage (example)

As an exhaustive list of tests, the parts that form consensus with customers can be visualized and essential. Furthermore, it is necessary to judge the extent of function confirmation for basic product groups as responsibility of the provider.

In the case of a functional test, describe the functional requirement so that a link can be established (Traceability).

An example of the visualization of the coverage of the test is shown in Figure 6. It is a matrix with vertical requirements and target equipment horizontally, red for added test view, blue for unit test items, yellow for coupled test items. And black for not-applicable.

4.3 Construction

Receive requests, define requirements, design, and prepare planning documents. Then, implement the construction surely as planned. A review on the plan is a prerequisite for customer approval and agreement formation and is essential. In the access to the site, prior explanation and, so that is part of the human system more relevant, such as the procedure of contact notification. For that reason, not only technical skills but also consideration for human skills, behaviors, are indispensable.

Conducting meetings every morning, attending attention at the pre-construction or post-meeting and appropriately dealing with problems leads to quality assurance. HEZ (Human Error Zero) activities and thoroughness of the basic operation, training and human resource development in the day-to-day, it is necessary to improve day-to-day improvement of manners. Human error is also attributable to human beings, and zeroing is a problem.

5. Evaluation

Efforts are being implemented for each service based on the idea of quality control (examples are shown in Table 6.) Clarifying request to requirements (visualization), and confirmation test for the requirement is essential. In addition, with regard to the combination of the constituent elements, the extent of stabilization, and coverage, considering the characteristics of the project and trying to form consensus with the customer. On top of that, assuming appropriate test range, the risk is also important to plan in consideration.

Table 6 Implementation of each service (example)

#	Policy of QC	1)Package	2)Base sys	3)construction
1	plan the work process for QC and confirming work	PP(Project Plan)	PP PRORIZE	PP
2	manage progress check and confirming work for work process	ASAP	PRORIZE	methodology
3	plan the Review at each process, for contents of function and configuration, objectives of test	PP	PP	PP
4	conduct the defect response, manage risks for concession	check list, CR(Change Request), ISSUE list	check list	check list report MASTER

ASAP : Accelerating SAP
PRORIZE: Base System Solution
MASTER: Construction Management System

5.1 Package Application

It is effective to sufficiently form consensus with customers because they can share the required level of quality. Even the agreed evaluation items may not be hired from the status or influence of the project and may be the next best response. In the background, the purpose, effectiveness, cost, time and priority of the project are largely influenced.

5.2 Base System

It is effective to grasp design and quality policy and traceability appropriately. Accumulation and sharing of achievement data is necessary as a system.

The completeness of the test depends on the characteristics and requirements of the project, but of course it is necessary to pay attention to the cost balance. Regarding the coverage of the test, it is effective to set the level of coverage in the project, taking into consideration the past actual data. When considering the matrix of the test items for the design, it is desirable to create a matrix of ranges and test items to be confirmed in the test and to visualize the weighting for each item.

Under the constraints of time and resources, it is important to seek the optimal solution. To that end, it is necessary to visualize the grounds and conditions of the planning stage, make a "completed difference analysis" at the completion of the construction and report completion of construction, and make continuous use of it in order to make use of it the next time.

5.3 Construction

Negotiation ability and bargaining power are strongly required in the field. For human beings are involved, on the assumption that the schedule does not proceed as planned, it is possible to face the negotiations at local, human resources properly can respond is essential. How to provide attractive quality is a point.

6. Conclusion

In terms of quality assurance without accompanying AP development, it is necessary to consider how to make quality and adequacy of verification. However, it is more important to confirm validity, that is, upper customer demand, harmony and affinity with the surrounding circumstances of the project and environment, essential satisfaction but not stated. For that reason, it is important to confirm that ambiguous requests and requirements are embodied as they go through the process (ensuring traceability). In doing so, it is necessary to clarify customer's purpose and desire, eliminate ambiguity, and adjust recognition (consensus formation).

For quality assurance, at least perform the following. Accurately grasp the purpose of the customer, obtain approval through UAT, and make sure the requirements definitions are visible and definitely realize, and verify the agreement contents. As with non-functional requirements, Metrics has document error rates, test densities, etc. However, metrics equivalent to software development scale is a subject to be studied in the future. And further proactive response based on ambiguity and uncertainty is required.

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Customer-Oriented Approaches to PMO in Southeast Asia JOC Project

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This paper discusses a case of PMO activity in system integration project for the M&A of a Southeast Asia's local bank by one of Japanese mega-banks. Author's team joined the project as PMO and contributed to the successful integration. The project consisted of over 150 business application systems in three places, customer's head quarter, local branch and the local bank. Author analyzes the important point for PMO in global JOC (Japan-originated Company) project in this paper. In Japan, it has been believed that global consulting firms have an advantage in global project because of their knowledge on global project and human resource such as language skills. However, author's team utilized the knowledge as a specialist and capabilities as a Japan originated ICT company to lead the project to the success. Our approaches to the issue of the project consist of two customer-oriented viewpoints, knowledge as a specialist and organization capabilities. From the result of the success of the project, it can be concluded that customer-oriented approaches are more crucial than knowledge on global project and human resource for global JOC project.

Keywords and phrases: Global JOC Project, Japan Originated ICT Company, Knowledge as a Specialist, Organization Capability

1. Introduction

The amount of investment in China market by Japanese companies are decreasing in these five years. On the other hand, those to Southeast Asia market are increasing (Figure 1). The main reason is that there are social and political changes in China such as the increase of labor cost, environmental pollution and control by regulator. In addition, the attraction as a consumption market, declining import tariff in Southeast Asia promoted their market growth.

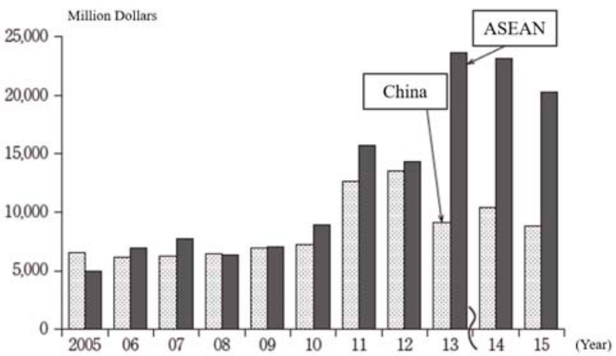

Figure 1 Investment by Japanese Companies [2]

Based on the trend, Japanese mega-banks started expanding their business in Southeast Asia. Purchase of Krungsri Bank (Thailand) by Tokyo Mitsubishi UFJ Bank, investment in Bank Tabungan Pensiunan National Tbk (Indonesia) by Mitsui Sumitomo Bank and investment in Vietcom Bank (Vietnam) are representative examples.

This paper discusses a case of PMO activity in system integration project for the M&A of a Southeast Asia's local bank by one of Japanese mega-banks.

2. Overview of the Project

2.1 Organization Structure

The project was carried out by three offices, Japanese mega-bank's Tokyo Head Quarter (Tokyo HQ), it's local branch (The Local Branch) and local bank (The Local Bank) (Figure 2).

The layer of the organization is 1) to 3) below.

1) Global PMO manages three offices.
2) PMO consists of Tokyo HQ PMO, The Local Branch PMO and The Local Bank PMO.
3) Target system are categorized to three areas, Accounting, Information and Treasury Systems. There are around 50 systems for each office.

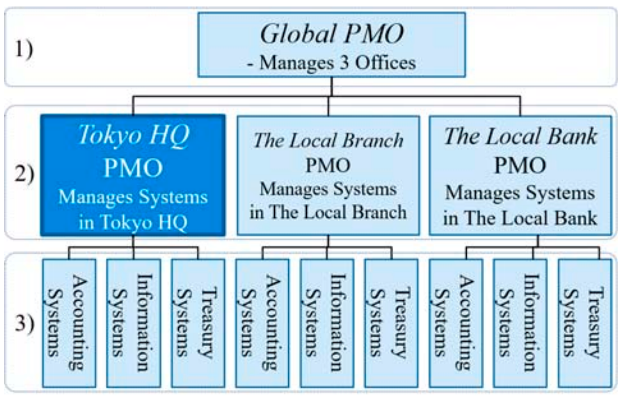

Figure 2 Organization Layer

2.2 Role of Tokyo HQ PMO

Tokyo HQ is responsible for the project. Therefore, Tokyo HQ PMO's role is not only to manage systems in Tokyo HQ but also to support other two PMOs to manage each office and to report to Global PMO for its report to management and FSA (Financial Services Agency) (Figure 3).

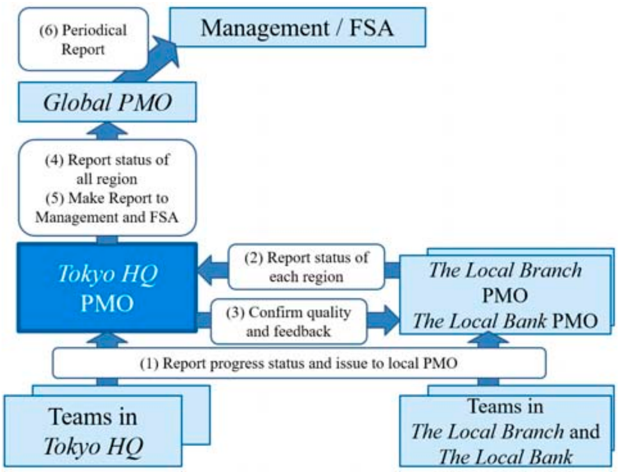

Figure 3 Reporting Flow Centering on Tokyo HQ

Regular meetings are held to share the weekly progress and to judge the closing of each phase (Table 1).

Table 1 Responsibility of PMO

Category		Attendee	Responsible PMO	Method
Weekly Meeting				
	Region Internal	All System	Each PMO	Con-Call
	Between Region	All PMO	Tokyo HQ PMO	Con-Call
	Report to Global PMO	Tokyo PMO		Face to Face
Phase Management			Tokyo HQ PMO	
	Phase Closing Judgement	All PMO		Con-Call

Generally, PMO's role and organization is categorized to three types (Table 2). Tokyo HQ PMO manages each team in Tokyo HQ and other two PMOs. On the other hand, it controls each team on behalf of project manager depending on the situation. Therefore, its role is "Management Type which includes Control Type in some part" and its organization is "Organization Internal (Individual) which includes Organization Internal (Common) in some part".

Table 2 PMO's Role and Organization

Scope	Category		Overview
	Role		
		Support Type	Consults members. Control level to the project is low.
		Management Type	Requires compliance to members. Control level to the project is medium.
		Control Type	Directly controls project. Control level to the project is high.
	Organization		
		Organization Internal (Common)	Considering the company's project management strategy and provides service to achieve the strategy to the whole company.
		Organization Internal (Individual)	Achieve partial function of the organization. Manage resource, quality and procurement.
		External Organization	Control external organization such as customer and promote communication

In this project, author's company joined Tokyo HQ PMO to support its daily activity.

2.3 Background of Request from Customer

At the beginning of the project, the global consulting firm (the Consulting Firm) joined Tokyo HQ PMO by utilizing their knowledge and human resource in global project. Therefore, experience of Japan originated ICT company was not necessary and author's company was carrying out some local systems' integration operation which we have originally implemented and operated.

However, customer requested us to support Tokyo HQ PMO because the Consulting Firm didn't have enough knowledge of banking business, IT skills and human resource. The project's phase was almost the end of Requirement Definition phase at the time. However, PMO members overworked four to five hours per day for the progress management. The customer had an anxiety about if they could conduct quality analysis properly for the closing of the phase.

Author's team didn't have PMO experience in global financial field. However, we recently carried out PMO support in the customer's Japan internal system integration. Key person of Toyo HQ's Planning Division evaluated the experience and requested to us.

3. Issue of the Project

At the beginning of the project, most of our company members objected to join the project because of customer's complaint to the Consulting Firm. In addition, some members suspected that it's difficult for Japan originated ICT company such as us to success in the project where even the Consulting Firm which has much knowledge and skill of global business failed. Therefore, we analyzed the Consulting Firm's existing issues and potential issues which we would encounter.

3.1 Existing Issues

Before joining the project, author's team asked Tokyo HQ's management to have an interview with their PMO members. As a result, we found that no satisfaction of Tokyo HQ PMO is resulted from three issues.

(1) PMO Resources

Key role of vendor is to support Tokyo HQ's project manager and PMO member. Therefore, we assumed that what we need to do is not only to do tasks which Tokyo HQ members instructed but also to utilize knowledge of PMO to lead customers actively.

However, only the leader was specialized in PMO skill in the Consulting Firm members. In addition, their leader was not a dedicated member and couldn't pick up customer's request and no satisfaction in real time base. At the same time, we found by the interview with customer that the Consulting Firm's members other than the leader couldn't lead or propose to customer and were waiting for customer's instruction and it lead to heavy burden of the customer.

(2) IT Skill

One reason of the difficulty of PMO in this case is that the number of integration target system was over 150 for three branches.

The Consulting Firm managed the project manually and it caused issue of time management and quality management. In case of weekly progress management, it took an entire day to confirm Tokyo HQ system's progress status, one day for The Local Branch and The Local Bank progress status. In addition, we found that quality was not enough because there were many mistakes because of manual process.

(3) Knowledge of Banking Business

As stated in 2.1, PMO in each site has to manage around 50 systems. In order to understand project's status timely to allocate resource, broad business knowledge of banking field was necessary.

However, although the Consulting Firm members had ordinal PMO skills, there were no engineers who are specialized in business field for banks and couldn't analyze and judge based on the knowledge. It leaded to the only formality project management.

3.2 Potential Issues

As the potential issue when we compare with the Consulting Firm, lacking experience of global PMO is one issue. Although this project is smaller than the local PMO project, the number of branch is three and we expect that here are limitation of communication and the issue of time difference.

(1) Communication Management

Because Local Branch PMO and Local Bank PMO are outside Japan, we anticipated that there will be issues which do not occur in Japan inside project such as project management method is not useful because of the difference of business culture.

At the beginning, main communication method was periodical progress meeting and e-mail. Therefore, the quality of communication was limited and it was difficult to share detailed nuance.

(2) Contract Style

Because of the limitation of customer's budget and vendor's human resource, the number of members which can assign was only a few and it was difficult to answer all the expectations of the customer.

A Company didn't fully agree with the customer about the scope before starting the support. It leaded to do all required tasks and to overwork or low quality. It was also the reason of the reduce of customer satisfaction.

3.3 Priority of Issues

We analyzed priority of existing and potential issues. The issue of human resource and skills we listed in 3.1 were already became obvious, and we evaluated as the most prioritized one. The next was communication management and contract style issue in 3.2 (Table 3).

Table 3 Issues and Priority

Priority	Category	Issue
1	Skill and Resource	PMO Resource
		IT Knowledge
		Business Knowledge
2	Communication	Communication between Branch
3	Contract Style	Scope of Support

4. Solutions for the Issue

We planned mainly four solutions to solve the issue. To confirm that all necessary points are covered by the solution, we plot the solution to PMBOK nine knowledge areas (Table 4).

Table 4 Solution's Scope in PMBOK Knowledge Area

	PMBOK Knowledge Area	Solution			
		Front-End Team	Back-end Team	Know ledge	Scope
1	Integration				
2	Scope				✓
3	Time			✓	✓
4	Cost				✓
5	Quality	✓		✓	✓
6	Human Resource	✓	✓		✓
7	Communication	✓	✓		
8	Risk	✓	✓		
9	Procurement				
10	Stakeholder		✓		

4.1 Organizing Redundant Front-End Team

For members who directly communicate with customers, PMO skill, IT and Business knowledge are indispensable. We organized front-end team which solely covers the skills. In addition, we arranged to assign at least one member who is a very high level specialist for each skill to lead customers. In order for quality assurance by internal review and to minimize the impact when one of member is absent, we arranged to assign at least two members who is a high level specialist for each skill (Table 5).

Table 5 Skill Set of Front-End Members

	Support	Skill (S: Very High, A:High)			
		PMO	IT	Business	English
Manager	Offsite	S	A	S	
Leader	Onsite	S	A	A	A
Member (Note 1)			S/A	A	S/A

At the beginning, customer requested us to assign two onsite members including leader. However, we judged that at least three members are indispensable to assure the quality, and negotiated with the customer and realized to make front-end team consists of three members.

4.2 Enforcing Back-End Team

Before joining the project, we made matrix of stakeholders from Tokyo HQ, The Local Branch, The Local Bank and our company. As a result, we found that there are areas which front-end members cannot cover.

Ones of our strength from the viewpoint of organization structure are following three points.

1) Our company's local branch member joined The Local Branch PMO.
2) Our company implemented Tokyo and nine overseas Treasury system for the mega-bank, and The Local Branch in this project was one of them.
3) Our Project Manager was in charge of Tokyo HQ for about 30 years and had knowledge about the whole system such as system structure.

These are advantages of our company which is Japanese multi domestic company and has been in charge of Tokyo HQ's business for a long time. We utilized this point to organize back-end team in this project.

We used not only official communication channel provided by customer but also our internal network with local branch members and each system member in order to understand the situation smoothly and concretely when issue occurs in each region (Figure 4).

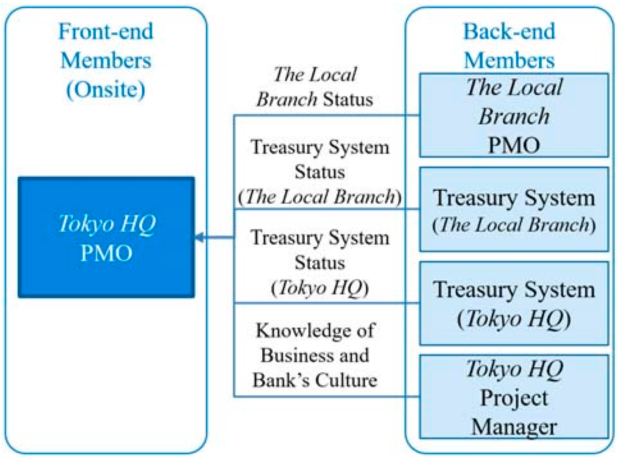

Figure 4 Front-End and Back-End Team

4.3 Using Knowledge in Our Organization

Timeline and quality of manual management was limited to manage around 150 systems in three branches. On the other hand, automation with existing commercial tools was difficult because there were project management rules which are original for the mega-bank. In addition, using their other project's rule was difficult because system management structure was vertical and information was not shared enough with other systems.

Therefore, we tried to get project management tool which we implemented in other system of Tokyo HQ from our company's member. We shared the tool with The Local Branch and The Local Bank to start automation at the same time. Also, we assigned front-end team member whose IT skill is especially high as a tool manager to reflect issues and customers' request on the tool swiftly.

4.4 Clarifying Scope

In this project, customer strongly requested us to organize the team within their limited budget. On the other hand, it was difficult for us to support all broad scope of PMO support from the viewpoint of our company's human resource and cost.

When we joined the project, we defined the scope of our support as basically the daytime in Japan and agreed with the customer. In case overwork is inevitable such as the time before the phase closing judgement meeting and migration rehearsal, we decided to make an agreement between our project leader and customer's project leader in advance. On the other hand, we also agreed with customer to support their request in daytime even if the task is out of scope and to maintain high productivity (Note 2) for customer's satisfaction.

5. Evaluation

5.1 Time Reduction

Automation by the tool realized to shortened the time of periodical operation such as progress status management and issue management to one-sixth of the original time. For example, weekly progress status management became half of a day which originally took around 1 to 1.5 days for each branch (Table 6).

Table 6 Effect on Shortening the Time for Weekly Progress Management

PMO	Time for Management (Hour)		
	Initial	After the Solution	Effect
Tokyo HQ	10	2	8
The Local Branch	8	2	6
The Local Bank	8	3	5

By this effect, it became possible to use the time which originally took for periodical operation for the tasks which PMO must use such as analyzing and solving the issues.

5.2 Quality Improvement

After the automation by tool, the number of defect, which was around 10 for a week by the check of Tokyo PMO and two to three for a week even by the check of Global PMO, was reduced to two to three for a week by Tokyo PMO and one for several months by Global PMO (Table 7). Thanks to this, it became easier to analyze progress status and to find out systems which has issues or problems.

Table 7 Number of Defects for Weekly Progress Management

PMO	Number of Defects Per Week		
	Original	After the Solution	Effect
Tokyo HQ	10	0	10
The Local Branch	20	3	17
The Local Bank	20	5	15

A problem occurred when the quality improved and the ordinal number of human errors became zero. There was a mistake in a report which is made once in a month and pointed out by the FSA. In ordinal case, it is a matter which is responsible for the vender who makes the report. However, the author's team had brought the enough relationship with the customer at this timing. Therefore, the problem in each side was fully discussed equally, and customer and we analyzed the reason and improvement method together. It was second order effect that the team made an agreement that both vendor and customer are responsible for the quality improvement and maintenance.

5.3 Cost Reduction

In the author's team, it became possible to maintain the PMO operation which the Consulting Firm did in six members by three members. We couldn't realize to operate by two members which is Tokyo HQ's original requirement. However, it is concluded that it was effective to reduce the man power for three and contributed to the reduction of the cost.

In addition, our team realized to reduce the overwork which took four to five hours per week was necessary in average before to no overwork in usual time and two to three hours in peak time once in a month. It contributed to the cost reduction for our company.

5.4 Customer Satisfaction

As an effect of shortening time, quality improvement and cost reduction, the customer satisfaction in related division highly improved (Table 8). It is important that the author's team could reduce customer's expectation by clarifying the scope and made a result higher than the expectation.

Table 8 Evaluation by Each Customer

Role	Evaluation
Project Manager	It was possible to understand each system's status timely and clearly.
Tokyo HQ PMO Leader	Analysis and proposal about each system's status was helpful for the discussion with PM.
Tokyo HQ PMO Member	It became possible to reflect the proposal of improvement smoothly to the output.
The Local Branch PMO Member	Trouble shooting of tools became swift and accurate. As a result, the burden of project management was reduced a lot.

5.5 Study in the Activity

Through the activity, we found some important points of JOC project compared with Japanese project.

(1) Human Resource and Technology

From the viewpoint of project management by PMO, most overseas branches don't follow the regulations smoothly compared with Japanese members. IT tool is especially effective for his point. Automation to avoid manual operation is helpful to regulate the output among each division and to manage and analyze the situation effectively.

(2) Communication Management

Communication between branches is sometimes difficult in JOC project because of time difference, language and business style difference. On the other hand, it is necessary to understand each system's structure for the integration of different organization's system. Building up back-end organization structure with the company's internal resource is effective. Sufficient and timely information sharing with back-end members to improve quality and speed of the activity.

(3) Understanding Unique Business Style

Burden of customer tends to become large especially for customers which has unique business rules (e.g. meeting rules). It's important to utilize experience of customer support in Japan for firm support of customer in JOC project.

6. Conclusion

6.1 Summary

In this project, author's team successfully improved quality, cost, delivery and customer's satisfaction and completed the project by utilizing profession and experience as a Japan originated ICT company. Based on this result, it is concluded that customer-oriented approach which utilizes experience and advantages are more important than knowledge and human resource which are originally thought to be necessary.

In order to use the result to other projects, it is necessary to change some approaches according to the background. For example, the time difference is only two to three hours in Southeast Asian project and difficulties of meeting is lower than those in Europe or America. In those cases, it is necessary to think about the difference and put it to practical use.

6.2 Conclusion

Our company got a request of PMO activity in other system integration project in Asia one year after this project and won the bid. Author believes that it is necessary to think about the issue above and use this experience for enforcing relationship with existing customers and making relationship with other customers.

In an increasingly globalized world, the author believes that more and more our customer in Japan will expand their business in global market. Japan originated company such as ours needs to differentiate with global companies and to go to global market with our Japanese customer as a good partner with them.

Notes

Note 1) We assigned at least one member whose skill is "S" for IT skill and English skill each.

Note 2) Author's team agreed that the responsibility of the output is to the customer.

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Survive with Diversity and Millennial Generation

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Balanced teaming by generation, by experience is important in project. Japan population is not balanced by age. Around 65 years old, there are 2.2 million people by age. Around age 25 generation, there are 1.1 million people. Lost 10 years of depression, Enterprise including IT industry has hired few regular employees of around 30 years old. The new graduates are consists of half of female, one third of foreign nationality in recent 5years. This shows diversity of gender and nationality. IT Offshore development has matured in these 15 years. Offshore has solid experienced staff around 35 years old. This paper shows intentional project staffing considering millennial generation, gender, nationality in Japan local, and local - Offshore diversity. This paper also showed Business Intelligence Methodology, architecture, Role model which supports diversity teaming.

Key Words and Phrases: Population Composition, Gender, Nationality, Multi Stage Work Life, Business Intelligence, Methodology

1. Introduction

In large (over 100 FTEs), long duration (over three years) project, by Age, by Experience balanced teaming is very important. Team with diversity is stronger when the project duration is longer. In society of Japan, Baby Boomers are retired in five to ten years. Work force is aging, reducing in all industry. IT industry is no exception. Large IT System Integration is knowledge intensive at first look but also labor intensive. The number of IT engineers is reducing especially in traditional SI integration.

The Japan population around 65 year old population is about 2.2 million per age. Around 55 years old population is about 1.5 million per age and it forms valley. Around 40 years old is about 2.0 million per age and forms peak again. Around 30 years old is 1.5 million per age. Below 25 years old is 1.2 million to 1.0 million per age. During the Lost 10 years after bubble corruption, all the enterprise did not hire regular employee around 30 years old generation is very thin in enterprise relatively in outré society. So called Millennial, around 20 to 30 years old need to be empowered in real project now and 10 years after. In this meaning, Millennial are very requested not only from each project but also from all the professional society. Under these circumstances, if regular employee and Japanese-Native people centric project consists of around 40 years old people only, it doesn't function. Traditional multi-layer sub-contracting structure doesn't solve this problem because of each Sub-contractor themselves have the same problems too.

Recent these 5 years, new graduate hiring, male-female ratio is 60% female and non-Japanese-natives nationality ratio is 40%. They were born outside Japan and graduated from Japan University. It is phenomena of empowerment of Female workforce. It is also empowerment of talented engineer immigrants. Offshore development has matured in these 10 years. They are around 35 years old; they have 10 years of experience. They are capable of the team leader. Offshore local people can manage the project by themselves. They can plan and execute the system development by themselves. The project staffing can utilize this Japan population generation difference, gender, nationality, offshore diversity. In order to have the common words among this diversity, BI Architecture, Methodology, and Role and responsibility are also very helpful.

2. Population composition of Japan

2.1 Japan population at 1961.

National Institute of Population and social security Research (2016) showed the Japan population composition by year. Figure 1 is the Japan population composition by age at 1961. The age around 43 decreasing is because of the Pacific war death. About 1milion people died. At the war from 20 to 30 years old men went to war and not returned. The age of around 23 were also born in The Pacific war. The number of people is less because of fewer men at internal Japan. The age around 15, they were born at 1945. 1945 was the end of the Pacific war and huge confusion occurred in this year. And soon after 1947 to

1951 over 2 million people per year were born, this is the Baby Boomers. But the Age of under 7 years old, the population become 1.5 million people and there happened already the fewer children situation. But in general, population balance was good and it forms right normal triangle shape. If the project team of 10 people was staffed at 1961, generation 50 years old is one, 40 years old are two, 30 years old are three, and 20 years old are four. This team is mixed of 30 % of two or three decades of experience and 70 % of new to 10 years' experience. It was good balanced teaming in nature.

60 years range, there are 1.5 million people per year. From 40 to 50 years old range, there are 1.8 million people per age. Around 35 years old, there are 1.5 million. Around 25 years old, there are 1.2 million.
If the project team of 10 people is staffed at 2016, 50 years old generation are two, 40 years old are three, 30 years old are three, and 20 years old are two.
This team is mixed of 50% of two or three decades of experience and 50% of new to 10 years of experience. It is not good balanced teaming in nature. In order to formulate the well balanced team, some action implemented in this macro point of view.

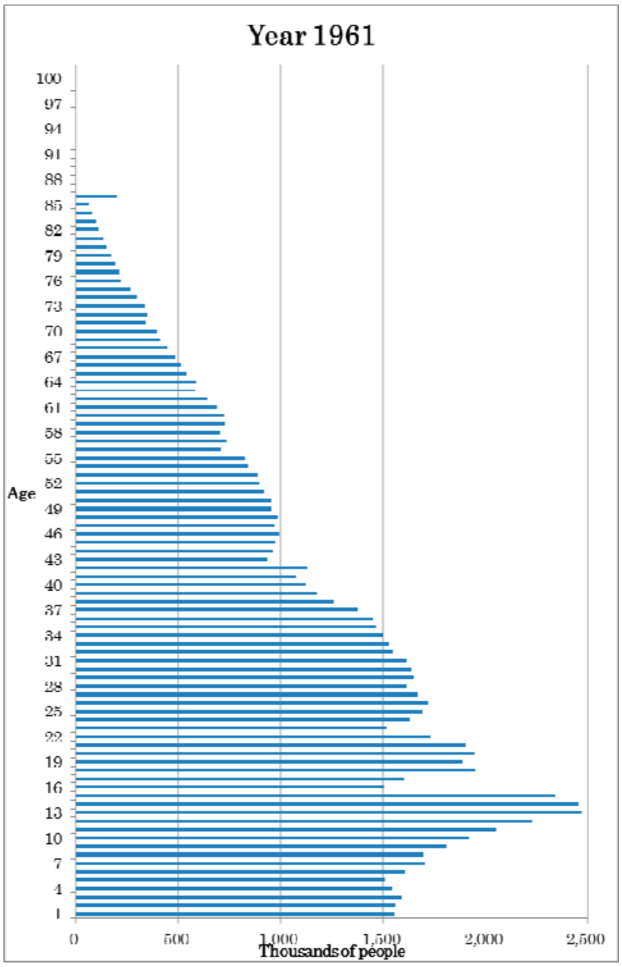

Figure 1 the population composition of Japan at 1961

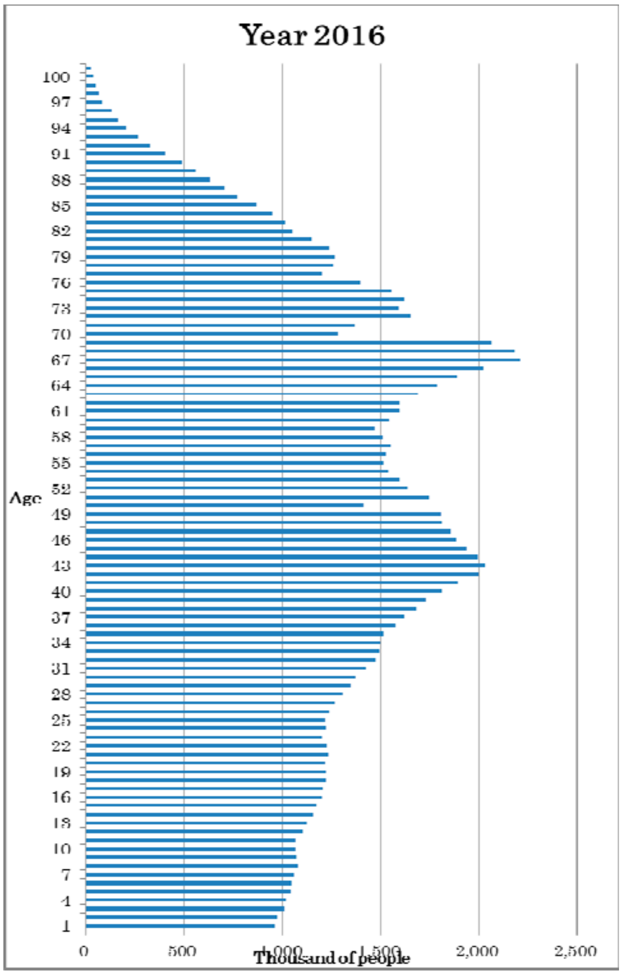

Figure 2 the population composition of Japan at 2016

2.2 Japan population composition at 2016

Figure 2 is the Japan population composition by age at 2016. From 65 to 69 years old generation is 1st baby boomers. Around 43 years old is 2nd baby boomers and they are children of 1st baby boomers. In precise, 2nd baby boomers are less than 1st baby boomers. So in this stage, the fewer children born problem already happened 40 years ago. From 50 to

These actions are described in the next chapter.

3. Project staffing based on Diversity and Millennial

The project staff was discussed traditionally from Men-month and duration point of view. Brooks, P. F. (1975) wrote that men and months were not interchangeable. But the discussion assumed the staff is coherent through the project. Now the diversity is inevitable and can be effectively used.

3.1 Each project impacted from macro environment

To see local regular employee, around 50 years old generation, the number of people are few because of consecutive long hours of hard work style made the less number of work force. Around 40 years old generation, the number of work force is relatively large according to 2nd baby boomers. From 30 to late 30's, the number of regular work force is very few. This age was "Lost 10 years in Japan". Around year 2000 it was "Employment Ice age". The enterprise hired few new graduates from college. There are few regular employees inside the enterprise. There is staffing hole in this age group. Figure 3 shows the number of staff from Japan local and offshore by age. This chart also shows very interested view from the point of lost 10 years, Millennial, local and offshore at 2016 project staffing

3.2 Hire of Millennial

Generations born at 1985 to 2000, the Millennial are children's of 2nd baby boomers. They are 20 to 30 years old now. The enterprise began to hire the new gradated in this age. But the number of Millennial itself is two thirds of 2nd baby boomers. In these 5years, 60 % of new graduate are women. Non-Japanese natives Nationality are 40%. They are born outside Japan and have graduated from Japanese college or university. Based on these conditions, 10 years of experience generation are first to diversity of gender and diversity of nationality.

3.3 Offshore workforce has grown and matured

Offshore development has started about 15 years ago. In these 5 years, the first generation of offshore team became late30's. They are very talented and can be a team leader of 10 to 20 people size. They are experiences with IT technology and are also experienced in Business Intelligence specific technology. They are also experienced project management such as progress management, Issue management, Change request, Human resource management, Cost management and so on. Interestingly their generation is the same as Japan "Lost 10 years", "Employment Ice Age". They filled the hole of around 35. This is the big discovery in this my three years project. This means offshore is not cheap labor but is the important middle layer, team leader, sub leader class work force which is lack of Japan regular employee.

3.4 Offshore generation and millennial application

This project applies the above mentioned condition.

Generation 1: They are Mid 40's, are technology or business core experts. They faced the customer, set the goal and think of approach to resolve the problem. This generation comes from Japan regular employee and are also 2nd baby boomers.

Generation 2: They are Mid 30's and are key designer or programmer. They understand design issues, programing issues, productivity issues and lead 5 people sub team. There are some subject matter experts who surpass over Japan local SMEs.

Generation 3: They are Millennial and late 20's. Some of them can design, build and test by themselves. Some of them are learning everything through the job. Offshore team are all graduate from the IT, Software related college or university, highly educated, highly motivated. Japan local team is great diversity. Half is women, half is born outside Japan and graduated from Japan College. The project manager and team leader have to keep in mind this diversity as the real, in front of our eyes situation.

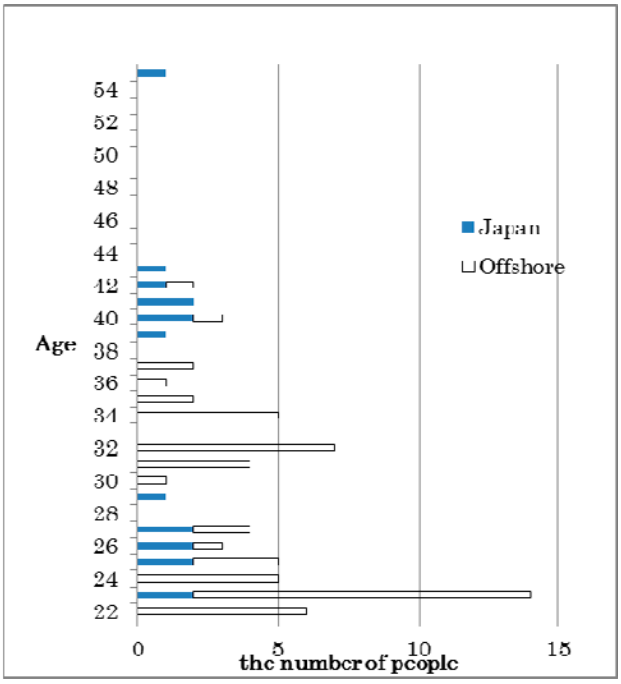

Figure 3 Age composition of this project
- Total 70 people

3.5 10 years after in Japan population

Let's think how it will be at 2026, 10 years after.

The population composition of Japan at 2026 is already determined now. Figure 4 shows the population composition at 2026. It means current 50's will be 60's and almost retirement. Or the work Life will be changed and continue to work over 65 years old as long as possible , let's say Some people would work or can work at 60s and 70s.
40's at 2016 will be 50's at 2026. Some of them will be management role but almost all will continue to work as Subject matter experts. 30's at 2016 will be 40's at 2026. "Employment Ice Age" influence remained. And leave a big hole there. 20's at 2016 will be 30's at 2026. 10's at 2016 are about 1 million people in average. New born babies from 2016 gradually decreased to some 0.7 million people. The enterprise still is trying to hire new graduate continuously for these 10 years, but because of the total young population will be 70% of 2016.

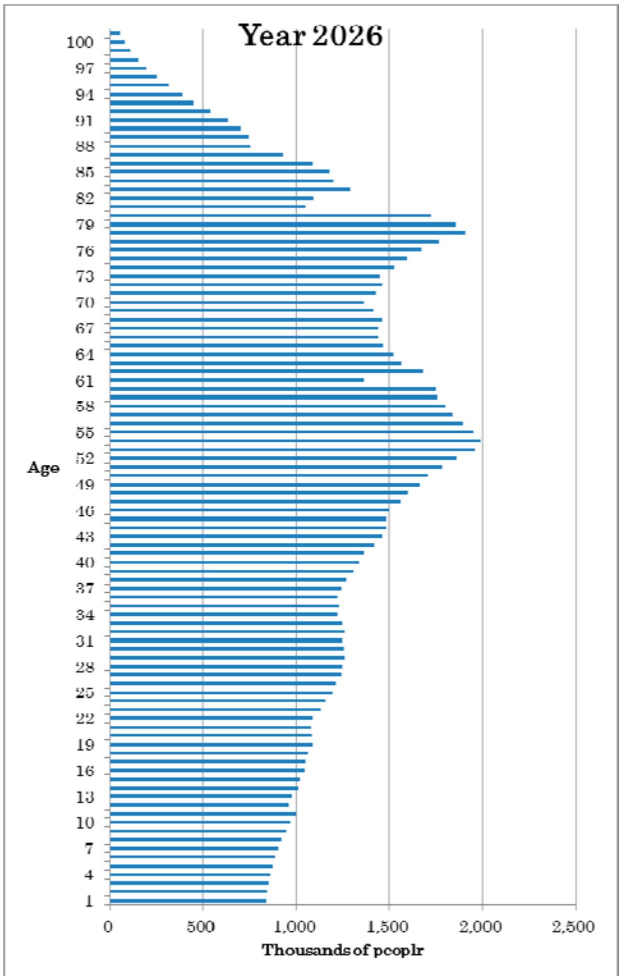

Figure 4 the population composition of Japan at 2026

Then the new hired graduate at 2026 will be half than 2016. The women gender diversity or Non-Japanese National diversity will be continued in this enterprise but many other enterprises also accept those diversities, then the new graduate for this enterprise will be decreased to half also at 2026.

3.6 10 years after at the project staffing

If the similar project will happen, how the project staffing will be in 2026 at this enterprise. The same project size, the same scope, the same role and responsibility. The project applies the same condition of macro population composition of Japan and Actual shape of 2016 staffing. Figure 5 shows the simulated project staffing 10 years after from Figure 3 under some assumption.

Generation 1: They are Mid 50's and are 2nd baby boomers. Retention rate assumes 60%. The number of people of this generation is different from 2016. At 2016, around 50's is only one but 2026 around 50's will be some seven people, even if retained 60% from 2016. Their role will be changed. They are still technology or business core experts, faced the customer and set the goal and think of approach to resolve the problem as an expert. Gratton, L. and Scott, A. (2016) wrote that they may or may not the management role, may work full time or as Portfolio worker. They are almost Japanese nationality, and Male gender.

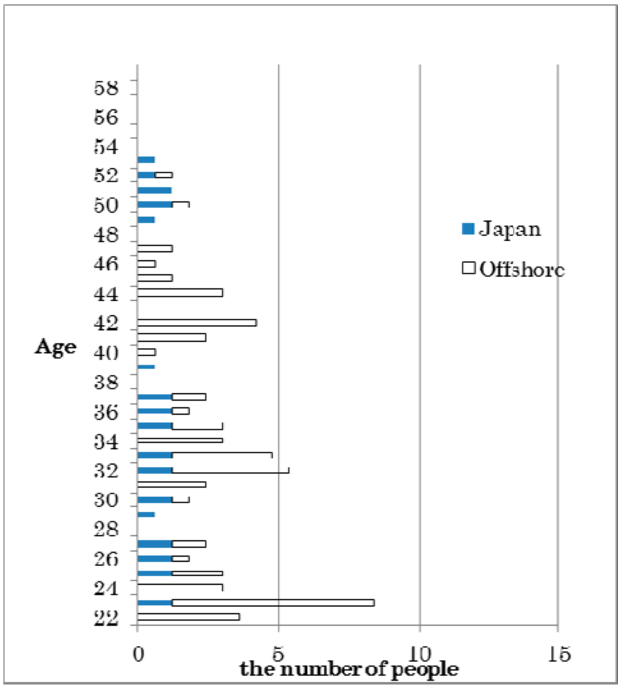

Figure 5 Age composition of this project
- Total 70 people

Generation 2: They are Mid 40's. Millennial become Middle Ages. Retention rate assumes 60%. They consist of offshore talents. No Japanese local. Some of them lead 10 people sub team. Most of them are subject matter experts. Some of Offshore members work at Japan local. They may face customer directly, may lead Japan local teams. Japan local teams will be more diversity.

Generation 3: They are late 20's. The sum of people from 22-29 is 11.6 million at 2016 and 10.9 million at 2026 in Japan. It is 6% decreasing. Wulf, D. M. (2016) shows that the big difference is seen at the offshore (China). The sum of people from 22-29 is 251 million people at 2016 and 120 million people at 2026 in China. It will be 53% decreasing. It will be half. So the 90% of people will be assumed in Japan local and 40 % of people in Offshore assigned to the project. Japan local team are continued to be great diversity. Half of the people are women, Half is born outside Japan and graduated from Japan college. Offshore team will be one third of total staff. This is huge change compared 2016 to 2026.

4. BI-Method-Architecture, Role and Responsibility, Estimation model.

4.1 Architecture based management effective in diversity

The project team has to deliver the "BI/Analytics system restructuring". The To-Be system will handle some thousand source files from tens of source business systems. It will create some thousand Data Warehouse Data Bases and some hundred Data Marts Data Bases. The project staff described above chapters consists of much diversity such as age, gender, experience, Nationality, local/offshore, and vender/Customer. They need the common words through the staff. Then, The BI/Analytical focused methodology was ready and applied for this project. This methodology has 10 years history.

This restructuring requires adopting Logical Business Data architecture change, physical source interface file change, Data Item definition change in systems. The business requires re-designing the analytical goal, approach, and detailing condition of analysis. BI/Analytical system development has some special characters on Architecture, Activities planning, Role planning, and schedule planning. Traditional custom application development methodology has not covered the BI type activities, Roles and responsibilities. The methodology established the architecture and related activities, Roles, Scopes and duration/work effort estimation tools.

The methodology provides the BI focused activities such as Business Analysis and Requirements, Data profiling, Data Quality, Extract Transform and Load, Data Modeling, Analytics and Reporting. It also covered common activities such as Solution Architecture, and Project Management. The method provides the R&Rs. Those are Architect, Business analyst, Data integrator, Data modeler, Reporting and Analyst and also it contains common roles of Project manager, Security, and Testing. The method defines the scope. Such as Strategy and planning, Solution Outline, Design, Build Cycle, Test and Deployment. It has standard duration, work effort distribution over the scopes.

Based on the standard method, additional risk was considered. The source system was restructuring simultaneously. The BI/Analytical system shall use upon the source systems/files in general and this was true to this project. The BI/Analytical system development schedule is dependent on the source system development schedule. This is the first risk.

Ongoing source systems restructuring was Big-Bang type. Ordinal big-Bang project schedule tend to be changed in history. If the source system's milestones would change or defer on the course of project, the BI/Analytical milestones shall be inevitably changed. The project plan has to be able to adopt the source system schedule change. The second risk would be huge change control on Design, Build, and Early Testing phase occurred from outside. Ordinal project tried to minimize the change in theory. But the BI/Analytical system had to implement the source system interface file specification changes. This was given condition from the beginning and can't be rejected. The project plan shall take into account of later phase huge CRs. Also financial baseline predicts the huge CRs beforehand.

The third risk is LOB user's communications. LOBs have responsible to restructure their own Analytical program, reports using the new Data Warehouses and DataMart. They shall set the new business goal/objectives and analyze in new data model in Business/System view, From AsIs data to ToBe data relation mapping. The project shall provide that information. These are rather than direct system development activities but are like publication, Education, knowledge sharing and change management. The project shall plan the wide range of communication plan in proper time, proper type of media, and proper group of LOBs.

4.2 Architecture and activities

The method defines total view of whole Application architecture. It consists of eight towers of activities. They are Sources, Content Management, Master data management, Data integration, Data Repositories, Business intelligence, Advanced analytics, and Access. Each tower has five to seven components. Each component has its own tasks and WBSs. This project chose Sources, Data integration, Data Repositories, Business intelligence, and Access. Three towers of Content Management, Master data management, and Advanced analytics are out of scope. The method expands those components into the following groups of activities, i.e., Project Management, Solution Architecture, Business Analysis and Requirements, Data Integration-Data Profiling, DI-Data Quality, DI-Extract Transform Load, Data Repository-Data Modeling and Analytics/Reporting.

4.3 Project Scopes

Scopes are System development life cycle or project phase. It starts from Strategy and Planning, then Solution Outline, Macro Design, Micro Design, Build Cycle, Test and ends at Deployment. The method shows the estimated hours by Activities and by Scopes. It is based on the various system numeric and characteristics.

Table 1 Relative Work Effort by Activities, Scopes

	SP	SO	Design	Build	Test	Deploy
SA	16	16	38	43	16	16
BA&R	6	12	36	25	12	12
DI-DP	1	7	21	10	5	5
DI-DQ	-	-	65	-	-	-
DI-ETL	-	23	114	182	91	45
DM	6	32	162	253	130	65
AR	-	4	33	21	17	8
PM	3	15	90	101	60	30

4.4 Role and responsibilities

The Methods defines the Roles and Responsibilities in this BI/Analytics architecture. They are Project Manager, PMO, Security, Enterprise Solution Architect, Business Analyst, Data Integration Architect, Data Integration Designer, Data Integration Developer, Data Modeler, Data Mapper, Database Administrator, Reporting/Analytics Architect, Reporting/Analytics Developer, Test Manager-BI, Test Manager-DI, Tester-BI, and Tester-DI

Each roles act in various tasks in WBS defined by Activities and Scopes. These roles turn into the staffing plan.

4.5 Duration and staffing plan

The method shows the standard scheduling plan based on start date and end date. It shows the staffing distribution by week, by roles. It shows how many roles are needed in specific scopes or number of weeks. The project plan should adjusted by resource locations. The BI/Analytical centric resources have supplied in specific locations. They have executed the BI/Analytics system development many times and summed up various experience. The project plan shall fully utilize the knowledge, experience and optimize the financial advantage. The industry knowledge focused to the business requirements and BI/Analytical expertize focused the design and build are two consideration of combination.

5. Conclusions

The diversity is inevitable and can be effectively used in project staffing. At 2006 age, diversity occurred in location which is Japan local and Offshore (China). The main diversity is location, Japan and Offshore. At 2016 age, diversity resides in generation, gender, Nationality difference in Japan local location. 10 Years after at 2026. The diversity at internal Japan local will be accelerated. Project has to apply multi stage, much diversity. In that situation, purpose specific but common architecture, methodology is also the important key to diversity team. .

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A Model for Appropriate Allocation of Project Managers to Megaprojects, Case Study: The Iranian Offshore Engineering and Construction (IOEC) Company

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The increasing speed of globalization and expansion of economic activities all over the world has further complicated the management of megaprojects; therefore, in order to compete and succeed, project-oriented companies need to identify appropriate project managers and allocate the competent and skillful managers to high priority megaprojects. The present paper aims at presenting a qualitative model for allocation of project managers to megaprojects, and explaining how the model has been implemented on a real world case study. For this purpose, at the first step, criteria required to rank project managers are identified and a project manager competency model is developed; then, the project managers of the case study are ranked and rated. At the second step, some criteria and indices are identified for rating and ranking the megaprojects, and the projects of the case study are ranked. Finally, a qualitative method for allocation of the project managers to megaprojects is introduced. The case study is the Iranian Offshore Engineering and Construction (IOEC) company, and the method proposed in the present research was implemented for 11 megaprojects and 6 project managers of this company. The results of the study presented in this paper are of interest to practitioners, especially senior managers, who manage project management offices or deal with portfolio and program management.

Keywords and phrases: Project manager's competency, megaproject, portfolio management, program management, IOEC

1. Introduction

The increasing complexity of projects is one of the main causes of the projects' failure in achieving their goals; the projects of energy industries and their processes are among the projects in which such increasing complexity is evident (IEA, 2006). The significant growth of the world's need for energy in the 21st century and, consequently, the increased construction of the infrastructural megaprojects (Kian et al., 2015), as well as the reduced accessible resources for meeting the energy requirements are among the factors that intensify this complexity; so that, based on the reports of the International Energy Agency, the new oil fields must be extracted and exploited under rigid environmental conditions such as deep waters and faraway regions. Extraction and exploitation under rigid conditions would increase uncertainty in projects accomplishment; as a result, the increased uncertainty would result in the increased complexity of projects and, consequently, the increased budget and time schedule of projects (Williams, 1999; Bosch-Rekveldt, 2011). Such projects are mainly known as megaprojects. Megaproject refers to a project with an investment of at least one billion dollar, the main features of which mainly include complexity, costliness, long execution time, and high level of uncertainty (Merrow, 2011; Flyvbjerg, 2003).

According to the reports, the increased complexity of the projects results in the increased failure rate of the megaprojects. A report published by independent project analysis (IPA) on 318 projects in energy sector all over the world indicates an explicit fall down and failure in performance of the megaprojects of energy sector (Merrow, 2012). This report indicates that 78% of the projects are disappointing. On average, the increase in expenses has been observed in 33% of the projects; besides, 64% of these projects have experienced a serious shortcoming in production during the first two years of their production process.

One of the main problems leading to the failure of megaprojects is the inappropriate allocation of the competent and proper managers for successful execution of the projects; hence, the project-oriented companies attempt to select the most competent, the most righteous, the most committed, and the best person for management of the projects. The appropriate selection of the managers would reduce the probability of failure in projects.

In order to increase success of the projects, the experts of management suggest the competency-based management of the human resources that emphasizes on the individuals' behavior. In order for an organization to execute the competency-based approach for the human resources, initially the competencies should be determined and then a model, which can describe all of these competencies, should be developed (Cochran, 2009).

The idea of competency was first introduced to the human resources literature by David McClelland in 1970s; in a research conducted for the United States Intelligence Agency, he perceived that competencies such as interpersonal sensitivity, positive intercultural considerations, and management skills differ among superior and ordinary intelligence officers (McClelland, 1973). Competency has a wide concept, and thus various definitions have been introduced for it so far. Draganidis and Mentzas (2006) defined competency as a combination of knowledge, behavior, and explicit and implicit skills, which give the individual the potential for effective accomplishment of duties.

In the past decades, the performance competency-based standards have been widely used instead of the knowledge-based competencies as a basis for evaluating the managers' competency (Webster, 2004; Crawford, 2005). These standards include: project manager competency development (PMCD) framework (PMI, 2002) published by project management institute (PMI, 2000), which is based on the project management knowledge, Australian national standard for project management mompetency (Australian Institute of Project Management, 1996) compiled by Australian national institute of project management, and IPMA competence baseline (ICB) presented by IPMA, which presents and clarifies the project managers' success in three main domains, including specialized, behavioral, and conceptual competency, under 46 indices (IPMA, 2006).

In addition to the standards, several articles have investigated and classified the criteria required for examining the managers' competency for management in various industries. Wickramasinghe and De Zoyza (2008) classified managers' competency in three knowledge-based, skill-based, and value-based domains. Young and Dulewicz (2009) introduced four domains of perceptual, aligning, interactive, and success-creating competency for the British Royal Navy. Fang et al. (2010) considered the competency indices, including personality, programming, management, professional ability, and interpersonal ability, as components of the managers' competency model. Muller and Turner (2010) recognized the three components of intellectual, managerial, and emotional competency as components of the managers' competency. Zopiatis (2010) introduced the technical, perceptual, interpersonal, executive, leadership, and managerial competencies as the main components for investigating the managers' competency.

The present paper aims at presenting a qualitative model for allocation of project managers to megaprojects, and explaining how the model has been implemented on a real world case study. For this purpose, at the first step, criteria required to rank project managers are identified and a project manager competency model is developed; then, the project managers of the case study are ranked and rated.

After rating and ranking the project managers, in order to reduce the projects failure and maximize the use of higher-level managers' potential, it is necessary to allocate the managers of higher level and higher rank to the projects with higher level and rank; therefore, besides the project managers, projects must be ranked and rated as well. On this basis, in the present study, some criteria will be also identified for rating and ranking the projects, and then these criteria will be demonstrated in a conceptual model. Finally, a qualitative method for allocation of the project managers to megaprojects is introduced.

In short, the objective and innovation of the present research can be presented as follows: 1) identifying the dimensions of megaproject managers' competency in order to qualify the project management and ranking the megaproject managers, 2) identifying the indices of ranking and rating the megaprojects, and finally rating and ranking them, 3) allocating the appropriate project managers to the rated megaprojects. Additionally, the methodology presented in this study has been implemented in IOEC Company, which is one of the largest public contractor companies in the field of constructing and installing the offshore structures of oil and gas industries in Iran. It must be noted that the projects of this company are mostly megaprojects, and it is the first time that the case study of this problem is published as an article.

2. Qualitative method for allocating project managers to megaprojects

Allocating the project managers to megaprojects requires clear and specified indices, which facilitate ranking and rating them. For this purpose, at the first step, components of the megaproject managers' competency model will be identified, and then the megaproject managers will be ranked and rated. At the second step, the criteria and indices required for ranking and rating the megaprojects will be identified, and finally, with regard to the level of the project and megaproject managers, a methodology will be introduced for allocating the project managers to megaprojects.

2.1 Project managers ranking method

Progress of any project is directly related to its manager's capability for successful implementation of the project in accordance with the program compiled for it; thus, it is necessary to evaluate and rate the managers of each project according to their background and previous cases, quantity and quality of the executed work, as well as problems and difficulties of the project during its execution. In this regard, it is essential to develop indices and then rate and rank the project managers in accordance with these indices.

2.1.1 Developing project managers' competency model

Modeling the competencies can be accomplished through one of the three following methods: adopting from the existing models, adopting from the models and modifying them, and designing a new model based on the organization's features. In the present study, the third approach was used for designing the competency model and, eventually, for ranking and rating.

The model's indices were collected and developed using text-study methods (library studies, articles published in scientific journals, published governmental documents, articles presented in seminars, conferences, and scientific speeches, utilizing internet technology, and using foreign scientific sites) and interviews with managers. After identifying and collecting the appropriate and key indices for management of megaprojects, these indices were reviewed several sessions with the project managers and experts. Finally, the identified and confirmed competency indices can be defined in three levels: the first level is comprised of three general domains, including technical, managerial, and individual domains. The second level is comprised of six dimensions, including general knowledge, specialized knowledge, human resources management, proper administration of project, and intrapersonal and interpersonal dimensions. Finally, the third level includes 24 sub-indices of the project managers' competency. Figure 1 demonstrates the conceptual model of the project managers' ranking indices.

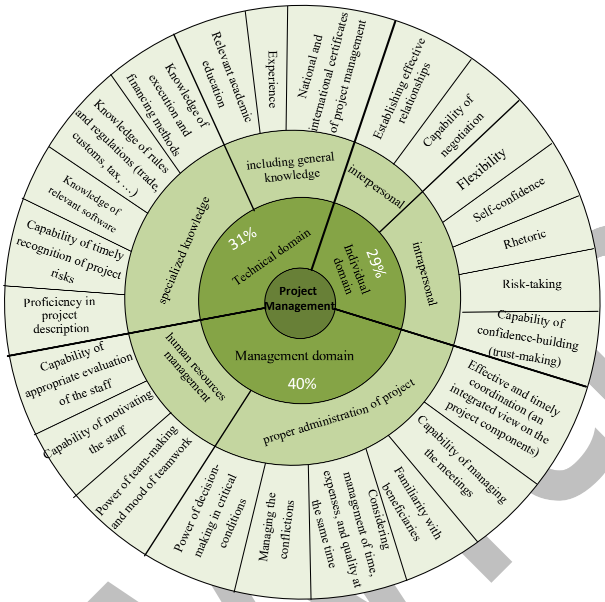

Figure 1 Conceptual model of indices for ranking the project managers

In Figure 1, competencies of the technical domain include the knowledge required for management of megaprojects. Competencies of the management domain are related to the managers' duties in terms of proper administration of the project as well as proper management of the human resources. Finally, the individual competencies are related to the personal characteristics of the manager as well as his/her relations.

2.1.2 Project managers ranking method

After identifying the indices of the project managers' competency, the next step is to determine the scores and importance coefficient of each index. Similar to the projects ranking, first, a questionnaire is distributed among the experts; then, after collecting the questionnaires, in order to examine the level of agreement between the experts' opinions in terms of the importance coefficient of the indices, the intraclass correlation coefficient (ICC) is calculated for each index. In the present research, due to the suitable value of Chronbach alpha, the mean method was used for aggregating the experts' opinions. Furthermore, the score range of the indices was determined in such a way that a score of 1 to 9 was allocated to each index. Table 1 represents the score and importance coefficient of each index.

In order to determine score and level of the project managers, first, the total weight of the scores is calculated for each manager; then, based on the obtained score and based on Figure 2, which shows the score range required by project managers to be rated at levels A, B, C, and D, level of each manager is specified. It must be noted that the project manager should acquire at least 40% of the maximum total score of the three technical, individual, and managerial domains; thus, the project manager should obtain scores of at least 86, 111, and 83 in technical, individual, and managerial domains, respectively.

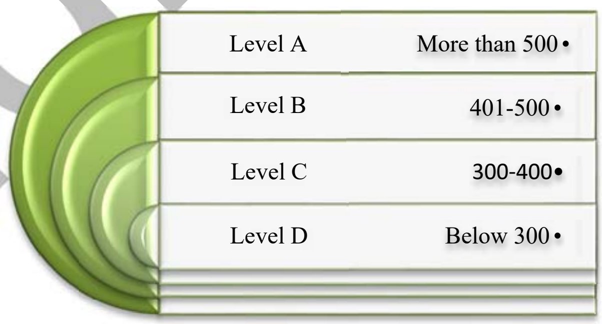

Figure 2 Score range for ranking the project management

2.2 Megaprojects ranking methodology

In this section, first, the indices of ranking the megaprojects will be presented; then, with regard to the presented indices, the approach of ranking and rating the megaprojects will be introduced.

2.2.1 Determining the indices of megaprojects ranking

The project ranking indices were collected though library study methods, articles published in scientific journals, published governmental documents, articles presented in seminars, conferences, and scientific speeches, internet, scientific databases, as well as interviews with managers. After identifying and collecting the appropriate and key indices for rating and ranking the megaprojects, these indices were reviewed and modified in a session with some of the project managers and experts. Finally, 18 indices were considered in four main domains of strategy, magnitude, complexity, and risks of the project, which should be calculated and analyzed during project evaluation. Figure 3 shows the conceptual model of the megaproject ranking indices.

2.2.2 Megaprojects ranking methodology

After identifying the major and key indices of megaprojects, the next step is to determine the score and importance coefficient of each index. Score and importance coefficients of the criteria can be commonly changed with regard to the changes in the range of the megaproject activities; so that, any company can have a wide range of different scores and importance coefficients with in accordance with its range of activities. In order to determine the importance coefficient of each index, a questionnaire was given to the experts. After collecting the questionnaire, in order to investigate the level of agreement among the experts' opinions on the importance coefficient of the indices, the ICC coefficient was calculated for each index. The obtained results showed a good value for Chronbach Alpha, which indicated that there was a good agreement and correlation among the experts' opinions. With respect to the good agreement among the experts' opinions, the mean method was used to aggregate the experts' opinions in the present research. Furthermore, the score range of the indices was determined in such a way that a score of 1 to 9 was allocated to each index. Table 2 represents the score and importance coefficient of each criterion.

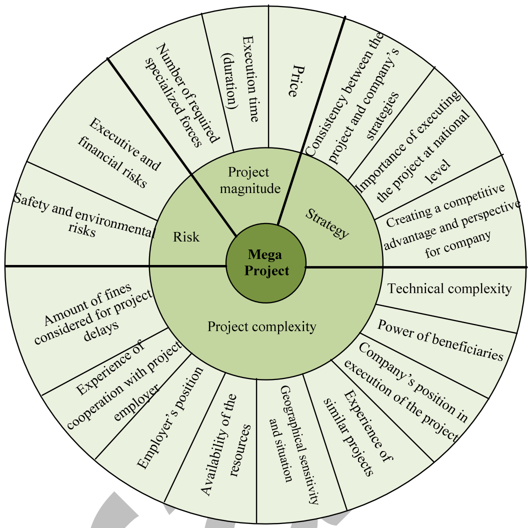

Figure 3: Conceptual model of megaproject indices

Table 1: Scores and importance coefficients of the project managers ranking indices

	Indices	importance coefficients	Score 1-3	4-6	7-9
Technical domain	Experience	5	Below 10 year	10- 20 year	upper 20 year
	National and international certificates of project management	2	National	-	International
	Relevant academic education	3	Bachelor	Master	Doctoral
	Knowledge of execution and financing methods	3	low familiarity	Medium familiarity	High familiarity
	Knowledge of rules and regulations (trade, customs, tax, …)	2	Low	Medium	High
	Knowledge of relevant software	2	low familiarity	Medium familiarity	High familiarity
	Capability of timely recognition of project risks	3	Low	Medium	High
	Proficiency in project description	4	Low recognition	Medium recognition	High recognition
Management	Capability of appropriate evaluation of the staff	3	Low	Medium	High
	Capability of motivating the staff	4	Low	Medium	High
	Power of team-making and mood of teamwork	4	Low	Medium	High
	Power of decision-making in critical conditions	5	Low	Medium	High
	Managing the conflictions	3	Weak	Medium	Good
	Considering management of time, expenses, and quality at the same time	4	Weak	Medium	Good
	Familiarity with beneficiaries	3	Low	Medium	High
	Capability of managing the meetings	2	Low	Medium	High
	Effective and timely coordination (an integrated view on the project components)	3	Weak	Medium	Good
	Capability of confidence-building (trust-making)	3	Low	Medium	High
Individual domain	Risk-taking	3	Low	Medium	High
	Rhetoric	3	Low	Medium	High
	Self-confidence	2	Low	Medium	High
	Flexibility	3	Low	Medium	High
	Capability of negotiation	4	Low	Medium	High
	Establishing effective relationships	5	Low	Medium	High

Table 2: Scores and importance coefficients of megaproject indices

	Indices	importance coefficients	Score 1	3	5	7	9
Strateg…	Consistency between the project and company's strategies	2	Low consistency		Medium consistency		High consistency

	Importance of executing the project at national level	2	Low		Medium		High
	Creating a competitive advantage and perspective for company	3	Low		Medium		High
Project magnitude	Price	5	Below $100 million	$100- 200 million	$200- 500 million	$500- 1000 million	More than $1000 million
	Execution time (duration)	4	Less than 1 year	1-2 year	2-3 year	3-4 year	more than 4 year
	Number of required specialized forces	4	Less than 10% of total employee	10-20% of total employee	20-30% of total employee	30-40% of total employee	More than 40% of total employee
Project complexity	Technical complexity	3	Project technology is available				Project technology is not available
	Power of beneficiaries	2	Weak		Medium		High
	Company's position in execution of the project	1	Small contractor				General contractor
	Experience of similar projects	3	A lot of experience		Almost similar to past experiences		Completely new project
	Geographical sensitivity and situation	2	Inside the country with low sensitivity		Inside the country with High sensitivity		Internationality
	Availability of the resources	3	Easy availability				Limited Availability
	Employer's position	2	A company with country reputation		A company with regional reputation		A company with international reputation
	Experience of cooperation with project employer	1	More than one time Experience				one time Experience
	Amount of fines considered for project delays	2	Less than 5%	5-10%	10-15%	15-20%	More than 20%
Risk	Executive and financial risks	3	Very low	Low	Medium	High	Very high
	Safety and environmental risks	2	Very low	Low	Medium	High	Very high

The next steps for determining the score and rank of the projects are as follows:

1. Importance coefficient of each index in the relevant score.
2. Summing the scores of all the indices calculated in step 1.
3. Determining the project level with regard to the scores obtained in step 2 as well as the score range for ranking the projects, as shown in Figure 4.

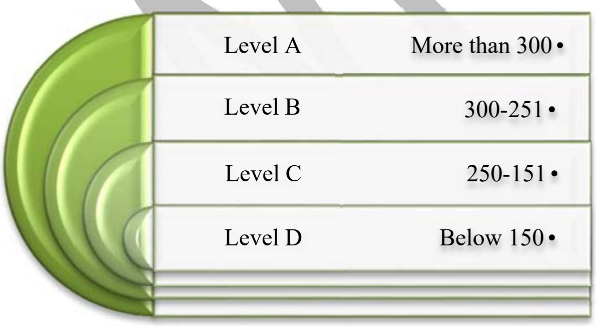

Figure 4: Score range for ranking the megaproject

2.3 Model of allocating megaproject managers based on the projects' ranks

After determining the rank of the projects and project managers, the final step is to select the appropriate manager for the project. In order for proper allocation of the project to the project managers, the conceptual model presented in Figure 5 has utilized.

As seen in Figure 5, increasing the score of project managers would make it possible to allocate the project with higher level to the project manager. For instance, a project manager with score of 500 will be capable to be allocated to all the megaprojects of the company.

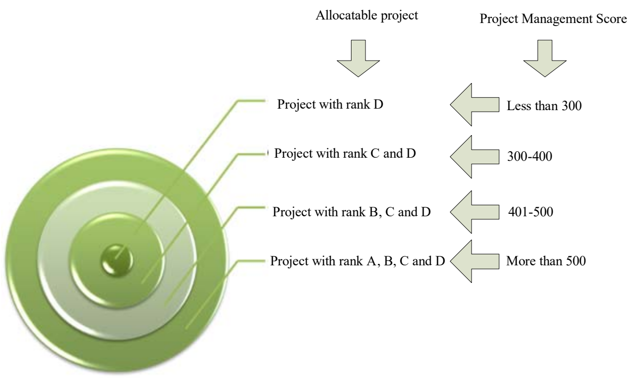

Figure 5: Conceptual model of allocating the managers to projects

3. Case study

The IOEC Company is one of the largest and most experienced engineering contractors in the field of purchasing, constructing, and installing the equipment in Iran, which is active in the offshore megaprojects such as construction, pre-installation, implementation, transportation, and installation of the jackets, gas and oil platforms, as well as piping operations on the seabed. Constructing and installing the gas platforms in the phases 4, 5, 12, and 14-21 of South Pars gas field, piping of the phases 1, 12, and 22 and between the phases 15 and 16 of South Pars field, engineering of the Oman-Iran pipeline, constructing the platforms of Abouzar and Forouzan oil fields, and so on, are among the most important megaprojects of this company. The identified indices as well as the presented methodology in this study will be implemented for ranking and rating the megaprojects and project managers of the company.

3.1 Megaprojects ranking results

Table 3 represents the current megaprojects of the IOEC company, which are to be ranked and rated in the present paper.

Table 3: Current megaprojects of the company

Megaproject	Location
Phase 12- Platform	South Pars gas field
Phase 12- Piping	South Pars gas field
Phase 14- Piping	South Pars gas field
Phase 14- Drilling	South Pars gas field
Phase 15-16- Piping	South Pars gas field
Phase 17-18- Platform	South Pars gas field
Phase 19- Platform	South Pars gas field
Phase 20-21- Platform	South Pars gas field
Phase 22- Platform	South Pars gas field
Forouzan	Forouzan oil field
Oman-Iran pipeline	-

In order to rank and rate the projects, a questionnaire was given to the experts in accordance with Table 2. After aggregating the opinions of the experts, each project was rated using Figure 2. Table 4 shows the rank and score of each of the company's megaprojects.

Table 4: Score and rank of each megaproject

Megaproject	Score	Rank
Phase 12- Platform	301	A
Phase 12- Piping	280	B
Phase 14- Piping	250	C
Phase 14- Drilling	323	A
Phase 15-16- Piping	249	C
Phase 17-18- Platform	306	A
Phase 19- Platform	306	A
Phase 20-21- Platform	304	A
Phase 22- Platform	284	C
Forouzan	230	B
Oman-Iran pipeline	150	D

As seen in Table 4, out of 11 megaprojects of the company, 5, 2, 3, and 1 companies are at levels A, B, C and D, respectively; therefore, in order for appropriate allocation of these projects to the managers, at least 5, 2, 3, and 1 project manager are required at levels A, B, C, and D, respectively. In order to validate the scores resulted from the methodology of the present study, the qualitative viewpoints of the experts on each project was collected using a questionnaire. Regarding the nature of the activities of the company's megaprojects, the individuals outside the organization would not have sufficient cognition and knowledge of the projects and, consequently, they would not be competent for validating the results of the presented methodology. Therefore, the experts inside the organization were asked to validate the methodology results. The selected experts included the highest-level authorities within the organization, megaprojects managers, and headquarter managers, who had sufficient knowledge, experience, and cognition about the projects.

Figure 6 shows the results obtained from the presented model and the experts' opinions. As seen in Figure 6, out of 11 projects, the qualitative viewpoints of the experts differed from the results obtained from executing the ranking model only in two projects of the phase 12 of the platform deck and phases 20-21. In other words, 82% of the results obtained from the presented model are the same as the experts' viewpoints. It is noted that the resulted differences are not very significant.

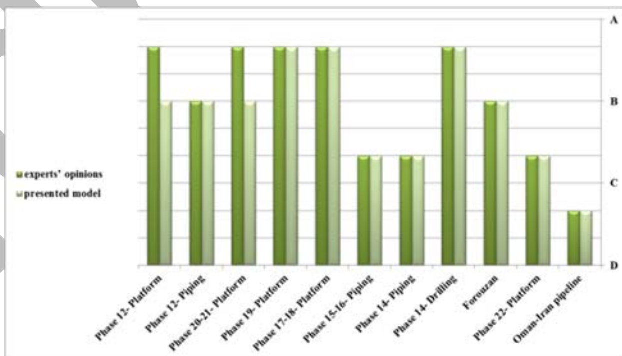

Figure 6: Comparing the results of presented methodology with experts' qualitative viewpoints

3.2 Project managers ranking results

In order to rank and rate the project managers, 6 project managers of the company (named as project manager 1 to 6) were selected; then, in order to determine the score of each manager, a questionnaire was given to the company's experts in accordance with Table 1. Table 5 represents the rank and score of each project manager of the company.

Table 5: Score and rank of each project manager

Project management	Score	Rank
Project management No. 5	478	B
Project management No. 3	440	B
Project management No. 2	437	B
Project management No. 1	353	C
Project management No. 4	342	C
Project management No. 6	339	C

3.3 Allocation results

Table 6 indicates allocation of the project managers to megaprojects. As indicated by Table 6, since no project manager couldn't acquire level A, the megaprojects of level A (12 deck, 14 drilling, phases 17-18, phase 19, and phases 20-21) were not allocated to any of the managers.

As indicated by Table 6, the megaprojects of level A were not allocated to any of the project managers, which was due to the lack of managers of level A in the company. In order to overcome the problem, the company required to recruit and employ powerful and level-A managers. In case of impossibility of recruiting the level-A project managers, the company is obliged to apply managers of lower level for level-A megaprojects, which would result in some problems for implementing the projects.

Table 6: allocation of the project managers to megaprojects

Megaproject	Project management number					
	1	2	3	4	5	6
Phase 12- Platform						
Phase 12- Piping		×	×		×	
Phase 14- Piping	×	×	×	×	×	×
Phase 14- Drilling						
Phase 15-16- Piping	×			×		×
Phase 17-18- Platform						
Phase 19- Platform						
Phase 20-21- Platform						
Phase 22- Platform						
Forouzan		×	×		×	
Oman-Iran pipeline	×	×	×	×	×	×

4. Conclusion

Inappropriate allocation of competent managers for management of the megaprojects is one of the major causes of failure in megaprojects. Therefore, in the present study, first, the megaproject managers' competency model was identified; then, with regard to the identified indices, an approach was presented for ranking and rating project managers. The competency indices identified and approved for rating and ranking the project managers can be defined at three levels: the first level is comprised of three main domains, including technical, managerial, and individual domains. The second level consists of six dimensions, including general knowledge, specialized knowledge, human resources management, proper administration of project, intrapersonal, and interpersonal. And finally, the third level of the model included 24 sub-indices of the project managers' competency. In order to reduce the projects failure and maximize the use of higher-level managers' potential, it is necessary to allocate the managers of higher level and higher rank to the projects with higher level and rank. To allocate managers with higher level and capability to more complex projects, 18 indices and criteria were identified in four main domains of strategy, magnitude, complexity, and risks for ranking and rating the megaprojects. Finally, the method and approach of allocating the project managers to megaprojects was described. The main advantage of the presented method is that it takes into consideration all the major indices for ranking and rating the megaprojects and project managers. In the common methods of ranking, such as DEA (data envelop analysis) and AHP (analytical hierarchy process), it is usually impossible to consider all indices. For example, in DEA, regarding its mathematical nature, commonly 5 to 8 indices are considered; while, in AHP, regarding the necessity of dual investigation of consistency of the indices that is time-consuming, only a limited number of the indices are taken into account. The purposed model focused on presenting indices for megaproject managers', where as existing PM competency model focused on general managers' indices.

In order to demonstrate efficiency of the presented method, the model was implemented in 11 megaprojects of the IOEC Company, the results of which indicated that out of 11 megaprojects of the company, 5, 2, 3, and 1 projects were at levels A, B, C, and D, respectively. The obtained results were consistent with the experts' viewpoints on rank and level of the project. The results obtained from rating the managers indicated that out of 6 investigated project managers, 3 were at level A, and the remaining managers were at level B.

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Method of Using "Carrot-and-Stick" for Project-Recovery Role-Sharing between "PM's Powerful Leadership" and "PMO's Followership and Servant Leadership"

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I participated in the two failed projects in the Project Management Office (PMO) of rescue team. I will explain the features and usefulness of the method of using "carrot-and-stick" role sharing between the powerful leadership of the PM and the followership and servant leadership of the PMO gained from rescue work. At early stages of projects recovery, there are two problems that affect the success and failure of rescue. One is a shortage of personnel in the leader class, and the other one is building a relationship of trust in a scratch team. I applied followership and servant leadership as the "carrot". I think that this will be necessary for project management from now on. It will be important not only for projects to succeed but also for growth and happiness for all.

Keywords and phrases: Powerful Leadership, Followership, Servant Leadership

1. Introduction

It has been said that 70 percent of information-systems development-projects have failed (Kawamura and Takano, 2014). For IT vendor companies, failed projects may sometimes seriously impact corporate management. Avoiding project failure and quickly recovering projects are big management issues.

I participated in two failed projects in a Project Management Office (PMO) on a rescue team (Figure 1). I will explain the features and usefulness of the method of using "carrot-and-stick" role sharing between the powerful leadership of the project manager (PM) and the PMO's followership and servant leadership gained from rescue work.

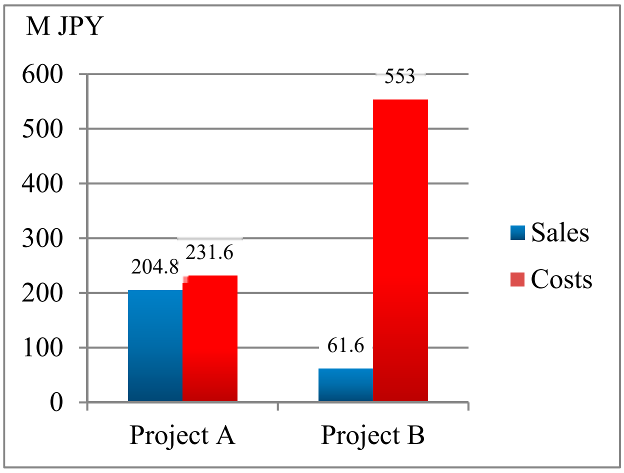


Figure 1 Failed projects

2. Serious problems to be resolved urgently

At the early stages of project recovery, there were serious problems that affected the success and failure of the rescue. These problems were caused by adding a large number of personnel for the rescue. One problem was that there was a shortage of personnel in the leader class, and the other was building a relationship of trust with the scratch team.

2.1 Shortage of personnel in leader class

The shortage of personnel in the leader class made it difficult to immediately and accurately understand the situations of the team. Therefore, the PM could not correctly judge a situation in the face of trouble, and this delayed project recovery.

In the two failed projects, most of the added personnel were developers and testers (Figure 2), and in the testing phase, there were few personnel in the leader class who could create their own progress and bug curves. Thus, the shortage of personnel in the leader class was, without exception, tangible.

2.2 Building relationship of trust with scratch team

Unless the problem of building a relationship of trust with the scratch team is solved, additional personnel cannot have a discussion with anyone, they have to work while being dissatisfied, and it is difficult for them to fully demonstrate their abilities.

In the two failed projects, after the rescue team participated, we added a large number of personnel who were scraped together from multinational teams (Figure 3). It was urgent to build a relationship of trust with this scratch team.

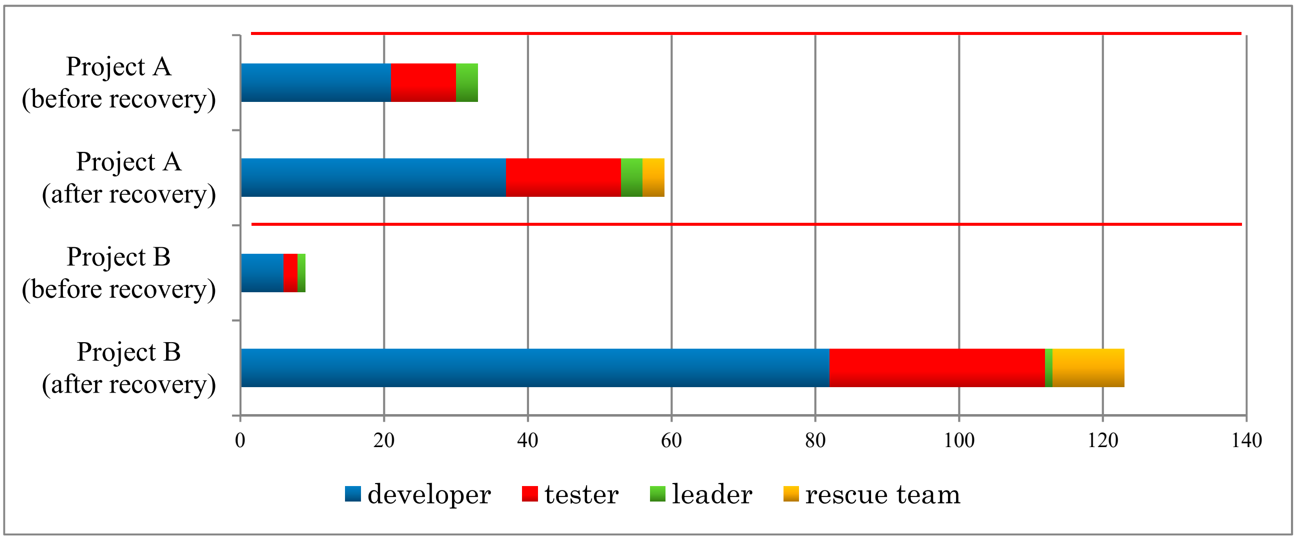


Figure 2 Adding a large number of personnel

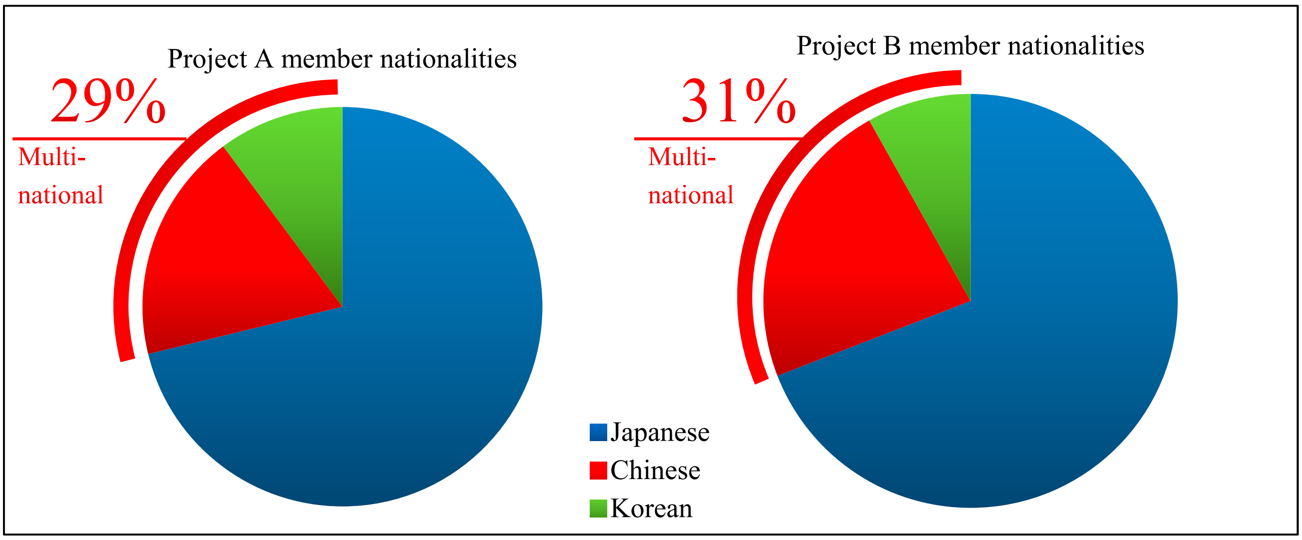


Figure 3 Member nationalities

3. Applying carrot-and-stick

As a solution to these serious problems, I applied the method of using "carrot-and-stick" role sharing between the powerful leadership of the PM and the PMO's followership and servant leadership.

3.1 Followership

"Followership" refers to a role held by certain individuals on a team. It is the capacity of an individual to actively follow a leader. Effective followers are individuals who are considered to be enthusiastic, intelligent, ambitious, and self-reliant. It differs from blind obedience.

Kelly's research shows that followers contribute 80 percent of the work in an organization, and leaders contribute only 20 percent (Kelly, 1992) (Figure 4).

The failed projects were the result of the projects proceeding in the wrong direction for various reasons. To quickly rescue projects from failure, the PM has to demonstrate powerful leadership to divert a scratch team from the wrong direction to the correct one.

However, this powerful leadership causes serious conflict. In particular, if the team consists of personnel without leadership experience, it is difficult for them to draw out the intentions of the PM, they focus only on the PM's strong forcefulness, causing them to shrink from fear, and they cannot understand policies and instructions correctly, causing a backlash, in the end, some personnel cannot honestly accept instructions from the PM.

Drucker mentions that "Organizations have to have values. But so do people. To be effective in an organization, one's own values must be compatible with the organization's values. They do not need to be the same. But they must be close enough so that they can coexist" (Drucker, 1992).

However, because their own values differ, it is difficult for personnel under powerful leadership to coexist with the PM's values.

As I already mentioned, to quickly rescue projects from failure, the PM has to demonstrate powerful leadership. Therefore, a key point is how the values of the personnel can coexist under this leadership.

In such cases, "followership" is an effective solution. Sivers said, "If you really care about starting a movement, have the courage to follow and show others how to follow. And when you find a lone nut doing something great, have the guts to be the first one to stand up and join in" (Sivers, 2010).

Divide the PM's policy and instructions into units that the members can work on. Sometimes, take the initiative to follow the PM's instructions and become a model for members of how to work. To move a large number of personnel exactly as desired, especially when there are a lot of personnel who do not have leadership experience, what is important is not only powerful leadership but also subjective followership.

3.2 Servant leadership

Servant leadership is at the opposite end of powerful leadership.

Greenleaf mentions that "The servant-leader is servant first ...It begins with the natural feeling that one wants to serve, to serve first. Then conscious choice brings one to aspire to lead. That person is sharply different from one who is leader first, perhaps because of the need to assuage an unusual power drive or to acquire material possessions..." (Greenleaf, 1991).

Powerful leadership is like that of the captain of a ship facing stormy waves. Saving the lives of the crew requires instantaneous judgment and execution power. A delay in judgment could lead to death, so the leader needs power.

In comparison, servant leadership is like that of the manager of a professional sports team. The most important thing for team victory is that each of the athletes exerts the best performance. The manager decides the policy and strategy, but during the game, instantaneous judgments are made by the athletes, not by the manager. The manager will support the athletes in demonstrating their best performance.

Drucker mentions that "Most people work with other people and are effective through other people. To be effective, one therefore has to know the strengths, the performance modes and the values of the people one works with" (Drucker, 1992).

However, in a scratch team, it is difficult to know each other's strengths, performance modes, and values. In particular, when there are a large number of personnel who cannot speak Japanese, the first step of becoming interested in each other is very hard.

In such a case, servant leadership is an effective solution. Servant leadership is always on the mind of whether a member of the team has a trivial problem or not. Even if a member has no problem, it becomes the first step of becoming interested in each other, which will lead to increased trust between members.

This servant leadership is recognized as "Leadership 3.0" in Japan (Table 1).

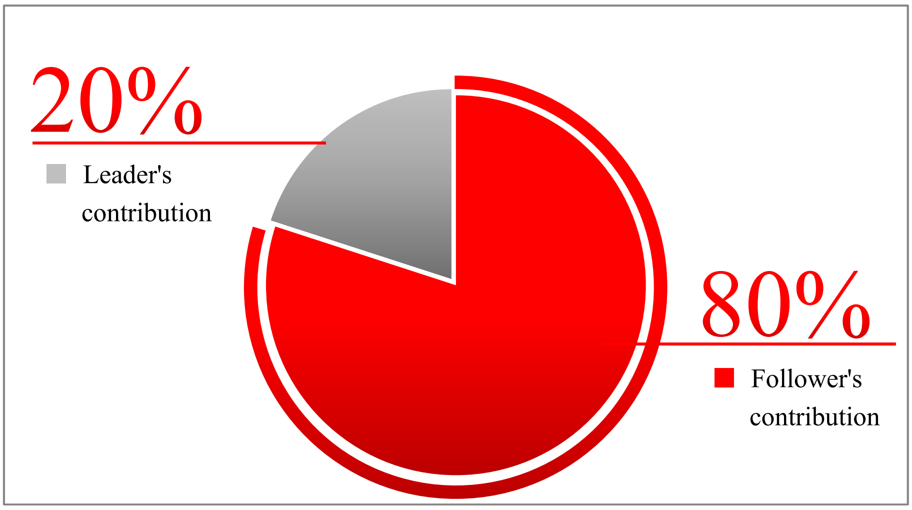
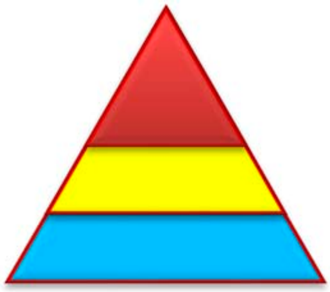
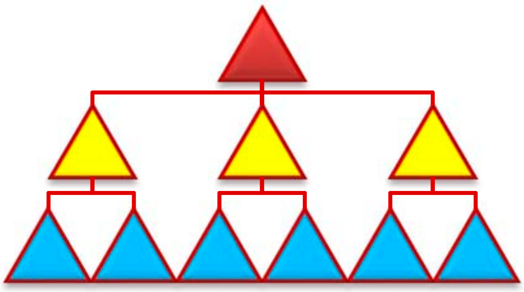
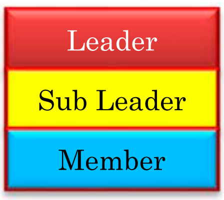


Figure 4 Contribution of leader and follower

Table 1 Kind of the Leadership

Version	Outline	Organization Chart
Leadership 1.0	Power <Centralization> The person with power stands at the top of the pyramid and dominates the organization centrally. The disadvantage is that it is impossible to respond to the diversifying demands of users because there is only one person to give instruction.	
Leadership 1.1	Power <Decentralization> Responsible people are put under the person with power to delegate authority and control the organization. The disadvantage is that an obstructive longitudinal society is built, and the relationship between parts of organizations worsens.	
Leadership 2.0	Charisma The direction of an organization is boldly transformed, encourage competition and learning. The person with power is called charismatic manager. The disadvantage is there is a strong tendency to rely on the charisma of the charismatic manager, so the speed of decision making is slow.	
Leadership 3.0	Benefactor The person with power stands at the bottom of the inverse pyramid and supports organization. Missions and visions are shared, and community awareness is cultivated. The independence of the individuals is extracted.	

Legend



4. Verification

In this chapter, the result of applying the carrot-and-stick method to recover from project failure is reported.

4.1 Followership

In the two failed projects, the PM used a somewhat strong-arm method to recover from project failure. He sometimes punished those who could not understand his policies as a warning to others. For example, the PM scolded members who were late for a meeting and refused to review low-level material submitted from members. Although the PM wanted to increase the member's efforts for quickly recovering projects, but member's motivation decreased day by day (Figure 5).

I applied followership as the "carrot". I divided the PM's policy and instructions into units that the members could work on. Before a meeting started, I would take members to the meeting room and participate in the meeting. I would explain to them how to make readable material, and I would sometimes share my voice as if I were a member who was explaining a troublesome situation.

In the other situation, on behalf of the four sub-leaders of the test team, who do not have leadership experience, I created tools to automatically generate their progress and bug curves from test items and explained how to use the tools over and over again.

As a result, personnel who do not have leadership experience came to imitate me, could understand policies and instructions correctly, began to understand the purpose behind the PM's strong forcefulness little by little, transformed into followers one by one, and autonomously contributed more and more day by day. The PM was able to understand the exact situation of the team immediately, and it became possible to correctly judge situations in the face of trouble. At the same time, the members who were in charge of the sub-leaders were able to learn how to use the progress and bug curves with OJT, and they could create their own in the following test phase.

4.2 Servant leadership

In the two failed projects, there were many international members such as from China and South Korea among the increasing number of personnel. Because they were not good at Japanese, they were apt to gather together with those of the same nationality, forming an invisible wall in the team. When they had a problem, they tried to solve it amongst themselves. This often caused the problem to get worse, which required a serious amount of extra work to reverse.

Therefore, I applied servant leadership as the "carrot". First, I started greeting members with "good morning" in their mother tongues. I always paid attention as to whether they had a trivial problem, and, fortunately, I can speak Chinese well, so I built a relationship by going to the seats of members and making small talk with them, such as about a delicious lunch restaurant in the vicinity.

As a result, they came to see me as someone who understood them and began to consult with me about trivial problems they had.

I solved each problem one by one. While they were just trivial, small things, resolving each one for each member one by one made them think "if I was in trouble that would be someone who I could easily go to for advice." Therefore, they gained a sense of security that enabled them to perform their best (Figure 6).

Figure 5 Conflict

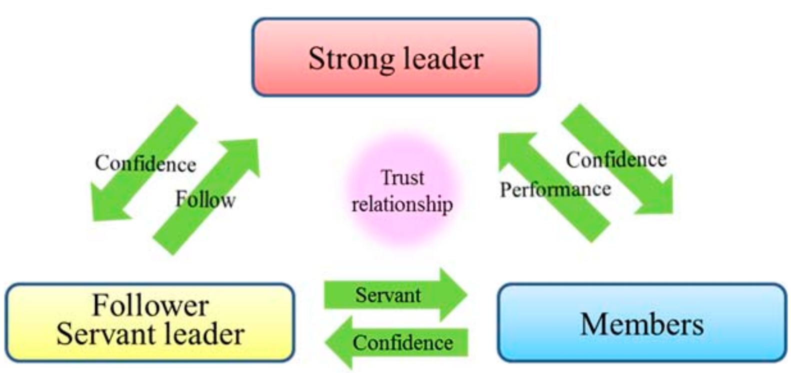


Figure6 Trust Relationship with team

5. Conclusion

Generally speaking, there are several roles when PMO support projects closely. One role is to check whether project management is appropriate from the viewpoint of a third party. Other one is to apply the defined methods, standards and tools to projects. These roles are very useful when PMO participates in the projects from the beginning, but if PMO participates in the failed projects in the middle, these roles may force personnel to an excessive burden.

Project failure seriously impacts not only corporate management but also the mind and body of personnel.

For everyone to be happy, the best strategy is perfectly avoiding all project failures. However, 70 percent of information-systems development-projects inevitably have failed (Kawamura and Takano, 2014). Therefore how a failed project is recovered becomes important.

While powerful leadership has become a little obsolete, when faced with a project that has failed, it is indispensable for recovering the project. Because a delay in judgment seriously impacts corporate management, if powerful leadership did not exist, management would not be happy.

In such case, PMO should take the lead to use "carrot". Role sharing between the powerful leadership of the PM and the followership and servant leadership of the PMO creates a strong synergistic effect, compensating for weaknesses and extending strengths.

I think that followership and servant leadership will be necessary for project management from now on. I hope that companies focus efforts on fostering followership and servant leadership.

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Predicting the timing of delivering major project deliverables
Case Study: The Iranian Offshore Engineering and Construction Company (IOEC)

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Forecasting the project completion time and also the timing when major deliverables of a project will be delivered, is extremely valuable to project managers and senior managers in project-oriented owner and contractor companies. Various methods exist for prediction: from deterministic or stochastic scheduling practices to earned value projection curves. The present paper, aims at presenting a different approach: a heuristic method for predicting the timing of delivering major project deliverables in megaprojects. At the outset, the paper classifies the articles dealing with forecasting project duration based on the source of data which can be used for predicting major milestones. Then a new heuristic estimation method is suggested which uses the past similar projects and project progress curve. The paper then describes how the heuristic forecasting method was applied to real world offshore oil and gas megaprojects of the Iranian Offshore Engineering and Construction (IOEC) Company and Finally, the predictions are compared with the actual outcomes. The results show that the heuristic prediction method has been acceptably valid. The results of the study presented in this paper are of interest to practitioners, especially project managers and senior managers, who manage projects and project management offices, or deal with portfolio and program management.

Keywords and Phrases: Heuristic forecasting, Completion time, Project deliverables, Project milestones, Planning fallacies, Past records, Project duration, Oil and gas mega projects, IOEC

1. Introduction

Forecasting the duration of a project or the timing of major milestones has been always one of the topics of interest in project management research. There are various methods to estimate completion time from observational and statistical methods to computerized analysis and artificial intelligence (Williems and Vanhoucke 2015), most of which use current project's history to either deterministically or stochastically predict the timing of delivering deliverables and meeting milestones.

A deterministic approach leads to point estimates. Only if the output of a methodology is deterministic, the methodology would be considered deterministic, regardless of its input (Batselier and Vanhoucke 2015), while the stochastic approach estimates the final points based on probability. Deterministic methods, however, are more widely used because they are simpler to apply (Barraza et al. 2004).

The research described in this paper, which rests in deterministic category, has the objective of developing a heuristic method to predict duration based on similar completed projects, while most other studies of forecasting duration , apply the ongoing project records. Advantages of the method presented herein are its simplicity and practicality. In addition, the results of the case study explained in this paper indicate an acceptable level of accuracy. Therefore, despite the uncertainties involved in any project, which render each project unique, similar projects found helping to predict the duration of the specific project in hand.

The remaining parts of this paper first review some prediction methods in the literature, suggesting a new classification of the methodologies used for prediction. The next section then introduces the suggested method in details as well as fallacies that could prohibit good prediction and planning. Finally, a case study is presented in which the method presented herein is implemented followed by the results and conclusion.

2. Forecasting methods

Vandevoorde and Vanhoucke (2006) classified and compared project duration forecasting methods, which apply earned value metrics, including the planned value method, the earned schedule method and the earned duration method, arguing that the earned schedule method is the most reliable method to predict the project duration, especially as the final stages of the projects are approached.

The planned value method, introduced by Anbari (2003), applies the planned value rate which is equal to the average planned value per time period. This method has being widely used to estimate the cost and to a lesser degree the duration time of the projects. The earned duration method, introduced by Jacob (2003), is defined as the product of the actual duration and the schedule. Both planned value and earned duration method rely on schedule performance indicator (SPI) to forecast the duration. Lipke (2003) criticized these methods and introduced the earned schedule method to overcome the drawbacks of those two methods, arguing that earned schedule lead to improved forecasting (Lipke 2006)

Furthermore, The Bayesian Adaptive Forecasting (BAF) method, a technique to predict the duration of a project, apply the expert's knowledge to determine a project's characteristics as well as the project's S-curve (Kim and Reinschmidt 2009). In another study, Caron et al. (2013) put forth a method based on BAF to combine the records from the current project data and the implicit knowledge of experts to forecast the duration of a project.

Classifying the articles on project control and earned value management (EVM) comprehensively, Willems and Vanhoucke (2015) showed there are various methods forecasting the duration of the projects. They classified the articles based on their methodology into five categories; observational analysis; extended earned value management analysis; statistical analysis; artificial intelligence; computerized analysis.

On the other hand, in the present paper it is suggested that prediction methods can be also classified in terms of the source of data applied for prediction. It is found that two distinct sources of data could be used for prediction; current projects or other project records.

Most studies employing the EVM methodology found in the literature, employ current project as their source of data to forecast the duration. The reason behind this may be rooted in the fact that the EVM methodology, one of the most widely disseminated techniques for monitoring and controlling projects, employ previous records of the current projects as its basis to forecast duration.

The artificial intelligence techniques, on the other hand, employ a machine to apply the learned knowledge in new situations, generalizing experience from past projects into new ones (Wauters and Vanhoucke 2016). Like EVM, most artificial intelligence techniques are widely applied to estimate the total cost of the projects and to a lesser degree forecasting the projects' duration before the beginning.

In these authors' view, other similar projects can be applied to forecast the project duration at the middle time of the ongoing projects, as it can provide useful data such as the characteristics of the past projects, the possible risks of the following projects, the possible obstacles and the approximate time of the remaining activities, combined with expert judgment. Therefore, it is suggested to categorize the forecasting duration methods based on the source of data used in prediction, as depicted in Figure 1.

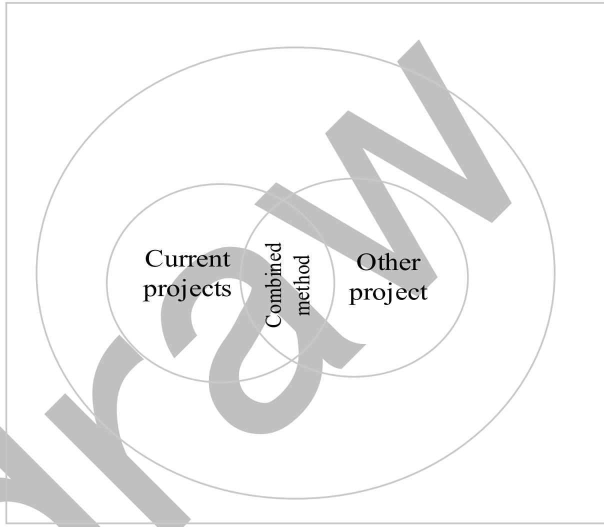

Figure 1 Source of data which can be used for predicting timing of delivering major project deliverables

In this paper, a heuristic method is introduced which primarily utilizes the outcomes of the similar past projects by using the projects progress curve and the knowledge and experience of the relevant experts of the field to forecast the completion time.

3. Heuristic Estimation Method

The suggested Heuristic Estimation Method (HEM) has four main steps (shown in Figure 2): selecting similar projects, generating a base case, incorporating the base case progress values, and fine tuning.

HEM is substantially based on the progress of the past projects actual data adjusted by expert judgment. In other words, the method employs the records from the former similar projects to forecast the timing of delivering the major project deliverables. Only after enough similarity between the ongoing project and previous projects is realized, it can be concluded that the parallel outcomes of the previous projects could conceivably recur in the ongoing projects with slight variations

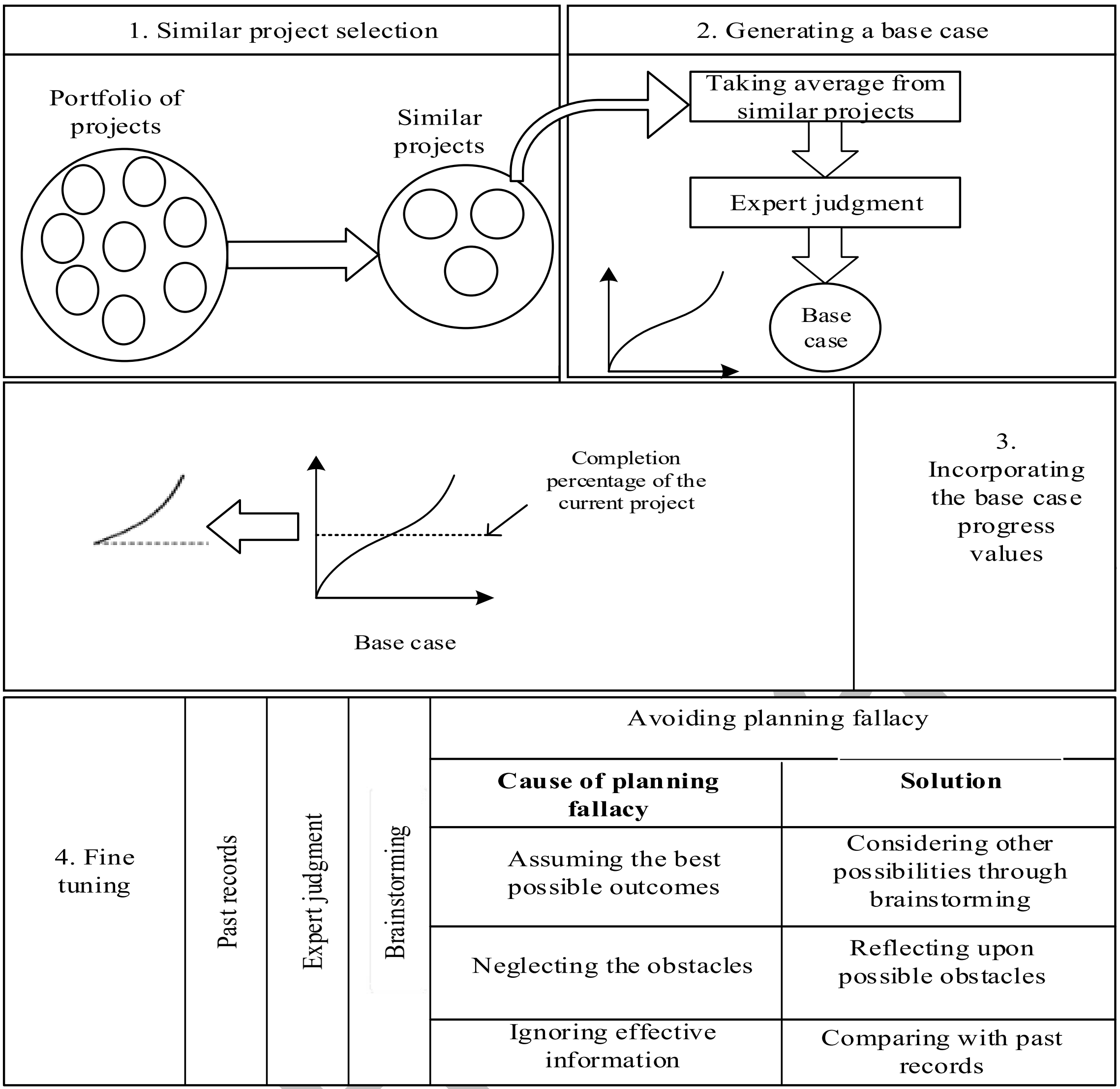

Figure 2 HEM model

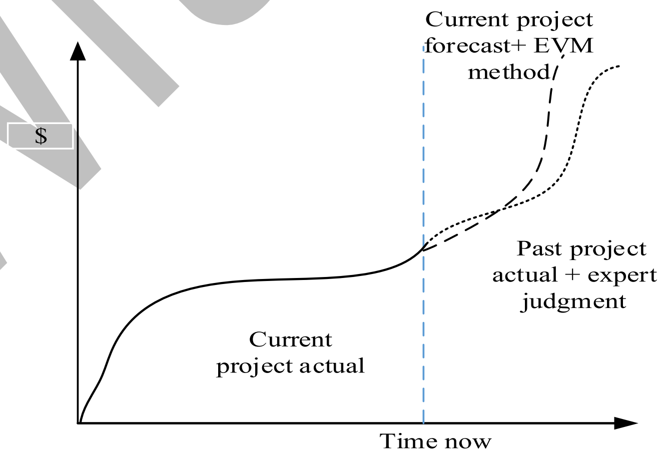

Figure 3 Duration prediction by current project or past project actual data

3.1 Selecting similar projects

Similar projects are identified and selected based on their type, technology, size and complexity. Project managers are familiar with the nature of projects in their field and they know which projects are similar. For example in an oil and gas company, it is clear for the project managers whether the specific project rests in the field of the gas facilities' projects in the offshore or onshore upstream , each of which different in nature. In addition, experts can be asked to help identify the similar past projects from the projects' portfolio of the company.

3.2 Generating a base case

The objective of this step is to define and assemble a normal progress as the base case. This includes taking average from similar cases plus tailor making different segments of the similar cases' S-curve. To tailor make the curve, extraordinary deviations like drastic slowdowns due to the country's political changes should be taken out, using expert judgment.

3.3 Incorporating the base case progress values

After generating a base case, the base case progress values are incorporated in the actual progress of the ongoing projects to predict the completion time. Accordingly, the base case is cut from the point which is equal to the percentage of the ongoing project completion and then connected to the remaining part of the ongoing project to estimate the duration time.

3.4 Fine tuning

Predictions based on the base case has to be adjusted, employing expert judgment to accommodate the unique conditions and risks of the current project. To that end, several factors including financial, market, political, and organizational risks by selected experts should be considered.

The experts assisting to adjust the base curve are selected from different categories such as the project management team's key members including the project manager, construction manager, procurement manager in addition to the company's senior management including the project management office manager, construct manager, operations manager and procurement manager. Furthermore, employing sub contractor's project managers can also be helpful at this level to assist adjusting the base curve. Figure 3 shows the duration prediction by the current project or past projects' actual data.

Applying brainstorming to find the best way to predict the duration of the ongoing project and adjust the base curve is needed at the final stage. Furthermore, considering the planning fallacies which could possibly occur during any planning and prediction is necessary to validate the prediction.

The planning fallacy is the tendency of individuals to underrate the time needed to accomplish the tasks (Kahneman and Tversky, 1979). Buehler et al. (1994) gave a remarkable example of the planning fallacy in their study where a class of students were asked to estimate the day when they would finish their thesis. The students completed their thesis on average more than sixty percent longer than what they had expected.

Planning fallacies are commonly observed in forecasting the project duration in project management. The reason behind these fallacies can be partly contributed to the disregarded data affecting the time of meeting milestones. Individuals tend to perceive the specific task or activity as unique, underestimating how similar tasks of different projects would be, consequently failing to consider the similarity of the projects and thus disregarding the substantial time needed to complete the past activities (Kahneman and Lovallo 1993). By comparing the progress rate of an ongoing project with progress rate of past projects in HEM, the similarity between the tasks in each project is comprehended so that planning fallacies due to disregarding related data are reduced.

Furthermore, people often consider the best possible outcome, instead of deliberation upon all other possibilities. In fact, when individuals devise a plan, they tend to consider the positive outcomes, disregarding the past difficulties. (Buehler and Griffin, 2003). Therefore, in the brainstorming, the previous difficulties as well as the alternative outcomes unexpected but plausible and complicated should be mentioned.

If individuals contemplate on the difficulties that could potentially arise, the planning fallacy would somehow disappear. Sanna and Schwarz (2004) argued that when individuals readily identify three obstacles that could impede the progression of the projects, they may unconsciously consider many other obstacles that could emerge, weakening their optimism and better predicting the time needed to accomplish their tasks. Therefore, by emphasizing to reflect upon three obstacles that could arise during the projects the planning fallacy would be dissipated to some degree.

4. Case study

The Iranian Offshore Engineering and Construction Company (IOEC), founded in 1993 to supply necessary production facilities in the oil and gas upstream industry, is the largest Iranian Offshore General Contractor in the oil and gas upstream industry. IOEC's projects include a complete range of services in offshore and onshore projects, domestically and internationally, such as gas/oil wellhead platforms of different sizes and subsea pipe lines with various specs. To abide with confidentiality, the pseudonyms of the IOEC's projects are used in this paper.

In IOEC, four similar ongoing projects, OP1, OP2, OP3, and OP4 were studied to forecast timing of delivering major deliverables. The gas production of these four projects was roughly 1 billion Standard Cubic Feet (SCF) with a wellhead platform tonnage of 2500 ton.

As the projects in IOEC differ in the gas production capacity, tonnage, technology and the design basis, in the first step, according to HEM, the completed projects which were similar in terms of the criteria mentioned herein to the ongoing projects were identified. Accordingly, five past projects were found similar to the ongoing projects, PP1, PP2, PP3, PP4, and PP5.

In the second step, the average of the past five projects' records were used to generate a base case. Before doing this, some extraordinary deviations or outliers in some similar cases were omitted, using expert judgment. For example, PP4 was completely on hold for eight months due to some political issues. Based on the expert judgment, the likelihood of occurring this issue again in the ongoing projects was so low that it was omitted from that part of the progress curve.

In the third step, the base case progress values were incorporated on the ongoing projects. As the ongoing projects had different completion percentages, the base case' progress curve was cut from different points. For example the completion percentage of OP1 was 65 percent so the base case was cut from the 65 percent point to connect to the ongoing project curve.

In the final step, the prediction based on the base case was modified by the expert judgment. Accordingly, several brainstorming was held in IOEC to identify the possible factors affecting the duration to normalize the base case' S-curve. Table 1 shows the effective factors identified during the brainstorming that could affect the timing of delivering major deliverables, with their estimated weight of importance.

Table 1 effective factors in forecasting projects' duration in IOEC

Factors affecting the duration time	Weight of importance
Resource constraints	30%
Lack of liquidity	20%
Issues about employer	15%
Shared resources	15%
Environmental	10%
Human resource	10%

Last but not the least, in order to avoid planning fallacies the solution as discussed in the previous sections were implemented, helping to forecast major milestones of the four ongoing projects.

4.1 Results and validations

In Table 2, the forecasts, done by HEM on four ongoing projects being at the different stages, are compared with the actual data when the four mentioned projects were completed.

Table 2 comparing the predicted data with actual data

Project's name	OP1	OP2	OP3	OP4
Total actual duration(month)	55	60	62	58
Percentage of completion at the time of the prediction	65%	34%	60%	65%
The time remaining at the time of prediction based on the actual results(month)	8.1	14.3	12.1	7.7
Estimation of the remaining time based on HEM(month)	8.5	15	12.5	8
Percentages of error	4.9%	4.9%	3.3%	3.9%

As shown in Table 2, the prediction of the completion times of the ongoing projects by HEM are fairly close to the actual completion time of the projects, all of which have percentage error under five percent.

Another fact to put in to consideration is that all the estimated times are longe than actual data. The reason behind this can be related to the solutions suggested in HEM to avoid the planning fallacies. Accordingly, the individuals possibly became more sensitive to predict durations accurately, forecasting the timing of the delivering major deliverables more pessimistically but precisely.

5. Conclusion

The contribution of the presented paper is twofold. The first contribution is classifying the papers dealing with forecasting duration of the projects on a new framework based on the source of data used for the prediction. The second contribution is proposing a method to forecast project duration and milestones based on the previous records from other projects.

In short, in the suggested method the records from previous similar projects are employed to generate a base case, forecasting the duration of the projects. Furthermore, the suggested method was implemented in IOEC to estimate four completion times of the ongoing projects, providing an acceptable estimation of duration compared with the actual results.

Although the case study was in oil and gas mega projects, there is no limitation to use the suggested method in other industries and even in smaller size projects. For the future research, it can be suggested to implement the suggested method in other industries and even in small size projects.

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A Consideration of Relationship between Team Management Efforts and Performance of Development Members

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Hitachi, Ltd.

In software development projects, we suppose that management skills of project leaders who have the role of directly managing development members affect the performance of development members. We have OJT (On the Job Training) programs for project leaders to improve their management skills. We conducted an OJT program for project leaders. This program targeted the Software combining process. We built same development teams so that the development skills were as similar as possible, and each team tested the Software combination using same source code. Each team leader devised management on progress and quality for own team. In this paper, we focused on the relationship between the team leader's management efforts and the team members' development performance, and analyzed and evaluated the difference in performance between development teams of the Software combining process.

Keywords and phrases: Project Management, Software Combining Process, Development Efficiency, Management Efforts, On the Job Training

1. Introduction

In software development projects, the skills of managers who are responsible for development management should affect the developers performance. Therefore, we promote OJT(On-the-Job Training) for develop leaders to train their management skills.

In this OJT, we conducted the Software building process and the Software combining process in the Software development process. At the Software combining process, we have built several development teams with nearly identical development skills. Each team tested using the same source code, but the performance of each team was different. I thought that the difference in performance was influenced by the management method of each team leader.

In this paper, we focused on the relationship between management method and development effort and analyzed the differences between development teams.

2. OJT

2.1 Outline of OJT

In our company, many departments promote to educate highly skilled IT human resources. Among them, our department has OJT as one method. The learner of our OJT is new employees and high-level engineers.

New employees with little development experience practice the software building process and the Software combining process. Specifically, in the Software building process, developers implement and test the software unit, and in the software combining process, developers test the combination of software units.

High-level engineers have about 10 years of development experience. Therefore, they learn management of developers rather than development.

2.2 The Software Combining Process of OJT

We performed the Software building process and the Software combining process at OJT. In this paper, we target the Software combining process. The structure of this process is shown in Figure 1.

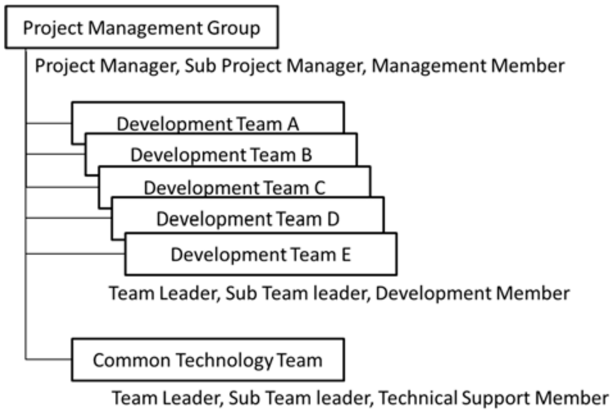

Figure 1 Project Structure

We built 5 development teams from A to E. A development team consisted of 1 team leader, 1 sub team leader, and 10 development members. We appointed high-level engineers to team leaders and sub team leaders, and new employees were appointed as developers.

We evaluated the new employee's achievement in the Previous Process and made 5 teams based on the evaluation. Therefore, the development skills of 5 teams were similar. Also the source code used in the targeted process was the same for all teams.

The noticeable difference between 5 teams was the difference in management method that each team leader thought.

3. Analysis

With regard to the Software combining process in this OJT, we evaluated the performance of the developer team with "Quality" "Cost" "Delivery Time". All the teams were able to achieve "Quality" and "Delivery time" in the same way. However, "Cost" was different for each team.

All teams tested the same source code, and development skills are almost the same. Therefore, we thought that the difference in "Cost" is the development efficiency. We have a hypothesis about the leaders' management is related to developer's efficiency. In order to verify this hypothesis, We analyze relation between management effort and development efficiency.

3.1 Analysis Data

This section describes the data used to analyze the performance of each team. First, The roles of team members are as follows.

A) Team Leader
   Management of Developers
B) Sub Team Leader
   Support for Team Leader
C) Developers
   Create Test Case & Test
   Fault Investigation & Fix
   Personal Progress Report
   Minutes of Progress Meeting

Management of developers defined "Progress Management", "Quality Management", and "Fault Management". Table 1 shows management categories.

Each team leader assigned parts of the management task to sub team leader. Table 2 shows the assignment of each team, using the management category. Among them, team D's Quality management was done by both leader and sub leader. Team E's Quality management and Fault management also overlap in leader and sub leader.

Table 1 Management Category

No	Category	Tasks
1	Progress Management	● Host a Progress Meeting ● Check Minutes of Progress ● Meeting Evaluate Team Progress
2	Quality Management	● Review Test Cases & Source Code ● Check Test Results ● Evaluate Team Quality
3	Fault Management	● Answer a Question ● Support for Investigation ● Instruct Solutions ● Configuration Control

Table 2 Assignment of Management Category

Team	Management Category	Leader	Sub Leader
A	Progress Management	✔	
	Quality Management		✔
	Fault Management	✔	
B	Progress Management	✔	
	Quality Management		✔
	Fault Management		✔
C	Progress Management	✔	
	Quality Management		✔
	Fault Management		✔
D	Progress Management	✔	
	Quality Management	✔	✔
	Fault Management		✔
E	Progress Management	✔	
	Quality Management	✔	✔
	Fault Management	✔	✔

Next, each management method is as follows. Progress Management Method is decided by leaders and project manager. Each team leaders decided the frequency and unit of developer's progress report. The report format was determined by the project manager, so there was no difference between all the teams. Table 3 shows the feature of Progress management of each team.

Quality management method and Fault management method followed Hitachi's standard rules. As a result, each team had no difference in Quality and Fault management method.

Finally, each management priority is as follows. Table 4 shows the priority of the management categories selected by team leaders.

Table 3 Feature of Progress Management

Team	Report Progress		
	Frequency	Unit	Format
A	Daily	2 to 3 developers	No difference
B	Weekly	2 to 3 developers	No difference
C	Daily	1 developer	No difference
D	Daily	1 developer	No difference
E	Weekly	3 to 4 developers	No difference

Table 4 Priority of Management Category

Team	Priority		
	Fault Management	Quality Management	Progress Management
A	High	Mid	Low
B	High	Mid	Low
C	High	Mid	Low
D	Low	Mid	High
E	Low	High	Mid

A and B, C teams had the same priority, but D team and E team had different priority compared with other teams. The reasons are as follows.

Team D:

In order to equalize the work weight of developers, leader evaluated team progress report every day. So team D prioritized the Progress management.

Team E:

In order to prevent rework by wrong fixed, leader strengthened the source code review. So Team E prioritized the Quality management.

3.2 Analysis Method

The relationship between development and management is analyzed qualitatively and quantitatively. In analysis of the paper, we evaluated using RDE(Ratio of development efficiency). RDE is the ratio of development efficiency between target team and average of all teams. These definitions used for the analysis are shown below.

DE_{Ti} : Development Efficiency

$$DE_{Ti} = \frac{Team\ Scale}{Team\ Costs}$$

ADE : Average of Development Efficiency

$$ADE = \sum^{n} DE_{Ti} \Big/ n$$

n : number of teams

RDE_{Ti} : Ratio of Development Efficiency

$$RDE_{Ti} = \frac{DE_{Ti}}{ADE}$$

TME : Team Management Efforts

$$TME = PME + QME + FME$$

PME : Progress Management Efforts

QME : Quality Management Efforts

FME : Fault Management Efforts

RPM_{Ti} : Ratio of PME to TME

$$RPM_{Ti} = \frac{PME}{TME}$$

RQM_{Ti} : Ratio of QME to TME

$$RQM_{Ti} = \frac{QME}{TME}$$

RFM_{Ti} : Ratio of FME to TME

$$RFM_{Ti} = \frac{FME}{TME}$$

RMC : Ratio of Management Category

$$RMC_{Ti} = RPM_{Ti} + RQM_{Ti} + RFM_{Ti}$$

3.2.1 Qualitative Analysis Method

We carried out the following 4 steps in the qualitative analysis.

(1) Classify the team into High-RDE and Low-RDE.
(2) Identify common items of the High-RDE teams.
(3) Identify common items of the Low-RDE teams.
(4) Analyze the difference between High-RDE teams and Low-RDE teams.

3.2.2 Quantitative Analysis Method

We carried out the following 2 steps in the quantitative analysis.

(1) Derive the percentage of management category from each team management efforts.
(2) Evaluate the correlation between RDE and the ratio of each management category.

3.3 Analysis Result

As a result of comparing RDE, A team (RDE_{TA} = 1.18) is the highest, and E team (RDE_{TE} = 0.82) is the lowest. Figure 2 shows the RDE of each team.

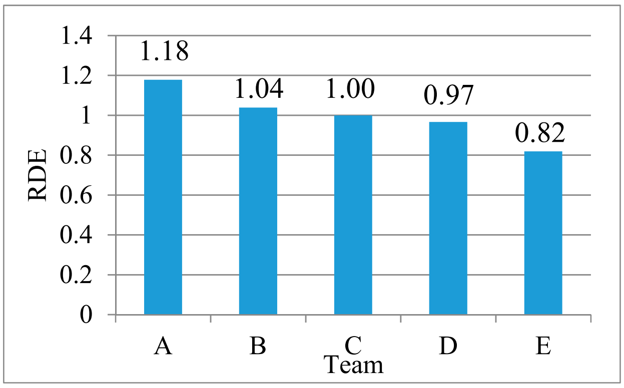

Figure 2 RDE of each team

3.3.1 Qualitative Analysis Result

As a result of classifying each team by RDE, High-Class is A, B, C team. Low-Class is D and E team. Table 5 shows the results of classifying teams with RDE.

Table 5 Classify Team by RDE.

Class	Team	RDE_{Ti}	Relationship between RDE_{Ti} and ADE
High	A	1.18	$RDE_{TA} > ADE$
	B	1.04	$RDE_{TB} > ADE$
	C	1.00	$RDE_{TC} = ADE$
Low	D	0.97	$RDE_{TD} < ADE$
	E	0.82	$RDE_{TE} < ADE$

As a result of analyzing by RMC, the priority of management categories of each team are the same as the plan shown in Table 4. Figure 3 shows the result of evaluating RMC.

Table 5 and Figure 3, the highest priority management category of high-class teams are Fault management. On the other hand, low-class teams are not the top priority for the Fault management. From this result, we obtain that the team have high RDE when the leader make a priority to the Fault management.

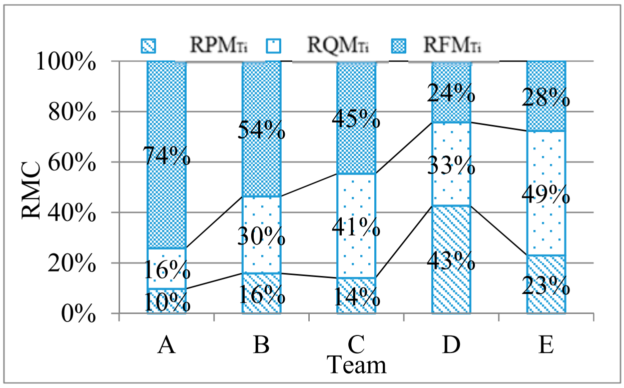

Figure 3 RMC of each team

Further, from Table 2 and Table 5, high-class Teams separated management categories between the leader and sub leader. But, low-class Teams overlapped some management categories between the leader and sub leader. From this fact, we find that teams have high RDE when leader's and sub leader's work are independent of each other.

3.3.2 Quantitative Analysis Result

We conducted Pearson's Correlation Analysis to examine the relationship between RDE and RPM, RQM, RFM. As a result, the obtained trends are shown in Figure 4, 5 and 6.

(1) Correlation Analysis between RDE and RPM.

Relationship between RDE and RPM is as follows.

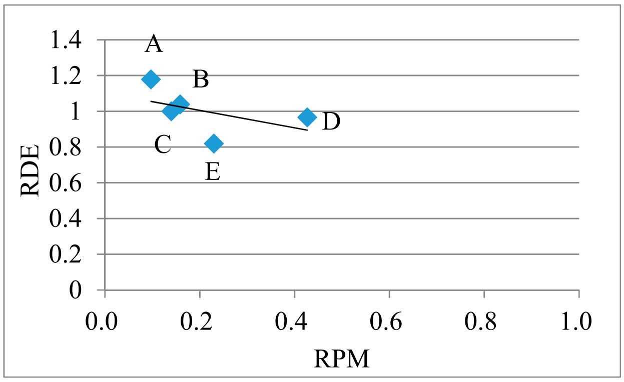

Figure 4 Relationship between RDE and RPM

Based on the results of the Analysis, RDE is weak related to RPM (r = 0.49, p < 0.5). So, there is a high possibility that there is a no relationship between RDE and RPM. The regression equation is as follows.

$$RDE_{Ti} = -0.48 * (RPM_{Ti}) + 1.10$$

(2) Correlation Analysis between RDE and RQM.

Relationship between RDE and RQM is as follows.

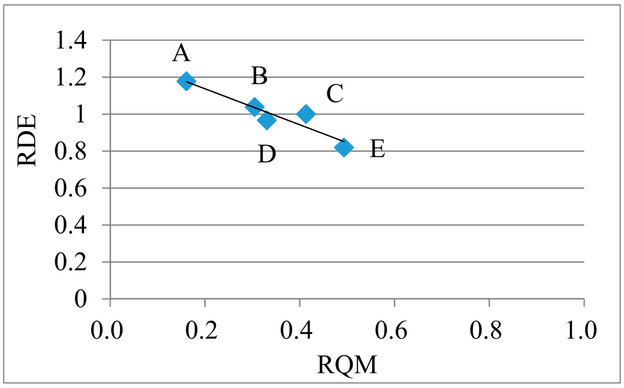

Figure 5 Relationship between RDE and RQM

Based on the results of the Analysis, RDE is very strong related to RQM (r = 0.93, p < 0.05). So, there is a high possibility that there is a negative relationship between RDE and RQM. The regression equation is as follows.

$$RDE_{Ti} = -0.97 * (RQM_{Ti}) + 1.33$$

(3) Correlation Analysis between RDE and RFM.

Relationship between RDE and RFM is as follows.

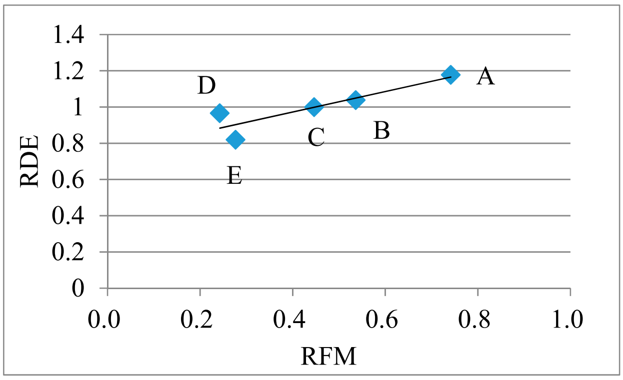

Figure 6 Relationship between RDE and RFM

Based on the results of the Analysis, RDE is very strong related to RFM (r = 0.88, p < 0.05). So, there is a high possibility that there is a positive relationship between RDE and RFM. The regression equation is as follows.

$$RDE_{Ti} = 0.57 * (RFM_{Ti}) + 0.74$$

4. Consideration

From the qualitative and quantitative analysis results, we concluded that ratio of management category based management plan influences the development efficiency. I think that we prove to some extent the hypotheses we have.

Especially, we found that there is a strong positive correlation between development efficiency and Ratio of Fault Management. The reason for this is probably because the leader has solved the developer's work problem. For example, leaders have a higher business understanding than developers, so it is easy to find trouble codes. Also, the leader has higher development skills than the developer, it is easy to fix trouble code. In this way, it is thought that supporting the leader with work that the developer is likely to take time was effective in improving development efficiency. Therefore, in order to raise the performance of the team, we think that fault management should be given priority in the 3 defined management categories. However, in software development, Progress management and Quality management are important items, so I think that there is no choice not to do those managements. If we did not manage these, it would have been difficult to keep "Quality" and "Delivery Time". For example, it is desirable to have a measure that automate as much as possible of Progress and Quality management. If so, leaders can focus on Fault management, which leads to improved development efficiency.

In addition, duplication of roles between the leader and sub leader may be a factor to lower development efficiency. Therefore, it is desirable that the work of leader and sub leader be independent.

5. Conclusions

In this paper, we considered the relationship between team management and development performance in the Software combining process through OJT. As general data in the system development project, management efforts are shown to be about 10% of development efforts(Japan Users Association of Information Systems, 2014). However, data on the breakdown of management efforts are not shown. In this regard, we were able to show data from both qualitative and quantitative analysis. I think this paper is one of the important achievements for management efforts.

However, we could not consider the leaders' skills and experience. Also there are only 5 samples of correlation analysis. Therefore, in this paper I could grasp the trend but could not conclude.

In the future, we plan to collect more data, analyze relationships such as management effort, development scale, number of team members, etc. and make use of the results for project management.

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An Improvement Case of the Human Resource Management for Information System Infrastructure by Applying the Rubric

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In the organization of internal information system infrastructure to which we belong, about half of the personnel are occupied by offshore workers. On the other hand, high-quality services of information system infrastructure are required because we must operate the mission critical systems. In such a situation, it was an organizational challenge to develop human resources for information system infrastructure engineer continuously and to maintain technical capabilities. Therefore, we focused on the "Rubric" that was sometimes used at the educational field, and clarified technical fields that must be strengthened by introducing evaluation indicators of information system infrastructure. In addition, we tried to train personnel by strategic On the Job Training and Off the Job Training. By applying the "Rubric", we showed that there are certain improvement effects on technical skills and a sense of belonging to our organization. In this paper, we describe an improvement case of the human resource management for information system infrastructure by applying the "Rubric".

Key Words & Phrases: Rubric, Information System Infrastructure, Human Resource Management

1. Introduction

In the organization of internal information system infrastructure to which we belong, about half of the personnel are occupied by offshore workers in China. It is difficult to maintain the personal technical skills because the turnover rate of offshore worker is higher than that of Japanese worker. (Ministry of Economy, Trade and Industry, 2016). On the other hand, high-quality services of information system infrastructure are required because we must operate the mission critical systems. In such a situation, it was an organizational challenge to develop human resources for information system infrastructure engineer continuously and to maintain technical capabilities. Therefore, we focused on the "Rubric" which was sometimes used at the educational field. Applying the Rubric, our organization can clarify technical fields that must be strengthened by introducing evaluation indicators. At the same time, each personnel can understand the roles required by the organization through evaluation.

Since the case of applying the Rubric to the help desk staff has been successful in the preceding research (Nakajima et al., 2016), we also applied it to personnel specializing in information system infrastructure according to this research. In this paper, we describe an improvement case of the human resource management for information system infrastructure by applying the Rubric.

2. Target personnel and its characteristics

In this chapter, we describe the definition and the characteristics of target personnel in the information system infrastructure.

2.1 The definition of target personnel

The personnel targeted in this paper are engineers in charge of information system infrastructure such as servers (OS, middleware), network and storage in information systems. In particular, they engage in each lifecycle of information system infrastructure (systemization planning, requirement definition, design and development, testing, migration, operation, and maintenance).

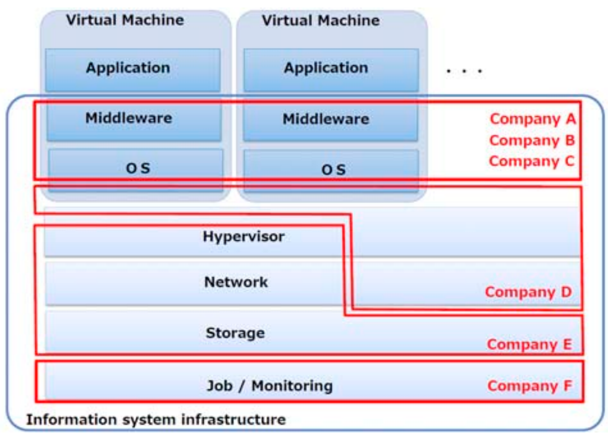

Figure 1 The technical fields in our organization and its partial responsibility

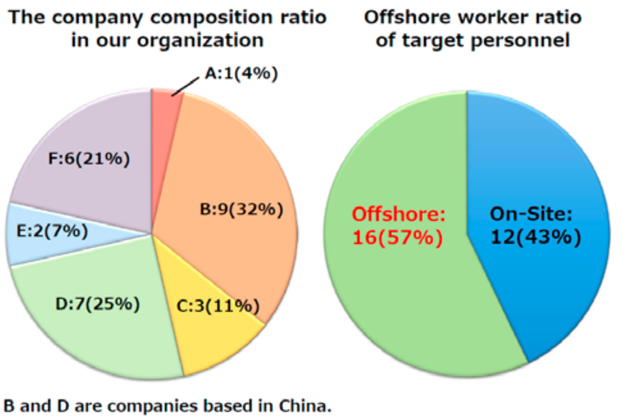

Figure 2 The company composition ratio and offshore worker ratio of target personnel

2.2 The characteristics of target personnel

We describe the characteristics of target personnel. In our organization, we provide a virtualization infrastructure as a private cloud service for internal systems. In order to develop and maintain this private cloud, we manage six partner companies. In this paper, six partners are called A to F companies. Each partner company shares work according to each technical field of the system infrastructure. Our technical fields and its partial responsibility are shown in Figure 1. In addition, our organization actively promotes offshore development, and about half of the target personnel are engaged in China. Moreover, Figure 2 shows the company composition ratio and offshore worker ratio of target personnel. B and D are companies based in China. As mentioned above, it is required to cultivate continuously while raising sense of belonging to the organization because turnover rate of off-shore worker tends to be higher than that of Japanese.

3. Challenge on human resources management in our organization

In this chapter, we describe the challenge of human resources management in our organization that has a lot of personnel mobility and has human resources who are required to have advanced technical capabilities. As mentioned in chapter 2, it was a challenge to continually cultivate advanced human resources in our situations that offshore worker accounted for about half. Since the offshore worker resigned one after another, we had a sense of crisis that we cannot maintain our organization unless we develop efforts to bring offshore worker attachment to our organization and strategies to develop highly-skilled technicians. Therefore, we describe from the viewpoint of "Motivation that is belonging to own organization" and "Technical skills".

3.1 Motivation

As a major factor related to motivation, there is a sense of belonging to an organization. In this paper, we defined sense of belonging to our organization as motivation. In order to keep the technical skills of our organization as a whole, it is required that each personnel keep high sense of belonging to their organization.

3.2 Technical skills

The technical skill mentioned in this paper is the ability required to develop and maintain the private cloud mentioned in Chapter 2. As mentioned in Chapter 1, since we operate the mission critical system, high-quality services of information system infrastructure are required. A continuance of high-quality services is necessary to keep technology at a high level.

4. Training by the rubric and strategic OJT / OFF-JT

We mainly made two efforts on motivation and technical skills challenges. We describe these approaches.

4.1 Rubric

We focused on the "Rubric" adopted in the preceding research (Nakajima et al., 2016) and applied it to human resources for information system infrastructure. The rubric is a method in which the teacher defines the standard of the student's level in several stages and gives an indicator to judge achievement degree. In our organization, we implemented it from two viewpoints, motivation and technical skills.

In order to compare with the preceding research (Nakajima et al., 2016), we introduced the same three indicators for the Evaluation of motivation. The three evaluation indicators are "commitment to own organization", "awareness at work", and "degree of job satisfaction". On the other hand, about technical skills, we defined 12 technical fields and their levels based on the indicator of a national skill research. (IT Skill Research Forum (iSRF), 2016) The 12 technical fields defined in this approach are shown below.

1. System architecture design
2. Platform design
3. System operation management design
4. Security design
5. Database design
6. Network design
7. Data migration design
8. Platform construction
9. System operation management
10. Security measures
11. Database construction
12. Network construction

For these technical skills, we selected a measurement method with indices suitable for the technical granularity in our organization. According to this approach, we were able to visualize the current technical skills and also improved a sense of belonging to our organization by feeding back the visualized results to each personnel. This feedback was dealt with make each personnel aware of the roles that they play in the organization. The detailed evaluation indicator will be described in the next chapter.

4.2 Strategic OJT / OFF-JT

We clarified the technical fields that must be strengthened for our organization by using Rubric. Based on the results obtained by Rubric, we worked on improving technical skills of personnel as our organizational strategy. We defined this as a strategic OJT (On the Job Training) and OFF-JT (OFF the Job Training). Next, the meaning of "strategic" is explained.

In our organization, OJT / OFF-JT for improving the technical skills have been left it to autonomy. In other words, the training depended on the individual's ability and degree of self-realization desire because respecting the autonomy of each personnel. Therefore, we considered the OJT / OFF-JT for skill improvement as our organization's responsibility, and developed efforts to support improvement of technical skills according to personal characteristics. In this paper, we define this approach as "strategic" OJT / OFF-JT. Specifically, we defined the "Priority Technical Fields (PTF)" from the 12 technical fields established by Rubric for each of the six partner companies, and set up "strategic" OJT / OFF-JT. Through this activity, it becomes possible to improve the skill comprehensively as our organization. In addition, we tried to raise a sense of belongings of each personnel by recognizing "strategic" OJT / OFF-JT. Detailed implementation procedure is as follows (STEP1 to STEP4).

STEP1) PTF determination of each partner company

We consulted with the leaders of each partner company, and decided four fields for each company from the 12 technical fields established by Rubric as the PTF. Basically, we strategically considered improving the good technical skills in each company, and adjusted to cover all technical fields as our organization when all the core competencies of each company are combined.

STEP2) Feedback to each personnel

The leader of each partner company notified the belonging personnel of PTF by face-to-face interview. At the same time, the leader gently raised the awareness of the personnel while confirming the intention of the personnel.

STEP3) Technical analysis on development projects

We identified projects in the future a few years ahead and analyzed the technical fields involved in those projects. In order to appeal our organization's technical capabilities, we examined and analyzed which technology (for example, Cloud computing, Big-data, IoT, AI, SDN etc.) to incorporate into the project and lead to new services.

STEP4) Project assignment

We evaluated the skill map sheet (Figure 3) for the partner company that best matches the development project analyzed in STEP 3. Among them, "strategic" project assignment was carried out taking into consideration the personnel desire and the technical field which would like to grow as our organization.

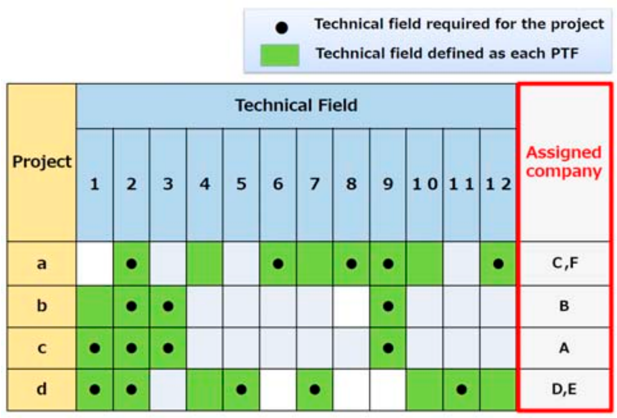

Figure 3 The skill map sheet for project assignment

Table 1 Commitment to own organization

	Commitment to own organization
1	You can undertake any work if you continue to work in this organization.
2	You can be proud of being a member of your organization to others.
3	You can think it is correct that you decided to work in this organization.
4	You can tell your friends that your organization is a very good organization.
5	You can think that many things are gained by working in your organization.
6	You can think that your organization will show your best in terms of work.
7	You can think that you ware happy to decide your organization instead of any others.
8	You can feel loyal to your organization.
9	You can agree with how to handle personnel in your organization.
10	You can think that you will not quit your job in your current work situation.
11	You can continue working in your organization even though you can do similar work.
12	You can think that there is no other place better than your organization.
13	You can make as much effort as possible for the development of this organization.
14	You cant hink that this organization has potential in the future
15	You can think that your organization fits your personal values.
16	You can think that you want to work in your organization from now on.

Table 2 Awareness in own workplace

	Awareness in own workplace
1	You can be interested in the work that you are in charge at the moment.
2	You can can be rewarding for my daily work.
3	You can proceed with current work as your own responsibility.
4	You can be proud of your work.
5	You can dig deeply the current your work.
6	You can think that your organization is doing as a team well.
7	You can think that you are a member of the team.
8	You can work with maximum effort.
9	You can think think that team members will help you if necessary on work.

Table 3 Degree of job satisfaction

	Degree of job satisfaction
1	Personal growth and capacity development
2	Fairness of treatment received from your boss
3	Communication with team members
4	A sense of accomplishment obtained from work
5	Support received from team members at work
6	Freedom of thought and action
7	Ethics of your boss
8	Instructions and advice received from your boss
9	Informal relationship with team members

Table 4 System architecture design

	System architecture design
1	You can assume the top level configuration of the system as the architecture realizing the systemization requirement.
2	You can decide the system architecture based on the assumed evaluation results of subsystem unit.
3	You can evaluate the feasibility of the system architecture and its maintainability satisfying the requirements.

Table 5 Platform design

	Platform design
1	You can choose the basic model of the platform based on the overall requirements for the system infrastructure.
2	You can consider combinations satisfying the requirements for the system infrastructure, and summarize the basic design of the platform.
6	You can evaluate and select the system platform design tool.
4	You can design configuration parameters for each component such as Hardware, OS, Middleware.
5	We can conduct product selection, physical configuration, parameter design that satisfies availability based on platform basic design.
6	You can select products and parameters according to the platform basic design.

Table 6 System operation management design

	System operation management design
1	You can formulate operational standards based on the system operation management requirements.
2	You can design the system operation manual based on the system operation management requirements.
3	You can design a backup / restore method based on the system operation management requirements.
4	You can design the parameters of the selected operation management tool based on the system operation management requirements.
5	You can create and review a system operational management design document.

Table 7 Security design

	Security design
1	You can design an access method by information asset according to security policy.
2	You can design properties according to requirements such as confidentiality, integrity, availability, etc. of information assets.
3	You can design network seculity according to requirements such as confidentiality, integrity, availability, etc. of information assets.
4	You can design safeguards to deter threats such as tampering with data on the network and computer viruses.
5	You can design restrict data access by individual unit, record access to data, encrypt data, etc.
6	You can decide the extent of security monitoring and how to store the security monitoring results based on emergency response requirements.

Table 8 Database design

	Database design
1	You can create conceptual data model based on data request analysis according to new application design.
2	You can validate the conceptual data model with users.
3	You can centralize data through the creation of logical data model based on conceptual data model.
4	You can verify the validity of the logical data model according to the conceptual data model.
5	You can select from various vendor product candidates in consideration of budget, purpose of database creation, etc. based on the requirement.
6	You can analyze the characteristics of the transaction and define the usage requirements of the data in detail.
7	You can define the physical environment of the platform, physical requirements of the database such as file volume, response time, etc.
8	You can decide whether it is centralized or decentralized by considering the necessity of data deployment at the site, access performance to data, etc.
9	You can design the physical database by considering the functions and constraints of the target DBMS.
10	You can adjust the performance such as field design / table denormalization, file access efficiency improvement, etc, making full use of the functions.
11	You can decide the physical placement of the database in consideration of alternative databases, distribution to multiple disks, measures against faults,
12	You can create and review a database design document.
13	You can clarify the requirements and scope of testing in the database and create test specifications.
14	You can determine the monitoring targets and the monitoring method of the database, and create the operational management plan of the database.
15	You can plan the maintenance policies of the database, taking into account company-wide standards and individual system requirements.

Table 9 Network design

	Network design
1	You can determine the network architecture, such as system placement, protocols, and evaluate the expected performance.
2	You can decide the network technology and equipment to achieve the necessary security measures by considering the security policy.
3	You can decide the backup and recovery method of the network equipment against network failure caused by disaster or accident failure.
4	You can plan the maintenance policy of the network system taking into account companywide standards and system specific requirements.
5	You can process the system operation on the new network and create a business migration plan on the new network from the existing network.
6	You can create a work plan for constructing a new network system including recovery work if a problem occurs in the user's work.
7	You can review network system design, maintenance plan etc. among network system users, application system development personnel, and vendors.

Table 10 Data migration design

	Data migration design
1	You can create a migration plan based on identification of migration target, migration method etc., and troubleshooting during migration work.
2	You can set migration test data, verification items etc. based on the object of the migration test, the development environment etc.
3	You can create a system implementation transition plan based on the system identifier to be migrated, migration method etc.
4	You can set migration test data, migration test programs, job control programs based on the object of the migration test and each environment.
5	You can put together a plan containing system test specifications, test cases etc., based on system requirements and each component requirement.
6	You can create a system test plan that includes the necessary resources, schedule, evaluation criteria, and how to deal with problems.

Table 11 Platform construction

	Platform construction
1	You can install servers and storage, OS, driver software, middleware etc. and check these normality based on the design document.
2	You can set the configuration parameters of the component based on the design document.
3	You can test the system operation on each component and check the normality on a component basis.

Table 12 System operation management

	System operation management
1	You can set parameters of the operation management tool and create job control program (jobnet, script etc.).
2	You can join the components and verify that the combined components and systems are joined correctly and meet the system design requirements
3	You can test that systems meet the systemization requirements.

Table 13 Security measures

	Security measures
1	You can identify enterprise information systems, network components, and select security products for each component.
2	You can do software development independently if you do not have a suitable security product that implements security system design requirements.
3	You can do the environmental security testing (requirements, vulnerability check) of the development function.

Table 14 Database construction

	Database construction
1	You can set the configuration parameters of the database based on the database design specification.
2	You can evaluate performance, security, integrity, backup / restore by database access test and confirm compliance with user request.
3	You can evaluate the test results, and work with the project stakeholders to consider the response and make improvements if there is a problem.

Table 15 Network construction

	Network construction
1	Based on the work plan, you can arrange equipment. When schedule problems occur, you can make adjustments each time and document the results.
2	You can install network equipment and lines, introduce network software, connect and configure each equipment.
3	You can test based on the network system test specification (repeat until the application function is confirmed or until the scope of the test changes).

5. Evaluation indicator

We describe the evaluation indicator for measuring whether the two measures mentioned in Chapter 4 were effective or not.

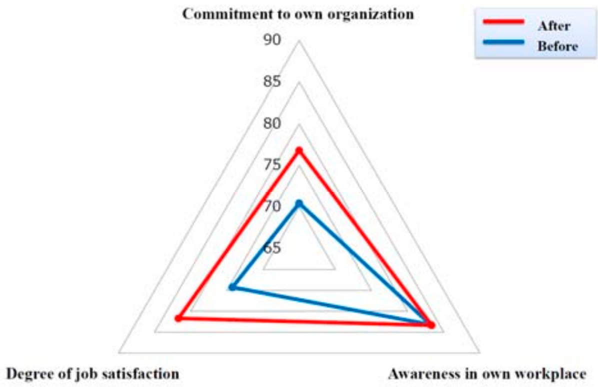

Figure 4 The change in the average value of motivation about all personnel

5.1 Evaluation of motivation

In this study, similarly to the preceding research (Nakajima et al., 2016), we measured a personnel's sense of belonging to our organization from three viewpoints.

Questionnaires for deriving scores on each viewpoint are shown in Tables 1 to Table 3. For each of these questions, each personnel evaluated themselves in five stages (Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly disagree). Since the number of question items is different among the three evaluation indices, normalize so that the full score becomes 100 points.

5.2 Evaluation of technical skills

As mentioned in Chapter 4, for 12 technical fields defined based on indicators of the National Skill Research (IT Skill Research Forum (iSRF), 2016), personnel self-assessed each question item in five stages. Evaluation criteria of 5 stages are objective standards because these can be judged from past experiences. Question items for each of the 12 technical fields related to the Information system infrastructure are shown in Tables 4 to Table 15. The skill of personnel was evaluated based on the level calculated from the answers to these questions (the level defined by iSRF).

6. Measurement of effectiveness

We describe the comparison of motivation and skills between before our effort and after one. As a supplement, the period of the effort was about three months.

6.1 Motivation

Figure 4 shows the change in the average value of motivation about all personnel of six partner companies. Changes in motivation of each of the six partner companies were almost the same as the overall trend, so we omit the publication. From Figure 4, it is understood that the "Commitment to own organization" and "Degree of job satisfaction" have improved by about 10%. There was almost no change in "Awareness in own workplace" which had already been at a high level before our effort.

An irregular triangle, that is, a biased tendency was seen before. However, it turned out that it improved to an equilateral triangle (that is a state with good motivation) by our effort. The results of interviews with some personnel are listed below.

- I was motivated as the goal was clarified by the Rubric.
- In the strategic OJT / OFF-JT, I felt that I was trusted and brought up. (Especially in offshore)

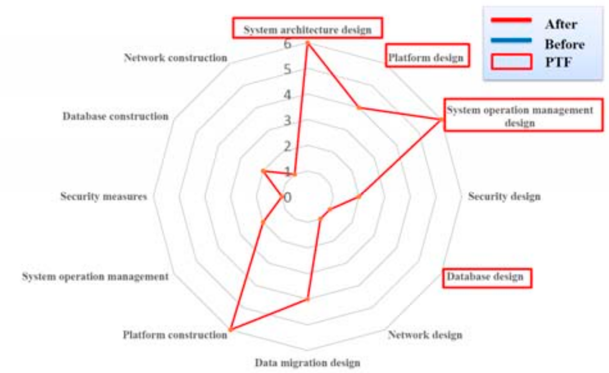

Figure 5 Technical skills (Company A) n=1

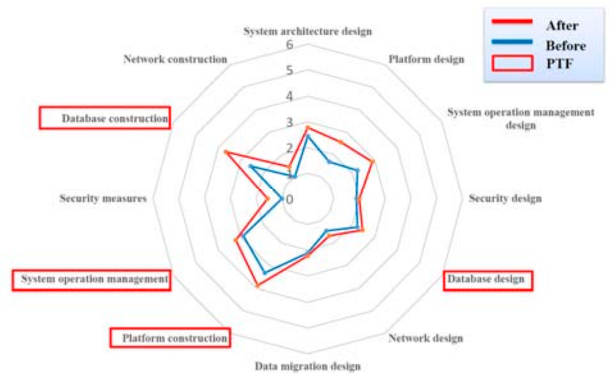

Figure 6 Technical skills (Company B) n=9

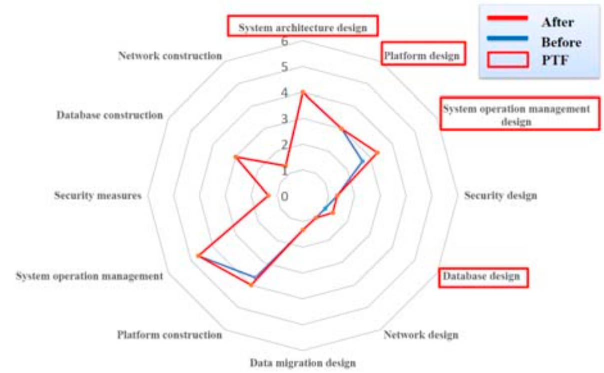

Figure 7 Technical skills (Company C) n=3

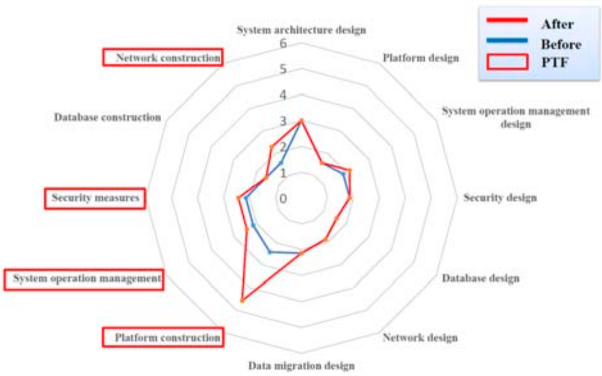

Figure 8 Technical skills (Company D) n=7

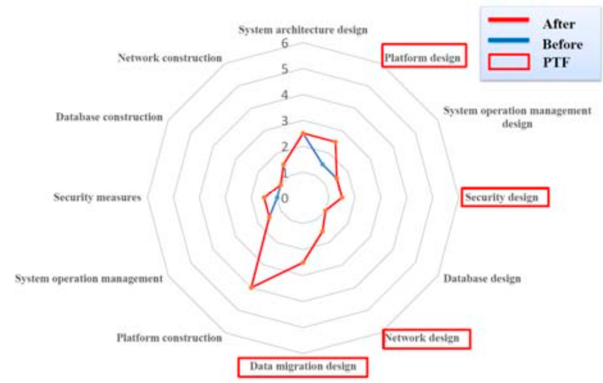

Figure 9 Technical skills (Company E) n=2

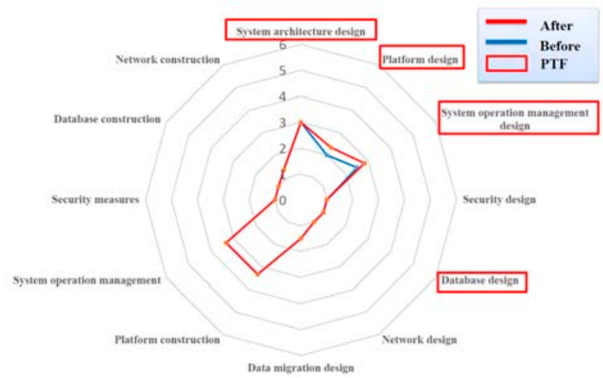

Figure 10 Technical skills (Company F) n=6

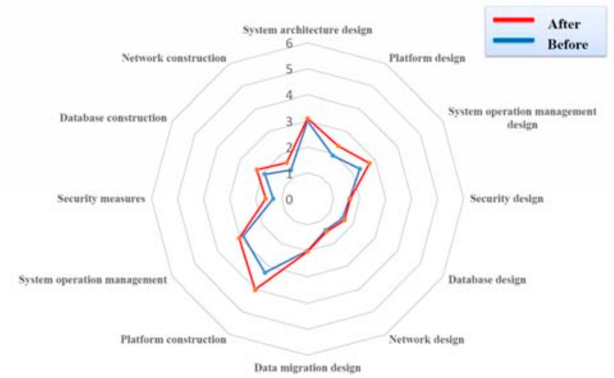

Figure 11 Technical skills (Overall) n=28

It shows that Rubric is helping to improve reliability in addition to promoting communication with the leader and other members. Furthermore, our efforts to conduct training at the top down were very pleasing to offshore personnel. In offshore personnel, they thanked the consignor for supporting technology acquisition because there are cultures that improve technical skills with voluntary efforts.

6.2 Technical skills

Figure 5-10 show the change in the average value of technical skills about each six partner companies. Figure 11 shows the change in the average value of technical skills about total of each six partner companies. Since we have set different PTF for each partner company, we show results for each partner company. The discussion obtained from results is described below.

- The technical skills of each company's personnel have been improved mainly in their PTF.
- The member in Company A did not see any change. The reason for these results is one sample (expert engaged for nearly 10 years).
- The members of Company B and D (offshore company) saw technical skills improvement focusing on their PTF. It is thought that OJT could effectively improve their skills because there were many new members who did not master any skills. In addition, it is considered that incorporating the study meeting for skill improvement as part of work time was effective.
- Company C, E, and F also improved their technical skills focusing on their PTF. It is a minute growth compared with B and D companies which originally have many beginners because this group includes some experts.

In this effort, it is considered that the main factor of improving skills is the fact that each personnel is aware of the indicator of technical skills.

7. Conclusion

In this paper, we described an improvement case of the human resource management in an organization of information system infrastructure by applying the Rubric. By applying the rubric, we showed that there are certain improvement effects on technical skills and a sense of belonging to our organization. However, since the approach period was about three months, we consider that the effect is still developing, and it is necessary to continue working on it in future. The lessons to be taught to the PM of information system infrastructure are listed below.

- It is important to make each person aware of the role in the organization in order to raise a sense of belonging.
- In order to improve information system infrastructure skills, we should work not only with OJT but also with OFF-JT.

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The Recommendations for Next Generation Offshore Development

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The use of China offshore has been accelerated since 2007 in many IT developments and after the ten years has passed, in addition to its overwhelming procurement capability, the understanding of Japanese culture and the capability to address the needs have been improved as well as the technical capabilities. On the other hand, Japanese IT companies are suffering the issue of IT resource shortage. It is difficult to resolve this issue in Japan alone so we consider that the best way is to further expand China offshore who is the pioneer of the offshore development and keeps tackling the leading-edge offshore development. We propose the planning of the offshore strategy, the team building based on the characteristics of leadership and fostering the understanding of the cultures. For example, it is the strategy based on the technology capabilities for work efficiency such as creation of tools and creation of processes and Autocratic leadership. We use the project which has leveraged China offshore development in large scale where these initiatives worked effectively. Then, we recommend the future of China offshore development taken in the consideration the use of the next generation IT technology the roles of Japan as "the next generation offshore development".

Keywords and phrases: China, South East Asia Countries, The Next Generation Offshore Development, The Human Resources Management, The Challenges Japanese IT Companies Facing

1. Introduction

The offshore development by Japan has been rapidly expanding in the context of domestic IT human resource shortage and the pressure on the cost reduction in the development. The total offshore development cost remains to be around 100 billion yen from 2007, 80% of which is China, showing the strong procurement capability (IPA, 2013). In the past, the major purpose of using China offshore development was for the simple cost reduction through provision of the workforce for the simple tasks in the development and the testing. However, they are making remarkable achievements recently by adapting to Japanese culture, and meeting Japan's needs through provision of the highly sophisticated offshore development capabilities with better retention rate, massive hiring of excellent human resources and the improved technical capabilities which drives the expansion of the coverage in the development and the leading edge offshore development. China remains to be important (IPA, 2013) despite the country risk, the economic impact from the currency exchange and rising labor cost in China which increase the needs to move IT development to the other fast growing Asian countries in the future such as Vietnam and Philippine.

This paper talks about the current China offshore development in the light of the changes in the times, politics and economy and the differences in the cultures and how it has evolved among with the advancement of IT technology and how it is used in the current projects, using the example cases. On that basis, we make the recommendation of "the next generation offshore development" including the future of the China offshore development, the role and the responsibility sharing with other offshore development countries and the use of the next generation IT technologies.

2. The challenges Japanese IT companies are facing and the reality of China offshore development

2.1 The challenges Japanese IT companies

Recently 86.9% of Japanese IT companies answered in relation to the manpower shortages as "severely short of human resources" or "somewhat short of human resources". Regarding the quality level of IT personnel, 90.1% answered as "seriously insufficient quality" or "somewhat insufficient quality". Especially, the dissatisfaction in "outsourcing of the system development" remains to be strong (IPA, 2017). The followings can be considered as the possible reasons.

- Further cost reduction in the development cost
- Secure the human resources to backfill the manpower shortage in Japan.
- Improve development speed
- Delivery in the short period of time
- Engage in the complex projects

The activities such as "strengthening/developing the internal resources" and "hiring/leveraging diversified human resources" are going on. However, it is difficult to improve the situation better by addressing them in Japan only. So we propose the expansion of China offshore development which is the offshore development pioneer and established outsourcing destination and subcontractor.

2.2 The current circumstance of China offshore development

The purpose of offshore development up to now used to be in the development cost reduction. The offshore outsourcing has 20-30%cost reduction effect compared against the domestic IT companies (IPA, 2013). The issues in China offshore development such as the cultural differences, the communication gap and the quality are being resolved every year and the experiences and the insights and know-hows are being accumulated. China offshore development is expected to expand further by leveraging them and we propose the specific plans.

3. The proposal for the expansion of China offshore development

In general, the offshore development in the past used to be the outsourcing of some of the design works, coding and unit test with the objective to reduce the development cost and supplement the human resource shortage of Japan. The skills sets of offshore resources were limited and the project management, methodology and the standardization were unique to offshore. The following actions are taken as the initiatives against the offshore development challenges in general.

- Create/explain the detail specification documents
- Use the communication tools
- Assign the bridge SE
- Business trip of onsite SE
- Promote better understanding of Japanese culture

Recently, in addition to the existing purposes, the improvement in the development speed and the engagement in the complex projects are required and in order to address, the global development site called Global Delivery Centers are established India, China and others as the extension of the activities we have been working on up to now and the industry expertise/skills are concentrated to the location specified by industry. And build up the specialties by accumulating the technical capabilities, the language capabilities, the assets and the knowledge deployed globally and combining the different strength each Center has to enable us to provide the added value of high and homogeneous quality. Furthermore, Centers of Competency is created where global Subject Matter Expert (SME) specialized in each industry/technology are gathered, leveraging the capability network of all Centers and provide the highly value added services to the customer (IBM Japan, 2012). The project management, the methodology are standardized, basically and compliant to the global standard. Given such a circumstance, we propose the following initiatives for China offshore development expansion.

- Understand China offshore expertise and the offshore strategy by combining them
- Dedicated leader
- Understand China culture

Table 1 shows the differences of the offshore development in the past and now.

Table 1 The differences of the offshore development in the past and now

No	Item	Past	Now
1	Purpose	・Development cost reduction ・Securing manpower to backfill the shortage in Japan	・Further cost reduction in the development cost ・Secure the human resources to backfill the manpower shortage in Japan. ・Improve development speed ・Delivery in the short period of time ・Handle complex projects
2	location	・Specified country	・Set up Global Delivery Center ・Good communication among the difference locations ・Set up Center of Competency with global SME who are specialized in industry /technology
3	Scope	・Limited ・Pilot	・Full life cycle ・Strategic
4	Skill	・Limited	・Accumulate the industry skill ・Build industry/ technical expertise ・People development ・Improve efficiency /drive automation
5	Project management	・Offshore unique ・Under Japanese control	・Comply with global standard ・Autonomy of

			Offshore locations
6	Methodology	・Offshore unique	・Standardized methodology ・Use of common process
7	Team structure	・Under Japanese team	・Team structure aligned with governance aligned with Japan side governance
8	Initiatives for expansion	・Create/explain the detail specification documents ・Use the communication tools ・Assign the bridge SE ・Business trip of onsite SE ・Promote better understanding of Japanese culture	・Offshore strategy by understanding expertise of each location and the combining them ・Use of dedicated leader ・Promote understanding of China culture

3.1 Understand China offshore expertise and the offshore strategy by combining them

Using its vast land and large population, China offshore centers are located at various places with difference uniqueness at each location. As for IBM application development/maintenance for example, Dalian is manly covering insurance customers and distribution customers and Shanghai is mainly covering banking customers and manufacturing customers leveraging the strength they have in specific industry for the development. As for IT skills, they have strength in the process optimization, the automation and tool creation. They also have the mechanism to develop/acquire both business skills and IT skills which will go on continuously. The mentality of China offshore members can be characterized as highly motivated to acquire skills and their learning speed is quite fast. Given the expertise China offshore teams have, we propose to create the offshore strategy as an input to the project management plan. 3.1.1 to 3.1.4 explain about the offshore strategy.

3.1.1 Development methodology/Quality assurance

The development methodology is to minimize the manual intervention which is the root cause of deficiency (including test strategy). The considerations are to minimize the manual works (development, unit test, test case creation, data preparation and test execution/verification), use the existing assets, maximize the parallel execution of tasks and promote the automation and the tools.

3.1.2 Role and responsibility

This section defines the approach of the role and the responsibility sharing between Japan and Offshore. First, all the tasks are broken down into smaller tasks and the process is defined and then share the roles and the responsibilities with Offshore. To avoid hollowing-out of the development and the management due the thoughtless overload to Offshore, the conscious thoughts are required when assigning the tasks, especially to Japanese junior members. Table 2 describes the approach of the roles and the responsibilities between Japan and the offshore.

Table 2 The approach of the roles and the responsibilities between Japan and the offshore

No	Process contents
1	Define the processes for all works in all phases.
2	In each process, the tasks are separated by Japanese SME, Japanese owner, Offshore SME, Offshore owner, and automation/tool.
3	Consider use of the offshore for Offshore SME, Offshore owner and Automation/tool creation.
4	Regarding person in charge of Japanese language, Japanese SME and Japanese owner are basically on-site. Define the required skills and create the offshore resource development plan along with it
5	Verify the process in the pilot and measure the effect and then apply.

3.1.3 Required skills and how to manage

The skills required for the project are defined by process and by role. Then the locations and the members with skill are mapped to them. The project member's skill sets are managed centralized manner to avoid the skills to be stored to some specific location or member. The dedicated team to manage the skills, the planned rotation of the members, the creation of the guidelines/the processes and the resource development plan need to be considered.

3.1.4 Project management

Japan and China use the common management index and processes to manage the project. It is structured to encourage Offshore to manage itself independently. The considerations are required on the compliance to the global standard, the offshore team creation aligned to the Japan team's governance and defining the communication means at each hierarchy level. Do not excessively depend on the offshore development and prepare the team and the processes to check the deliverable of China offshore. Plan to assign Japanese members to the offshore site and the offshore members to the on-site so that both teams can watch each other interactively.

3.2 Leveraging Autocratic leadership

In Table 3 Lewin leadership theory, Autocratic leadership, Democratic leadership and Laissez-Faire leadership are commonly known (WIKIPEDIA, 2017). The project needs to be managed using different types of leadership depending on the characteristics of the project/team and/or the situation. China offshore leaders have tendency to be good at Autocratic leadership. They have strong governance, powerful control and are quick in decision making so that they can be very effective when the project is characterized as below:

- Project with short delivery period
- Large scale project
- Go into the homestretch to achieve the major miles
- Quick and flexible resource assignment change
- Take actions in the difficult phase or situation where the managerial judgment is required.

It is vital for Japan team to make case-by-case decision on the offshore scope by understanding China offshore leader's character and the project/the team situation.

Table 3 Lewin leadership theory

No	Style	Detail
1	Autocratic leader	Authoritarian environments are characterized where the leader determines policy with techniques and steps for work tasks dictated by the leader in the division of labor.
2	Democratic leader	Democratic climates are characterized where policy is determined through collective processes with decisions assisted by the leader. Before accomplishing tasks, perspectives are gained from group discussion and technical advice from a leader.
3	Laissez-Faire delegation leader	Laissez-faire environments give freedom to the group for policy determination without any participation from the leader. The leader remains uninvolved in work decisions unless asked, does not participate in the division of labor, and very infrequently gives praise.

3.3 Promote the understanding of Chinese culture

With the aim to improve the command of Japanese, IBM China offshore is providing the language training outside of working hours and repeatedly conducting the discussion/presentation in Japanese. Not only hosted by training department, China employees voluntarily hold meetings, trying to understand the cultural differences of Japan and China to fill the communication gap. In the project they show willingness to understand Japan project uniqueness such as the quality control indicator and the security requirement the customer demands. On the other hand, Japan team tends to be less eager to understand Chinese culture. For example, the meetings are set without considering one hour time difference from Dalian, the work plan is built ignoring the commuting traffic situation or holidays in China such as Chinese New Year which cause the communication gap. To build the true relationship between Japan and China offshore, the following actions are needed to deepen the understanding of Chinese culture.

- Training relevant to the cultural differences between Japan and China
- Japanese management visiting to China
- Survey research by questionnaire
- Regular-base award to the members who make contribution to the project

4. The projects which actually use China offshore and its evaluation

In this chapter, we use the successful project case which have used China offshore for the development and evaluate the effect of the approach taken for expanding China offshore development. The below is the overview of the project.

- Core system renewal of the financial institution
- Required to ensure the existing functionality and the system structure change
- Conversion to language running on the new platform.
- 4 years of the application development and the test period.
- The target application is more than 5million steps.
- The resources at the peak time: more than 1500 members. And over 50% China offshore.
- China offshore members were allocated at 3 places, Dalian, Shanghai and Japan.

4.1 The evaluation of China offshore strategy

4.1.1 The evaluation of the development methodology/the quality assurance

The project was characterized as the large-scale conversion with guarantee of the existing functions and the automatic program conversion was adopted as the development strategy in order to minimize the manual works which enabled the heavy use of China offshore. In the testing, the comparison of new system test result and the old system test result for verification was applied from early phase of the project to make the best use of the existing assets. The Figure 1 shows the test method. These methods resulted the use of offshore resources to be more than 50% overall, and in the testing phase, it reached more than 90%. No major defect has occurred after the go-live which allow us to give credit for high quality.

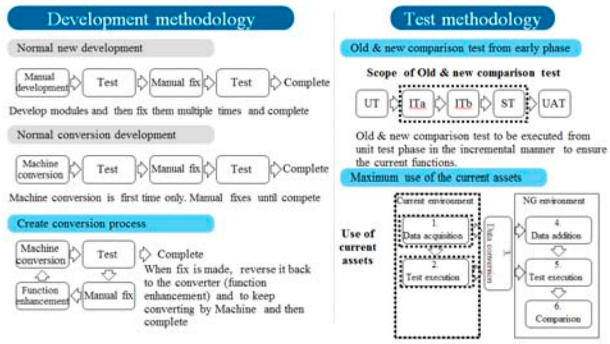

Figure 1 Development method and test method adopted

4.1.2 The evaluation of the role and the responsibility

In the project, the process was to test in the current system and the new system to compare test results from the early phase to guarantee the existing functions using the existing assets and then, the system structure was changed. It was different from the normal waterfall type development process, unique to the project. The approach of Japan/China role and the responsibility mentioned in 3.1.2 was used to define the detailed process and identify China offshore scope. As the result, there were differences in the proportion by phase however, the offshore members were involved in the every phase and over 50% offshore was achieved as a whole. In every process, the automation and the use of tools were promoted to improve the work efficiency. 130 tools were developed which brought 20-50% productivity improvement. Table 4 shows the major effective tool groups for test, library management, defect management and report. The use of tool in the requirement definition, the design, the development and the test was mainly led by China offshore technical member. We evaluate that their IT skill exceeds that of Japan.

Table 4 The major tools developed in the project

No	Group	Detail
1	Test related	・Execution batch tool to execute test preparation, execution, verification and evidence collection. Tool to deploy the test result damp to layout ・Data conversion tool
2	Library management related	・Environment re-building tool ・Data consistency check tool ・Data migration batch tool
3	Defect management related	・Debug tool ・Dump collection/comparison tool ・Abend root cause analysis tool ・CALL information trace tool
4	Report related	・Progress report creation tool ・Quality report creation tool ・Coverage statistics tool

4.1.3 The evaluation of required skills and the management method

In the project, the required skill and the number of required resources were defined for each process and China offshore members were mapped against it. As an example, Table 5 shows the skill mapping for testing. When the sufficient number of members was not available or the members did not have skill, the development plan was created and promoted. Regarding the skill owned by location or specific member, the guideline and the tools were shared and the planned member rotation was conducted to promote sharing of the skill. Figure 2 shows the number of resources move by rotation. We evaluate that we are able to realize flexible resource move/change and skill sharing.

From the fact that we were able to develop more than 40 China offshore members to communicate with the customer in Japan, we evaluate that it was an effective initiative.

Table 5 Test related skill mapping

R : Required

No	Process	Role	Member required	Business skill: General business skill	Business skill: Unique business skill	Development language skill: COBOL	Development language skill: JCL	Development language skill: SQL	Test skill: Test phase understanding	Test skill: Test case specification understanding	Test skill: Test prep-execution procedure understanding	Test skill: Test result verification procedure understanding	Test skill: PD procedure understanding	Product skill: RTC	Product skill: TSO	Product skill: TWS	Product skill: DB++	Product skill: HLLAPI	Product skill: [illegible]	Product skill: File Manager	Product skill: Debug Tool	Product skill: Fault Analyzer	PM skill: Planning	PM skill: Project management	Japanese skill: Speaking	Japanese skill: Documentation	Japanese skill: Reading
1	Test execution /verification/PD	SME leader	20	R	R				R	R	R	R	R	R	R	R							R	R	R	R	R
		Test execution owner	40	R	R		R	R	R	R	R			R	R	R										R	R
		Test result verification owner	50	R	R		R	R	R	R	R	R		R	R	R				R						R	R
		Test result review owner	40	R	R				R	R	R	R	R	R	R	R										R	R
		PD owner	50	R	R	R	R	R	R	R			R	R	R	R		R		R	R	R				R	R
2	Library management	owner	8				R			R				R	R			R	R							R	R
3	Data management	owner	8				R	R		R					R		R		R							R	R
4	Defect	owner	4	R	R				R	R				R	R										R	R	R
5	Workflow management	owner	4												R										R	R	R

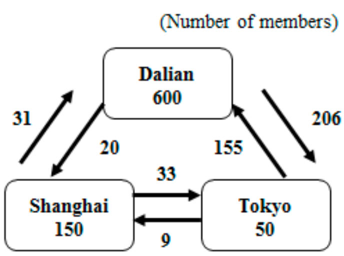

Figure 2 Planned resource rotations

4.1.4 The evaluation of project management

As for the quality control, the quality control team was built in China offshore compliant to IBM global standard which reviewed the appropriateness of the project in each phase from the planning to the development and the testing. Working together with Japan quality control team, the process and the methodology were shared between Japan and China to manage overall quality of the project with uniformity. Figure 3 shows the quality control structure.

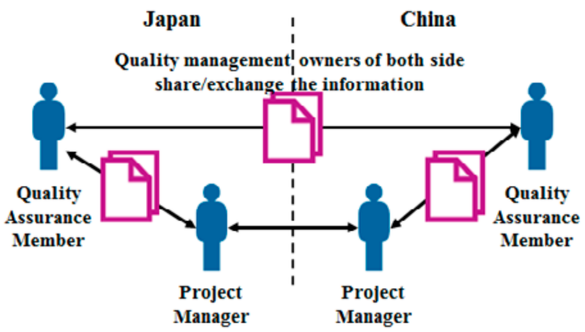

Figure 3 Quality control structures

China offshore team is structured to align with Japan governance team with defined China counter partner against Japan member. The communication means and the escalation path were defined at every hierarchy level for smooth communication. Almost all China offshore leaders have obtained PMP so we evaluate that we were able to manage the project with the structured project management method. Figure 4 is the project organization structure.

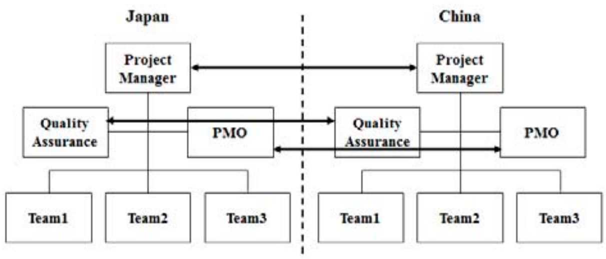

Figure 4 Project organization

4.2 The evaluation of Autocratic leadership

When the test planning and the test preparation delayed, or the starting of the test delayed despite that the test completion date could not be changed, top-down Autocratic leadership made hard push and achieved all the major milestones. When the multiple tests were running in parallel to catch up the delay, the daily flexible change of the member's assignment and the prioritization were important. The team could have overcome the difficult situation by the top-down decision making of China offshore leaders and their strong control. In the final phase of testing, China offshore made decision to execute the tests for 24 hours by 3 shifts to make the final push. It was very effective to leverage China offshore Autocratic leadership. Under such a circumstance, it was critical for Japan team to communicate and share accurately about the situation of Japan team facing, the messages from the customer and importance of the milestones.

4.3 The evaluation of better understanding of Chinese culture

Japan China cultural difference related e-Learning was mandatory for Japan leaders to promote the understanding of Chinese culture. The management and the leaders visited Japan on regular basis and directly talked with China offshore members. We evaluate that those activities have enabled us to understand the real challenges at the team level and build the relationship.

The questionnaire survey was also conducted to Japanese members and China offshore members regarding ideal SE, ideal leader, motivation, the requirements for success, upside and downside of offshore and the result was analyzed and the feedback was provided where there was a huge gap. We found out from the questionnaire result that "words of appreciation from Japan leader" and "award" were effective to motivate China offshore members, so the regular award system was put in place to keep China offshore members motivated. These efforts made Japanese members to understand Chinese culture more and use them for the project management. Table 6 shows some of the questions.

Table 6 The questions in the questionnaire

No	Question
1	What makes SE to be excellent?
2	What makes a leader to be excellent?
3	When do you think you are motivated in the project most?
4	What is most important for the success of the project?
5	What are good about the offshore development?
6	What need to be improved in the offshore development?
7	What motivate you?

5. Conclusion

5.1 Conclusion

In this chapter, we proposed three things; the initiative to expand China offshore development, understanding of China offshore expertise and offshore strategy based on their combination and use of Autocratic leadership and promotion of understanding of Chinese culture. In the actual project, the effects of these initiatives were verified and their effectiveness was proved. We can evaluate China offshore exceeds Japan members, especially in the technical skills for work efficiency improvement such as use of the tools/ the automation and the management skill typified by Autocratic leadership exceeded Japan members. We think Japan members need to reconsider about the perspective of China offshore in addition to the past cases, own experience and the acquisition of new skills.

5.2 Future Prospects

At the beginning, China offshore was positioned as the outsourcing destination of Japan for one small development. As described in this paper, they are becoming a one of major business partners for Japan after going through the various initiatives of Japan and China. In addition, the country risk and the economic impact of the currency exchange and the labor cost raise motivate Japanese enterprises to move the offshore development to other Asian countries such as Vietnam and Philippines. We consider the three initiatives described in the paper are also effective for the offshore expansion in these Asian countries. It is vital to quickly understand the expertise of each country and then create the offshore strategy and build the offshore team with understanding of leader's character. Another success factors were the regular visit of Japan members to China and the questionnaire to understand the mindset difference. Japan will be required to develop with optimal offshore development, leveraging the strength of each offshore location. Among these offshore locations, the importance of the offshore development pioneer, China offshore will increase further. Now we are in the global era where Japan resident Chinese are increasing and the Japanese enterprises are proactively hiring the foreign nationals.

The new technologies such as Cloud, AI and IoT are rising in IT technology. Under such a circumstance, China offshore has technical strength in process creation, automation, tool creation and manual creation and quickly develops new technology capability, so that they should be able to realize the higher productivity and quality by efficiently applying high speed development method using IBM Watson and Cognitive PMO (IBM Japan, 2017). In near future, we expect China offshore development becomes the center for globally consolidated solutioning and resource management by leveraging Center of Competency with global SME specialized in each industry/technology in addition to the latest IT technology.

On the other hand, excessive reliance on offshore aggravates Japan to lose development experience and skill shortage, risking weakening of domestic resources skill level and the hollowing-out. It will also become the risk from the project management perspective. For example, the cost increase due to Japan team's inability to make fair assessment of the offshore estimation, the quality loss due to not being able to check the reliability of the offshore deliverables, the decrease in the customer satisfaction caused from inability to control the stakeholders which will lead to the project failure. To avoid those risks, as the experiences and the skills are built up in the domestic resources in the long run, the judgment to have certain tasks to be covered by Japanese resources in the role and responsibility sharing with the offshore and the skill management are important. In team building, by setting the team to check China offshore deliverables and preparing the checking process will result the prevention of skill loss and hollowing-out. Japan team should not forget about the needs to drive the project management based on the overall optimization perspective in the future.

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In this paper, I would like to give my thanks to project leaders and members who worked together on the offshore project. In Addition, this paper would not be created without the support of Takashi Uesaka (The director of IBM Japan), who gave me the first conceptual idea for this paper. I would also like to express my gratitude to him.

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Application of Agile Development to Parts of System Development having Complex Data Requirements for the Purpose of Inhibiting Rework

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Our company uses waterfall model for system development and ensures its program quality by applying our own quality control measures at the upstream process. However, defects still occurred downstream, causing rework and a possible negative impact on scheduling and costs. The analysis of the defects has revealed that its cause was by the occurrence of a requirement leakage in a project with complex data requirements which were so complex that leakage could not be avoided even when a customer participated in the design review meeting. As a solution, agile development is applied to parts that have high possibility of breaking out the requirement leakage. For the other part of a system development, conventional waterfall model is kept since our upstream process quality control measures are found to be effective. Additionally, upon applying agile development, the risk clarification and the implementation of measures, we considered, are taken with respect to quality, cost, and schedule. As a result, we have substantially decreased the number of requirement leakage pointed out at the downstream process which kept a work on schedule and stayed cost within a set budget.

Keywords and Phrases: Agile, Waterfall, Inhibiting Rework

1. Introduction

In the development of software systems based on the waterfall model, it is important to ensure quality for each process without carrying the defects of a process over to the subsequent processes. Our company has implemented different quality assurance measures for each process to ensure the quality of specifications and programs. In the development of systems with complex data requirements, however, the complexity of the data often causes problems that make it necessary to return to upstream processes to address the missed requirements discovered downstream, in spite of the design reviews involving the client. This rework caused by missed requirements has a significant negative impact on scheduling and costs of the project. The key question, then, is how to detect the missed requirements at an early stage. With the purpose of early detection of missed requirements, we set out to apply the agile development method specifically to complex data requirements, which have a high potential for being missed. This article clarifies the risks involved, the examination of the countermeasures for these risks, and the evaluation of the results of applying the countermeasures.

2. Past Approaches and Issues

2.1 Past Approaches

System development based on the waterfall model chronologically follows these work processes: definition of requirements; basic design; detailed design; production; combined testing; and consolidated testing (Tsukamoto and Saeki, 2015). This method uses stricter planning in upstream processes to reduce the amount of rework downstream (IPA, 2012). The agile development method, on the other hand, accepts the client's changing requests, creating programs that operate within short periods of time in order of priority. It repeatedly checks and incorporates the requirements during the iteration work, while gradually improving the programs' completeness. Any requests from the client to change the requirements are reflected in subsequent development and/or testing phases (IPA, 2017).

Our company develops software systems using the waterfall model. Typical programming issues that occurred in the past include missed requirements, changes in specifications, gaps in the perception of specifications, deficiency in documentation, defective programming, and defective design. Each issue, occurring downstream, creates rework upstream that makes a significant negative impact on scheduling and costs. We have implemented a variety of quality assurance measures for upstream processes to circumvent issues downstream, including the Hitori Ipponme check® technique (Yamada et al., 2010) and design reviews.

2.2 Issues

In spite of the quality assurance measures for upstream processes described above, defects still occurred downstream, causing rework and a possible negative impact on scheduling and costs.

The analysis of the defects that occurred in downstream processes produced the results shown in Table 1, which categorizes the number of identified defects by cause using incidence density (number of incidents/KLOC). Table 1 reveals that, as a cause of defects occurring in downstream processes, missed requirements lead the other causes by far, as indicated in incidence density. This issue arose because the data requirements were so complex that the design reviews, which is the quality assurance measure for upstream processes, failed to notice that not all requirements had been covered, even when the client was involved. This is why the design reviews, which are in place as a quality assurance measure, could not detect defects. Instead, we found that the defects were detected during the test process using the client's data equivalent to those used in actual operation.

On the other hand, the incident density of the other causes such as defective design and deficiency in documentation was low. These favorable results can be attributed to the implementation of Hitori Ipponme check® technique (Yamada et al., 2010) and design reviews, which are the quality assurance measures for the system development based on the waterfall model.

Table 1 Analysis of the Causes of Defects Occurring in Downstream Processes

Cause	Incident Density (Number of Defects/KLOC)
Defective Design	0.06
Deficiency in Documentation	0.05
Missing Requirements	0.27
Gap in the Perception of Specifications	0.02
Change in Specifications	0.07

2.3 Examination of Countermeasures

Based on the analysis results discussed in 2.2 Issues, we looked into measures to reduce missed requirements occurring in downstream processes.

For the missed requirements, which occurred due to the complexity of the data requirements, our examination focused on the fact that they were detected during the test process using the data equivalent to those used in actual operation. Our examination found that it would be effective to check missed requirements with the client at an early point by using a program that operates on the client's data. Based on this finding, we decided to use the agile development method. For the issues not stemming from the complexity of the data requirements, such as defective design and deficiency in documentation, we believe that our quality assurance measures for upstream processes for the system development based on the waterfall model are functioning well. Thus, we decided to develop systems based on the waterfall model as long as the issues did not stem from missed requirements, applying the traditional quality assurance measures. In other words, we decided to employ the agile development method specifically for cases with complex data requirements, thereby applying the agile method to parts of the system development based on the waterfall model.

2.4 Projects to which Measures Were Applied and the Application Method

Table 2 shows the overview of the projects to which measures were applied. For easier evaluation before and after the application of measures, we used projects that were similar to those used in the analysis of issues in 2.2. Table 3 shows the scope of application for the agile development method and for system development based on the waterfall model.

Table 2 Overview of Projects to Which Measures Were Applied

System		Business System
System Structure		Client-Server Model
Development Content		System Reconstruction
Total	Total Development Size	250 KLOC
	Parent Body	900 KLOC
Skills of Member Developers		Experience in Development Based on the Waterfall Model Experience in Quality Assurance Measures for Upstream Processes No Experience in the Agile Development Method
Staff Organization		17
		Supervising Project Manager (1) Project Manager (1) Project Leader (1) Member Developers (14)
Duration of Development		25 Months

Table 3 Scope of Application for the Agile Development Method

Development Method	Development Size (KLOC)	Parent Body (KLOC)	Member Developers (Number)	Dev. Duration (Months)
Waterfall	210	800	11	25
Agile	40	100	3	7
Total	250	900	14	25

Figure 1 shows how the agile development method was applied. The agile development method repeats the requirement definition and development/test combination as a unit of iteration. Tests used the data equivalent to those used in actual operation to detect missed complex data requirements. The missed requirements detected thus were addressed during the requirement definition of the next iteration. Our tests repeated this iteration until all data variations were exhausted.

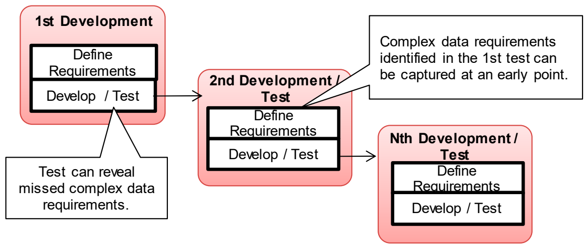

Figure 1 Overview of the Application of the Agile Development Method

Figure 2 shows the work processes where the agile development method was applied to parts of the system development based on the waterfall model. Up to the basic design, the parts where the waterfall model was applied and those where the agile method was applied were implemented simultaneously. The agile method was specifically applied to the detailed design through the combined testing processes.

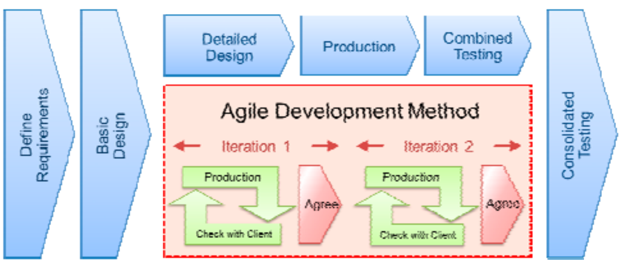

Figure 2 Processes to Which the Agile Method Was Applied

In applying each development method, we identified the risks associated with the quality, costs, and scheduling, as well as examining and applying measures. The following section describes the details.

3. Risks and Countermeasures for the Application of the Agile Development Method

The purposes of applying the agile development method in this project were to reduce rework in downstream processes to “keep the costs within budget” and to “strictly observe the delivery deadline". After setting the target value to zero incidents of rework in downstream processes, we extracted the following three risks expected for this project, and examined the countermeasures for these risks.

Risk 1: Quality Deterioration
The lack of experience in the agile development method on the part of many team members may cause confusion and lower quality.

Risk 2: Increased Costs
The costs may increase if the number of iterations exceeds expectation, i.e., the requirements do not settle.

Risk 3: Delayed Schedule
Numbers of iterations that exceed expectation may delay the project beyond the deadline.

The following section discusses the results of examination on countermeasures for the risks.

3.1 Countermeasures for the Risk of Quality Deterioration

(1) Implement Requirement Check Reviews

As a quality assurance measure to reduce the risk of deteriorating quality, we decided to conduct a requirement check review at the end of an iteration. This review enables the detection of complex data requirements in one cycle. Additionally, the knowledge unique to the operation is necessary to detect complex data requirements and implement appropriate measures for the next iteration. Thus, the project team should include a member who is knowledgeable about the operation from the client side, and one from our company. Further, a programmer should participate in requirement check reviews to share and learn the operation-specific knowledge, so that the changes to be made in the next iteration may be easier to implement. Figure 3 shows the overview of a requirement check review.

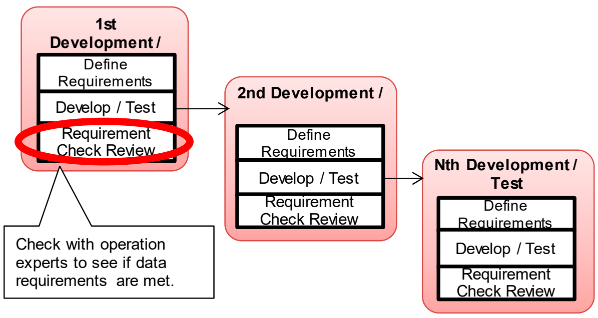

Figure 3 Overview of a Requirement Check Review

(2) Select a Skillful Programmer

Select a skillful programmer to reduce the risks of quality deterioration and delayed schedule. As the agile development method used in this project required programs to be developed in short cycles while maintaining quality, we considered a skillful programmer to be important. Table 4 shows the criteria established for this project for selecting a programmer.

We first considered experience in the agile development method to be a required skill. However, as we had been developing systems based on the waterfall model, it was difficult to find programmers with experience in the agile development method. Therefore, we created the selection criteria on the assumption that the members would use their experience in previously participated system development based on the waterfall model, its productivity, and quality as skills. To develop a system in a short cycle while maintaining quality, we set the criteria for productivity and quality in selecting the members to: possessing higher productivity compared to other members; and meeting the established quality criteria.

As programs are created to operate based on requirements in the agile development method, we consider that design skills are required in addition to programming skills. Thus, we made the selection criteria to include experience in engaging in all processes of system development based on the waterfall model in order: basic design; detailed design; production; combined testing; and system testing. As it is also required in the agile development method to reduce incidents of defective design, deficiency in documentation, and other identified issues not related to missed requirements, we added a criterion of having experience in implementing quality assurance measures for upstream processes for our company's system development based on the waterfall model.

Table 4 Criteria for Selecting a Programmer

Selection Criteria	Description
Productivity	Possesses higher productivity compared to other members.
Quality	Meets the established quality criteria.
Development Experience	Has been engaged in all processes in order: basic design; detailed design; production; combined testing; and system testing
	Has implemented quality assurance measures for upstream processes for our company's system development based on the waterfall model.

3.2 Countermeasures for the Risk of Increased Costs

(1) Utilize the Agile Development Method for the Purpose of Checking Complex Data Requirements

Requirement check reviews are conducted with the client in between iterations. In this development project, the purpose of these reviews was not to change requirements or add functions, which is the case with the normal agile development method, but rather to check complex data requirements. If change in requirements and addition of functions are requested, these changes are managed so that they stay within the expected costs, thereby avoiding the risk of increased costs.

3.3 Countermeasures for the Risk of Delayed Schedule

(1) Prioritize Work

Prioritize work by starting with high-priority work to reduce the risk of delayed schedule. We believe that work with a high degree of difficulty has a high potential for receiving frequent design- and program-related changes due to its difficulty, giving such work a high risk of delayed schedule. It may also be difficult to adjust the client schedule for the actual operation day if the work needs to be put into actual operation early and is used frequently. Thus, priority was decided based on the actual start of operation, the degree of difficulty, and the usage frequency.

(2) Create Countermeasures to Improve Work Efficiency

The agile development method repeats collection of requirements; development; and testing. We believe that higher efficiency during this iteration reduces the risk of delayed schedule. Analysis of the work for which the agile development method was used reveals that the tests that were conducted based on checklists are iterative work, which has a potential of higher work efficiency. This finding led to our belief that higher testing efficiency would improve work efficiency in the agile development method. Based on the results of our examination, we decided to provide test assistance tools (our standard development assistance tool, project-specific data entry assistance tool, and test result check tool). Table 5 shows the overview of these test assistance tools.

Table 5 Tools Provided for Work Efficiency

Tool	Tool Overview
Data Entry Assistance Tool	Enters test data as a batch for a test.
Test Result Check Tool	Automatically compares the results of a test run by a program and the data prepared in advance for verification.

4. Results and Evaluation

This section evaluates the results of the countermeasure application to the risks discussed in Section 3. Items for evaluation were quality, costs, and scheduling.

Tables 6 and 7 show the results of the quality evaluation. These two tables use the density of the defects (incidents/KLOC) that occurred in downstream processes to compare the quality of a similar past project, where the waterfall development model was applied to the entire project, and that of this project, where the agile development method was applied to parts of the development based on the waterfall model. Table 6 compares the defect density for the project as a whole, while Table 7 compares the defect density for the parts of the project to which the agile development method was applied.

Table 6, which compares the two projects on a whole project basis, shows that the defect density for the missed requirements was 0.27 incidents/KLOC for the similar past project, while the defect density for the same defect for this project was 0.01 incident/KLOC. This finding indicates that the requirement check reviews, which were set up in 3.1 (1) as a countermeasure for the risk of deteriorating quality, were effective in significantly reducing the number of identified missed requirements occurring in downstream processes. Table 6 also shows that the density for defects other than the missed requirements for the similar past project and this project was 0.013 incidents/KLOC and 0.012 incidents/KLOC respectively, resulting in approximately the same density. This may be because the use of the agile development method was limited to the parts whose data requirements were complex, whereas the traditional development based on the waterfall model was used for the other parts together with the traditional quality assurance measures.

Table 7 shows that the defect density for missed requirements was 0.00 incident/KLOC for the parts where the agile method was used, indicating that the missed requirements were inhibited. The values for defect density for issues other than missed requirements, i.e., defective design, were approximately the same as those for the past similar project after applying quality assurance measures for upstream processes. This may be thanks to the selection of a skillful programmer who has experience in implementing our quality assurance measures for upstream processes, discussed in 3.1 (2).

Table 6 Comparison of Defect Density for the Entire Project

Type of Project	Dev. Size (KLOC)	Defect Density of Missed Requirements (Incidents / KLOC)	Defect Density of Issues Other Than Missed Requirements (Incidents / KLOC)
Similar Past Project (Waterfall Model Used in All Parts)	150	0.27	0.013
This Project (Agile Method Used in Some Parts)	250	0.01	0.012

Table 7 Comparison of Defect Density by Cause for the Parts to Which the Agile Development Method Was Applied

Cause	Defect Density for the Past Project (Incidents/KLOC)	Defect Density for Parts Where Agile Method Was Used (Incidents/KLOC)
Defective Design	0.06	0.05
Deficiency in Documentation	0.05	0.01
Missed Requirements	0.27	0.00
Gap in the Perception of Specifications	0.02	0.00
Change in Specifications	0.07	0.08

Next, we will evaluate the costs. Table 8 shows the actual cost ratio of the parts of the development where the waterfall model was used and those where the agile method was used with the cost originally budgeted as 100%. The actual cost of the agile-based parts of the development was 94%, keeping the cost within the original budget. In addition, the waterfall-based parts stayed around the budget, with the overall project staying within the original budget. These results may well be thanks to the significant reduction of identified incidents of missed requirements discussed in the quality evaluation section, and the countermeasures for the increased cost risk discussed in 3.2.

Table 8 Cost Evaluation

Development Method	Original Cost (%)	Actual Cost (%)
Waterfall	100	98
Agile	100	94
Overall	100	96

Next, we will evaluate the schedule. Similar to our evaluation of the costs, we will evaluate the schedule of the waterfall-based parts of the development, and that of the agile-based parts, respectively. Table 9 shows the duration of development originally expected and the actual duration of development. Both the originally scheduled duration and the actual duration were 25 months, enabling the project to complete on schedule for a timely delivery. These results may well be thanks to the significant reduction of identified incidents of missed requirements discussed in the quality evaluation section, and the countermeasures for the delayed schedule risk discussed in 3.3.

Table 9 Duration of Development

Development Method	Original Duration of Development (Months)	Actual Duration of Development (Months)	Deviation
Waterfall	25	25	0
Agile	7	7	0
Overall	25	25	0

5. Conclusion

The analysis of the causes of rework occurring in downstream processes of our past development based on the waterfall model revealed that missed requirements occurring in system development dealing with complex data requirements was the major cause. To countermeasure this, we used the agile development method in parts of the waterfall-model-based system development. In using the agile development method in parts of the waterfall-model-based system development, we extracted risks, and examined and applied measures from the quality, cost, and scheduling aspects.

As a result, we were able to significantly reduce missed requirements, as well as keeping the cost and schedule within the originally expected values.

We would like to implement the following in the future:

(1) In the agile development method, documentation is restricted to the requisite minimum, making it possible for the creation of documents necessary for maintenance and operation to have been omitted. We need to evaluate the need for documentation based on the maintenance and operation of this project, thereby improving the definition of the documentation deliverables for the future agile-based development from the maintenance and development aspects.

(2) We will be checking the validity of applying the agile development method to similar projects by continuously collecting the quality evaluation results. Although, in this article, the scope of application of the agile development method was determined based on the decision of our experts, we will also need to be checking the validity of the way we determine the scope of application. In applying the agile development method, however, we will need to have a correct understanding of the characteristics of a project in its planning phase and have our experts review the issue carefully, before deciding whether or not to apply this method.

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The Communication Challenges for Overseas Project Management in Japanese Multinational Companies

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As long as globalization becomes more and more important for Japanese Companies to expand its overseas businesses on a sustainable way, it consequently generates several challenges that domestic centered Japanese companies need to deal with for a proper global expansion. On the project management point of view this is no different. The process of globalization implies a wide range of challenges, however, one in specific is the very fundamental element for a successful overseas project management which is communication. The term communication comprises not only the adoption of a common business language but also comprises how the information flows through the project management stakeholders. This element has a vital importance for an international project management environment whose teams' members usually have different background, different level of education and of course, make use of different languages. This article will focus on the analysis of the main communication issues on project management that Japanese multinational companies face on the process of internationalization. In addition to it, this article will also analyze a case study where a lack of communication negatively impacted the project rollout in an affiliated Company. Finally, this article will describe the lessons learnt and the countermeasures taken to mitigate the communication issues between the Japanese headquarter and its overseas affiliated Companies.

Keywords and phrases: Communication Issues, Globalization, Language, Overseas Project Management, Overseas Businesses

1. Introduction: Why internationalization is crucial for Japanese Companies?

Throughout 1980s and early 1990s, Japanese Companies have achieved a tremendous expansion of its businesses by taking over its home market and heavily investing in R&D and its industrial base. During this period, the strong demand of the internal market aligned with the heavy investment of the Japanese companies on its industrial base and the strong demand for exportation, have led the companies to drive its attention into its home market rather than expanding in overseas.

However, the market conditions, both internal and external are no longer as favorable as it used to be for Japanese companies. Considering that the process of globalization became the fundamental basis of the world´s economy contributing with the unification of the global market, several non-Japanese companies have penetrated once insular Japanese market bringing a stronger competition Japanese companies did not have in the past on its home market. In addition to it, several researches indicates that the Japan´s market is expected to shrink as the demographic trends show that the population of Japan will be reduced by 15% in 2050 and by 34% in 2100 in comparison to 2015 as shown on the following table:

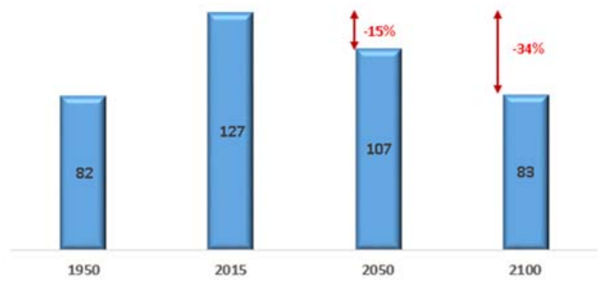

Figure 1 Population demographic trend in Japan (in million).

While the demographic trend of Japan indicates the population will decrease over the next decades, the same research indicates the population of emerging markets (especially India and Africa) will considerably increase as shown on the below table:

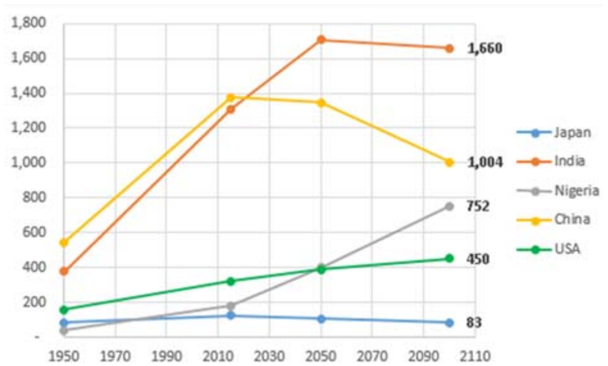

Figure 2 Population demographic trend comparison (in million).

The above scenario indicates that the demand of emerging markets in Asia and Africa will considerably increase on the next decades as a consequence of population growth, therefore the multinational Japanese companies need to seriously consider the overseas expansion as an important and crucial part of a sustainable growth plan for the upcoming years. In other words, Japanese companies need to consider in the present all challenges the process of globalization requires for a successful global expansion.

That being said, this paper intends to describe on section 2, the challenges Japanese companies face on the process of globalization and how it affects the project management on overseas market, determine a problem to be discussed on section 3, scrutinize the focus problem on section 4, analyze a case study on section 5, describe the lessons learnt on section 6 and finally on section 7 describe the conclusion of this article.

2. Common issues faced by Japanese Companies on the process of globalization and how it affects the project management on overseas market

As long as globalization becomes more and more crucial for Japanese companies to expand its business in a sustainable way, it consequently generates several challenges and issues that domestic centered Japanese companies need to deal with for a proper globalization expansion. On the project management point of view, this is no different. To deal with the project management on an overseas environment which generally involve several stakeholders in different countries, with different background, way of management and different language it´s crucial to understand these elements in beforehand to properly deal with a multicultural environment that the process of globalization requires.

On the below are listed the most common issues faced by Japanese Companies on overseas project management:

I. Cultural Difference: The cultural difference is unavoidable as it affects not only Japanese Companies but all other organizations that consider to expand its businesses into overseas markets. However, this item plays an important role on the globalization process and therefore, the project management as it is the first step to understand what value is on a customer point of view, and more importantly, how project management can deliver such value to the local customers.

II. Different level of maturity in project management: A diversified environment which is one of the main attribute of overseas project management, implicitly indicates that a different level of maturity and education in project management are expected. Therefore, the consideration of this subject in beforehand is quite important in order to equalize the principles of a proper project management among the stakeholders involved with an overseas project.

III. Communication issues: Inevitably one of the main issues faced by all enterprises when they consider to move to overseas market is the language itself. Which language the companies should use when they´re dealing with an overseas project management? The answer seems to be obvious but when the players are non-English speaking companies the answer might not be so obvious. Of course the language itself does not necessarily mean it will generate a communication issue, however it´s plays an important role of communication issues the Japanese companies face when they need to deal with non-Japanese speaking stakeholders.

IV. Different methods of decision making in local companies and the head office in Japan: Different companies have different methods of decision making on project management. This statement is very well noticed when we compare Japanese Companies with Non-Japanese companies. The decision making in Japanese companies is usually a collective process that involve several stakeholders. Depending on how complex the Company´s structure is, the decision making might take more time than non-Japanese stakeholders expects as it usually involves a considerable number of Japanese stakeholders that need to be acknowledged about any subject related to project management.

V. Organizational differences: The Japanese headquarter usually has a complex organizational structure that allows the Company to have a dedicated division or department focused on project management and project risk assessment. For the affiliated companies however, the human resources structure are usually very lean and it´s very common to see the project management (especially project risk assessment) being carried out by a department that usually has a different scope of activities (e.g. Financial Planning, Sales, Accounting, etc.). As a consequence of that, the project risk assessment sometimes is not well performed due to limitation of human resources in local affiliates.

3. Objective

Despite the wide range of challenges faced by Japanese Companies on the process of globalization, this paper will concentrate the analysis of the communication as a key factor for a successful implementation of the project management on overseas affiliated companies.

Firstly, this paper will analyze the main communication issues on a multilingual and multicultural environment as a consequence of overseas business expansion. Secondly, analyze a case study where the lack of proper communication negatively impacted a project rollout in an affiliated company. Thirdly, analyze the lessons learnt and countermeasures taken in order to mitigate communication issues.

4. Communication as key factor for a successful project management in an overseas environment.

The overseas business expansion for Japanese Companies has turned into a key element for the sustainability of most of big corporations in Japan. The once domestic centered Japanese companies have to plan and consider how to drive a sustainable overseas growth as a consequence of the expected decrease of domestic market in future. Thus, the impact of globalization process on the Company's internal processes and management is inevitable. This assumption is also valid for the overseas project management and on the below are listed the main issues identified:

I. Business language: The adoption of a common business language is mandatory element for a proper identification and risk assessment on projects. Nowadays, English has turned into an unstoppable trend and has been adopted as the common business language in basically all businesses transactions and situations. However, for non-English speaking Companies, this subject can play an important role for a poor communication between headquarter in Japan and the local affiliated Companies due to lack of an appropriate proficiency in English on both sides. As a consequence of poor communication among the project's stakeholders, several issues on projects rollout can occur without the preparation of a proper contingency plan to minimize these risks (implies the Companies to be more reactive rather than proactive).

II. Who are the stakeholders of the project? This is one of the most important communication issues faced by the affiliated companies under the management of Japanese Companies. Usually the Japanese headquarter has a complex organizational structure which implies a wider range of stakeholders that usually are unknown by the affiliated companies. This issue can generate unnecessary communication noises that can become a considerable obstacle for the project management between the multinational Japanese Company and its overseas affiliated company.

III. How decisions are made? This is also an important part of the project management that need to be properly communicated. Usually the process of decision making on affiliated companies and its Japanese headquarter differs from each other. This means the length of time needed to get things changed and approved are also different as a consequence of organizational structure differences. The lack of an appropriate communication on this subject can generate delay in decision making or even induce to take important decisions without a proper assessment of the risks on the projects in question.

IV. Documents, guidelines and educational materials not translated into other languages: Despite English being considered as a common business language for most of the enterprises in the world, for non-English speaking companies, this issue can be an important element for the communication detachment between the headquarter and the affiliated Companies. Usually the key resources of the local project management have English proficiency that can facilitate the communication between the head office and the local business. However due to the lack of time of the project managers sometimes they can't act as translators for the remaining members of the project management team, and therefore, important instructions sent by the head office in English can't be fully understood by all members of the group.

5. Case study on an affiliated company: When the lack of proper communication can negatively impact a project rollout

In order to better illustrate how communication can play an important role on a project risk assessment and rollout, this paper will describe a case study where a lack of communication was the very fundamental driver of the project fail. Due to the complexity of the project, some items have been simplified and the analysis will be focused only at the perspective of communication problems that affected the project rollout. On the below is described the details of the case study and the main problems identified.

5.1 Case study

An overseas affiliated company has considered to enter into a public tender for a significant IT manufacturing project with the local government. Due to the size of the project, the decision to participate or not on the public tender has been escalated to the head office in Japan. At that time, the project risk assessment team had been recently established and the methodology of risk assessment was not yet well understood by the overseas affiliated companies. Moreover, the person in charge for the said project at the affiliated company was originally a sales person who had no previous experience in project risk assessment especially on the financial point of view.

During the project risk assessment, the head office had distributed in advance a checklist expecting the local project stakeholders to study and assess the risks involved on the said project in advance to the risk assessment meeting. However, as the time was running out some items of the risk assessment list were overlooked and the head office stakeholders have not being informed about a key issue of this project related to exchange rate risk. As the project was addressed with the local government, the expected income related to it was agreed to be received in local currency, however, the components of the manufacturing products were determined to be purchased in dollar as the supplier of the components was a foreign company.

After deciding to participate in the public tender, the local affiliated company had been finally awarded with the said project. However, after being awarded the Country faced a strong devaluation of its currency in comparison to dollar and the euro and, as consequence, the project's profitability dramatically decreased generating a significant loss for the Company that had not been initially expected. The devaluation of the local currency had brought to the affiliated Company a significant loss that affected not only the Company's profitability but also the Company's Cash flow.

As a consequence of that the project rollout had been severely impacted due to the successive losses and lack of cash to pay the suppliers in an appreciated currency.

5.2 Communication issues identified

On above case study, there were several communication issues identified that negatively impacted the project rollout as described on the below:

I. Lack of clear communication among the stakeholders about the exchange rate risk of the project.

II. Lack of communication in sharing with the local affiliated Company past experiences about how to properly assess risks on projects (especially those involving financial risks).

III. The local project manager did not have access to educational material about project risk assessment.

IV. No formal and standardized process for project risk assessment was available at that time.

Essentially the lack of communication about the exchange rate risk among the project stakeholders was definitely the root cause of the unsuccessful performance of the said project. At that time, a formal and standardized process of risk assessment was not yet available that consequently allowed a key project risk to be overlooked by all project stakeholders. In addition, a lack of internal communication tools (e.g. intranet, project management risk website, etc.) to share best practices on project risk assessment was not available which also contributed for the exchange rate risk on the project be overlooked by the stakeholders.

6. Lessons learnt and countermeasures taken in order to mitigate communications issues

In order to avoid the same problems in future, several actions have been taken in order to improve the process of project risk analysis and also improve the level of communication among the stakeholders. On the below are listed the main actions taken:

I. Creation of a standardized process for project risk assessment.

II. Establishment of a clear approval flow that may differ depending on the size and importance of the project.

III. Creation of project risk management website where the local affiliated companies can easily navigate and find essential documents about project risk management.

IV. Implementation of educational training in order to increase knowledge about project management and share renowned best practices established in PMBOK and PRINCE2.

V. Translation of as many project management documents as possible at least in English in order to assure a better understanding about the key activities of project management.

VI. Engagement of key sponsors in each affiliated Company in order to ensure the project management rules and practices will be fairly adopted by all related people.

All the above actions had the essential purpose to increase the communication between the head office and the local affiliated company and also minimize the knowledge gap among the people involved on project management.

7. Conclusion

The process of globalization is an essential and important part of a sustainable growth plan for the big Japanese corporations. Therefore understand the communication challenges this process generates especially at the project management point of view, are the fundamental basis for a successful overseas expansion. Communication issues are often seen on project teams which have a common language but when the project is widened to an international environment, the communication plays an even more important role on project management. The most common communication issues identified between the Japanese head office and its affiliated companies on project management were the lack of knowledge about who are the stakeholders of the projects, how decisions are made and of course the language itself.

In order to overcome those communications challenges, several actions were taken such as to create standard project management documents at least in English, to create a communication channel (e.g. intranet) where the project managers can easily access documents, educational material, approval rules, etc. In additional, it was essential to engage key sponsors in each affiliated company who took the role to encourage the project management team to study and acknowledge the principles of project management established by the head office. In-class and virtual trainings were also an interesting tool used to avoid communication problems on project management.

As a conclusion, when a proper communication channel is established on a project management environment (especially those involving overseas stakeholders), critical issues become easier to be identified which will surely contribute for a successful business expansion to overseas markets.

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Increasing Uncertainty – The Essential Need for Competencies beyond Planning and Controlling

Astrid Kuhlmey Matthias Winnig
Sicher durch Veränderung

Business world is becoming more and more complex, thus there is an increasing need to cope with unexpected occurrences. Especially within projects, which are defined as „unique“ and very often seen as „business adventures“, planning and controlling comes to it’s limits. Risk management and agile approaches aim to be an answer, however they are still designed on planning principles.
In 2016 German project management association (GPM) has published an expertise “Handling of unforeseeable events within projects” describing and evaluating the “as of situation” by scientists and practicing experts. One major outcome is that there are competencies beyond planning and controlling where projects can benefits from. These competencies can be trained in advance to be capable of acting when unexpected events appear.
Based on the outcome of the expertise, the presentation will exemplarily illustrate one typical approach to prepare yourselves for the “unexpected” incorporating scientific background and practical experience. A brief exercise will be included. In addition, a short structured summary of further approaches and their basic assumptions is provided.

1. The need for competencies beyond planning and controlling

Projects are defined to be “unique” or even “adventures”. Thus it cannot be predicted what in detail will happen. However, planning and controlling is essential to achieve the objectives:

- The plan gives orientation how to proceed.
- The planning process is very helpful to get an understanding of how the project looks like.
- The plan reflects the common understanding of all team members how to proceed and therefore is essential in communication within the team and with stakeholders outside the team.
- Deviations from plan are signals that objectives might be in danger.
- And: Planning and controlling is an instrument to feel safe which is essential to keep the capability of deciding and acting.

Planning and controlling therefore is a basic competency in project management, and must not be omitted. However, it does not reflect real project life and even the best plan is not the promise that reality will follow it ;). Future cannot be predicted which at least by definition is valid for initiatives specified as unique.

The extensive development of the discipline “risk management” is one attempt to cope with this situation. However, risk management is also a plan-based approach, as it covers the “known unknowns” and outlines what can be done in case they appear. That does again not include unpredictable occurrences. To eliminate the “unpredictable” planning and controlling is a comprehensible, usual but useless attempt as it does not cope with it. Therefore it needs approaches which go beyond planning and controlling. These approaches have to fulfill the very simple but fundamental requirement to keep or make the project team (the actors) capable in deciding and acting even if something appears which could not be predicted. Thus it needs a practice which makes them feel confident and safe - even if the plan becomes invalid.

2. Terms and Definitions

Before we will look into the approaches more in detail, we have to agree on some terms which describe the “unpredictable”.

Unforeseeable / unexpected

Occurrences which cannot be predicted even if the plan is close to perfect are “unexpected” or “unforeseeable”.

Unsafe

"Unsafe" describes the state of a human being when the unforeseeable occurs. Human beings then tend to feel uncomfortably, they tend to get afraid by losing control. That might lead to fear, to stress and the loss of the capability to (re-)act.

Uncertainty

Uncertainty describes the universe of unforeseeable occurrences. "Life is uncertain" is a kind of a mindset and a personal believe: Even if you widen knowledge infinitely, you cannot predict the future. From a more practical standpoint it is irrelevant whether or not you can predict the future. Even if you could, the effort to do so would increase dramatically and the gain of a perfect plan is highly questionable. However, the underlying mindset influences project management culture and there is a significant difference whether you assess uncertainty as "disturbance" or even "error" or you assess it as something which cannot be avoided and even might open new opportunities. However, in both cases uncertainty cannot be controlled.

Complexity

Complexity means that the number of parameters influencing the current situation exceeds the potential of the human beings dealing with. Thus it is clearly distinguished from uncertainty. Very often these parameters are "homemade", and there are approaches like "complexity reduction" where you regain "control".

Doubled Uncertainty

In case of the occurrence of an unexpected event further unforeseeable occurrences appear when trying to "solve" or better deal with the situation. Objectifying action (based on planning and analytical procedures) does not suffice to cope with the situation.

3. How to act with uncertainty?

In 2016 German project management association (GPM) has published an expertise "Handling of unforeseeable events" describing the "as of situation" and providing structured approaches how uncertainty could be handled and what might be their benefit for projects (Böhle et alii, https://www.gpm-ipma.de/know_how/studienergebnisse/umgang_mit_ungewissheit_in_projekten.html). The authors have gathered scientific approaches as well as implemented approaches. From both standpoints they are offering structures how to maneuver in uncertainty. The following aspects describe major outcomes of the expertise:

- All approaches provide a feeling of safety beyond planning and controlling. Some are offering a model how uncertainty can be structured (e.g. based on hero's journey or Ken Wilbur) others strengthen the personal (inner) stability and self-confidence by facilitating sensing and intuition.
- There is no toolbox. However, there are competencies which can be trained while and in advance to unexpected occurrences.
- Most approaches are holistic,
  - Embodiment is an essential part. Intellect does not play the major role as it does in the classical project management.
  - Instead of planning and controlling (which are mainly intellect driven) it needs competencies like creativity, intuition, mindfulness, perception, expert know how based on experience. These kinds of competencies are perfectly represented by Mr. Scott (Scotty) from Star Trek (see below).

4. Competencies beyond planning and controlling

When we have a look at Mr. Scott what do we remember first. I remember him saying "The impulse will collapse in a few minutes", I remember that "trial and error" was his course of action in critical situations, in situations of uncertainty. I remember him "talking" with the engine. This is what our scientific colleagues from ISF (Institut für sozialwissenschaftliche Forschung e.V.) call "subjectifying experience-based action". It is described in four levels:

- **Proceeding**

which is explorative, discovery-oriented and dialogical

- **Thinking**

which is associative-pictorial

- **Perception**

which is sensual (based on „feeling")

- **Relationship to the environment** (not only to human beings but also with objects) which is characterized by close, affinity unity, empathy.

This perfectly fits to what Mr. Scott does. He perceives the engine by sensing. Therefor he needs to have a close and empathic relationship with it (sometimes he even “seems to be the engine”). When dealing with issues pictorial retrospections or even new pictures pop up and he proceeds carefully and exploratory moving towards a solution.

During this process he increases his expertise, his know how by direct learning while doing. This is what our ISF colleagues call “experienced-based knowledge” and based on that “experienced-based action”.

Now it comes to the question how to prepare ourselves in advance (before the unexpected occurrence appears).

Experienced-based learning and subjectifying action are based on some underlying meta-competencies:

- Knowing and accepting myself (self-confidence) - not in the sense of ego (“self-appreciation”) but in the sense of self-recognition.
- Taking the liberty to make mistakes.
- Having pleasure to explore.
- Perceiving (as long as possible) before judging and deciding (mindfulness).

To improve these meta-competencies it needs personal safety and stability.

Perfect media to train these competencies and the process of experienced-based learning are Martial Arts, esp. Internal Martial Arts, and their underlying principles:

- Personal safety and stability is caused by the so-called “inner stability”. It is “located” in the human body and can be easily called up when sufficiently trained.
- Self-confidence, humility and mindfulness are objectives in Martial Arts.
- Perceiving without or better as long as possible without judging is a principle in Martial Arts.
- Making mistakes is an immanent part of the learning and training process.
- Embodiment of the competencies leads to sustainability.
- Pushing hands (the two person training routine of the Internal Martial Art Taijiquan) with it four steps (Ting Jin: listen to energy/power, Dong Jin – understand energy/power, Hua Jin – bypass energy/power, Fa Jin – add energy/power) is an excellent example for subjectifying action.

But as said before, Martial Arts do not provide a toolbox but they are a holistic impulse to get the picture of what it needs. And it should be understood as stimulation for a lifetime learning process to improve resources beyond intellect: Again remember Star Trek and Lieutenant Commander Worf, who constantly exercises Martial Arts which stabilizes him to not only survive uncertainty but also gain from it.

5. Summary:

Projects per definition make the demand on project teams to be capable of deciding and acting when unexpected occurrences appear. The existing project methodology – even considering agile approaches - is based on planning and controlling capabilities which are not really suitable for and in uncertainty. Approaches dealing with uncertainty are usually holistic and facilitate the human need for safety which is a pre-requisite for being capable to act. For this purpose some make use of a model, where you can “locate yourself in the situation of unexpected occurrences” others strengthen the resource of personal (inner) stability. Both can be trained in advance to unpredictable occurrences.

During more than 20 years ISF Munich has worked out a sociological approach how to supplement intellectual approaches (objectifying action) with an experienced-based approach. The underlying meta-competencies and the learning process can be trained in Martial Arts. Hereby the role of the body in business environments changes from trouble maker to invaluable resource.

6. Attachment: Exercises

Exercise „Standing“

Practice:

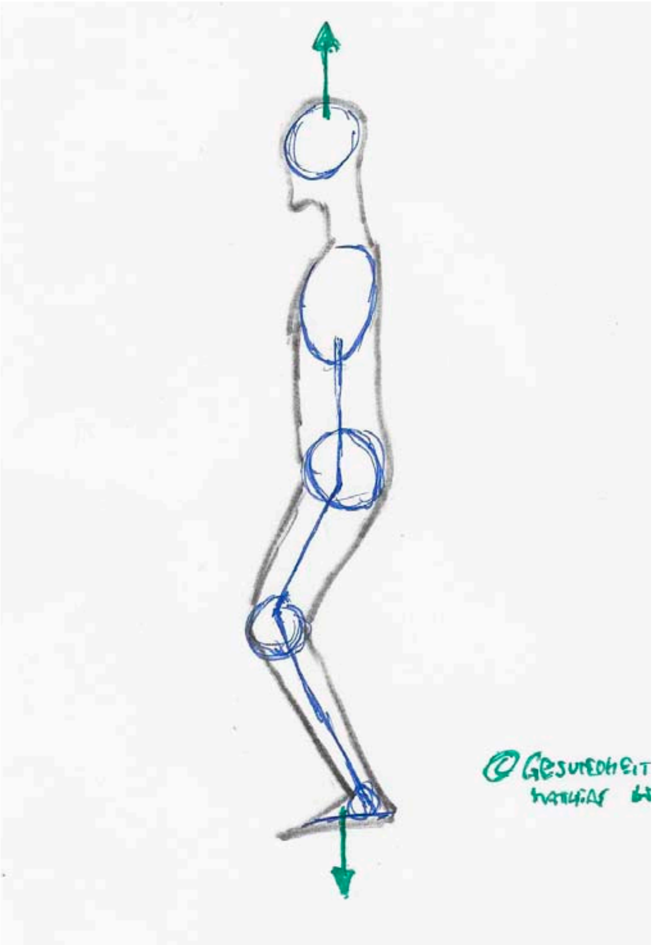
1. Standing as we are used to in business context -

or as it is educated in Germany: "Chest out - Belly in"
Span yourself by

- Exerting your upper body
- Stretching your shoulders
- Slightly tensing your face (but still smile ;))
- Straightening your knees

2. Standing as we trained in Taijiquan

Position yourself in natural posture by



- Bending your knees slightly
- Hips and backside like “sitting on a bar stool”
- Back relaxed and straightened up
- Shoulder tensionless
- Relax your jaw

<u>Questions for personal reflection / observations:</u>

- What did you perceive?
- What made a difference between the two poses?
  - How did you perceive your feet?
  - Where in your body did you sense your balance point?
  - Where did your perceive the weight of your body?
- Which pose seemed to be more stable, which one safer?
- Which pose was “more efficient”?

<u>Messages I want to share:</u>

- Taijiquan posture reduces tension, lowers balance point.
- Business posture carries a portion of weight in upper muscles, needs more energy.
- In business context, esp. when presenting, business posture signals importance and self-confidence.
- Taijiquan posture increases mindfulness and perception.
- Both postures lead to presence and concentration, therefore no posture is superior. Which one to choose depends on the context and the energy consumption, you are willing to spend. "There is always a price you have to pay ;-) "
- Perception and mindfulness is one basic competency when it comes to uncertainty.

Exercise „Standing with Movement“

<u>Practice:</u>

1. Standing in Business Posture
- Start moving forward and backward
- Keep posture!
- Amplify movement
2. Standing in Taiji posture
- Start moving forward and backward
- Keep posture!
- Amplify movement

<u>Questions for personal reflection / observations:</u>

- What did you perceive?
- What made a difference between the two poses?
- Which posture seemed to be more stable, which one safer?
- What happened when you fall?

<u>Messages I want to share:</u>

- Both postures stabilize but the stabilization process is different
  - Business posture is our cultivated reaction – we increase tension - when we are under pressure or have to move. Therefore business posture makes us feel safe. We are under the impression that as we control muscles we also control the movement.
  - Taijiquan posture is strength in flexibility, with every movement we “re-stabilize”. Feeling rooted makes us feel save and really self-confident
- When movement overspends stability, in both postures we pass out. However, in Taijiquan posture passing out is more stress-free as it is softer and less hurting.
- When it comes to uncertainty being flexible, stable and feeling safe is a basic competency. The

feeling to be safe is generated by our body when she/he is rooted and centered. This can be trained in advance to the situation of uncertainty.

Wagile: Combining Waterfall and Agile Methods, its Advantages and Challenges

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This paper examines a case where Agile software development method is partially incorporated into large-scale mission-critical IT system development. Conventionally Waterfall method has been generally employed for such kind of development in consideration of controlling delivery dates or legal constrains. Meanwhile, in a project delivery in which the authors have taken parts, we faced some requirements that are characteristic in recent years, such as flexible and efficient development process, or rapid transformation of the client's business environment. To meet those requirements, it was recognized that Waterfall method has reached limits and it can be effective to partially incorporate Agile methods. Specifically, requirements clearly defined at the beginning of this project were handled using Waterfall method, while ones not clearly defined or recognized at development phase of Waterfall method were dealt with Agile method. The latter were designed and implemented incrementally and iteratively, and released separately at multiple timings. At the part where Agile methods were applied, we tested applying Scrum partially to existing process for Design Change Requests (DCRs). The team has implemented this "Wagile" method, a Waterfall + Agile hybrid, in the field and found it fairly effective in terms of delivery time and efficiency. This paper describes the method in detail, its advantages, and challenges we have faced.

Keywords and phrases: Frequent Releases, Waterfall, Agile, Wagile, Mission-Critical System

1. Introduction

This paper discusses an IT system development project, in which we built a Manufacturing Execution System (MES) for factories of flat-panel display devices. The system has the following characteristics:

- A mission critical system that requires 24/7 up-time
  The system is vital to keep day-to-day operations running at the production site. The factory basically has its operation running 24 hours a day, throughout the year. That in turn requires the system to establish sufficient quality and availability. Unexpected down-time caused by troubles such as system failures immediately halts all operations throughout the factory. To prevent such situations, it is necessary to aim for a certain quality level starting from when the system is being developed, to implement a stable system.
- Detailed documentation
  The system in practice is utilized by operators at the production site. On the other hand, the communications throughout the development phase is primarily dealt with by the members from IT department of the factory. Therefore, it is vital to confirm the consistency between the system's design and the requisites from the production site. It is achieved by producing relevant documents, and establishing an agreement based on them. Furthermore, they will be also useful to provide a sufficient serviceability, and to ensure future extendibility.

Conventionally, development of these kind of system should have been achieved by applying a waterfall model, to secure quality and schedule. In fact, waterfall model had been widely applied in development of the MES system at the authors' department.

On the other hand, recently an increasing number of requirements have been observed that do not fit conventional development method well. This can be explained by the client enterprises being in increasingly fierce competition. For example, display devices for smart phones are in its shifting trend to gain higher resolution, larger size, and curved surface. The quickness of incorporating changes like these has been increasing dramatically in the last several years. As a result, manufacturers of display devices are facing challenges in converting its product models or modifying their specs, to keep up with the market's demand. To cope with this, they need to bring in new manufacturing equipment or sometimes to set up a completely new factory. This in turn requires a number of modifications to the MES and their operations.

One of the recent system requirements to MES is an adaption to a new production model. As described above, quick and solid ramp-up of the new model is essential from the business point-of-view. This brings some new requirements to the MES development project, that were hardly observed before. In the next chapter, those characteristic project requirements will be explained.

2. Project requirements

(1) Functional requirements gradually taking shapes

The first one is that functional requirements are not fully clarified at the time when the contract is signed.

When the factory is preparing to manufacture a new model, it is expected that MES will also need some new functions, or modifications to its existing functions. As the new model needs to be manufactured as soon as possible, changes to the system will be developed in parallel, well before the factory completely establishes its manufacturing process for the new model. On the other hand, the manufacturer's business perspective imposes some limits on when the new model needs to start being produced, and how much money can be spent on IT-related (i.e. MES) modifications. This leads to the situation where signing the contract of system modification defines the term and cost, while what should be achieved in the contract will be partially determined after starting the project. It is also expected that all functional requirements cannot be clarified in a short term, but rather they will be gradually settled as the project progresses.

Under the conventional waterfall method, such situation would require signing a separate contract that handles only the requirement definition process. Then using the outcome of this first contract, term and cost of the remaining work would be estimated and incorporated into the second contract. However, in the case that this paper discusses about, it is not possible to fully define all requirements in the early stage, while the term and cost of the whole project is imposed for a business reason rather than a technical one. Therefore, it requires some mechanism that provides a flexibility, allowing the project to adapt to new or changing requirements through its term.

(2) External interface with flexibility

There are several external sub-systems that communicate with the MES through inter-system interfaces. Those sub-systems include controlling systems for manufacturing equipment or product transporters. As a part of preparation for new models, those external interfaces can also be added or modified. In the design phase, it is necessary to define interface specification, while the testing phase requires actual implementation of the said external system. Those work items are performed by the vendor of each sub-system, based on separate contracts between the vendor and the client. Therefore, they are not always in sync with the MES modification project.

Those cases, like (1), also require some mechanism that can handle specifications or schedule determined gradually through the project.

3. How to proceed development

These days, customer's requirements reach to both of two demands, to set up production environment rapidly and to implement functions specialized to customer's circumstance in a project of application development. To achieve this, it is efficient to use original MES assets IBM own rather than developing a system from scratch. Both of the two demands above can be realized by developing either customization based on MES asset or modification for new requirements that the customer raises.

However, all new requirements are not always clearly defined at the beginning of the project. Some are raised in middle of the project and it is usually not clarified which part should be implemented first and which should not immediately.

Therefore, two methods in combination are applied to manage both of requirements; those clearly defined at the beginning of the project and others not even in the middle of the project.

In the following explanation, these keywords are used to simplify the description;

- Base Development: to customize based on MES assets,
- Earlier Requirements: those clearly defined in the beginning of the project,
- Later Requirements: those raised in the middle of the project or not clarified in the beginning.

The two methods in combination are Waterfall method and Agile method. In the way to proceed development projects, Waterfall method is used to manage Base Development and modification for Earlier Requirements, and Agile method to manage modification for Later Requirements.

Figure 1 shows all of development tasks divided into management areas of the two methods.

(1) Tasks to proceed with Waterfall method

As described above, Base Development and modifications for Earlier Requirements are managed with Waterfall method.

Base Development is consisted of customization tasks from MES asset into specialized system for customer's environment. It includes some changes of middleware configurations for customer's environment like schemas or tables name of database. It also includes changes of descriptions for customer's name or system name in UI of client applications.

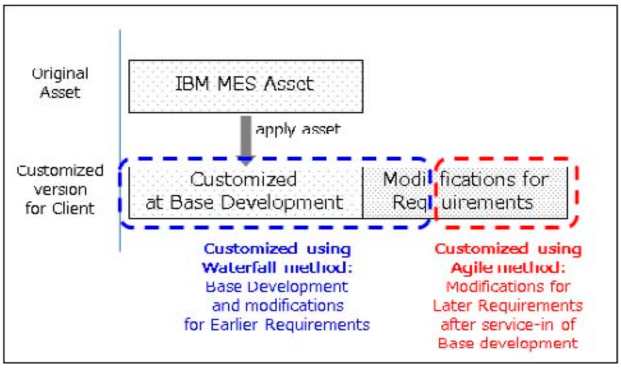

Figure 1 Two methods in combination

Modifications for Earlier Requirements include both of additional development for functions that the customer needs and deletion of that are not necessary for the customer's environment.

Figure 2 shows summary of project steps with Wagile in application development.

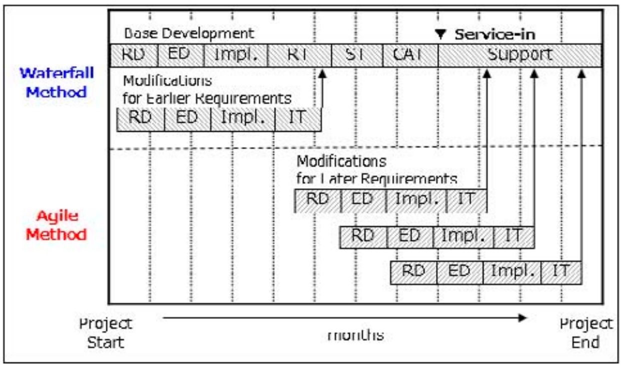

Figure 2 Summary of project steps in Wagile

The upper area in figure 2 indicates steps in Waterfall method.

To explain each step briefly;

1) RD: Requirements Definition for both of Base Development and modifications for Earlier Requirements,
2) ED: External Design for both,
3) Impl.: Implementations for both, including internal design, coding and unit test,
4) RT: Regression Test for Base Development,
5) IT: Integration Test for modifications for Earlier Requirements,
6) ST: System Test for merged modules as products of both of Base Development and modifications for Earlier Requirements,
7) CAT: support for Customer's Acceptance Test,
8) Service-in and start of production run,
9) Support for customer after service-in.

This flow is almost the same as Waterfall methods known as a usual case except for merge tasks of modules implemented at each step for Base Development and modifications for Earlier Requirements.

(2) Tasks to proceed with Agile method

On the other hand, each Later Requirement has different timing to complete requirement definition and clarification of scopes.

So they should be prioritized in an order as each one completes its RD. And they should be treated in individual steps of repetition for ED, Implementation, IT and tasks for release, in this order.

To summarize characteristics in modifications for Later Requirements;

- The timing to complete RD differs in each requirement,
- The workload differs in each,
- Customer sometimes changes the priority between requirements,
- Customer usually needs to use the functions that have completed tests immediately in production environment,
- Since production run has already started, it is needed for updated module to be released into a running environment.

In addition about release tasks, multiple phase development and release method was previously used. In this case, requirements were grouped into two or three groups based on release timings, like phase-1, and phase-2. This reduced the number of release events and thus system downtime, that affects end users' usage time. However, these days it is needed to release functions that have completed tests immediately so that number of release tasks tend to increase.

Therefore, it is important to manage in details of repetitional development and release tasks considering priority change and Agile method like Scrum is applied for this situation.

The lower area in figure 2 indicates repetition of development cycles in Agile method. Each step is explained in next chapter.

4. Steps in details at Agile method

This chapter shows details of each steps at modifications for Later Requirements in Agile method. First there are three system environments for different purpose for usage after service-in, described as below;

- DEV: environment that IBM members use for implement, test and build modules as products,
- TEST: environment that customer uses for verification, means CAT for the product of modification for requirements,
- PROD: environment for end users in actual operation after service-in.

(1) RD: Requirements Definition
The scopes of customer's requests are clarified. Especially it is important to confirm scopes on the interface of external systems. The target of system modification is created and agreed on by the customer.

RD start when customer raises the request for the first time and ends on clarification of scopes. But it is usually hard to complete RD in short term partially because of uncertainness of some teams such as system vendor, causing difficulty of definition of system interface. So hearings for several requests are proceeded in parallel. This chapter shows details of each steps at modifications for Later Requirements in Agile method.

After RD completed, the repetitional tasks starts at ED for the next step.

(2) ED: External Design
System constitution after modification is decided and changes are confirmed with the customer by updating documents for external specification, including table definition of database, UI definition, and external interface definition.

(3) Impl.: Implementation and IT
Coding, UT and IT are performed in DEV environment.
It is worth noting that PROD has already been running for actual operation since service-in, and the source codes are under configuration management in a repository.
So it is necessary to check out only the portion needed to be changed from the repository and to apply changes into these files, building and testing in DEV environment.

(4) Release tasks into TEST
Modules that have completed IT in DEV environment are released into TEST environment.
If some modifications for multiple requirements have completed tests in DEV environment in the same period, they should be released into TEST environment at the same time. But sometimes customer changes the priority for each requirement. So it is needed to select only modules to be released for a particular requirement separately from others.
To deal with this situation, a release script is developed for the purpose to show the list of difference between modules of DEV and that of TEST to select which module to release or not.
This script makes it possible to release the modules only for a particular requirement.
And this script also suppresses the time for release tasks and the mistakes caused by human errors.

(5) CAT: supporting Customer's Acceptance Test
Customer performs verification tasks, CAT for the product of modification for requirements.
If some modifications for multiple requirements are released into TEST environment at the same time, they should also be released into PROD environment together. But sometimes customer decides to release modules, that are released into TEST at multiple release events, into PROD at one timing.

(6) Release tasks into PROD
Modules that have completed CAT in TEST environment are released into PROD environment.
The release script is also used at this step.
As described, PROD environment has already been running for end users since service-in. So it is important to suppress system downtime that affects for end users' usage time.
The release script makes it possible to complete release tasks in short time and to avoid accidents caused by human error. It also enables separated releases, even one release for each requirement individually, resulting increased numbers of release events with no troubles.

This repetition of development cycle described above as (2)-(6) are performed for each requirement clarified scope at (1).

5. Comparison with Scrum method and consideration

As described on the previous section, Agile method is used for management for modification of Later Requirements. It was originally oriented to apply Scrum methods into actual project. But it became directed into repetitional development not restricted so much by Scrum rules after all. This is because this way was less burdensome.

This section provides comparison against actual Agile method with Scrum and its consideration.

(1) Team organization and roles

Product Owner, Development Team, Scrum Master are the three roles in Scrum method.

In actual project, the positions and roles are customer's team leader and members, IBM team leader and members.

To make relations of roles into Scrum roles, the ideal case would be;

- Customer's team leader: Product Owner,
- IBM team members: Development Team,
- IBM team leader: Scrum Master.

But it does not actually hold ideal relations above. IBM team leader has responsibility to bring RD to completion with hearing customer's request and clarifying scopes and to perform IT. It is deeply involved into Development Team tasks. So it is hard to keep Scrum Master role independently.

(2) Term of cyclic development

Term for one sprint is fixed in Scrum method.

In actual project, the workload differs according to each requirement,

One sprint treats some backlog items in a usual case in Scrum, but in actual method cyclic term is defined by single requirement. It seems the unit of task is much larger for performing a major modification than treating one backlog item.

(3) Product backlog and priority for tasks

In the case where backlog items are properly managed in Scrum method, Development team decides which items to process in a single sprint (and they bring items into sprint backlog and manage by themselves) .

In actual project, the priority for requirements are decided by customer considering desired delivery date and status of clarification of scopes.

IBM members can propose the priority in perspective of impact for change of system configuration but cannot determine the priority finally.

Also, items in product backlog should have clarified scope in the list. But actually cyclic development starts after RD has completed. So usually the list corresponding to backlog is empty or has only the remaining one item.

(4) Number of members in Development Team

Number of people in a development team is recommended to be three to nine in Scrum method. In actual project, number of development members for modification for Later Requirements differs depending on phase of project. Only three members at maximum remained in actual case.

In situation it is not clear when RD completes and when members can start ED tasks, it is difficult to keep members for the project without any tasks.

(5) Continuity of project

In Scrum method, development tasks update the Product at every sprint to deal with items in the backlog. Any specific goal is not set or it is not an objective to complete the Product, and still the project can continue. So it is suitable in the case where the project can keep development team (three to nine members) and customers can keep continuous contract, updating the Product for long term.

In actual case, the project has a defined end of contract term and defined goals. So it is clarified what tasks need to be completed at the end of the project.

Therefore, in the end of actual project, the system should be completed. There may be a following contract but it would be usually only for maintaining the applications. It is difficult to keep modifying the system with a maintenance contract only.

In comparisons described as (1)-(5) above, items (1), (3), (4), and (5) are of importance in a success of the application development project with Wagile method applied. Consideration points to improve in these items are listed as below.

- Need to let customer join the Scrum team

As described at (1), ideal team construction includes customer's team leader as Product Owner. To enable customer's leader to spend more time to communicate with Development Team in her/his often busy schedule, it is needed to have some efficient communication ways to reduce her/his workload.

In actual project, all team members in Scrum are not always at the same place. It depends on the phase in the project, but it is clear that the number of members at customer's site gradually decreases except for a few who support customers after service-in of development managed with Waterfall method. Development members are usually away from customer's site, working at their own office.

To make customer's leader join the Scrum team as Product Owner, it is necessary to prepare communication ways with Development Team across different places. It should be a solution to use common communication tools like IBM Connection Clouds or Slack.

- Workload provisioned for modifications for Late Requirements vs. actual estimation of requirements raised throughout the project

  In this Wagile method, a fixed amount of workload is reserved for Late Requirement. But as described at (3), all requirements are not always clarified about the scope. Some takes longer time before completing its RD, and development members don't always have items to start working on in ED and implementation phases. Also in consideration of (4), it is hard to make an estimation of how many members should be kept for modification toward the end of the project.

  It is necessary to aggressively encourage the customer for early completion of RD. In some cases, it would be better to ask the customer to urge other vendors of external systems, especially when there is a delay in defining the specification of external interface.

- How to deal in the case the workload estimation for new request exceeds the remaining reserved workload

  After completing some modifications for Later Requirements and the remaining reserved workload become less near the end of the project, sometimes it occurs that the workload estimation for new request exceeds the remaining workload.

  In such situation, it is needed to let customer decide to raise an alternative request that fit the remaining workload, or sign a new contract for additional workload to complete the request. Also in consideration about (5), it is necessary to propose to keep Agile method in the future and to encourage aggressively the customer to keep continuous contract.

6. Conclusion

As described above, project management using Waterfall and Agile methods in combination realizes both of two demands, to set up production environment rapidly and to perform the modifications flexibly.

Through experiencing the management of actual projects with Wagile method, some issues are found at modification for Later Requirements.

Especially there was a situation where few requests were raised by the customer before the last two months of the project. It caused to take complex adjustment among members' workload, development terms and release timings for the requirements. To avoid such situation, it is necessary to aggressively encourage the customer to raise new requests earlier, and to support them to present each request to complete RD tasks.

Preparing tools like release scripts is also necessary, to make the cyclic tasks efficient from ED to release phases. The release script described on this paper is specialized for the customer. But in future more generalized tools at automated test and continuous integration should be used for other customers.

In addition, to make an efficient Scrum team including the customer, communication tools are also important as described above.

Scrum method is a kind of management culture and it should be spread and shared among customers and own development team members, enabling to keep and increase the number of project managed with Wagile method in the future.

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B02

Quantitative risk analysis process of oil and gas upstream service contracts

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Introducing of MBSE FRAMEWORK for a System Development

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Today's systems are getting more and more complicated and sophisticated such as IoT and autonomous car driving systems. The complexity of system increases the risks of high development cost and system failures. One of the causes is miss communication among stakeholders due to poor system specification. To solve this problem, we have been performing development process improvement with Model-Based Systems Engineering (MBSE). MBSE is the formalized modeling approach (e.g. using UML, SysML) to support system development. But we recognize what kind of diagram we should create for each process is a problem, and lack of diagrams to be created lead to miss communication. To solve these problems, we developed MBSE FRAMEWORK. Our MBSE FRAMEWORK is in table form. This form places the system development process on the vertical axis and places the design elements on the horizontal axis. Each cell defines SysML or UML diagrams we should create. By using this framework, developers can understand easily what kind of SysML or UML diagrams they have to make. Also, all stake-holders can come to a common understanding on system specification and reduce miss communication.

Keywords and phrases: Work product, Framework SysML, UML, Traceability

1. Introduction

System development in automobile industry is becoming complicated by computerization and autonomous car driving, and required to comply with functional safety standard ISO26262:2011.

The complexity of system increases the risks of high development cost and system failures. We think one of the causes of these risks is miss communication among stakeholders due to the legacy text based development. In addition, functional safety standard ISO 26262:2011 requires unambiguous, comprehensible and traceable work products.

We had already defined process. But in many cases, the granularity of work products for each projects was differ and insufficient traceability. These affected cost and quality management.

In order to deal with these problems, we introduced MBSE. MBSE has already been defined many methodologies. We considered which MBSE methodologies fitted our projects. Each methodology has defined what kind of model diagram should be created at which timing. But it is difficult to understand the relationship between model diagrams. In a project to develop with a team, to define the model relationship is very important for model consistency. The diagram types and their relationships affect scope, cost, time, quality and human resources. In order to minimize these effects, we developed MBSE FRAMEWORK.

2. Decision of MBSE Methodologies

2.1 MBSE Methodologies

MBSE has the following methodologies (Estefan, 2008):

- Dori Object-Process Methodology (OPM)
- IBM Rational Unified Process for Systems Engineering (RUP SE) for Model-Driven Systems Development (MDSD)
- IBM Telelogic Harmony-SE
- INCOSE Object-Oriented Systems Engineering Method (OOSEM)
- JPL State Analysis (SA)
- Vitech Model-Based System Engineering (MBSE) Methodology

(Items are sorted in alphabetical order)

This time, we chose OOSEM.

2.2 What is OOSEM?

The Object-Oriented Systems Engineering Method (OOSEM) integrates a top-down, model based approach that uses OMG SysML™ to support the specification, analysis, design, and verification of systems.

OOSEM includes the following development activities (Friedenthal et al, 2014):

- Analyze Stakeholder Needs
- Define System Requirements
- Define Logical Architecture
- Synthesize Candidate Allocated Architectures
- Optimize and Evaluate Alternatives
- Validate and Verify System

2.3 Why OOSEM?

We focused on "Logical Architecture".

Defining the safety concept is important aspects for functional safety. The logical architecture is helpful to define the safety concept using safety design pattern.

Safety design pattern is defined by many papers. (e.g. Armoush 2010)

3. MBSE FRAMEWORK

3.1 Purpose of MBSE FRAMEWORK

Our framework aims to clarify the system design activities and clarify the relationships between work products.

3.2 Effects

We expect that our framework will show the following effects:

1) Project Scope Management

Our framework is useful for the input to WBS because this defines the system design activity.

2) Project Time Management, Cost Management

Our framework is available for the time estimate about system design activities because this can assume the work products.

3) Project Quality Management

Our framework can eliminate the discussion on notation and concentrate in technical review.

4) Project Human Resource Management

Our framework can be used as education for new participant members.

3.3 Definition of MBSE FRAMEWORK

Figure 1 shows MBSE FRAME WORK. In this figure, the vertical axis represents the system development process, and the horizontal axis represents the design elements.

The system process consists of "Analyze Stakeholder Needs", "Define System Requirements", "Define Logical Architecture", and "Synthesize Candidate Allocated Architecture". These processes are in accordance with OOSEM process. "Analyze Stakeholder Need" and "Define System Requirements" have a relationship of derivation. "Define System Requirements" and "Define Logical Architecture" have a relationship of decomposition. "Define Logical Architecture" and "Synthesize Candidate Allocated Architecture" have a relationship of synthesis. These relationships are represented by arrows in Figure 1.

The design elements are divided into "Model Elements Space", and "Diagram Space". These have a relationship of linkage. This is shown by dotted arrow in Figure 1.

"Model Elements Space" exists for consistency. This space subdivides into "Stakeholder", "Property", "Data Definition", and "Interface Definition". "Diagram Space" clarifies the diagrams that need to create. This space subdivides into "Requirements", "Behavior", and "Structure".

3.4 Analyze Stakeholder Needs

Analyze Stakeholder Needs is composed of the following activities:

1) Analyze Stakeholder

linkage ↔ analysis →

	Model Elements Space				Diagrams Space			
	Stakeholder	Property	Data Definition	Interface Definition	Requirements	Behavior: Interaction	Behavior: State Machine	Structure
Analyze Stakeholder Needs	(1-1) Stakeholder List				(1-5) Stakeholder Concern	(1-6) Use Case		
Define System Requirements	(2-1) Operational Domain	(2-2) System Property	(2-3) Operational Data	(2-4) Operational Interface	(2-5) System Requirements	(2-6) Operational Scenario	(2-7) Operationl State Machine	(2-8) System Context
Define Logical Architecture	(3-1) System Logical Domain	(3-2) Logical Block Property	(3-3) Logical Data	(3-4) Logical Interface		(3-6) Logical Behavior	(3-7) Logical Block State Machine	(3-8) Logical Structure
Synthesize Candidate Allocated Architectures	(4-1) System Physical Domain	(4-2) Physical Block Property	(4-3) Physical Data	(4-4) Physical Interface		(4-6) Physical Behavior	(4-7) Physical Block State Machine	(4-8) Physical Structure

derive ↓ decom pose ↓ synthesize ↓

Figure 1 MBSE FRAMEWORK

2) Analyze Stakeholder Concern
3) Analyze Use Case
4) Analyze Domain

The first Step in "Analyze Stakeholder Needs" defines stakeholders and their concerns. Use cases and Operational domain are derived from their concerns. Figure 2 shows their relationship. Stakeholder is defined in "Stakeholder List (1-1)" using model element. "Stakeholder Concern (1-5)" using block diagram are analyzed "Stakeholder List (1-1)". "Use Case (1-6)" and "Operational Domain (2-1)" uses these defined stakeholders. The Dotted arrow named "linkage" in Figure 2 shows their relationship.

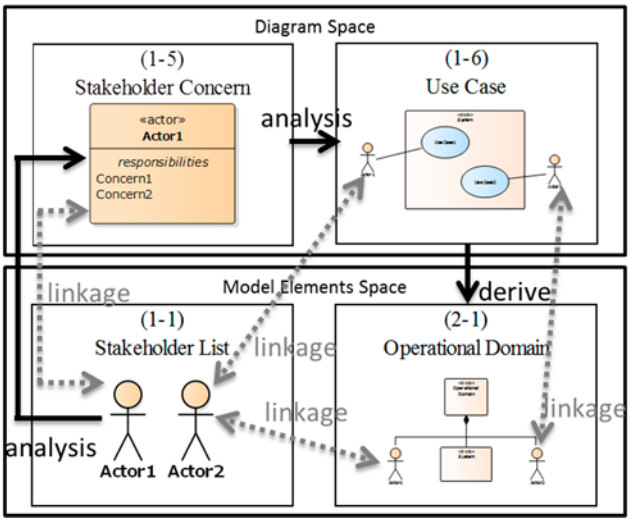

Figure 2 Relationships with Use Case

3.5 Define System Requirements

Define System Requirements is composed of the following activities:

1) Analyze Operational Scenario
2) Analyze System Context
3) Analyze System Requirements
4) Analyze Operational State Machine

3.5.1 Analyze Operational Scenario

"Operational Scenario (2-6)" using activity diagram are derived from "Use Case (1-6)". These diagrams are drawn up each use case and define interaction between the system and the stakeholders. "Operational Scenario" defines the actions and the data of each stakeholder and system of interest. The action is defined by "Operational Property (2-2)"using model elements. The data is defined by "Operational Data (2-3)"; this is also using model elements. The partitions defined by "Operational Scenario" link "Stakeholder List (1-1)". These relationships are shown in Figure 3.

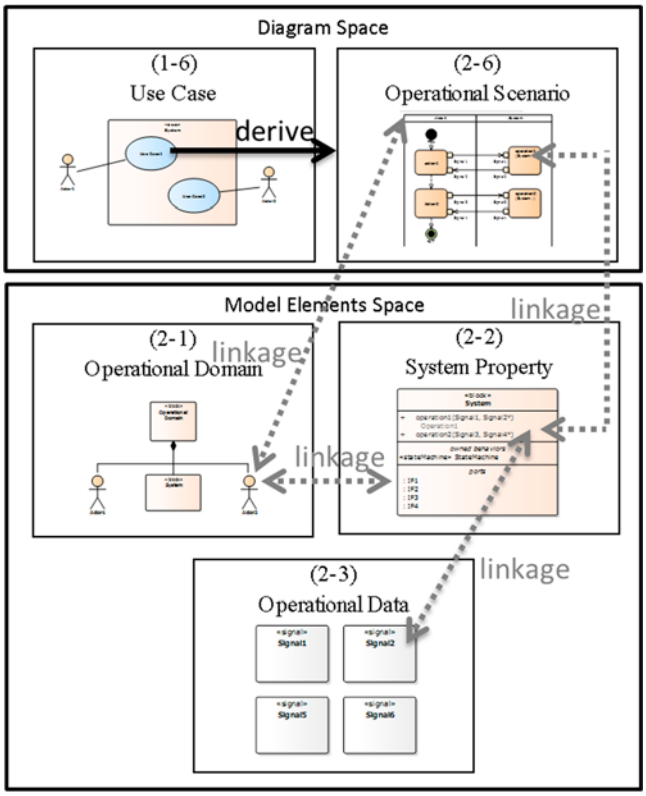

Figure 3 Relationships with Operational Scenario

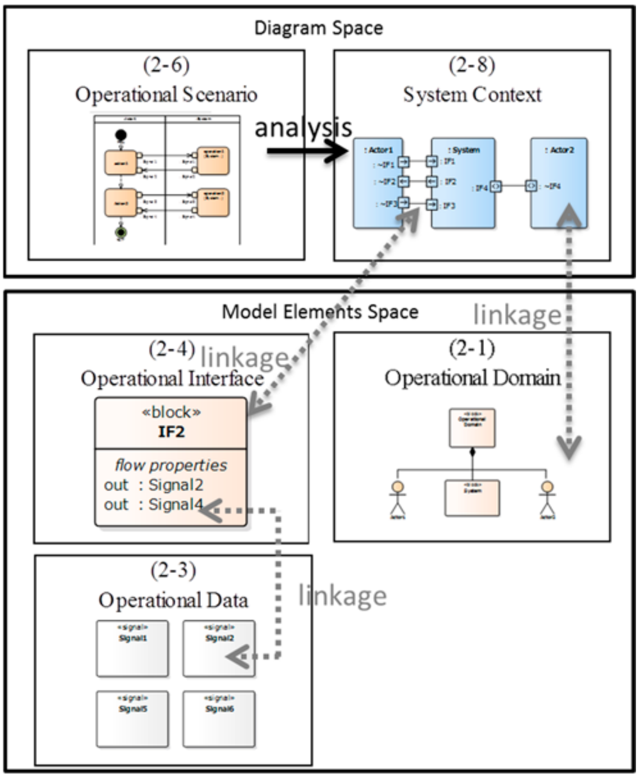

Figure 4 Relationships with System Context

3.5.2 Analyze System Context

"System Context (2-8)" using internal block diagram is derived from "Operational Scenario (2-6)". The system context shows the relationship between stakeholder and target system. The interface is defined by

"Operational Interface (2-4)" using model elements. "Operational Interface (2-4)" has "Operational Data (1-3)" as flow property. Stakeholders and target system is defined by "Stakeholder List (1-1)".These relationships are shown in Figure 4.

3.5.3 Analyze System Requirements

"System Requirements (2-5)" using requirements diagram is derived from "Stakeholder Concern (1-5)". System Requirements consist of functional requirements, performance requirements, and interface requirements. Functional requirements and performance requirements are defined by analyzing "Operational Scenario (2-6). And Interface requirements are defined by analyzing "System context (2-8)". These relationships are shown in Figure 5.

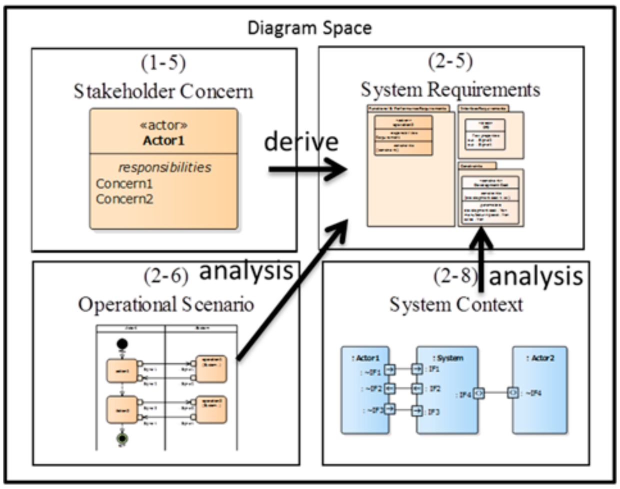

Figure 5 Relationships with System Requirements

3.5.4 Analyze Operational State Machine

"Operational State Machine (2-7)" is defined by analyzing "Operational Scenario (2-6)".
The state Machine includes triggers and actions. Triggers have a relationship with "Operational Data (2-3)". And actions have a relationship with "System Property (2-2)". These relationships are shown in Figure 6.

3.6 Define Logical Architecture

Define Logical Architecture is composed of the following activities:

1) Analyze Logical Domain
2) Analyze Logical Behavior
3) Analyze Logical Structure
4) Analyze Logical Block State Machine

3.6.1 Analyze Logical Domain

The first step in "Define Logical Architecture" defines the logical domain. The logical domain means decomposing the system to the logical elements (e.g. obstacle detection sensor) "Logical domain (3-1)" using model element is defined by decomposing "Operational Domain (2-1)".

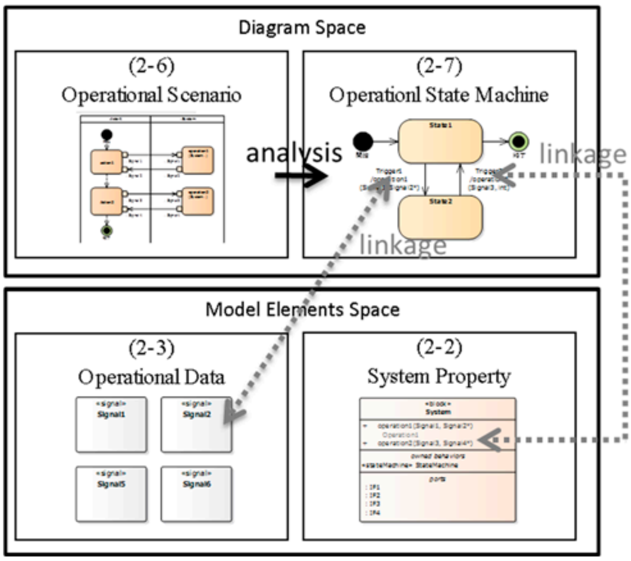

Figure 6 Relationships with Operational State Machine

3.6.2 Analyze Logical Behavior

The second step in "Define Logical Architecture" defines the logical Behavior. The logical behavior defines how behave the systems through the logical elements. "Logical Behavior (3-6)" using activity diagram is defined by decomposing "Operational Scenario (2-6)". This diagram defines action and data of each logical block defined by "Logical Domain (3-1)".The action is linked "Logical Block Property (3-2)" and the data is linked "Logical data (3-3)". The partition defined by "Logical Behavior (3-6)" link "Operational Domain (2-1)". These relationships are shown in Figure 7.

3.6.3 Analyze Logical Structure

Next in "Define Logical Architecture" defines the logical structure. The logical structure shows the overall logical system configuration and logical interface between logical elements. "Logical Structure (3-8)" using internal block diagram is defined by decomposing "System Context (2-8)" This diagram defines the interface between logical blocks. The logical block is defined by "Logical Domain (3-1)" and the interface is defined by "Logical Interface (3-4)". In functional safety development, the logical structure is important because this diagram can use safety analysis and build safety mechanisms. These relationships are shown in Figure 8.

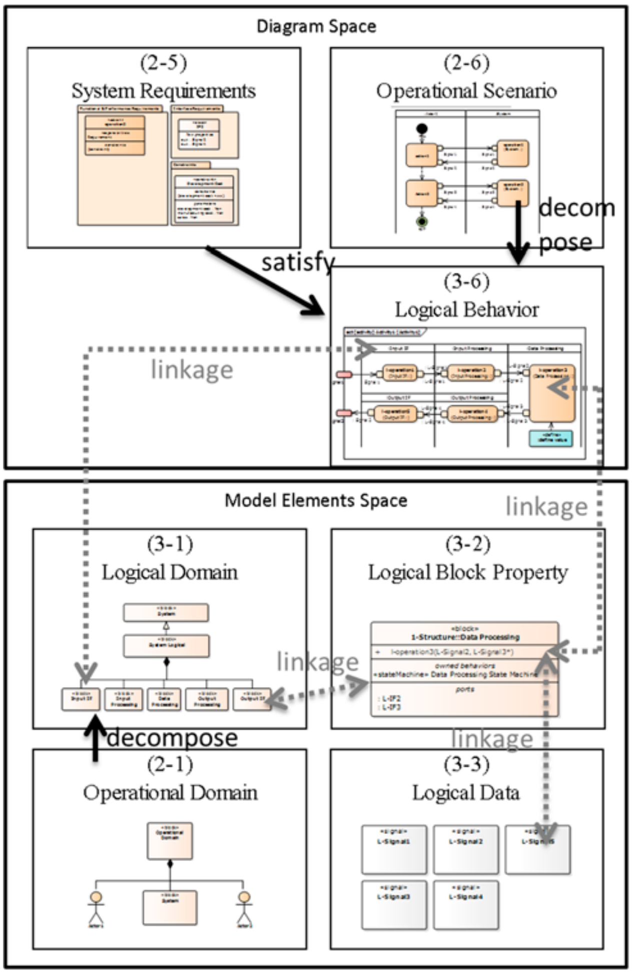

Figure 7 Relationships with Logical Behavior

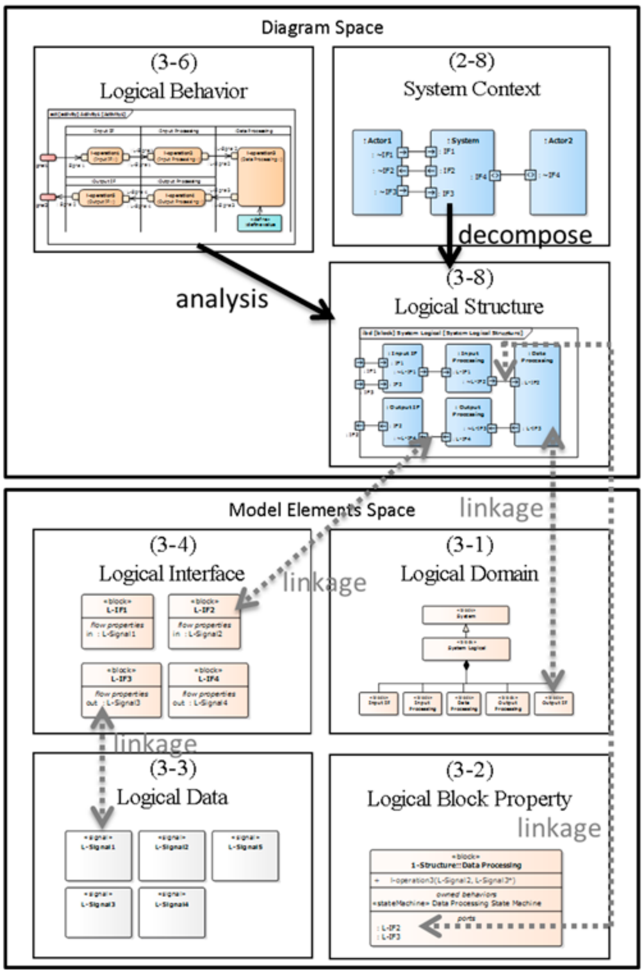

Figure 8 Relationships with Logical Structure

3.6.4 Analyze Logical Block State Machine

The final step in "Define Logical Architecture" defines state machine. "Logical State Machine (3-7)" is defined by analyzing "Logical Behavior (3-6)". Trigger link "Logical Data (3-3)" and action link "Logical Property (3-2)".

3.7 Synthesize Candidate Allocated Architecture

Synthesize Candidate Allocated Architecture is composed of following activities:

1) Analyze Physical Domain
2) Analyze Physical Behavior
3) Analyze Physical Structure
4) Analyze Physical State Machine

3.7.1 Analyze Physical Domain

The first step in "Synthesize Candidate Allocated Architecture" defines the physical domain. Physical Domain means actual elements (e.g. millimeter wave radar). "Physical Domain (4-1)" is defined by synthesizing "Logical Domain (3-1)".

3.7.2 Analyze Physical Behavior

The second step in this section defines the physical behavior. This activity is defined how behaves the system through the actual elements. "Physical Behavior (4-6)" is defined by synthesizing "Logical Behavior (3-6)". The action defined in this diagram is linked "Physical Block Property (4-2)". And the data is linked "Physical Data (4-3)". These relationships are shown in Figure 9.

3.7.3 Analyze Physical Structure

Next step in this section defines the physical structure. The Physical structure shows the whole system configuration and physical interface between elements. "Physical Structure (4-8)" is defined by synthesizing "Logical Structure (3-8)". The interface defined in this diagram is linked "Physical Interface (4-4)". The physical block is linked "Physical Domain (4-1)". These relationships are shown in Figure 10.

3.7.4 Analyze Physical State Machine

The final step in this section defines physical state machine. "Physical State Machine (4-7)" is defined by analyzing "Physical Behavior (4-6)" The trigger defined in this diagram is linked "Physical Data (4-3)" and the action is linked "Physical Block property (4-2)".

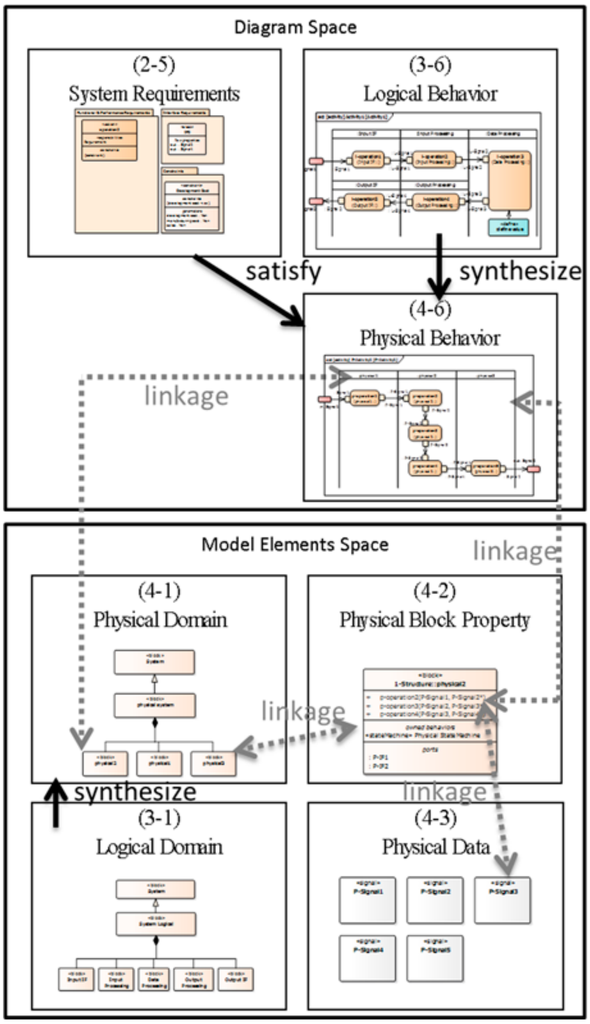

Figure 9 Relationships with Physical Behavior

4. Conclusion

System design activities were able to be systematized by constructing MBSE FRAMEWORK, and visualized the relationship between the models. As the result, developers were able to understand easily what kind of diagrams they should be created. And this brought common understanding among the stakeholders. By combining process definition and our framework were able to define development activities in more detail.

Challenge for further works, we will consider software design framework.

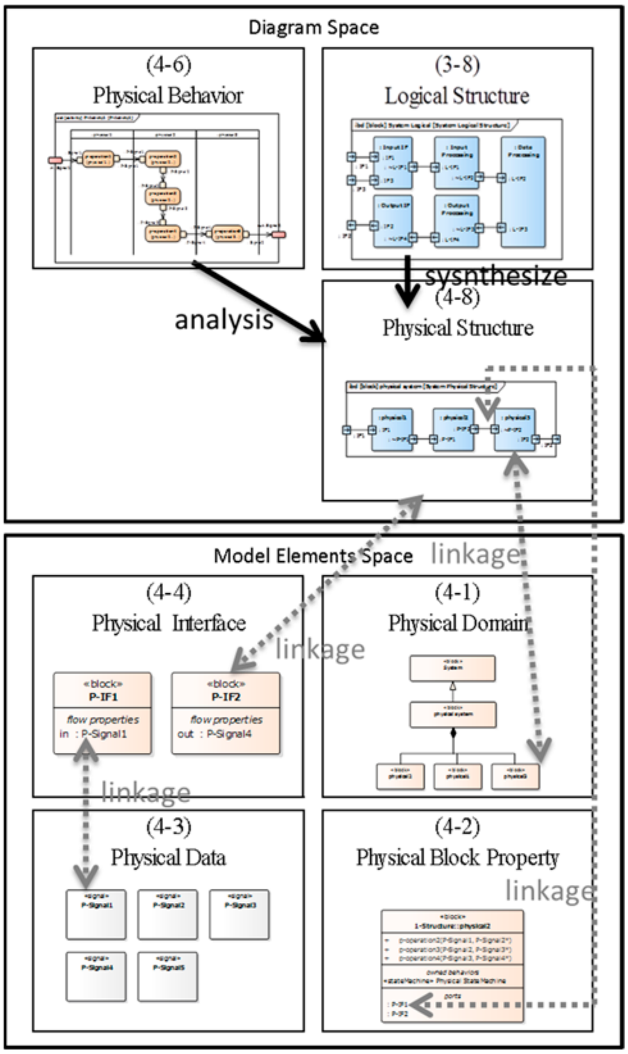

Figure 10 Relationships with Physical Structure

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Case Study of Educating Software Test Techniques to IT Engineers in Myanmar

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Many Japanese companies begin to expand their business to Myanmar, because Myanmar has abundant labor force and cost advantage. In software development, some projects outsource implementation or testing to Myanmar as a new base of offshore development. On the other hand, their technical skills has not reached the level required by Japanese companies. So, we educated techniques of software testing for engineers of a software development company in Myanmar. Firstly we measured their skill levels. Based on the result, we organized the training menus to have them understand the objective of software test before learning the knowledge. In addition, we aimed to give them the ability to think logically with exercise. After the training, we evaluate whether their skills improved with final test. We confirmed that their skills improved, and future tasks became clear.

Keywords and phrases: Software test, Test design, Off-shore development, Myanmar, Education, Training

1. Introduction

In Japan client companies usually outsource to system integrators to develop their system. An outsourced system integrator may outsource a part of the system development to another company. Offshore development that system development is outsourced to overseas companies is common. The main reason to outsource to overseas companies is to reduce costs. However, since the quality of deliverables created by vendors in offshore has not reached the quality level required by the outsourcer, outsourcer will need to execute additional works and involve excessive costs. In order to solve this problem, there are some countermeasures such as strict control of work in offshore and closer communication between the outsourcer and the vendor in offshore, but it is a fundamental countermeasure to educate engineers in offshore to improve their technical skills about system development.

In this paper, we introduce the case that we tried to train IT engineers in Myanmar where attracts attention as a new country for offshore development in system development in recent years. In chapter 2, the reasons why outsourcing to Myanmar increases are described. In chapter 3, the objective to educate IT engineers in Myanmar and the plan to achieve the objective are described. In chapter 4, the result that we went to Myanmar and carried out education to IT engineers there is described. We emphasize that a part of original plan are corrected while training because we decided not to achieve the objective according to the original plan. Finally, in chapter 5, points to make education succeed are considered, that is, to acquire necessary skills for short-term training. Although they are considerations from this case in Myanmar, their knowledge apply not only to Myanmar but also to engineers in other countries including Japan. In addition, future works for further improvement of technical skills in Myanmar are described.

2. Background

2.1 Japanese companies enter to Myanmar

Myanmar is called "Last Frontier in Asia". Due to recent democratization, many Japanese companies are beginning to advance. There are more than 50 million people in Myanmar, so they have abundant labor force. In addition, the cost competitiveness is their greatest advantage as the initial salary for university graduates is about 100 to 200 dollars. This is one twentieth to one tenth of that of Japan, one fifth of that of China and one third of that of Vietnam (Nihon Keizai Shimbun Electronic Version 2012). Furthermore, because Myanmar and Japanese grammar are similar, it is also characteristic that Myanmar people can learn Japanese faster than people in other countries. There is a result that Myanmar people can learn the contents of Japanese textbooks which are said to take normally 300 hours to understand in 150 to 200 hours ((Nihon Keizai Shimbun Electronic Version 2012). Moreover, there is an advantage that it is easy to work with Japanese because they have a temperament similar to the Japanese that is discreet assertiveness, diligent, and cooperative (Nihon Keizai Shimbun Electronic Version 2012).

2.2 Offshore development in Myanmar

In Japan, offshore development that a part of tasks of system development are outsourced to overseas companies is common. As the country to which the offshore development is outsourced, China has been mainstream so far. The main reasons were technical skill, Japanese language ability, and low cost. However, in recent years, as the cost of China is rising, outsourcing to countries other than China begin to be examined by Japanese companies. One of the new countries is Myanmar. Major system integrators such as NTT DATA, Fujitsu and Hitachi have made their respective subsidiary companies in Myanmar and recruit talent in Myanmar (ITpro 2012).

NTT DATA established NTT DATA Myanmar in 2012. As of 2017, NTT DATA Myanmar hires more than 200 local talent and NTT DATA utilizes NTT DATA Myanmar as a new supplier for offshore development. In the development of the Myanmar Central Bank's mission critical system, which began to operate in 2016, NTT DATA Myanmar participated in the early stages of the system development and contributed greatly to completion of the development (NTT DATA News Release 2016).

3. Educational objective and plan

3.1 Objective of education

Although IT engineers in Myanmar have the merit of low cost, it is still hard to say that technical skill and Japanese language ability have reached the same level as China.

Regarding Japanese language ability, the merit of fast learning is mentioned in previous chapter, but in fact there are variations in skills among engineers. In light of the level of the Japanese Language Proficiency Test shown in Table 1, there are not so many people acquiring N1or N2 level who can communicate with Japanese without troubles. It is not easy to read documents written in Japanese or to understand Japanese explanation in Japanese. As a matter of fact, some of engineers in Myanmar translate Japanese documents using online translation service, or they are sometimes talk with Japanese people through interpreters.

Table 1 Level of Japanese Language Proficiency Test

Level	A summary of linguistic competence required for each level
N1	The ability to understand Japanese used in a variety of circumstances.
N2	The ability to understand Japanese used in everyday situations, and in a variety of circumstances to a certain degree.
N3	The ability to understand Japanese used in everyday situations to a certain degree.
N4	The ability to understand basic Japanese.
N5	The ability to understand some basic Japanese.

With respect to technical capability, they have not been able to work at the quality level expected by Japanese companies that have outsourced. There is a lack of skills to work according to the specified process and skills to create work products with high quality. Some engineers learned information technology at university, but they do not have enough skills to practice.

Under these circumstances, we educated IT engineers in Myanmar for the objective of improving the technical skill. In offshore development, coding and testing based on design documents created in Japan are often outsourced. Therefore, we decided to target testing in this education and aim to improve testing skills.

3.2 Preliminary survey of students

In this education, due to constraints such as schedule and budget, the following assumptions were made.

- Five students who were selected by their manager
- Three times of local education
  (Once in January, February, and March of 2017)
- About 2 to 3 days per one time

We had heard from their manager preliminary that experiences, skill levels and Japanese levels of the students were various. We made a brief survey preliminary to know that they actually have what kind of experiences and how much skills. The survey items were as follows.

- Questions about development experience so far
  [10 questions]
- Questions about using testing tools
  [20 questions]

- Questions about terms related to the test [50 questions]

Because it is the objective to measure the approximate level of knowledge and experience, the answers to the questions were self-reported. In other words, we did not confirmed that "Have you used the testing tool really?" or "Can you correctly explain the meaning of the term?”

3.2.1 Development experiences of the students

For the five students (A, B, C, D and E), the answers to the years of development experience among 10 questions on development experience so far were as follows.

- A: 5 years or more and less than 10 years
- B: 3 years or more and less than 5 years
- C: 3 years or more and less than 5 years
- D: 3 years or more and less than 5 years
- E: 1 year or more and less than 3 years

Apart from the years of development experience, examples of the questions are that the type of applications that they have developed in the past (e.g., web system, smartphone application), development models that they have used (e.g., waterfall model, agile), and programming languages that they have used. In addition, for those who have experience in testing, we also investigated the work they have carried out in the test (e.g., test design, test execution).

3.2.2 Knowledge and utilization experience of testing tools

We asked about 20 testing tools. 8 testing tools were representative open source tools, such as JUnit and Selenium. 8 testing tools were tools in-house manufactured by NTT DATA. There were 4 questions asking about the type of testing tools that is not limited to a specific tool like "defect tracking tool"

Table 2 shows the number of testing tools answered by each student from the three options "I have used it before", "I have heard it, but never used it" or "I have never heard" against each test tools.

Table 2 Survey results on the use of testing tools

Answer	A	B	C	D	E
Have used before.	7	7	5	1	2
Have heard but never used.	13	13	8	3	8
Never heard.	0	0	7	16	10

3.2.3 Knowledge of testing terms

We asked questions about 50 testing terms. We asked terms directly related to test such as "black box test", "decision table test", "stub", "regression test", and "test drive development". In addition we asked questions about the development or project management terms that test engineers should know such as "UML", "MVC model", "WBS "Reliability growth curves", "exclusion control", and "SQL injection".

Table 3 shows the number of testing terms answered by each student from the three options "I can explain it", "I have heard it, but cannot explain it" or "I have never heard it" against each testing terms.

Table 3 Survey results on testing terms

Answer	A	B	C	D	E
Can explain.	24	34	6	0	3
Have heard but cannot explain.	26	14	30	17	27
Never heard	0	2	14	33	20

3.2.4 Stratification of students

As a result of this survey, five students were classified into three groups.

- Person who has experience in testing [A, B]
  They know all the testing tools, and they have used some tools.
  They know all terms related to tests, and they can explain some terms.
- People who have little experience in testing [D]
  She has never heard any testing tools.
  She has never heard most of terms related to tests, and she has heard a few terms.
- The middle between the above [C, E]

3.3 Planning of education

Based on the results of the preliminary survey, we planned three times education in Myanmar as shown in Table 4.

Table 4 Educational plan

	Summary of plan
1st time	Training to teach basic knowledge on the whole test.
2nd time	Training to teach one of test design, test automation, test management as a specialized technique for testing.
3rd time	Measuring the degree of skill up by understanding test and hearing.

In the first training, we decided to teach common knowledge for everyone. There might be a lot of known information for the two who have experience in the test, but since there was a possibility that they do not understand correctly, we would train for everyone. Then, depending on their aptitude, intention, skill level and understanding degree of the first training, we would decide who will be taught which technology and aim to acquire practical skills in the second training. After that, they would practice in real project what we teach them. Then, at the third time, we planned to confirm whether they were able to acquire the skills.

4. Result of education

4.1 The first training

In the first training, we taught the basic knowledge such as objective of the test, test process, work products of the test, and test type. In particular, as for the objective of the test, we had been requested by the manager of the students, so we taught it intensively. Specifically, we introduced some examples of failures related to systems and software and we explained that it is the objective of the test to find bugs before release so that those failure will not become obvious. In addition, as an introduction to the second training, we explained introductory information about test design technique, test automation, test management.

The first training was lecture only and ended on 1 day (about 8 hours). We did not have exercises. Training materials were prepared in English. We gave a lecture in Japanese, and the interpreter consecutively translated it into Myanmar language and told it to students.

Since we stayed in Myanmar for another two days, we heard students and confirmed the experience of system development and testing so far and the interest in the tests.

4.2 Review of educational plan

After finishing the first training, we felt some gaps with what we initially assumed.

Firstly, the experience of testing was less. This was something we knew from the preliminary survey, but we felt that their experiences were less than we assumed. With development experience, we thought that they might have been involved in testing and they have knowledge of the test, but I did not feel that. Because they did not have the experience of the test, we felt that understanding degree is low in a lecture that we teaches unilaterally.

Those who had experience of the tests carried out test work with the consciousness that they only had to do what they were instructed, and did not understand the objective of the work correctly. In the first training, as described above, we explained that the objective of the whole test is "finding bugs". On the other hand, we did not explain the objective of the various tasks in the test, but we felt that we should also tell the objective of each task in detail.

Based on this result of the first training, we reviewed the plans for the second and subsequent education as shown in Table 5.

Table 5 Educational plan (after review)

	Summary of plan
2nd time	Explaining and exercising the test design technique.
3rd time	Solving the problems that developed the contents taught in the second training, and measuring the understanding degree.

Even if we taught too professional techniques as planned in the second training, we could easily predict what they cannot understand at the current level of their knowledge, so we decided that we should teach more basic technology. Therefore, we focused on the test design which is the basic concept of testing, and aimed to cultivate the ability to think through exercise-centered training. Although there are various test design techniques, we first decided to teach only equivalence partitioning and boundary value analysis, which are the most basic techniques.

In addition, we decided to measure the understanding degree of what we taught by giving an exercise after the second training. In the third training, we would explain the answer of the exercise and supplement the part they cannot understand. Originally, we had planned that in real projects they practiced what we taught, but it was one of the reasons for reviewing the plan that there was no project at such a timing as to practice what we taught them at that time.

4.3 The second training

In the second training, we first taught the objective of the test design that is making test cases. Specifically, we explained that they must consider the tests necessary to achieve the objective of testing to find bugs, they must reduce tests appropriately to finish the test in a limited period, and they must write documents so that others in their project can understand the contents of the test which would or had be carried out.

After that, we explained equivalence partitioning and boundary value analysis, and exercised test case design exercises using these techniques. The exercise took up the process of registering "name" and "password" on the web screen. It is an exercise to decide the input value for testing in case there are several conditions of characters that can be entered for each input item. A part of actual exercise is shown in Figure 1. Although the characters on the web screen were set to Japanese, the description of the condition of the input items was set to English (excluding the name of the input items). Assuming a scene actually developed, it is necessary to make test cases from design document written in Japanese. However, the objective of this training was mastering the test design technique, because we wanted to avoid obstructing the achievement of the objective that they cannot read Japanese, we wrote design documents in English. Also, we requested not only they learn how to use the technique but also they express in the figure how to think until deciding the input value to tell other people (Figure 2).

In addition, it was also done by exercises to describe the final test cases. The test case requires not only the input values decided by using the test design technique but also other information necessary for executing the test. For example, if there are no input in the item "name", it is necessary to decide what is entered in another input item "password". This is because if there is no such information, the person executing the test gets lost. By actually writing the test cases they experienced that the test case is completed when all the information necessary to execute the test are described.

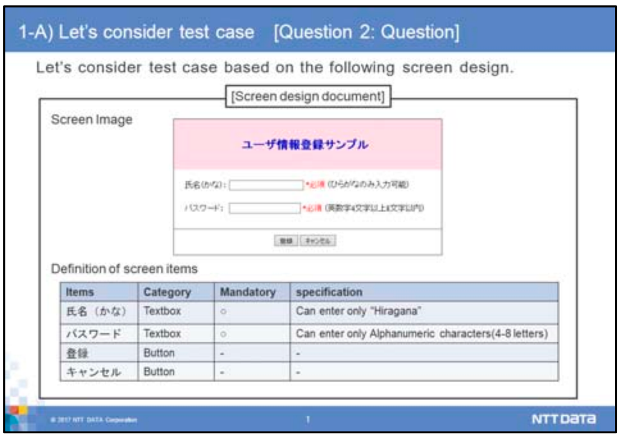

Figure 1 A part of exercise in the second training

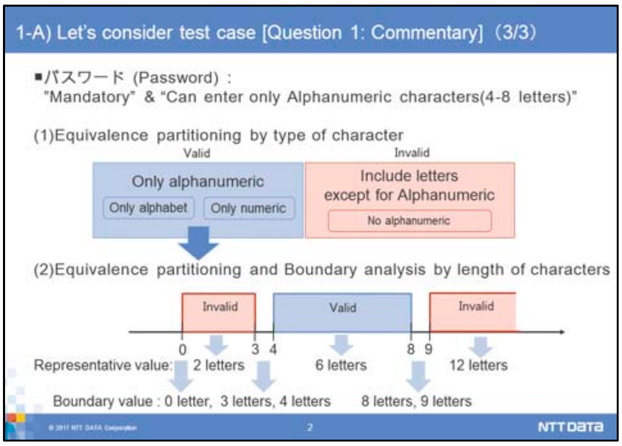

Figure 2 Example of answer for the exercise

4.4 Confirm understanding degree

We got the feeling that they were able to understand to some extent at the end of the second training. We gave exercises to confirm understanding degree. This was an understanding test. As for the exercise in the second training, the understanding test was to decide the input value of the test using the equivalence partitioning and the boundary value analysis, and to describe the test case.

Just as in the second exercise, we asked for input values for input items on the Web screen. The input items are "name", "telephone number", "mail address", "birth date", and the items in which numerical values that have an upper limit value must be input (Figure 3).

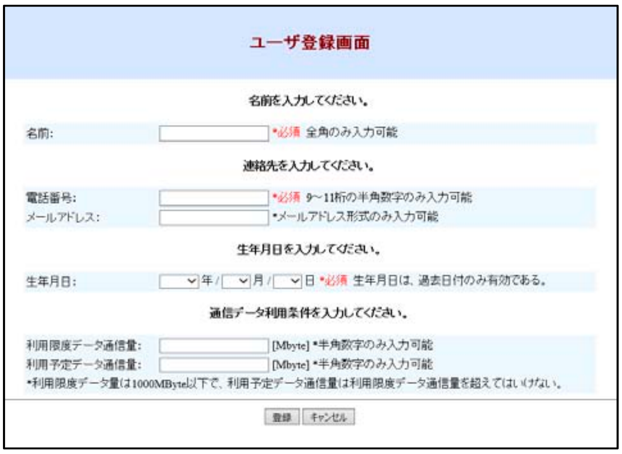

Figure 3 A part of understanding test

The question of applying the test design technique to "name" was correctly answered. This is because it was almost the same as the "name" that was in the exercise of the second training. On the other hand, the answers were not correct for other input items. This is because they tried to apply the same idea when applying the test designing technique to "names" and "passwords" in the exercises of the second training. Therefore, they could not solve the problems with different input conditions. The description of the test case was correctly answered.

5. Conclusion

5.1 Understanding degree of test design technique

As a result of three training sessions, they were able to do what we taught about test design as it is. On the other hand, it was found from the measurement result of understanding degree that the ability to apply is not acquired. Equivalent partitioning and boundary value analysis taught this time logically derive test cases from design documents according to predetermined rules. As a result of the exercise using the techniques, it was a secondary effect that logical thinking ability was acquired.

Also, in this training, we initially assumed to solve the exercise problem individually, but it became a group exercise spontaneously. Therefore, among the five participants, it was divided into those who are in a position to teach and those who are in position to be taught. Understanding was deepened by teaching each other, and a group exercise succeeded.

5.2 Evaluation of the content of the training

As for the content of the training, we consider that understanding degree increased by changing to the exercise-centered training at the skill level of the students. In addition, we were able to strongly aware the objective of the test work. The reason why the training was successful is after doing the first training (Do) according to the plan initially established (Plan) to evaluate the result of first training (Check) and improve the contents of the second and subsequent work (Act). We considered that the PDCA cycle could be implemented properly.

5.3 Future work

In this training, only a part of the test design techniques has been taught yet. There are various technical areas for testing, such as other test design techniques and techniques related to test automation or test management that were originally planned to be taught. In the future, we would like to define the technical areas of the test and the skill level for them and clarify the steps to improve skills.

We think that the knowledge obtained in this education are not limited to Myanmar. In the education that we have done in Japanese office in the past, we have taught that there are best practices for software development and it was natural that we should develop under the rule based on the practices. In other words, we did not mention why it must be developed in such way, or what problems arise if we do not follow that way. Through this training, we were able to reconfirm the importance of understanding the objective or reasons of work. Also, we think that there are many engineers including Japanese who are not good at thinking logically and clarifying the thinking process. As we learned that their skills can be acquired in this exercise, we would like to develop the training course for education in Japan.

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The problem of missing security requirements

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Engineering Lead, Nixu Oyj

Organizations invest in defensive security measures, monitoring and security teams to protect business. Yet It takes on average 191 days to identify a data breach and 66 days on average to contain the data breach. General Data Protection Regulation (GDPR) becomes enforceable in may 2018. GDPR extends the EU data protection law to all companies processing data of EU Residents. It imposes both functional and non-functional requirements to the data architecture as well as functional requirements. Security defects are costly as they are typically found in later project phases causing delays and budget overruns. Yet in the digital age of cloud, mobile and IoT, project managers must accelerate their solution development to keep up with the competition. This is why requirements setting and testing efforts need to shift-left. Projects need to start security activities early and execute them incrementally. Project managers are looking answers for Questions like; How to build secure systems and avoid costly security fixes and how to incorporate privacy-by-design and digital identities?

Keywords and phrases: Requirement management, scope management, secure by design, GDPR, software quality attributes, STRIDE

1. Challenges to be solved

The driving factor for digital change are emerging dynamic connections of people, processes, things, service and data. According to Gartner (Gartner's top 10 technology trends 2017) AI and machine learning have reached a critical tipping point and will increasingly augment and extend virtually every technology enabled service, thing or application. Creating intelligent systems that learn, adapt and potentially act autonomously rather than simply execute predefined instructions is primary battleground for technology vendors through at least 2020.

Organizations are faced with the challenge of how to build secure solutions and know they are secure the entire lifecycle. Still Many of today's organizations invest in defensive security measures, monitoring and external security team(s) to protect their business.

The increased world-wide digitalization with new possibilities and risks demand higher IT security. For example, services like Shodan and Nmap HVAC can be quite easily used to find out weak points in digital IoT solutions. To solve these challenges, security must become resilient and adaptive.

1.1 Good or bad quality is no surprise

Combined with the challenges of the digital age of cloud, mobile and IoT, project managers and Product owners must accelerate their solution development lifecycles to keep up with the competition. This requires a different approach to security requirement engineering. Successful implementation of security related requirements is hindered by poor state of the process of security requirement gathering and analysis. Missing, misunderstood or poor requirements contribute to the late discovery of security related defects.

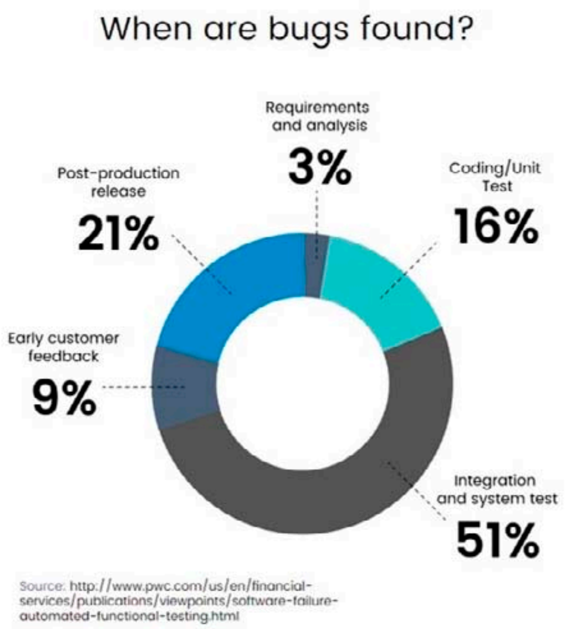

Figure 1 Various phases where defects are found during software development lifecycle

From studying several hundred organizations, Capers Jones discovered that Requirement engineering is deficient in more than 75 percent of all enterprises. In fact, having high-quality security requirements might be the most valuable and most difficult task of a software project.

1.2 Security flaws are costly

Security defects are often found in later phases of solution lifecycle during testing and release phases. The costs related of fixing a defect during testing and release phase is considerably higher that during conception, design and development phases.

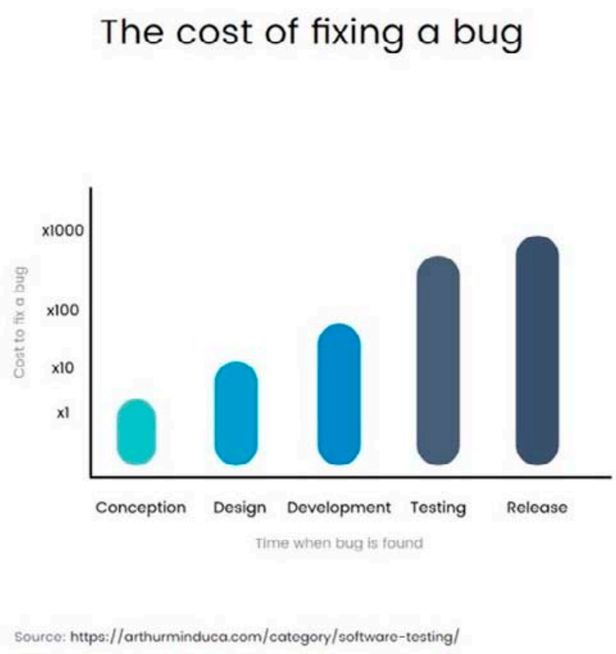

Figure 2 Visualisation of cost of fixing defects in various solution lifecycle phases

Organizations face also monetary fines from security authorities. For an example in spring 2017 an UK company Boomerang video was issued a 60 000 pound fine. In its report ICO (Information Commissionaire's Office the UK's independent authority set up to uphold information rights) stated "If a company is subject to a cyber-attack and we find they haven't taken steps to protect people's personal information in line with the law, they could face a fine from the ICO. And under the new General Data Protection Legislation (GDPR) coming into force next year, those fines could be a lot higher."

Rationales behind the fine included for example lack of penetration testing on Boomerang Video website (Pentest should have detected SQL injection errors. Solution failed to ensure that he password for the account on the WordPress section of its website was sufficiently complex (password security). To make things worse, Boomerang Video had some information stored unencrypted and that which was encrypted could be accessed because it failed to keep the decryption key secure (lack of encryption and failure of key management). In addition, encrypted cardholder details and CVV numbers were held on the web server for longer than necessary (violates storage limitation/retention)

2. Built in security

Aligning quality and regulatory requirements with business needs already early in the project inception phase can reduce operational costs, allow a shorter feed-back loop do development, reduce rework and enable quick delivery to production. All these actions enhance the overall quality. Projects build in security by Establishing Security requirements, creating quality gates and performing security and privacy risk assessments.

Security requirements can be divided into two categories: security features (for example: system shall not have SQL injections) and secure features (For example system uses Object-relational mapping libraries). When defining the security requirements, it's important to make distinction between a negative, "assurance type" od secure feature requirements or a positive security requirements. Foundational security concerns and privacy issues such as confidentiality (data, processes and services are protected from unauthorized disclosure and access), integrity (data, processes and services are protected from unauthorized modification and are thus delivered as intended) and availability (data, processes and services are protected from denial of service and are thus available to authorized users) are traditional main concerns for creating secure systems.

Additional security characters are nonrepudiation (access to or modification of data, processes or services cannot be denied by any of the parties), assurance (services or processes can trust that the parties to a transaction are who they claim to be) and ability to protect the integrity of information and prevent denial of service.

Each security character is a source of building collection of general security requirements.

2.1 Basics for building secure systems

Basis for building and deploying secure solutions consists of Secure implementation, identifying tools and methods supporting the goals and secure development and deployment. Secure implementation consists of actions to identify which controls and safeguards need to be implemented to build resilient system, to prevent vulnerabilities and other security issues in the software. This is done by following security development lifecycle (SDL) processes such as Microsoft SDL or security activities SAMM.

Identifying tools and methods supporting the goals consists such as automated scanning as part of CI – Continuous Integration.

Secure development and deployment are methods and tools needed to secure the development environment and deployment pipeline all the way to production ensure that there is no room for malice in the Continuous Delivery (CD) process).

To reach this Project managers and product owners need to work together with various security stakeholders such as application-, solution- and enterprise architects to consider security requirements early in the designs of applications or solutions. Development teams want know how to implement requirements so they do not need costly fixes during deployment or production phases, and security professionals want to have the capacity to react quickly to vulnerabilities.

Security of a solution is closely related to fundamental engineering practice. If organizations follow the recommended engineering practices, resulting solution is likely to have security features considered. However, even compromises would be made for the recommendations to gain usability or other benefits, it is useful for architects and developers to understand the decisions with respect to security. These can then be taken into consideration during evaluating the residual risks.

In addition to secure development and secure deployment principles organisations need to incorporate security features into solutions. Security needs to be considered throughout the development already during requirements and architecture speciation all the way to implementation. To reach this project managers and product owners need to work together with various security stakeholders. At the design level application-, solution- and enterprise architects create architectural patters than need to match the selected security strategies. Architectural choices will lead to higher security by including prevention measures, methods to detect attacks and identifying how system reacts to attacks. Getting the architecture as well as implementation details correct will enable creation of solutions that include prevention measures, detection of attacks, and describe how the system should react to such events.

Requirements need to be refined by security specialists. Already at this phase, security specialist is able to identify possible missing or unclear requirements that could affect security of solution. During the design implementation by developers, having built-in security capabilities coupled with secure deployment and design frameworks enhance security and overall quality.

2.2 Various sources of security requirements

Secure systems are those that can be trusted to keep secrets and safeguard privacy (J.Rushby 1993)

Security needs to considered throughout the development process for creating effective multi-layered approach. At the architecture level, security considerations enable developing relationships between components. Architecture selections are important for realisation for security, but do not alone achieve security and finally the implementation determines the final outcome.

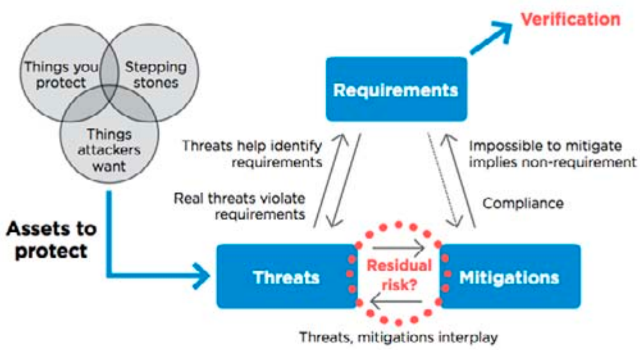

Figure 3 Identification of various sources of security requirements

Regardless of whether a development team uses SAFe, Scrum, Kanban, Waterfall, or any other method, essential outcome is delivering functionalities. A Secure Development Lifecycle discovers threats and transforms them into features, stories or some other form of requirement to be prioritized and implemented.

Threats are identified from assets needing protection, for example using the STRIDE or applying the attack-tree-analysis method. For the identified threats, mitigations are determined, and are in turn enriched into requirements for the project to implement. At the design phase, architecture and design are reviewed so that they contain the necessary base for implementing the requirements.

2.3 Technology based requirements

While many of the requirements based on threat analysis can be implemented as features and controls into the software, development teams must also focus on security concerns rising from the selected underlying technology.

In the world of micro services systems like headless ecommerce are build more and more based on components and libraries. This means less written code and more integrations and application programming interfaces, API's. These kinds of solution environments are difficult to test as the change can happen in multiple locations. In addition, defects stemming for interface faults are one of the most common problems in software. For these reasons, special focus on interface security requirements are needed. When specifying the requirements both the system being built and the future systems interacting with the system being built needs to be considered. Building controls is not enough security considerations for procedural specifications and data structures needs to be specified.

Leveraging security capabilities provided by the components and infrastructure enhances the overall security. Also, the Open Web Application Security Project (OWASP) and SANS best practices lists should be taken into considerations when creating security requirements. OWASP Application Security Verification Standard (ASVS), OWASP top 10 and CWE/SANS top 25 software problems lists can be used as a baseline for requirement engineering.

3. Regulatory requirements – GDPR

General Data Protection Regulation (GDPR) becomes enforceable in May 2018 and extends the scope of the EU data protection law to all companies processing data of EU Residents. GDPR imposes both functional and non-functional requirements to the data architecture as well as functional requirements such as erasure, restriction and data export in compliance perspective.

Due implementation of GDPR is a documentation requirement and security considerations are also part of GDPR requirements.

3.1 GDPR imposes various requirements

The aim of the regulation is that the controlling & processing parties must know what personal data is being handled, for which purpose and on what basis. This implies also a lifecycle-model for handling of data that requires additional knowledge on the contents of information, source of information, and the data flows in general. Also, the time the information is stored has to be determined. GDPR poses various functional, design and territorial requirements into systems.

Functional requirements such as User has access to all data, portability/export of all data to support user queries, Erasure/anonymization of all data, need to follow to whom/where data is disclosed, Ability to block automated decisions such as profiling all are source of new security requirements.

For design requirements pseudonymization poses needs to make sure that UserID should never be email or other obvious identifiers, storage limitations (plan/minimize storage of personal data outside) and Encrypt data or explain why data is not encrypted need to be considered.

Territorial requirements has a main rule that processing data has to be limited into EU/EEA plus certain countries.

3.2 Special focus on logs

Logs are the backbone of diagnostics, identifying errors in troubleshooting and observing software in debugging actions. Logs are used to trace actions, observe and monitor solution. In GDPR logs are seen as indirect personal data. This means that for example transparency policy requesting that log info is disclose in privacy policy applies.

For GDPR purposes audit, access and error logs have new specific requirements such as: audit logs should have data on modification. Access logs to have login/logout with time stamps and ID. Error logs should not contain personal data (but effectively may contain in legacy systems)

3.3 Requirements are complex

Implementing security requirements can be complex. Various mechanisms and stakeholders need to be recognised and worked with. For example, implementing simple sounding security requirements from GDPR "data erasure" consists of various steps.

First organization needs to identify various mechanisms influencing the requirement. Then many, stakeholders need to be identified and gathered to work together. Identifying all related interfaces, integrations and data stores needs to be done.

Examples of mechanism to identify: What is the erasure strategy on high level? What are the technical implementations in individual system? How are retention times implemented? How to handle systems where erasure isn't technically feasible and how to handle legacy systems? Stakeholders for this work include system specialists and system owners.

Examples of interface considerations: Which parts of the system require new user interfaces? Are there caches which need to be refreshed? What other data needs to be updated or shown differently? Stakeholders for this work include UI designers and developers.

Example of questions need to identify integrations: Are there integrations which are affected? How are other systems notified of system change? What is the master system for the data? What happens in other systems if the data is not available? Stakeholders for this work include System owners (many) as well as third parties, partners (also many).

Finally charting all the data stores: What locations physically store the data? How are log file contents handled? How about backups? Stakeholders for this work include data owners and developers

4. Holistic view to security requirements

Organizations wanting to solve how to deploy with efficiency, and ensure that the deployment pipeline safeguards the integrity of the systems need to have holistic view of security requirements. Relevant security requirements can be derived from various internal software quality attributes, compliance and regulatory sources. Internal software quality is often supporting the overall quality experience of the solutions and are not usually visible or directly experienced by end users.

4.1 Security attributes

When identifying what to protect security attributes contribute to protecting the system against unwanted usage. Requirements for authentication (user identification), authorization (determining what authenticated user can and cannot see and do), Privacy (ability to not disclose data that is protected to unauthorized users), Resisting penetration attempts and social engineering vulnerabilities, secrecy (system is not disclosing information of underlying systems) virus-free: product will not transport virus, or appear as one And piracy Resistance: illegally copy and distribute the software or code is not possible. In addition, the Compliance requirements for various security standards relevant too context.

4.2 Other Software Quality attributes

Various other software quality attributes can be used to elicit security requirements. At least attributes such as Efficiency (performing in efficient manner without doing what it's not supposed to do), data agnosticism (supports various data formats and handles noise), reliability (product manages various difficult situations), stability (no the crashes, unhandled exceptions or script errors present) robustness (handling the foreseen and unforeseen errors gracefully without leaking potentially harmful information), stress handling (coping under heavy load), recoverability (recovering and resuming operation after fatal error) and data Integrity (data remains intact throughout the product) all have security supporting requirements.

4.3 Insecurity is the new norm

Even with the purposeful and holistic requirements the evolving threat landscape, new technologies such as mesh networks, ever growing business requirements and increasing technical complexity leave room for systems to be hacked. In an essay Bruce Schneir (2007) concludes that we often perceive the security the wrong way:our assumption is that the system is secure until proven wrong. While in fact, Schneier suggests that if you want system to be secure, a better way is to start by assuming it is insecure, until proven otherwise.

System's ability to survive from attacks are built by having resistance to attacks being able to recognise attacks and ability to recover after attacks

In order to increase the readiness to tackle a cyber risk organizations need to ensure visibility into environments, know where the data is and ensure ability to react and recover.

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Research on the Effects of Deliverables Management utilizing Integrated Repository at a Large-scale Project

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In a large-scale development project, it is deemed difficult for all of the project members to work under common grounds, for communication channels grow extensively as the project size becomes larger. This is especially true since design documents are created via Office applications in a high volume of papers and files, making it difficult to maintain the consistency across them. Needless to say, many defects are also hidden in the source codes developed from such a high volume of design documents, and in many cases, they are estranged from design documents as a result of repeated changes and revisions to source codes. Such issues occur not only during the development phase but also the maintenance phase of new systems. Meanwhile, as Tom DeMarco stated in his saying of “You can’t control what you can’t measure,” it is mandatory to make project assets “visible” and furthermore “measurable” numerically so as to manage a large-scale project with a high volume of work products well. Provided the above, this paper describes how a large-scale project has made the design and development information “visible” and “measurable,” and what kind of effects were attained as a result of implementation based on the actual sample case of Integrated Repository. To be more specific, the development and usages of Integrated Repository will be introduced such as the consistency check upon repository registration, the automated generation of deliverables based on the registered information, the traceability assurance between design and development information, the measurement of scale information such as various lists, the impact analysis at the timing of revisions/modification utilizing search functions, and the use of analysis functions such as the estimation of processing time estimation in order to verify each of the effects respectively. As a result of using Integrated Repository, it is confirmed that it has led to the improvement of productivity, work products and quality by restoring key information extracted from standardized design documents into the repository, and releasing the functions to refer, analyze, and generate files as Web applications to all of the project members.

Keywords and phrases: Integrated Repository, large-scale projects, visualization, measurement

1. Introduction

As a means of forecasting software development estimation, Boehm(1981) announced COCOMO model. Thereafter, the basic cost model and the concept behind have become universal, despite changes made to development languages, methodologies and development processes with the times. Meanwhile, as shown in Figure 1 by Nunokawa(2012), the development productivity per step in the entire project would be lowered, as the number of project members or the line of codes increased.

In Figure 1, the vertical axis shows the relative value, which means that the effort for development is relative value of 1, if development scale is 1 kilo step. What Figure 1 indicates is that there are productivity differences of several times to tens of times depending on the development scale. Also, in small-scale development, individual differences are largely influenced by productivity, but as the scale gets bigger, it is leveled out, and defect removal activity instead has a decisive influence on productivity. After grasping the tendency of these large-scale projects, it is necessary to take countermeasures not to lower development productivity as much as possible.

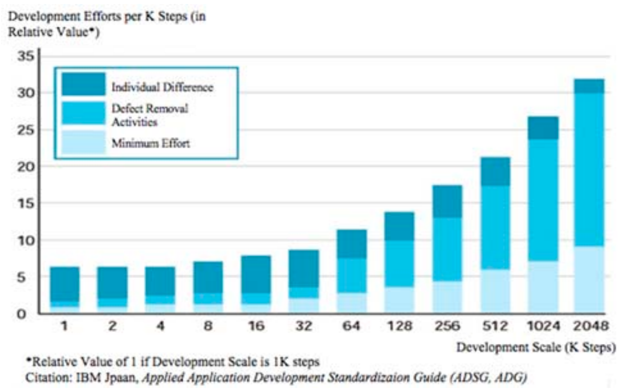

Figure 1 Relation between the scale and the efforts for development

To solve this productivity issue, the effectiveness of Integrated Repository which has been introduced as a countermeasure to a real large-scale project will be examined.

2. The issues large-scale projects face with

Now, a question should be addressed here: What causes to decrease the development productivity in large-scale projects? There are three causes according to the data from IPA/SEC White Paper 2016-2017 on Information-Technology Promotion Agency Japan(2017).

The first cause is the complexity of system. As the scale increases, the numbers of functions and data items increase, and the combination of these elements also increases exponentially. Therefore, the checking processes become complicated, while increasing the processes of exception, branching and judgement at the same time.

The second cause is that organization efficiency decreases due to an increase in communication paths. As the team becomes gigantic, the number of participants in the project increases, and the communication paths among stakeholders in turn increase. In addition, the number of project members who are waiting for instructions increases, and the communication loss increases. As the system size increases, the project members dedicate themselves to a clearer division of labor such as the system infrastructure, database, and common functions, and the types of products to be created also increase. This means that all of these divided members need to get together for any events to be carried out.

The third cause is that the defect removal activity increases. The larger the project is, the greater the number of stakeholders in the project becomes, the greater the number of communication channels increase dramatically, and the more the complexity increase. For this reason, it is difficult for members to have the same understanding on the work products produced in the project, and the consistency across the work products cannot be maintained. Since the development period is long in large-scale projects, the number of corrections and changes made to the source codes increases. As a result, bugs are mixed in the source codes developed from the design document, and a deviation may occur between the design documents and the source codes with a high possibility. This problem may happen not only during the construction phase of the new system development project, but also during the maintenance phase of the new system development.

For these reasons, if the project scale becomes large, the basic productivity of the project decline and quality control becomes difficult.

3. The solution by introducing Integrated Repository

As a method to prevent this, a communication tool would be introduced to the members, that is, Integrated Repository, which allows all members to easily access the latest design information and perform consistency check on the latest design document.

With respect to the complexity of the system, the productivity slowdown among the project members resulting from the project complexity can be prevented through maintaining the consistency of the work products and taking actions to visualize the latest design information. When the project scale becomes large and the number of functions increases, the system is simplified through reorganizing subsystem division and looking at functional strength. Despite the simplification, the system may still be complicated inevitably for some cases. Therefore, if a large amount of design information is visualized and consistency is maintained at all times, the project member can obtain correct information without confusion.

As for the increase of communication paths, it is possible to reduce the number of necessary communication paths and prevent a decrease in productivity mainly through the communication with Integrated Repository. For large-scale projects, the project members tend to dedicate themselves to specific works, and contradictions across different design documents can easily occur. However, the communication loss can be reduced, if the consistency check is done properly since it raises the accuracy of the design documents. In addition, the project member should be able to do the impact analyses based on multiple design documents easily since they can identify which members should be communicated and void unnecessary communication, so that a decrease in productivity can be prevented.

Regarding the increase of defect removal activity, it is possible to reduce the number of defects in the source code by checking the consistency between the work products and improving the quality of the design documents. This leads to prevention of defect removal activities.

As such, if Integrated Repository is applied to large-scale projects with its two features, namely “visualization” for extracting design information from work products and "measurement" for quantifying inconsistency across the design documents made from the extracted design information, the quality in large-scale projects will be improved.

3.1 "Visualization" of the design information

If all project members can discuss with each other based on the latest design information, communication loss will be reduced. To that end, it is necessary to "visualize" design data that allows the project members to access updated data at all times through project period by extracting design data from the latest consistent design documents.

However, this does not necessarily mean that the "visualization" is good all the time. As Gopal, Mukhopadhyay and Krishnan (2005) mentioned, the project management would fail, if it requires a lot of efforts to collect the data needed for the visualization of the work product quality. Therefore, it is necessary to lower the work efforts through different ways such as the automation of the data collection.

Project members should be granted the access to the latest information on errors and inconsistencies throughout project life, and they should also be able to access the latest status of design information as easily as possible.

3.2 "Measurement" of design data

What is sought in projects is not only to extract the design data from the latest design documents to do "visualization", but also to quantify the whole project for "measurement" in order to grasp the entire status for the promotion and management.

For example, the quality of the design documents is quantified and managed in a project when the errors and inconsistencies on the design documents are identified via extracting inadequacies and inconsistencies in the design documents and listing the number of cases. By checking the status weekly, it will lead to the continuous improvement of quality. Also, it will allow the project members to have an easier access to the project information and to create a more precise plan for test phase as the consistency among JOBNETs per test calendar date is identified and processing time by test calendar date is clarified.

In addition, the freshness of information is certainly important in understanding the status correctly. However, the project management may be failed, if it takes too much efforts to collect and analyze the design data, similar to "visualization." Thus, it is important to collect the quantified data automatically and analyze the data using tools.

3.3 Utilizing Integrated Repository which realizes "visualization" and "measurement"

In order to maximize quality in projects, the operational flow as written in Figure 2 will make the visualization and measurement possible.

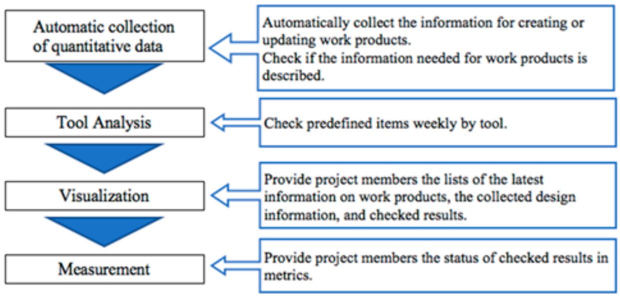

Figure 2 Operational flow of Integrated Repository

In collecting some quantitative data automatically, it is important to secure quality by gathering the information on work products and their changes in a timely manner, by simultaneously checking input information, and by fixing oversights and defects immediately.

As for tool analysis, tools are used to check consistency across work products based on the design information secured with quality.

For the visualization, the developers will always have the access to the latest information through the list of design information with consistency in it and the references made available on Web.

For the measurement, quantification will be required as the next step of visualization. Therefore, the result of consistency checks performed against design documents has been quantified, and put numerical values on the status of fixing errors so that the status of quality improvement can be checked.

In stabilizing the visualization and measurement of quality, it is important to automate processes and reduce efforts as much as possible to be able to continuously visualize and measure the status throughout the entire project period. To these, Integrated Repository is proposed since this has the functions which automatically investigate, check, and digitize the base information from the design documents created.

In this paper, the large-scale project is used as a specific example in order to verify what kinds of designed information has been extracted, and how the lists created from the information extracted impact.

4. What function Integrated Repository has

Integrated Repository is applied to a real large-scale project, of which the basic information is shown in Table 1 to show the size of the project.

Table 1 The basic value in the project applying Integrated Repository

Work products	Volume of documents	Unit
Macro design document	2,000	Number of files
Micro design document	5,000	Number of files
Program step	6,700,000	Number of COBOL program steps (exclude comments)

It takes time if the progress status of this huge volume of design documents and the consistency across these work products are investigated periodically and manually. Also, the visualized and measured information would be out-of-date and would not be in real time to improve the quality of work products, if it takes more man-months in collecting information and doing these verifications in the project while the work products are getting completed increasingly. Figure 3 describes how Integrated Repository is leveraged to resolve this situation, and how the productivity is improved by checking the project status in a defined procedure as written in Figure 3, and the consistency between work products and the measurement in the project.

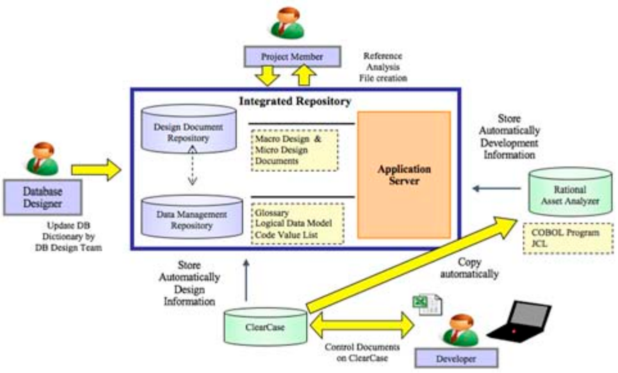

Figure 3 The way to manage work products

As illustrated in Figure 3, in this project, the design documents are stored in IBM Rational ClearCase (hereinafter referred to as CC) that manages history management while the HOST development assets such as COBOL programs are stored in IBM Rational Asset Analyzer (hereinafter referred to as RAA). The design information from CC and development information from RAA are stored in Integrated Repository in order to check traceability of design and development documents.

Before registering work products, Integrated Repository performs some format checks defined beforehand, for example, whether necessary items are listed in. After the registration, Integrated Repository automatically collects the digitalized data from twenty-two kinds of work products in macro design and micro design documents. Integrated Repository then executes the consistency check across work products weekly to improve the quality of work products continuously. These functions aim at getting rid of quality unevenness in the design phase and some hidden items which are not become apparent at an early stage. Through connecting with RAA, Integrated Repository verifies five kinds of the traceability between the work products in the design phase and in the development phase. Then, these functions referring and analyzing the collected information and creating lists in Web application are incorporated. Based on the result, it is realized what can improve the quality of work products and the development productivity of designers and developer. The details of these functions in Integrated Repository are shown below.

4.1 Consistency check

Currently, there are two kinds of the consistency check in the project by the method shown in Figure 4.

One is the format check that is done against what is stored in Integrated Repository. The other is the consistency check across documents or between documents and the automatically created lists after stored.

The first check, or the format check done against the documents, is the check that guarantees the described level of design documents, and that keeps the minimum level of quality. Twenty-two kinds of documents are checked as the first check in the project.

The second check is the consistency check across documents. Thirty-eight kinds of documents are examined as the consistency check in the project. The consistency check is conducted weekly and traced the results and correspondence. The errors should decrease to zero by the end of each phase.

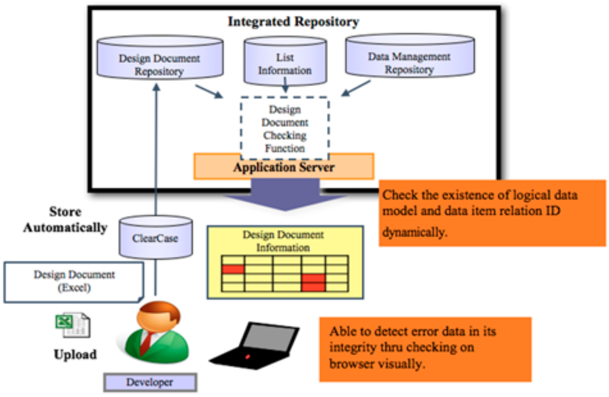

Figure 4 Flowchart of consistency check

4.2 Create each list based on registered data and measure project scale information

Integrated Repository automatically creates seven kinds of lists from the registered documents and collects the project scale information.

•Functions list (links between use cases and functions)

• Messages list
• Programs list
• Common functions list
• System application control function list
• CRUD (database access list)
• JOBNET list

Each list is created by collecting data from some work products. For example, CRUD is generated automatically using by design information from macro design documents, common function design documents and the physical entity list. Integrated Repository also has a function that shows the data on Web. Therefore, the developers in the project can easily get the data access information required in each program. The designers in the project analyze the influence from the latest CRUD information.

At the same time, Integrated Repository automatically generates the JOB and JOBNET diagrams based on the information attained from both Integrated Repository and RAA as a result of connecting them together. Integrated Repository has a function that creates an entire JOBNET diagram, a NET list based on the design information extracted from 8 design documents, for example, JOB list, JOBNET specification, BATCH flow. Through this, these different kinds of JOBNET information are integrated into one document, and then, JOBNET diagram will be generated. Thereby, the users can extract JOBNET information by test calendar date, search for a prior or a posterior JOBNET process, and add up processing time. During development period, it is more difficult for the larger scale of project to create the entire JOBNET diagrams manually while keeping the information fresh because the change requirements occur frequently. Therefore, it is effective to create these documents automatically via Integrated Repository.

4.3 Secure the traceability between design information and development information

Integrated Repository has five kinds of function for traceability check, and also has a functionality to make the result of traceability check available on the Web.

• Create the function list from the design documents of each function

Integrated Repository creates the rule list from macro design documents, and makes sure that all of the business rules identified during the former phase, or requirement definition phase, are included. And then, it traces that the functions defined form business flows and service flows exist on the automatically created function lists or the common function lists based on micro design documents.

• Traceability of business rules

Integrated Repository checks if the business rules received from customers are described in the rule specifications of macro design documents appropriately.

• Traceability of interface ID

Integrated Repository also confirms that the interfaces between the system and external systems are associated with the service ID.

• Traceability between transaction and interface

Integrated Repository analyzes how interface IDs in the business transactions are associated with others in the JOBNET, and also allows the users to see the inconsistency list of interface ID without I/O transaction in any JOBNET.

• Traceability of CRUD

Integrated Repository makes comparison between CRUD information from micro design documents and physical entity lists generated through the normalization of current data against the database entities extracted from macro design documents in order to check if there are any unused entity or unwritten entity in any document. It also traces whether the data item is fully created, updated and deleted using CRUD information.

Through these traceability functions, the inconsistency between the design documents and development documents can be detected before testing.

4.4 Utilization and scalability of analysis functions

There are several analysis functions for the resources shown in Table 2 in Integrated Repository.

Table 2 RAA analysis target resources

Resource name	Volume of resources
Program	5,000
DAO program	10,000
JOBNET	20,000
Entity	300
Data item	20,000

For a basic impact analysis of changes such as data specification change, it can be analyzed through web screen by leveraging search functions and display functions. For complicated impact analysis such as requirement changes in order to minimize risk of affected areas, a hierarchical program chart will be generated with design information from both Integrated Repository and RAA. The analysis is much easier to do with this chart visualizing complex relations among programs.

Now, Integrated Repository that is built at the initial stage of the project is designed in consideration of scalability. For example, the design information collected automatically is included in the database, and is released for the project members. When the project advances and the situation changes, a new analysis for the collected design information will become necessary. If there is the analysis demand from an application team, the expansion of the function based on the collected design information is enabled then.

5. Effects by functions of Integrated Repository

In this chapter, the effects utilizing functions of Integrated Repository that were introduced in Chapter 4 will be verified.

5.1 Effects by consistency checks

There are three effects induced by the consistency checks done at the timing of registration to Integrated Repository.

Firstly, the quality for deliverables is ensured because the basic information is verified when extracting it from design documents.

Secondly, the work effort of 120 man-months for quality improvement activities is reduced in total by checking basic 100 information automatically at the timing of repository registration. It can save 15 minutes per document because it changed from manual to automated operation. There are between 2,000 to 5,000 documents per deliverable, and when each document is presumably updated 10 times on average, 19,000 hours (120 man-months) can be reduced in total.

Thirdly, it is the effects against quality improvement. Approximately, 0.5 defect per document was found through the consistency checks done at the timing of repository registration. That is to say, approximately 40,000 defects were found and modified before the development. In other words, those could have become defects and the rework might have been necessary to deal with them, if those were not identified in advance.

Assuming that one-hundredth is identified as a defect in the later processes and it takes two man-days to deal with the defect, 40 man-months will be reduced as a result.

Meanwhile, the consistency check between the documents found 100 to 200 new errors every week. It contributed to continuous quality improvement because those errors were fixed in a timely manner. All in all, the consistency checks done at the timing of repository registration is therefore essential because it is the first step for "measurement" and generates synergy for quality.

5.2 Effects by creating each list based on registered data and measuring project scale information

By automatically creating the list, it brings about effect of reducing the workload for manual processing. In this section, the effects are examined by highlighting two specific examples of the CRUD and JOB list, and JOBNET diagram.

At first, the CRUD will be examined here. If the list of CRUD information is updated manually due to the change of design documents, it takes about 1 minute. But, in order to avoid the work conflict, it is desirable to assign a manager for list update. In such a case, additional workload will be required to make a workflow. On the other hand, if the list is automatically generated, the only task that a designer does is to upload some design documents to Integrated Repository, so that there is virtually ZERO effort for updating the list (about a few second).

The trigger of changing CRUD information is a change requirement or a defect. In this project, there are approximately 2,000 change requirements in total. About 600 change requirements, or 30% of total, are the changes related to database and entity items. This resulted in an effect of reducing about 1 man-day.

Now, the JOB list and JOBNET diagram will be examined here. It is helpful if there are JOB list and JOBNET diagram because the number of JOB and JOBNET are huge and the connections are complicated in a large-scale project. For example, when it is necessary to find out impact caused by defects and estimate a required time to fix it, it is more effective if the JOB list and JOBNET diagram exist. In the project applied to Integrated Repository, as shown in Table 3, the number of JOBs is 50,000 and the total number of NETs is 20000. In addition, the average number of jobs running on the day is 10,000.

Table 3 Basic numerical value of a project applied to Integrated Repository

Unit of collection	Volume
JOB	50,000
JOBNET	20,000
Average JOBNET per day	10,000

Consequently, it is difficult to research a prior or a posterior JOBNET for plurality of class without a list like an entire JOBNET diagram as shown in Figure 5.

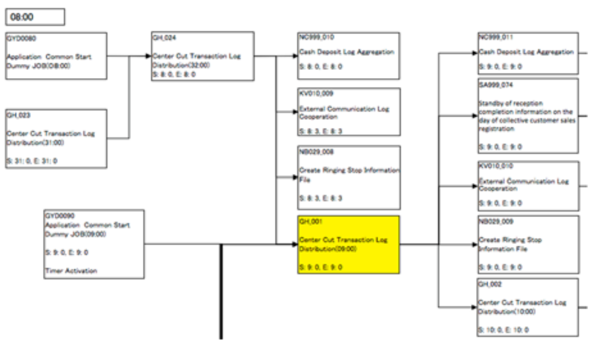

Figure 5 List of entire JOBNET diagram and process time per test calendar date

For example, if one JOB needs to trace 2 levels of pre-processing and 2 levels of subsequent processing, 13 JOBNET should be checked on the condition that each JOBNET connects to 2 JOBNET. If it takes 1 minute per 1 document, it takes 14 minutes totally. On the other hand, in the case with an entire JOBNET diagram, the diagram, check classes, and pile up the number of JOBNET processes has been updated, and it takes 2 minutes. Based on this result, working time is shortened by 1/7. In a similar way, in case of without having an entire JOBNET diagram, it takes 1,000 minutes to extract the JOBNET per a test calendar date and search the bottle neck process and pile up the processing time. But, in the case with an entire JOBNET diagram, it takes only 10 minutes. Therefore, working time is shortened by 1/100.

A test planning team is able to estimate a system test period of each test calendar date exactly and easily in planning system test by implementing the function of extracting JOBNET per test calendar date. That means, it could be beneficial if a test planning team could use workload not for planning system test period, but to consider the aim of test which is basic work of project.

The automatic generation of the list itself has a small effect of reducing the man-hour. However, it is found that the effect can be obtained by utilizing the scale information of the project obtained from the list for analysis and planning.

5.3 Effects by traceability check between design and development information

Traceability checks are performed through design information and development information. Because a possible error could be detected prior to testing by the traceability check, rework efforts in development process could be lower than in testing process. In addition, inconsistencies could be detected timely and made visible and measurable to application development people because traceability check between the source codes and design documents have been performed weekly. Consequently, errors would be modified accordingly in a timely manner. As the result of the visualization and measurement, it has also contributed to early detection and then workload saving.

5.4 Effects by the utilization & scalability analysis functions

Utilizing analysis functions by information of Integrated Repository including information imported from RAA, design and development information could be connected. Consequently, analysis can be proceeded from the points of design and development views. In addition to that, cost and workload can be reduced.

As for scalability in the case of large-scale development project, various kinds of analysis might become necessary and special temporary analysis might be needed because the project period for such projects tends to be longer and a project scope tends to be wider. Therefore, the specification of Integrated Repository databases is shared and accessed among project members in order to analyze ad hoc when necessary in a timely manner.

6. Conclusion

Many of the projects have performed the visualization and measurement of Cost and Delivery out of QCD until now in order to manage project status. However, there are few projects that have conducted the visualization and measurement of Quality. Based on the results of applying Integrated Repository for quality measurement through our real sample case, it is evaluated that it would improve the quality subsequently. In addition, it could be said that there are much effects on Cost and Delivery as well. Especially, it is effective to apply the measurement of quality for large-scale projects as means to prevent from lowering development productivity. In conclusion, this paper can be an initiative to practice this measurement of quality through the implementation of Integrated Repository in large-scale project.

In addition, Integrated Repository is planned to be converted into an asset so that it will be applied to other projects. For the assetization of Integrated Repository, what needs to be done is to select suitable functions, generalize each function, and turn work products into templates as future tasks.

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Managing Quality by Checking the Completeness of Customer Requirements from Initial Phases to the Test Phase

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Developers needing to develop larger and more complicated systems for their customers might encounter the following problems: (1) If customer requirements are omitted or not finalized in time, the development and delivery might be delayed and system quality might be lowered. (2) If checks do not cover all of the customer requirements during the design and test phases, rework might become necessary later in the development project. Such rework increases development costs. This paper proposes two approaches to address these problems: *completeness checks* and *requirements tracing*. In the requirements definition phase, developers take steps to increase the visibility of customer requirements, and developers and customers participate in completeness checks to ensure that the specifications contain all such requirements. In the design and test phases, requirements tracing verifies that the specifications contain the customer requirements. In addition, in the test phase, requirements tracing verifies that such requirements have been implemented in the system. This paper discusses the quality management effects of applying these two approaches to the entire development process, ranging from the requirements definition phase and the design phase to the test phase.

Keywords and phrases: Quality, Management, Initial Process, Requirements Definition, Trace

1. Introduction

In system development, the cost of removing defects (such as bugs) from a system is said to account for approximately 40% of total project costs (Sharon and Richard). In addition, it is well-known that the later that defects are detected, the higher the modification costs and the greater the impact on the entire project. Therefore, in system development projects, it is vital to implement quality management controls and to build in quality from the earliest phases.

Moreover, problems in the requirements definition phase, the initial phase of the project, tend to cause major project complications later on. In a survey on system development, 43% of respondents indicated that collecting user requirements and defining system requirements were important for improving quality. Therefore, it is crucial to ensure quality from the requirements definition phase, to prevent defects from being incorporated into the system and to reduce defects that are detected in the later test phases.

In the requirements definition phase in the past, we carried out project management by judging the suitability of the defined requirements for each individual project, based on prior project experience and guidelines from organizations such as Japan's Ministry of Economy, Trade and Industry and the IPA (Information-Technology Promotion Agency). However, the following issues led to repeated cases of delivery delays and compromised quality, which resulted in project failures: omissions in requirement specifications created by customers (Hosokawa, 2013) and differences in understanding of the completeness of the requirement specifications (Gause and Weinberg, 1993) . We also experienced cost increases caused by rework in later phases. This rework became necessary for reasons such as the following. (i) Even when the defined requirements were adequate, in the design and test phases we were unable to check whether every single one of the complex system requirements had been incorporated into the design. As a result defects requiring rework were later detected. (ii) There were omissions in the checks to confirm that all the requirements were covered by the vendor test cases. As a result, defects were detected during customer testing.

This paper presents measures that were implemented at Hitachi, Ltd. (abbreviated hereafter to “Hitachi”) to increase the visibility of the requirements and their status, from the initial phases to the test phases. In particular:

- *Requirement completeness checks* enable stakeholders to clearly understand whether the requirements are sufficient and complete enough to develop the system.
- *Requirements tracing* enables stakeholders to clearly understand whether the requirements are incorporated into the design, and whether the tests cover all the requirements.

2. Increasing the Visibility of Requirement Definitions and Their Status

Two measures are implemented for increasing the visibility of requirements and their status. The first measure is a *requirement completeness check* (see section 2.1 below), which is implemented in the requirements definition phase. The improved visibility provided by this check makes it easier for stakeholders to check whether customers' requirement specifications are sufficient to cover all the details needed to develop the required system. The other measure is *requirements tracing,* which is implemented jointly with the customer in the design and test phases. The improved visibility provided by tracing makes it easier for stakeholders to understand whether the requirements are incorporated in the design, and whether tests that check the implemented requirements are conducted. Figure 1 below shows both measures and the phases to which they apply.

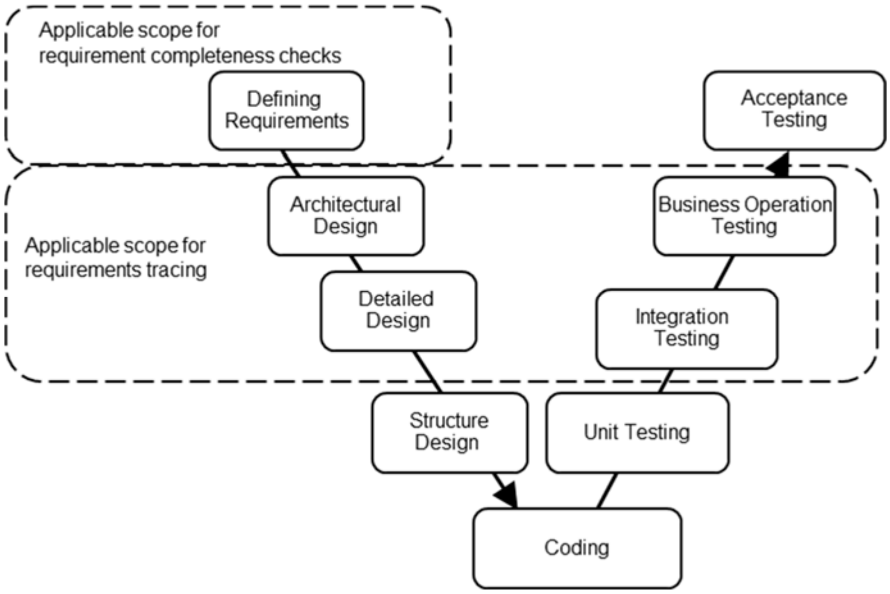

Figure 1 Phases in which Measures are Applied

2.1 Requirement Completeness Checks

Requirements related to business operations and functionality are directly connected with customers' business operations. Therefore, in the past, rather than performing completeness checks, stakeholders extensively discussed and examined methods for extracting customers' requirements and methods for compiling and increasing the visibility of the extracted requirements. On the other hand, non-functional requirements concern the system itself, and not customers' business operations, so there was a tendency to provide vague or unclearly presented requirements. To resolve this problem, we assigned individuals on each project team to address obscurities, and referenced materials such as the *Non-Functional Requirements Description Guide* published by the IPA. However, there were still instances of delivery delays and compromised quality due to omissions in the requirement specifications created by customers, and due to differences in understanding about the completeness of requirement specifications. To address this, Hitachi built upon the *Non-Functional Requirements Description Guide* by incorporating past failure experiences and individual knowhow from each project to devise and implement requirement completeness checks as a countermeasure.

2.1.1 Overview of Requirement Completeness Checks

A requirement completeness check comprises a total of seven categories. The categories include the six categories set forth in the IPA's *Non-Functional Requirements Grades* and the category *Project Management* which was added by Hitachi. Table 1 below explains each of the categories in a requirement completeness check and lists the number of focus points for each category. Hitachi added the Project Management category in order to clarify system development assumptions and matters concerning development project management, from the perspective of performing development as a development vendor. Moreover, by concretely describing details of the different category focus points, we are standardizing the entire company's work quality, and also providing improvements for our customers based on easily comprehensible descriptions. Table 2 shows an example of a focus point for the added category of Project Management. Figure 2 shows an example of the category focus point aimed at clarifying, or making concrete, the description. To visually convey all of the details related to requirement completeness, each component of the categories is compiled in a matrix. The improved visibility provided by this matrix makes it easier for stakeholders to quickly see whether the defined requirements are sufficient to develop the system.

Table 1 Requirement Completeness Check Categories and Number of Focus Points

No.	Category	Description	Num. of focus points
1	System Availability	Requirements that enable the system service to be used continually	6
2	Performance and Scalability	Requirements related to system performance and future system enhancements	7
3	Operation and Maintainability	Requirements related to system operation and maintenance services	17
4	Migration	Requirements related to migrating assets of the existing system	4
5	Security	Requirements related to ensuring information system security	13
6	Environment and Ecology	Requirements related to the system's equipment environment and system ecology	12
7	Project Management	Requirements related to the project, such as objectives and approaches, project scope, and schedules.	12

Table 2 Example of a Focus Point for Project Management

No.	Focus points	Focus points to verify for *Project Management* (Excerpt from the Requirement Completeness Table)
1	Scope of Development	Amongst all the business operations related to this system, clarify any descriptions about the scope of the system to be developed. - If there is an existing system, clarify any differences between the existing system and the new system. - If there are end-user terminals, verify the locations and types of the terminals.

No.	Focus points	Focus points to verify for *Performance* (Excerpt from the non-functional requirements grades)
1	Online Response	Considering the characteristics of the business operations being systematized, what level of response is necessary? Decide peak characteristics, and...(*subsequent text omitted*).

Clarifying the focus point

No.	Focus points	Focus points to verify for *Performance* (Excerpt from the Requirement Completeness Table):
1	Online Response	- Considering the characteristics of the business operations being systematized, what level of response is necessary? Decide peak characteristics, and...(*subsequent text omitted*). - Caution is necessary for large-scale searches. If the existing system is replicated, response times will become delayed due to added functions, distributed servers, etc. - Consider the order of processing, and consider restricting access traffic beyond what is required by the performance requirements.

Figure 2 Example of Clarifying a Focus Point

2.1.2 Method for Applying a Requirement Completeness Check

There are essentially two major methods for applying a requirement completeness check. In one method, when Hitachi is providing support to customers in creating the requirement definitions, we carry out checks together with the customer to find out whether the details of the created requirement definitions are suitable. By checking the component items of each focus point, by checking whether the requirements for each function are sufficient, and then by recording that information in a matrix, we increase the visibility of the requirements.

The other method is used to eliminate discrepancies in understanding when Hitachi is performing development as a vendor. In this case, we check whether we can develop the system based on the requirement definitions created by the customer, and notify the customer about any insufficiencies or details to be verified. We increase the visibility of problems in the requirement coverage checks by incorporating steps (into internal processes in the initial phases) to verify the level to which requirement completeness checks have been conducted.

Figure 3 below shows the requirement completeness table as a matrix. Figure 4 shows the requirement completeness table as a compilation of focus points.

				A. Availability				...
				Operation schedule		Business operation continuity		...
No.	Section	Paragraph	Details	C	H	C	H	...
1	1.1			●	●	●	●	...
2	1.2			●	●	●	●	...
3	1.3			●	△	×	▲	...

Legend:
● Sufficient
▲ Unclear
△ Insufficient
× Lacking
— Not applicable

C: Customer, H: Hitachi

Figure 3 Requirement Completeness Table (Matrix)

	Component items	Description	Rating	Concerns	Future approach
System availability	Operation Schedule	While the system is running, and during suspension operations and system failures...	●		
System availability	Business Operation Continuity	In guaranteeing system availability, the scope of required business operations...	△	Underlying conditions are unclear	Investigate current business operations
⋮	...	...	...	...	...

Legend:
● Sufficient
▲ Unclear
△ Insufficient
× Lacking
— Not applicable

Figure 4 Requirement Completeness Table (Compilation of Focus Points)

2.2 Requirements Tracing

In one incident in the past, a large-scale failure occurred resulting in the suspension of transactions in a financial system that needed to be reliable. From that experience, Hitachi implemented *requirements tracing* as a control measure to verify that both the orderer and the development vendor check that all requirements (without omission) have been integrated into the designed content during the development phase, and all requirements (without omission) are checked during vendor testing.

Hitachi has been implementing requirements tracing in system development projects under our commission since 2010. We discuss the effects of requirements tracing below.

2.2.1 Overview of Requirements Tracing

For requirements tracing, after the requirement definitions have been created, the customer assigns an ID to every component item in the requirements, and makes a requirements tracing table. In the design phases, the design specifications for each of the requirement tracing IDs are made, and the orderer and the development vendor check the information to prevent requirements from being omitted from the design, while also mutually coordinating their understandings to prevent discrepancies in the understanding of requirements and to reduce the incorporation of defects. In the test phases, test checklist IDs confirming each of the requirement tracing IDs are recorded to prevent tests from being omitted. For each phase's results, we calculate the requirement fulfillment rate (requirement fulfillment rate (%) = *number-of-items-verified* ÷ *total-number-of-items* × 100), and at the end of each phase compare it with target values, to increase the visibility of the quality accumulating in each work phase.

Figure 5 shows an example of a requirements tracing table.

Requirement ID	Classification	Requirement details	Tracing information						
			Architectural design		Detailed design		Unit testing		...
			Results	Section	Results	Section	Results	Checklist	...
AA-0101-01	Performance	XXXX	Poor		OK	△△	OK	Performance -0001	...
AA-0101-02	Performance	XXXX	n/a		OK	△△	n/a		...
BB-0101-02	Scalability	XXXX	OK	××	OK	□□	OK	Scalability-0003	...
...	...	...		...		...			

Figure 5 Requirements Tracing Table

3. Examples and Effects of Applying Requirement Completeness Checks and Requirements Tracing

Requirement completeness checks have been implemented throughout Hitachi. Section 3.1 provides examples of applying the checks and qualitative evaluations of the checks.

Requirements tracing has been implemented in a number of projects with good results. Section 3.2 discusses the effects of requirements tracing in terms of defect objectives, and describes the quantitative results of such tracing in the test phases of the projects.

3.1 Examples and Effects of Requirement Completeness Checks

Before and during FY (fiscal year) 2015, requirement completeness checks were conducted for 70 projects. Most checks were for large-scale systems and systems requiring high reliability. In FY 2016, the checks were conducted for 32 projects. Table 3 shows customers' and project members' evaluations of the requirement completeness checks. From the evaluations, the biggest effect on project management is probably that this check process makes it easier to claim additional costs incurred due to modification of requirements that became problematic during the course of the project. In particular, it becomes easier to claim costs for modifying requirements that were evaluated and agreed on with customers in advance.

Table 3 Evaluations of Requirement Completeness Checks

No.	Evaluator	Evaluation
1	Customer	I could convey the requirements clearly.
2	Customer	I could increase the visibility of the requirements, and evaluate the requirements definition work.
3	Hitachi PM	As a result of agreeing upon baselines with the customer in advance, when requirement modifications were needed later on, we were able to coordinate easily.
4	Hitachi PM	We could organize unresolved matters, and manage problem issues.
5	Hitachi Leader	It has been advantageous as a tool for performing checks, since we had no prior mechanism for checking whether requirements were sufficient.
6	Hitachi Leader	Each of the details to be checked in requirements definitions was organized, and there were no differences in the contents of checks performed by different checkers.

3.2 Examining the Effects of Requirements Tracing

Table 4 shows results from projects where requirements tracing was applied. Figure 6 shows a comparison between defect target numbers and the actual number of defects detected during acceptance testing. As indicated by the fulfillment rates in each phase in Table 4, the fulfillment rate during each system's business operation testing was 100%. Due to the increased visibility of the requirements and their status, we could confirm that test cases were present for every requirement (without omission). A fulfillment rate of 100% was even achieved in the design phases for every system other than System A and System C, which means that we are successfully verifying that the requirements are being incorporated from the initial phases.

The fulfillment rates for both System A and System B were low in the architectural design phase (15.7% and 10.0% respectively) because both systems were developed when we had just started applying requirements tracing. However, the resulting high visibility of the requirements and their status resulted in the effect that requirements for later systems (Systems C to F) were incorporated in the architectural design phase with high fulfillment rates. Moreover, for System A, which was a replacement system not needing large-scale functionality improvements, tracing was required even for items that were not being modified, resulting in the development scale being disproportionate with requirements tracing numbers, which made it difficult to coordinate person hours with the customer. In subsequent development, we made adjustments such as changing tracing granularity according to whether an item was within the improvement scope or not. (For example, we just recorded differences in functionality names and the locations revised in the design specifications.)

In terms of the number of defects detected during acceptance testing, in every system other than System D, the number was lower than the target, meaning that requirements tracing was effective. Even in integration testing and business operation testing, the number of defects tended to be lower than the target, which was the effect of verifying completeness in the design phases and performing requirements tracing. Furthermore, compared with the target defect numbers in each system, the cost reduction effect associated with defect countermeasures was 2% on average.

Table 4 Results of Requirements Tracing Checks

No.	System name	Scale (Ksteps)	Number of items traced	Fulfillment rate (%) in each phase				Number of defects					
								Integration testing		Business operation testing		Acceptance testing	
				Architectural design	Detailed design	Integration testing	Business operation testing	Target	Result	Target	Result	Target	Result
1	System A	130	2242	15.7	97.8	78.2	100.0	65	57	18	7	9	3
2	System B	552	2445	10.0	100.0	20.8	100.0	210	159	14	14	7	1
3	System C	198	562	34.1	86.5	40.2	100.0	211	181	14	8	7	1
4	System D	91	233	64.8	100.0	62.2	100.0	65	73	4	3	2	3
5	System E	227	227	46.4	100.0	39.2	100.0	62	33	5	3	3	0
6	System F	307	461	97.8	100.0	60.6	100.0	104	103	16	13	8	7

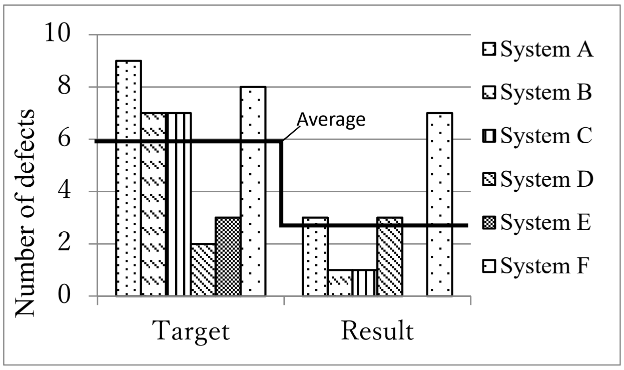

Figure 6 Number of Defects in Acceptance Testing

4. Future Issues

We primarily applied requirement completeness checks to systems requiring high reliability, and used qualitative evaluations to examine them. Future issues include changing to a more user-friendly format in order to develop them for other systems and examining the checks using quantitative evaluations.

In terms of requirements tracing, for System D and System F in Table 4, the number of defects during acceptance testing was almost in line with targets, thus revealing a minor effect. The defect technicalities were even related to requirement definitions, and more particularly to interface specifications in the defined requirements. Business operation requirements and non-functional requirements are targeted in requirements tracing, but due to the fact that interface specifications were not targeted, we were unsuccessful at removing the associated defects. Tracing which includes interface specifications is a future issue. Moreover, requirements tracing is a measure that was implemented together with customers for particular stock exchanges, so another future issue is developing requirements tracing for other internal systems.

5. Conclusion

By increasing the visibility of the requirements and their status (whether the requirements are sufficient) in the requirement completeness checks, we were able to reach a shared understanding between the requirement creators and vendors. In doing so, we were able to build consensus on the development requirements, and manage the fundamental quality associated with development. In requirements tracing, we successfully increased the visibility of the requirements and their status (whether the requirements were incorporated into the design and implemented in the product) in each phase, and verified that no requirements were omitted in the design and test phases. As a result, we reduced defects in acceptance testing, and reduced the person hours associated with defects by 2% on average.

We found that these two measures ensured requirements-related quality from the initial phases to the design and test phases.

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Proposal on a Quality Evaluation Method by Data Modeling Method in a Large Project

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In order to achieve the quality assurance process under the general quality management, prevention is important in design phase. This is because the recovery cost of the defect found in the inspection process jumps several tens of times as compared with the recovery cost in the design process. However, in case of a large project that includes a production size exceeding 1Mstep and hundreds of members involved, it is not easy to detect defects by qualitative deliverables in a design process and there are many cases in which defects caused by the design process were found after the inspection process. In large-scale projects, these defects can often cause damage that causes project collapse. In order to settle this issue, a method that visualizes and qualifies the project quality in the design process is necessary. This article describes a method that evaluates the quality of an entire application in the design process by applying the data modeling method normally used for a database logical design to initiate sustainable quality improvement in its early stage, and furthermore describes knowledge about the development method (how to determine the application timing/patterns of quantification/measures for efficiency etc.) to effectively use this method through an application case to an actual project.

Keywords and phrases: Assessment, Quality Management, Quality Control, Data Modeling, Waterfall Model, Pmbok

1. Introduction

Projects of system development with a fixed price contract, which is called system integration, account for a large part of Japan's IT industry, and most of them adopt waterfall development method. Furthermore, in the financial and public sectors, there are many projects in the scale of production exceeding 1Mstep with hundreds of people involved.

In a waterfall process type of development, reworking in the downstream phase often incurs an exorbitant cost increase. The larger the magnitude of a project, the more pronounced the tendency becomes. In such a project, therefore, a defect that passes unnoticed in the upstream phase can often cause damage so serious as to break apart the project.

Referring to the general status of large-scale projects, it is described the findings of the preventative assessment of how to detect a defect that won't be detected originally until the inspection process.

The author elaborates on issues in detail in Chapter 2, describes the methodology of implementation in Chapter 3, and presents the findings from the results of the methodology being applied to a practical case in Chapter 4.

2. Issues

To maintain quality in the design process, it is essential to secure "the accuracy of deliverables matching the requirements" and "mutual conformity between deliverables". Quality can be secured from a neutral perspective by the assessment of these elements.

In mega projects, however, there are many adverse factors that obstruct their realization. It is considered that there are two main obstructive factors.

Firstly, the upstream phase often goes on with too much reliance on implicit acknowledgment between designers and different interpretations on design documents.

One of the probable causes of this phenomenon is the nature of products being too qualitative. The closer is a project to the start of the upstream phase, the larger is the probability of a relevant statement being described in natural sentences in the specifications. It is far from rare that earlier portions of the definition of requirements are presented not even in sentences but in illustrations of an overview that consists part of the specifications.

As a result, the process goes forward with an insufficient mutual understanding between the user and designer, and between the different developers involved. So, the user is required to vanish temporarily at a certain stage. The misunderstanding that remains up to this stage is quite unlikely to dissipate within the design process.

The cause of this discord is a discrepancy between the mutual awareness. Persons involved do not recognize the existence of such a discrepancy. Therefore, they naturally cannot discover the discrepancy without an objective inspection. This is why a defect inevitably occurs in the inspection process.

Secondly, there are too many teams and deliverables. A mega project contains more than 10 teams specialized, for instance, in business applications software team alone. Imagine that an order is issued to examine consistency between deliverables. Suppose that the business applications software team is creating 10 kinds of deliverables, each having 10 functions. The resulting combinations of deliverables count 1,000.

In reality, these combinations are narrowed down to apparently effective combinations. Still, there are too many that stay put.

In an actual inspection process, a greater number of combinations need to be pursued comprehensively. But there are very few cases wherein enough workload is incorporated to respond to all the combinations in the assessment process.

For these reasons, a mega project cannot secure “the accuracy of deliverables matching the requirements” and “mutual conformity between deliverables” in many of the design processes. To solve this issue, a method of assessment that can detect a critical discrepancy between designs is required to be established.

The author proposes one such method in the next chapter.

3. Proposal for a proper assessment method

Here, the author elaborates on a viable method to visualize and quantify the quality of a project in the design process.

3.1 The purpose of this method

Among the defects that are discovered in the inspection process, those that can lead to a massive reworking are classified largely into two groups. One is the group that fails to satisfy “the accuracy of desirables matching the requirements”. In other words, it does not echo the demand of users. The other is the group that falls short of meeting the standards of “mutual conformity between deliverables”. That is to say, this group resonates the demand of users but deliverables contradict each other. The purpose of this initiative is to distinguish these two groups at an early stage in the design process.

3.2 The scope of this method

3.2.1 The process to be assessed

The part of the design process to be assessed should best be selected near the end of the external design process. A defect, that can cause a reworking, occurs in external design process. Because, the requirement of users is incorporated into the system design during that process. It is, therefore, appropriate to carry out the assessment before that process comes to an end.

The process to be assessed is positioned after “requirement definition process”, which is focused on the need to consolidate the demands of customers. Its behavior in the system is hardly defined. On the other hand, the next “internal designing process”,highlights the refinement of the behavior in the system, therefore, substancially losing the connection to users.

3.2.2 Deliverables to be assessed

The design deliverables to be assessed are squeezed to one data model (ER diagram). There are three reasons for this.

The first is the nature of the system design proper to the data model, which is not only a simplistic blueprint that is mounted with a database but also a kind of requirements-defining tool that visualize the static demands of users. This is generally called a conceptual data model, which can design static system specification, independent of dynamic system behavior designed by sequence diagram etc.

The conceptual data model, when accurately constructed, works like a mirror that reflects the demands of users. “Elements that do not accurately reflect user demands” can be identified by the assessment of this mirror.

In the assessment work, “static requirements” get a higher priority than “dynamic requirements” because the latter is nothing but the behavior intended to materialize “static requirements”.

The second is the nature of consistency intrinsic in a data model. Look at the ER diagram, known as a general tool to describe the data model. It is a description method in the first place to secure consistency between multiple by means of entities (Note 1) and relationships. If the diagram becomes the target of assessment, the existence of “deliverables that reflect user demands but contradict each other” can be located, The third and last is efficiency. By the assessment of the data model, the quality of the whole system can be assessed with a minimum workload.

The data model usually does not exist in a one to one relationship with the screen or function. These elements interact with each other to constitute one data model as a whole. As the minimum unit of the data model, the entity rarely maintains a one to one relationship with the screen and function. (Should the entity be designed to be one to one with them, consistency would mostly likely be exposed to a risk of being lost.)

As a result, the absolute number of deliverables that have to be assessed at the same timing is notably smaller than seen in other specifications. By the way, the class diagram is another requirements-defining tool that can visualize static user demands. It can include system functions and behavior in the blueprint at the time of designing. Consequently, the volume of information increases each time the process moves forward.

On the other hand, the ER diagram can principally display nothing but static data and their relationships, meaning a limited amount of information. It will, therefore, be an effective target of the assessment.

Since quality assessment is no more than an act of the project, it is impossible to check all the specifications in view of cost and time restraints. To figure out the total quality with a minimum operation, it is required to identify the portion that can help capture the essence of the system and subsequently implement an effective assessment method.

An essential and effective assessment becomes possible if the general nature proper to the data model is fully exploited.

If at all possible, “reliability”, “usability”, “integrity”, “maintainability”, and “confidentiality” are supposed to be subject to design assessment from the respective viewpoints. This time, however, the target of assessment is narrowed down to the “integrity” of the data model. This is because a defect in the “integrity” of data can straightforwardly express the presence of “elements that do not accurately reflect user demands” and “elements that reflect user demands but contradict each other”.

In this paper, the assessment is implemented only from the most effective viewpoint in an attempt to capture a critical defect with minimum labor. The integrity of data can be broken down into “accuracy”, “completeness”, and “consistency”.
(See Table 1)

The author here refines the viewpoints of the assessment of data model quality with a focus on “integrity”, “completeness”, and “consistency”. He subsequently clarifies its type of risk(QCD), and where in the inspection process defects may arise explicitly and sets up criteria for assessment. (Table 2)

Table 1 System integrity

Integrity	the property that the data and information held by the system are perfect and it can be maintained	
	Accuracy	All data are correctly processed
	Completeness	All data necessary for realizing the requirement exists
	Consistency	The meaning and granularity of all data are consistently the same, and it is aggregated in one place

3.3 Perspectives of the assessment

Table 2 Criteria for assessment (part of all)

#	Point of review		Risk factors	Description	Remarks	Risk	Risk actualization process
10	Accuracy	Function	Inaccuracy for designed function(incorrect , unnecessary)	Analyzing from design documents and interviewed requirements, the data model is incorrect for the function, or unnecessary designs are defined.		Q (quality degradation)	Testing(unit)
11	Consistency	Entity	Naming	The meaning of the entity name is hard to understand.		D (delay of duration)	Testing(integration)
12			Duplicate entities	· One entity is located in multiple areas · There are entities that do not belong to the area		D (delay of duration)	Testing(user accept test)
13		Relationship	shortage of relationship	Analyzing from design documents and interviewed requirements, the relationship is insufficient.	Be aware of the relationship outside the area	Q (quality degradation)	Testing(integration)
14			N:N relationships	Many-to-many relationships exists in ER diagram.		Q (quality degradation)	Testing(integration)

3.4 Assessment and continuous quality improvement

The assessment sets its target on a data model already reviewed in the project and repeats a review only from the viewpoints mentioned earlier. At that time, the number of items pointed out is recorded for each viewpoint. The collected data will be used to visualize the quality.

Depending on the results of the assessment, efforts will be made to continuously improve the quality. In a preferable approach to the proper method, the data model should be considered to be correct and other deliverables should be adjusted to the model. It is because, if deliverables fit in with the data model accredited with integrity, those deliverables as a whole are most likely to maintain integrity.

Therefore, the data model that has completed this assessment needs to stay in the state of integrity by absorbing all corrections that have been pointed out.

4. Assessment case of actual project

4.1 Background of the assessment

The following is an example of the assessment of a large-scale project of a certain bank.

It is a five-year massive scale project featuring 3.5Mstep and over in the estimated total STEP number, the construction cost estimated to be 80 billion yen, the participation of multiple vendors, and 800 people involved at a peak. The timing of the assessment was set in the final stage of the external design. It was carried out by a five-member team over the period of 1.5 months. Out of 815 entities in all data model, 249 entities were sampled out for the assessment.

4.2 Assessment protocol

The following is the data model assessment protocol. The method that was actually used in a real project is highlighted here though there can be multiple methods applicable depending on the circumstances.

(a) Narrowing down the target of assessment

First, narrow down the data model usable for the assessment. All data models should preferably be assessed. For the purpose of this particular assessment, however, choices were limited because of the volume that could be assessed by the assessment team members within 1.5 months. The data models that were not directly related to user's requirement were omitted and those which realize the common tasks were given higher priorities. The reason was that a defect in a common task was considered to wield greater influence. Examples of common jobs are common masters like customer masters.

(b)Figuring out requirements for business requirements

An assessment team furnished with fundamental data design skills needs to be mobilized to figure out the business requirements. They can use deliverables taken from the previous process. Examples of such deliverables are the screen design, format design, and specifications that carry an overview of the functions.

(c)Hearing

A hearing should be held with the project team who has designed the data model to be assessed. The criteria mentioned earlier should be followed during the hearing.

(d)Create a data model for a preliminary assessment.

Based on the data model that has been designed in the project and the results of the hearing, the assessment team designs a data model for a preliminary assessment. This model is made up of a simplistic ER diagram focused on the key and main data items alone.

Here, main data items refer to data items that users are conscious of. Items that are present in the screen and format consequently meet the definition of main data items. In case there are too many screens and formats and are likely to add to the workload, the target of assessment is squeezed to a new input screen.

(e)Making a list of corrections

Corrections are collected in a list when a corrected version of the data model is designed. They need to comply with the criteria stated earlier with no exception.

(f)Feedback

Give feedback on the corrected data model and the list of corrections to the project organizer. After the feedback, refer to the list of consented corrections and complete a list of the items pointed out for quality.

4.3 Quantification and visualization

Based on the list of items pointed out for quality, quantification and visualization are attempted from the three viewpoints.

4.3.1 Viewpoint of the benchmark

Count the number of items pointed out for each predefined benchmark and visualize the rate of accuracy, consistency, and completeness. (Figure 1) These indicators can imply the following risk:

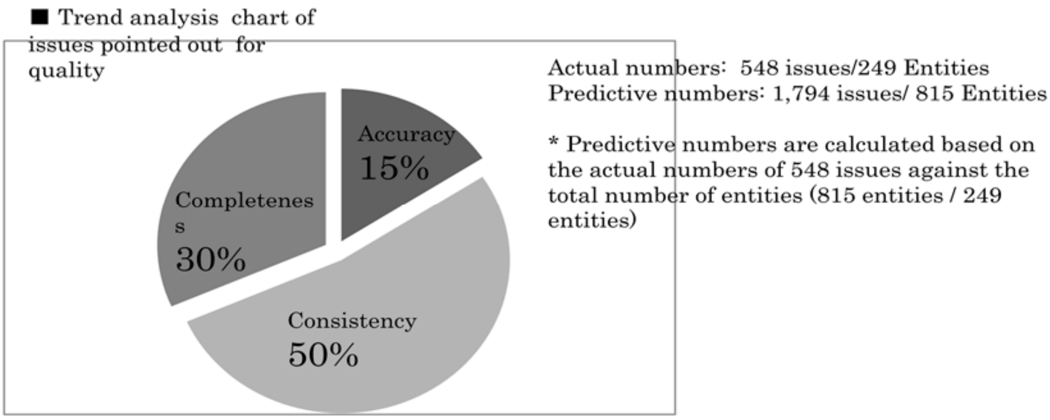

Figure 1 Analysis of trends

(a)A higher accuracy indication rate suggests insufficient skills of the project members and their inability to understand the requirements or the inability to express their judgment.
(b)A higher completeness indication rate suggests the absence of a project member who manages the entire requirements and therefore the risk of leakage exists.
(c)A higher consistency indication rate suggests the risk of insufficient communications between team members attributable to top-to-bottom sectionalism.

4.3.2 Viewpoint of actualization process and QCD

For each actualization process, add up the number of cases in each category of risk and present the result in the form of a graph, thereby visualizing the quality of the project as a whole. (Figure 2) It can be said that the correction of a defect exercises greater influence in the lower part of the actualization process. Even if the number of items pointed out remains unchanged, the status of the project is worse if such items concentrate on the lower part of the process.

4.3.3 Viewpoint of the cost

To express the evaluation of the project quality, what is required is not a relative evaluation but an absolute evaluation. Though the benchmark of a similar project, if available, might seem usable, this is an unrealistic idea because any benchmark is meaningless unless obtained on the same basis. Alternatively, an estimated loss amount is presented as the absolute evaluation.

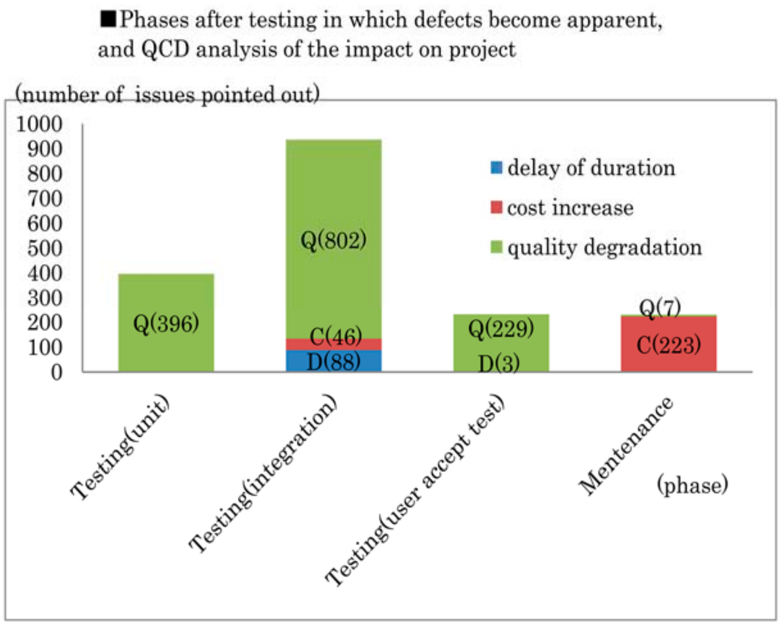

Figure 2 Analysis of risk actualization process

The cost for the correction of a defect rises four times in the unit test process compared to the design process, seven times in the integration test process, 10 times in the user test process, and 40 times in the maintenance process.

In this particular assessment, the actual cost required to detect and correct a defect is multiplied by the coefficient applicable to the actualization process in order to draw the picture of the modification cost on the assumption that no assessment is made. In addition, the obtained modification cost is assigned proportionately to each entity by the occupancy rate so as to present an estimate of the total defect modification cost in the whole project.

This estimated cost is compared to the fund appropriated to risks that are predicted in the entire project with the aim of presenting the basis of a judgement of whether or not to proceed with the project. Therefore, it is a very useful indicator for the project manager.

Also, the estimated costs for defect modification in respective areas can be displayed to indicate the order of priorities in the engagement with quality improvement. (Figure 3)

4.4 Findings

In this assessment case, the current quality evaluation initiative paved the way for the reexamination of quality plans in the project and could get the quality improvement activity off to a start.

Out of the quantification methods presented, by the way, the viewpoint of the cost proved to be most useful for project management. In a mega project, main stakeholders are those in corporate management. For mutual communications with these people, this indicator turned out to be usable to measure return on investment and decide priorities and in many other ways.

4.5 Technical twists

In this case of assessment, plans for assessment in the design process were originally not incorporated in the project but added later on. Therefore, it became necessary to limit the scope of assessment to the areas with great efficacy and then carry out the assessment in a short period of time.

Take an example. In a real project, data items that invoke user consciousness exist side by side with those that aim to manage the system but wait to be defined in the later part of the process. It should be noted that both types of data items exist in the same entity. This phenomenon is seen many times even in the final stage of the external design process.

For an efficient teamwork, the setup of specific common criteria is required to remove system control data items from the target of a review.

In the current assessment, such criteria were established and shared among team members to distinguish the items to be left from those to be deleted explicitly so that the assessment could concentrate on the elements that were effective at the level of data items.

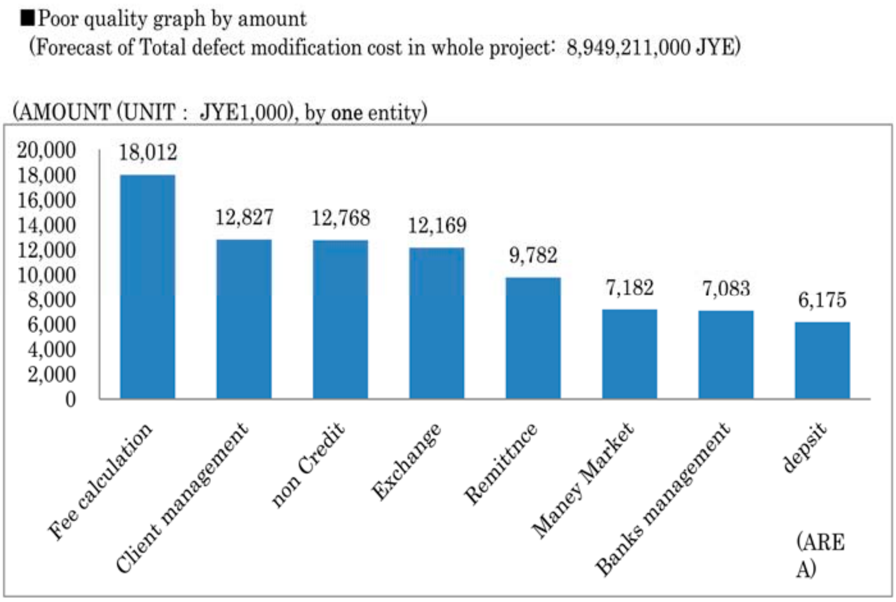

Figure 3 Analysis of estimated loss amount

5. Conclusion

5.1 Summary

This paper aims to embody the primary concept of quality management: “Prevention is more important than inspection”, “Quality is achieved by planning, designing and building, not by inspection”. Project management acknowledges these words as important but appears to fall short of inserting this concept positively into the process of quality assurance and auditing.

If the reason is shortages of practical tools and techniques, the techniques elaborated in this paper can probably be used to correct the situation.

The current assessment aims to visualize the future cost of quality (COQ) at an early stage. This can be a key factor in determining the direction of project management. As in all examples of EVM using the cost to measure progress management, the cost is quite a useful indicator for communications between stakeholders. The project manager is, therefore, required to exploit this indicator.

5.2 Perspectives

The techniques specified in this paper place their target on the project that defines data models as deliverables at least in the external design process. Some projects start designing data models only in and after the internal design process. In such a case, application of the techniques needs to be twisted to a certain extent.

The author is determined to examine the possibility of expanding the current techniques in an effort to increase the number of projects, to which these techniques can apply.

Note

Note 1) “Entity” is a unit that expresses the smallest chunk of data in the ER diagram. On the physical ER diagram, it is synonymous with the table.

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Organization Attribute Optimization of International Knowledge Transfer

- Two-point Comparison of Software Development Organization -

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In software industry, the way so-called "offshore development" which is to develop software separately in different countries is used. Under the recent situation of internationalization of software development worldwide, it is very important to build new organization which can generate cost and quality benefits on the one hand, can also create global competitiveness of technology and product the other hand. Recently in Japan, offshore development is increasing because of a lack of human resources and so on. Like so, Japanese offshore development is promoted with unique background. It is required for offshore development to transfer knowledge effectively and efficiently between international organizations. Whether or not knowledge transfer is made smoothly depends on what kind of knowledge need to be transferred. For example, the knowledge is complex and difficult to understand is one and the knowledge is not explicit but implicit knowledge is other one. It also depends on what kind of attributes the sender organization has and on what kind of attributes the receiver organization has. For the reason company try to change its attribute so that it can transfer knowledge smoothly. In this paper, author surveyed and analyzed organization focusing on its attribute how company has taken action to optimize the organization in order to transfer knowledge effectively and efficiently.

Keywords and phrases: Software Development, Knowledge Transfer, Offshoring, International Organization, Organization Attribute

1. Introduction

In this paper, author survey and analyze international knowledge transfer on the subject of software development in Japan, which is called offshore development.

The Software Industry Society (2005) pointed out the characteristics of Japanese software industry which is a multilayered subcontracting structure centered on major vendor companies, and under the recent situation of internationalization of software development worldwide, it also pointed out the importance of building new organization which can generate cost and quality benefits on the one hand, can create global competitiveness of technology and product the other hand.

In recent years offshore development has expanded due to shortage of human resources. Despite Japanese offshore development that has been pursued from such unique background, discussions in the field of project management have been conducted mainly from the viewpoint of communication management and quality management. Knowledge transfer is one of the most important factor for successful offshore development because knowledge need to be transferred to receiver organization in different country. Author surveyed and analyzed receiver organization attribute how it had been optimized in order to transfer knowledge effectively and efficiently.

2. Previous research survey

Author summarize previous research survey below.

2.1 Software Development

One of a typical process model of software development is the waterfall development process model which is presented by Lois (1970). The information system development process (see Figure 1) presented by Kunitomo (1994) has been made based on his experience of Japanese systems engineer education.

In Japanese offshore development, it is typical scope to outsource internal design tasks and part of program development tasks (coding and unit testing) in this process.

According to Shannon and Weaver (1949), communication was a process in which a sender expressed a concept he or she wishes to convey using a certain means, and a receiver interprets it. Onishi (1992) discussed that software development could be regarded as communication from human to computer and that it is possible to apply this model.

2.2 Knowledge Transfer

Von Hippel (1994) presented the concept of information stickiness which was the cost necessary for information seekers in new places to acquire, transfer, and use information from an original place to solve problem. He asserted that high and low of information stickiness would decide where innovation would occur and presented patterns of problem solving places related to innovation. In addition, he mentioned that information stickiness was classified as knowledge attributes or organization attributes. The concept included organizational elements and beyond information classification. Furthermore, Ogawa (2000) mentioned that it was possible to allocate resources more efficiently for innovation activities by clarifying who was the innovator by information stickiness.

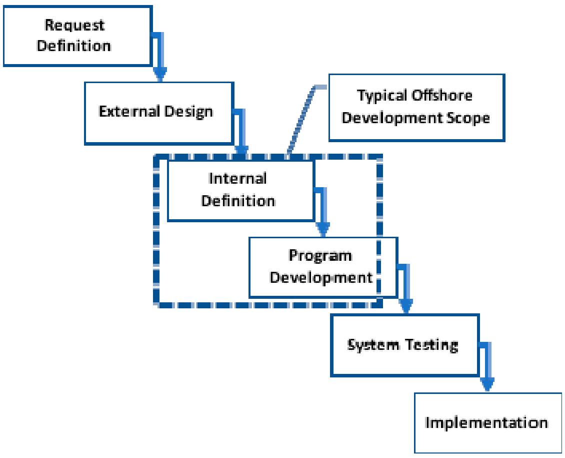

Figure 1 Information system development process
Source) Author revised on Kunitomo (1994) P.4

Ulrich (1995) presented a product architecture theory that allocating the functions of the product to the physical components and establishing the architecture to the extent that the interface between the interdependent components was determined. He defined modular architecture as a small interdependency relationship between components and had an established interface and integral architecture as a high degree of interdependence and adjustments must be made. He discussed knowledge transfer from the product architecture perspective.

2.3 Offshoring

According to Ito (1999), outsourcing across the border like global offshore development (global outsourcing) had "cost-oriented" type and "technology-oriented" type. The latter "technology-oriented" type was intended to seek out foreign technologies that Japan did not have or Japanese technologies are behind foreign technologies. He mentioned they were seen in Israel and India.

According to the IT Human Resources Development Division (2012), the main objective of software offshore development in Japan is "reduction of development cost". Major development partner countries are China, India, Vietnam and the Philippines. In particular for China, the ratio of "reduction of development cost" is high at 96.8%. According to the IT Human Resources Development Division (2016), in recent years, although feeling of insufficiency of IT human resources quality was not greatly changed, feeling of insufficiency of IT talent quantity was increasing year by year. It mentioned the total percentage of "very insufficient" and "somewhat insufficient" was high from about 90% to mid 90%.

Kumar, et al. (2009) explained by using three concepts of "interdependence integration", "handoff" and "information stickiness" to understand and manage task interdependence in recent offshoring or global division of labor. They presented three important points which were information sharing decisions to reduce information stickiness, investment to lower information stickiness, investment to enable information sharing and management of sticky information.

3. Issue setting

In this way, in order to facilitate knowledge transfer, it is reasonable to take action to lower the information stickiness that means to reduce knowledge transfer cost. It is natural to think that an organization adapts itself to the environment and changes to an organization that can transfer knowledge much better. Therefore, in this paper, author surveys the same contents to the same organization two time points on the organization attribute of receiver organization which affects the skill of international knowledge transfer in software development, and analyzes what kind of change in organization attribute occurs, and clarifies the factor by comparing them.

3.1 Survey perspective

From the past survey of Goto (2017), it is obvious that the following attributes of receiver organization have a big influence on the skill of knowledge transfer between international organizations of software development.

- Language ability
- Years of IT business experience

- High level of motivation of the receiver in case if he/she have general and industry standard information and knowledge based on a certain years of IT industry experience
- Ratio between designers and developers

In other words, language ability is important for facilitating knowledge transfer, but when it comes to having general and industry standard information and knowledge through business experience, the motivation becomes more important and language ability becomes relatively less important. In addition, it is found that problems are likely to occur when the number ratio between designers who create functional specifications from requirements and developer who create technical specifications or programs is different.

If these organization attributes influence the skill of knowledge transfer, it is assumed that organization would take action and changes in organizational attributes are taking place. As a result, if the skill of knowledge transfer is improved, the problem of offshore development is considered to be solved. I would like to survey this point.

3.2 Hypothesis

First of all, if survey of the same contents for the same organization at two time points about language ability and years of IT operation experience are conducted, it is common sense to consider language ability to improve and years of IT operation experience to be longer.

Hypothesis 1. Language ability and capability by years of IT operation experience as organization attributes become higher with the passing of the years.

However, organization attributes may be affected by retirement of highly-qualified members and entry of new recruits.

Secondly, since the high motivation of the receiver organization is important to improve skill of knowledge transfer, actions to maintain or improve some motivation are taken. As a result, motivation is maintained and improved.

Hypothesis 2. Motivation as organization attribute is maintained and improved with the passing of the years.

However, organization attributes may be affected by retirement or as a result of inappropriate action for motivation maintenance and improvement of motivated members.

And regarding the ratio between designers and developers, if the ratio of designers is small, problems are likely to occur, so it is considered that the ratio of designers will be increased.

Hypothesis 3. The ratio of designers to developers of the organization as a whole will increase with the passing of the years.

However, since the designers and developers have different roles, the ratio will be balanced if the ratio reaches a certain percentage.

4. Research method

The survey was conducted for a global company A, which has a base in China for offshore development of software for Japanese companies. Company A entrusts a part of system implementation projects ordered from Japanese customers to Japanese subsidiary to Chinese subsidiary. Author surveyed the offshore development member of that Chinese subsidiary. First survey was conducted in April 2015, and second survey was conducted to the same organization using the same questionnaire in May 2017, two years later. By comparing the results of the two-point survey, we analyze what kind of change in the organization attribute occurred.

Offshore development members are targeted to those who are participated in add-on function development projects of packaged products for application systems of Japanese customer. The application system is, for example, a purchase management system, a manufacturing and production management system, a sales management system, a human resources and labor management system, and so on. Prior to the survey, author surveyed the attribute information of each member to his/her boss (see Table 1). The number of offshore development members was 104 in 2015 and 97 in 2017.

Table 1 Member attribute information survey summary

Survey content	Members' attribute information
Respondent	Boss of member
Period	Sent on April 22, 2015, received a response on April 30 (1st) Sent on May 25, 2017, received a response on June 14 (2nd)
Method	Sent and received by e-mail

A survey by questionnaire was conducted for offshore development members concurrently (see Table 2).

4.1 Survey

As an attribute of a receiver organization affecting skill of knowledge transfer, main role in project was surveyed to capture the characteristics of the organization as a whole (see Table 3).

Table 2 Questionnaire survey summary

Survey content	Answer to questionnaire
Respondent	104members (1st), 97members (2nd)
Period	Sent on April 22, 2015, received a response on April 30 (1st) Sent on May 25, 2017, received a response on June 14 (2nd)
Method	Sent and received by e-mail

Table 3 Survey items (organization-wide attributes)

Attribute information	Description
Main role	Main role in the project (design, development etc.)

In order to analyze the experience, ability, motivation which individual attributes are considered to be organizational attributes, the question items in Table 4 to 6 are set respectively. Why the question item “Accept to work in Japan” treats as motivation is that from the pre-survey members who can work in Japan are more willing to and motivated to participate in projects such as communication with the Japan side sender organization.

Table 4 Survey items (individual experience)

Question item	The intention of the question
Years of IT industry experience	Judge the IT industry general business experience / ability
Length of work in company A	Judge the work experience / ability unique to Company A
Number of project experience	Judge knowledge / ability from the number of experiences

Table 5 Survey items (individual ability)

Question item	The intention of the question
Position	Rank of members
Language ability	Japanese Language Proficiency Test Level

Thinking that skill of knowledge transfer affects the outcome of the project, author gathered evaluation data of quality, cost, and delivery for each project member is participated in (see Table 7). And all projects are categorized as "problem" project or "normal" project. If a project meets one of evaluation criteria, it should be "problem" project and if it does not meet all the evaluation criteria, it should be "normal" project.

Table 6 Survey items (individual motivation)

Question item	The intention of the question
Accept to work in Japan	Whether the member accepts work in Japan or not
Period of work in Japan	Acceptable period of work in Japan

Table 7 Project Evaluation Item / Evaluation Criteria

Evaluation item	Evaluation criteria
Quality	Whether the quality problems adversely affect costs and delivery date
Cost	Whether the cost exceeded the initial plan
Delivery date	Whether the delivery date was delayed from the initial plan

4.2 Analysis method

In the first survey, the results defined in the project evaluation item / evaluation criteria which are thought to affect the skill of knowledge transfer were set as "problem" and "normal" flag type items, and it was set as the objective variable. Other survey items were used as explanatory variables, and author conducted importance analysis by logistic regression analysis. As the result mentioned in the section 3.1, it became clear that the four attributes of the development side country (receiver) organization have a big influence on the skill of knowledge transfer between international organizations of software development. In this time, by comparing the results of the second survey, we compare changes in project evaluation and changes in organization attributes set for each survey item and analyze the differences.

5. Analysis result

The results of comparative analysis are summarized below.

5.1 Two-point changes in organization-wide attributes

In the first survey, there are three types of main role as a whole, with 3.9% by project manager (PM), 24.0% by designer, and 72.1% by developer, respectively (see Table 8). In the second survey, the project manager (PM) decreased to 2.1% (1.8%

decrease), the designer to 45.3% (21.3% increase), the developer to 52.6% (19.5% decrease). The ratio of developers decreased instead of the ratio of designers increased.

Table 8 Comparison of number of people and ratio by main role

	Number of people			
	1st	%	2nd	%
PM	4	3.9	2	2.1
Designer	25	24.0	44	45.3
Developer	75	72.1	51	52.6
Total	104	100.0	97	100.0

Looking at the ratio of main role, designer per PM in the "problem" projects was 2.5 and developer per PM in the "problem" projects was 13. Compared to "normal" projects, they were 10 and 24.5 respectively so PM ratio in "problem" projects was relatively smaller. In addition, the number of developers per designer was 5.2 for 'problem' projects and 2.5 for 'normal' projects (see Table 9). This means if the ratio of developer per designer is smaller, project will be well controlled and becomes "normal" project. As a result of the second survey, the number of designers per PM increased to 22, 2.2 times compared to the first case, and the number of developers per designer decreased to 1.2, 0.48 times compared to the first case.

Table 9 Number of people in main role by project evaluation

	1st		2nd
	Problem	Normal	
Designer/PM	2.5	10.0	22.0
Developer/PM	13.0	24.5	25.5
Developer/ Designer	5.2	2.5	1.2

5.2 Two-point changes in organization attributes of individuals

Regarding the items on experience, ability and motivation in the first survey, the order of impact on the "problem" project is (1) Language ability, (2) Years of experience in IT industry, (3) Position, (4) Length of work in company A, (5) Accept to work in Japan, (6) Number of project experience (see Figure 2).

In the second survey, it has changed as (1) Position, (2) Accept to work in Japan (3) Years of experience in IT industry, (4) Number of project experience, (5) Length of work in company A and (6) Language ability (see Figure 3).

Next is to describe the first survey of each item. Regarding experience, the importance of years of experience in IT industry was high, and length of work

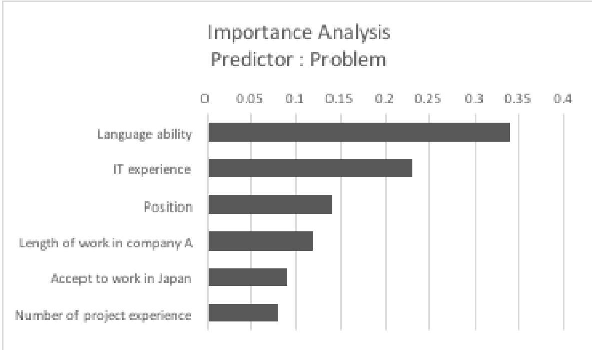

Figure 2 Project Evaluation Impact Analysis (1st)

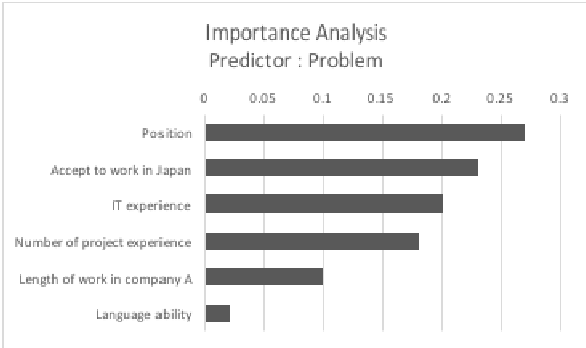

Figure 3 Project Evaluation Impact Analysis (2nd)

in company A was relatively low importance. This means industry common experience is considered to be more important than experience unique to Company A. And from the result that the number of project experiences has the lowest importance, there is not much difference between the case of long-term in one project and the case of short-term in multiple projects.

As for the ability, it was confirmed that the importance of communication is high from the result that language ability is the most important. Although the impact is lower than the language ability, position, as it would indicate IT capability level, is considered to be important.

Regarding motivation, author assumed that a member who accept to work in Japan would be more willing to work in Japan and the motivation for the project is higher. But survey result shows that the impact was relatively lower. In the second survey, a significant improvement in the level of language ability was found. The highest level of Japanese proficiency level 5 increased by 15 points, from 46.2% to 61.2%. As the ratio of level 2 to 4 in the 2nd survey decreased compared to the 1st survey, the overall improvement was found (see Figure 4).

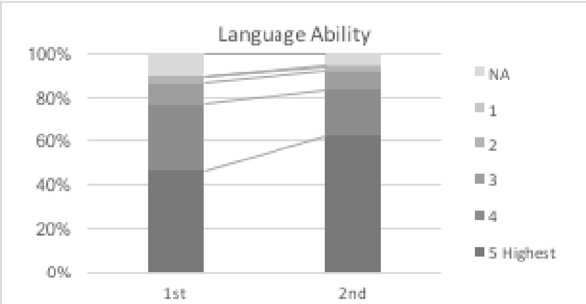

Figure 4 Two-point change in Language ability

Regarding years of experience in IT industry, more than 2 years to 5 years or less layer and more than 10 years layer increased, while less than 2 years layer and more than 5 years and less than 10 years layer decreased (see Figure 5).

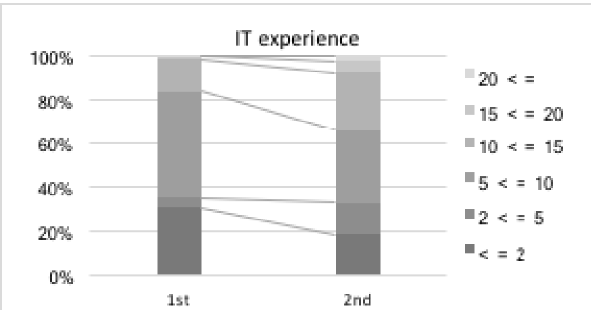

Figure 5 Two-point change in Years of IT experience

Regarding accept to work in Japan, the ratio has increased by 45.5 points from 30.8% to 76.3%, indicating that some action to motivate has been taken (see Table 10).

Table 10 Two-point Comparison of acceptance to work in Japan

	1st	%	2nd	%
Accept to work	32	30.8	74	76.3
Not accept to work	72	69.2	23	23.7
Total	104	100	97	100

6. Discussion and implications

Based on the analysis results, author discuss about how the organization made effort to optimize itself considering how smoothly it could proceed knowledge transfer.

6.1 Hypothesis verification on organization attributes

Three hypotheses were set focusing on organization attributes for survey and analysis. They are verified based on the analysis result.

Hypothesis 1. Language ability and capability by years of IT operation experience as organization attributes become higher with the passing of the years. The importance of language ability was also high and the improvement of ability level was remarkably seen compared to the past year. Regarding the years of experience of IT operations, its increase was also seen compared to the past year. Therefore, the capacity improvement with the linguistic ability and years of experience of IT operations as organization attribute set in hypothesis1 was verified.

Hypothesis 2. Motivation as organization attribute is maintained and improved with the passing of the years. The ratio of members who accept to work in Japan compared to the past year has increased significantly. Therefore, motivation maintenance and improvement as organization attribute set in hypothesis 2 was verified.

Hypothesis 3. The ratio of designers to developers of the organization as a whole will increase with the passing of the years. In comparison of the ratio of the designer to the developers of the organization as a whole, the number of designers per PM increased to 22, 2.2 times increased compared to the 1st survey. And the number of developers per designer was 1.2, 0.48 times decreased compared to the 1st survey. Therefore, action to increase the ratio of designers in the whole organization set in hypothesis 3 was verified.

6.2 Knowledge transfer model

From the analysis result, author examine the organization model of receiver considering the organization attribute which impact on the knowledge transfer from the Japan side (sender) to the development side (receiver).

As the organization attribute of the receiver impacting on knowledge transfer skill, author examine the whole organization attribute showing the characteristics of the whole organization and individual attributes such as experience, ability, motivation as organization attributes separately.

Figure 6 shows “Organization Attribute Model – Personal” which indicate process of converting the knowledge transfer process affected by organizational personal attributes into (1) a process of converting knowledge into symbol information such as language that can transmit knowledge, (2) a process of understanding the written information as a language, (3) a process pf understanding the specific meaning of the description content and the corresponding organization attribute (see Figure 6).

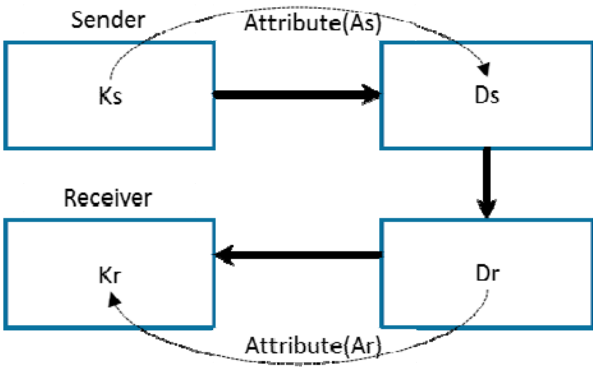

Figure 6 Organization Attribute Model - Personal

Also, when viewing the knowledge transfer activities of individuals as the whole organization, it is considered that knowledge transfer with multiple designers, developers, and systems has been carried out at the offshore development organization (receiver). Therefore, Figure 7 shows “Organization Attribute Model - Overall” which indicate (4) a process of result of understanding by which the receiver takes action (see Figure 7).

7. Conclusions

In this paper, author analyze the knowledge transfer between international organizations, focusing on offshore development of software, especially focusing on "how did receiver organization make efforts to optimize the organization considering how smoothly it can transfer knowledge?". Because the Japan side (sender) and the development side (receiver) are separate organizations and divided into multiple bases working together, the cost of knowledge transfer will increase. Therefore, it is meaningful to know the method of optimizing the organization attribute on the receiver side impacting on skill of knowledge transfer for reducing the knowledge transfer cost.

In addition, we tried modeling on the relation between knowledge transfer and its organization attribute. We want to verify the validity of this model in the future.

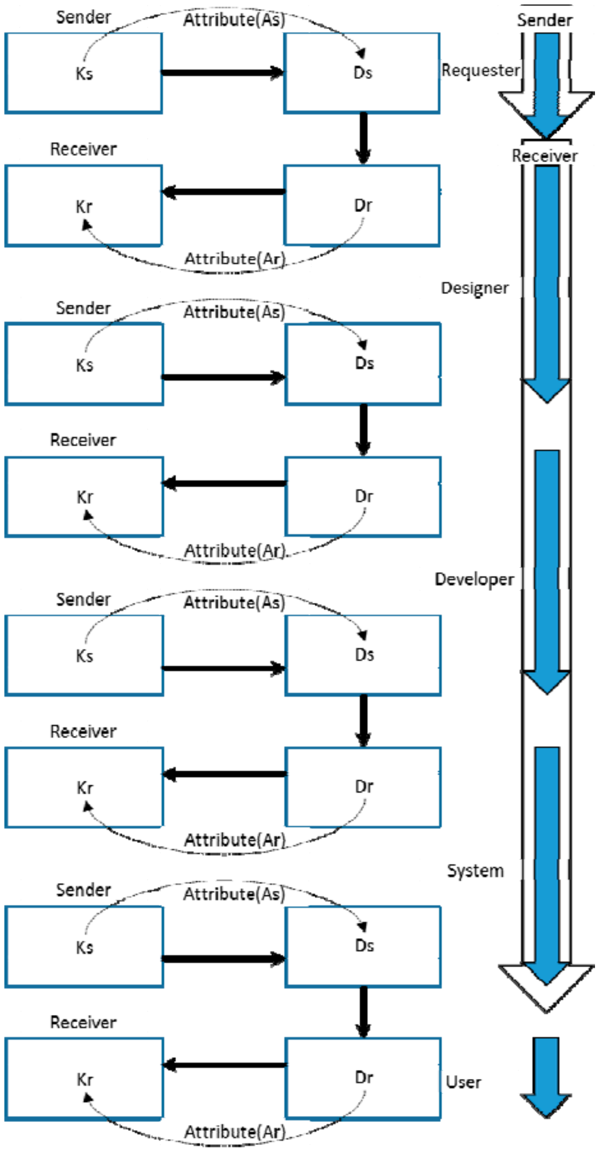

Figure 7 Organization Attribute Model - Overall

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Quantitative Risk Management Method for System Development Projects

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Recently, the interest in the risk management process has been growing. Risk management aims to lead the project to success by eliminating negative factors that can cause a project to fail. Therefore, it is expected the number of failed projects can be reduced in organizations that have introduced risk management. However, this expected result has not been obtained yet. In this study, we first analyzed the risk management process for system development projects managed recently, and then identified the factor that risk management did not meet the expected criteria. Next, to eliminate this factor, we proposed a quantitative risk management method that could yield a more successful risk management process. On applying the proposed method to a real risk management case, we concluded that the proposed method is effective.

Key Words & Phrases: Systematic Risk Management, Logistic Regression Analysis, Quantitative Project Management

1. Introduction

"Software dependent Society" has arrived. Important functions such as organizational operation, home electronics, and automobile control are controlled using software. Therefore, many companies focus on system development.

However, according to reliable statistical information (Nikkei Computer,2003), only 27% of all projects succeed in all aspects of quality, productivity, and delivery time (QCD) in domestic and foreign system development projects. 3/4 of the projects, thus, do not meet all the criteria of QCD, resulting in 24% of software development projects being canceled (Standish, 2009).

To solve this problem, interest in introducing risk management processes in system development has increased. Risk management is defined as leading projects to success by eliminating negative factors that may cause the project to fail. In general, risk management processes introduce project management standards and guides such as PMBOK (Project Management Body of Knowledge)(Rose, 2013), P2M (Program & Project Management for Enterprise Innovation)(P2M, 2014), PRINCE2 (projects in controlled environments, 2nd version) (Tomanek et al 2015) as reference models, and introduce specific risk management practices presented in these guides.

However, even when the "best practice model" is introduced, the number of failed projects is not decreased. The findings suggest that successful implementation of the risk management process does not contribute to the reduction of failed project occurrence.

We think that there are two major factors contributing to the event described above.

One factor is the project management standards and guides that have been proposed and developed in overseas systems do not match practices in place in the domestic system development projects, because the standards and guides developed overseas are often based on large-scale projects. It is difficult to apply them to the standard sized system development projects in Japan.

The other factor is that even though the standards and guides are correct, they have not been successfully introduced in the system development site. When standards or guides to a system development site are introduced, conformance to the standards and guides take precedence. However, their goal is not Conformance, but Performance. In both cases, it is necessary to establish an appropriate methodology to introduce risk management processes to standard sized project management in the Japanese industry.

To address this issue, we first analyze four cases of a specific risk management process conducted recently, and identify the factors that will create a bottleneck in order to decrease failed projects. Next, to solve the problem of failure, we proposed a method to introduce a risk management process appropriately. The proposed method includes quantitative risk management and the implementation of risk countermeasures. When we apply our proposed method to a real case for the risk management of system development projects, a measurable effect was confirmed in the reduction of the number of failed projects and also a reduction in the contingency budget.

In most of the earlier research on risk management of system development, Boehm (Boehm, 1991) and Williams el al (Williams, 1997) initially introduced the implementation methods of risk management practices that are commonly used presently, such as risk identification, evaluation, classification, and prioritization. When such a method is generally perceived, risk management process is also adopted widely for project management standards and guides such as PMBOK, P2M, PRINCE2 and process evaluation models such as ISO9001 (ISO9001, 2015) and CMMI (Capability Maturity Model Integration) (Chrissis, 2011), Since then, improvement practice in each life cycle of risk management, risk identification using risk breakdown structure (Rasool et al, 2012) and risk assessment method (Menezes, 2013) have been reported. In addition, with the advancement of risk management technology, quantitative risk analysis (Galway, 2004) and the Six Sigma approach (Zafar, 2015) have been proposed and carried out.

Although such prior research explains the potential of success for the risk management process, it does not describe why such best practice does not successfully operate in the real world. To the best of our knowledge, no particular prior research discusses the appropriate method to introduce risk management process.

The remainder of this paper is organized as follows: In Section 2, we analyze a case of implemented risk management practice where we consulted. In Section 3, we identify the reason that risk management was not successful and describe the problem to be solved. In Section 3, we propose a quantitative risk management method by using a statistical tool, logistic regression analysis. In Section 4, the effectiveness of the proposal is evaluated by applying the method to a real case of system development. In Section 5, we discuss the result of the case study. Finally, Section 6 is the conclusion.

2. Factors risk management fails

2.1 Case analysis of risk management process

First, we aim to clarify the reason that the number of failed projects has not decreased, even after best practice of risk management process is successfully introduced in organizations. We analyze the factors by taking up the four organizations that we have involved in management consultation so far.

Below is a summary of the organizations to be analyzed.

- (Case 1) Electronic control of vehicle amenity
- (Case 2) Electronic notebook, which maintains a schedule, dictionary, and custom program
- (Case 3) Air conditioner System controlled by an Internet-based remote control
- (Case 4) Derivative development of value added of acoustic measurement calibration equipment

By analyzing four development cases, we found the following four problems in the risk management process:

- (Problem 1) Since the notification risk alarm from the project manager (PM) is delayed, of risk countermeasures could not be implemented in time. For the PM, a similar problem occurred multiple times in his experience; he thought that it could be solved every time. Therefore, he did not report the emergence of risk to the higher-level managers.
- (Problem 2) Too focused on delivery date and cost in QCD, confirmation work on the quality is set side. Since the development project was originally planned in the midst of the development period, it was biased toward keeping the delivery date. Therefore, the organizations were averse to rework due to risk management activities and hesitated to report risk occurrence.
- (Problem 3) Despite being originally planned to activate risk response measures in an event-driven manner, project members did not accurately understand the risk management process, and subsequently reported risks at weekly progress meetings that caused notification delays.
- (Problem 4) Despite the trigger and threshold for risk interpretation defined clearly in the risk management ledger, the roles and responsibilities were misunderstood and the risk were not reported correctly

The four problems listed above indicated that the risk management practice was not incorrect, but that risk countermeasure actions were not in time.

2.2 Factor analysis risk management was not on time

Next, we analyze factors that contributed to risk management not occurring on time, by creating a fish-bone diagram (as shown in Figure 1) from the documents and minutes left during the past risk management assessment. As a result, the following four factors were clarified

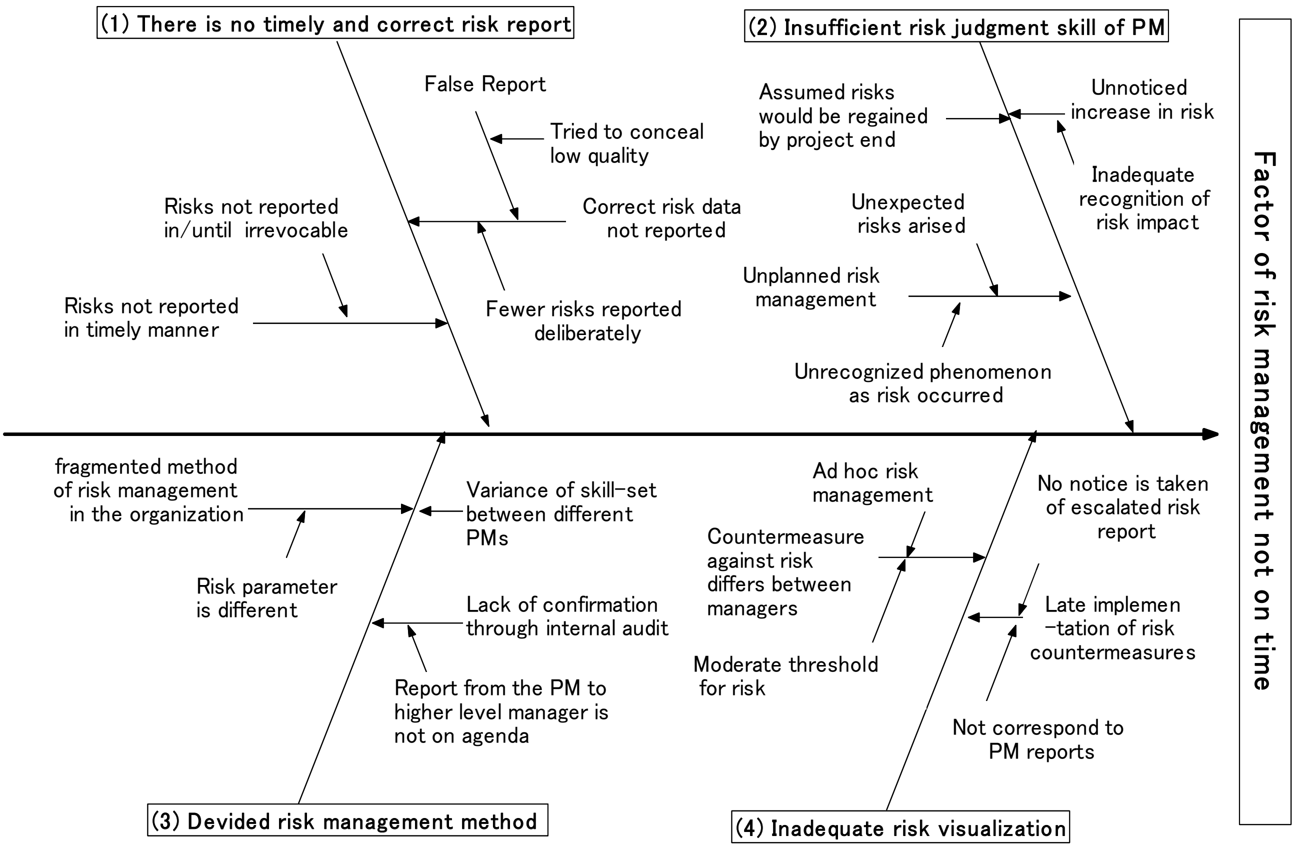

Figure 1 Fish-Bone Chart of Problems

- (Factor 1) There is no timely and correct risk report. Even when the risks expand and it becomes too late to adequately manage them, organizations may sometimes report less risk or hide critical risks since the project is on a position to be evaluated by higher-level managers. Therefore, a correct risk report was not delivered on time. This is the cause of problem 1.
- (Factor 2) Insufficient risk judgment skill of PM
Due to the PM's insufficient risk judgment skill, such as insufficient identification of risk and undistinguished critical risk, Organization did not manage the risk properly. Therefore, it is the cause of problems 1, 3 and 4.
- (Factor 3) Divided risk management method
Due to insufficient communication between PM and higher-level managers, divided terms and methods are used, and insufficient information is presented, which is a factor in problems 2 and 3.
- (Factor 4) Inadequate risk visualization
The risk management ledger includes the PM's subjective evaluations. Higher-level managers are unable to monitor risk situation of the projects. Therefore, it is a factor in problem 4.

3. Quantitative risk management method of system development projects

3.1 Basic policy

Risk is a potential thing and it does not necessarily become explicit. Therefore, if risk countermeasures are always activated ahead of schedule, unnecessary labor will be spent and costs will increase.

For a good risk management process, it is important to prioritize the order of the risk, prioritizing the risk with the larger influence range when it is determined that the risk is almost definitely going to occur. Therefore, in this research, we set up the following four basic policies:

(1) Set clear risk criteria
Objective judgment criteria are set for each practice of the risk management process such as registering it in the risk management ledger, identifying risk explicitly, and using the quantification method.

(2) Status judgment using a mathematical model
Using a mathematical model, risk criteria is set dynamically according to project circumstances.

(3) Introduction of subject matter expert (SME) and quality assurance (QA)

To solve the problem of skill shortage related to risk management, a SME, a specialist in development process and risk in the engineering field, and QA are introduced to discuss risk countermeasures.

(4) Alignment

Aligning the basic policies of (1) to (3) with the risk management process.

3.2 Procedure

We define quantitative risk management process by organization as shown in Figure 2. The risk management process consists of five stages: risk management planning and preparation, risk identification, risk analysis and quantification, risk prioritization and response strategies, and risk monitoring.

We aim to establish an effective risk management process by mapping out four basic policies to help this risk management process. Hereafter, the procedure of risk management is described along each stage as outlined above.

Figure 2 Procedure of Quantitative risk management process by organization

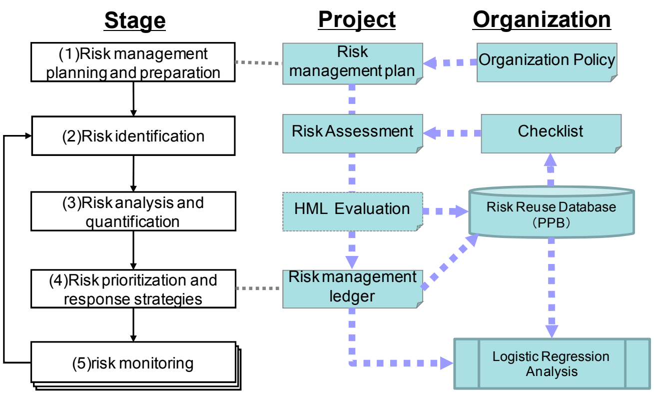

Figure 2 Procedure of Quantitative Risk Management Process by Organization

3.2.1 Risk management planning and preparation

In Stage 1, we first define the organization's policy, and then each project will plan and prepare for risk management. Organizational policies mean a policy to tackle risk management from perspective of the circumstances of customers and external environment of the organizations. Organizational policies will help prevent the spread of risk approach in each project, diversification of risk management direction by projects, or cost increase of risk countermeasures.

Next, we prepare a risk management plan in accordance with project scale, and difficulty level. Organizational resources of indirect departments that can be invested must be limited. For example, if a risk management meeting is planned at every life cycle process with a short-term project (such as a six-month project), the burden on personnel such as the SME and QA will increase. It is important to consider these people's efforts when making a risk management plan.

An example of an adequate risk management plan is shown in Table 1.

Table 1 Risk Management Plan

5W1H	Contents
Who	PM, SME, QA
What	Identify risk that cause the process delay
How	Use the check list developed from experience
Why	Compensate for lack of skill of newcomers

3.2.2 Risk identification

In Stage 2, we identify causing risk by implementing risk assessment.

Risk assessment is conducted through SME interview using an organized risk checklist. The checklist has two goals. One goal is to recognize the risk factors that are unintentionally overlooked. The other goal is to prevent recurrence of problems that occurred in past projects.

To ensure the completeness of the risk factor, an element called "7 Keys" is used in the risk checklist. "7 Keys" is a classification of risk elements that refers to stakeholders, business interest, task and schedule, team, scope, risk, and organizational interests. The "7 Keys" classification helps to grasp comprehensive monitoring of project, internal and external risks, and project threats and opportunities for improvement.

Next, to prevent the recurrence of past troubles, we selected the risk factors accumulated in the organization that had been predicted to recur in the current project and technical area. We incorporate them into the risk checklist.

Risk assessment is carried out using this checklist created from the goals described above. These clarify risk events, influences, causes, and results by discussing the detected risk contents with three persons: the PM, SME, and QA. Planned risk assessment is carried out and risk occurrence and extinction are also judged at this stage. An example of "7 Keys" is shown in Table 2.

Table 2 "7 Keys"

Key	Contents
Stakeholder	Document stakeholder management plan
Business benefit	Understanding of customer's business environment
Task & Schedule	All deliverables are delivered within the customer's designated deadline
Team	Complement a position to which a role is not assigned
Scope	Number of change requests received
Risk	The process of risk management is documented
Organization Profit	Range of EVM values to report in contract management

3.2.3 Risk analysis and quantification

In stage 3, we analyze the risks identified at the previous stage and perform quantification.

When a development project has items to be managed, the project distinctly registers and manages the items in each separate management ledger such as issue management, dependency management, risk management, and crisis management.

However, since a risk in the dictionary sense has broader meanings, even unnecessary things are registered in the risk management ledger. For example, if deliveries from outsourcers are delayed and the master schedule of the project body is influenced by the delay, the PM registers the receipt date and countermeasures to be taken in the dependency management ledger and risk management ledger as well.

In this research, the management ledgers used for a project are defined as issue management, dependency management, crisis management and risk management. When there are items that have no obvious ledgers to report in, the item will be recorded in risk management. Each ledger and its contents are explained in Table 3.

Next, the priority-level of risk is judged by urgency of response required for the task as well as the probability of risk, and then classified as HML (High, Middle, Low) during the risk management meeting. The effect of the implicit risk is converted into time or amount. This information, which is related to risk, is used as a reuse database. If the risks are eliminated by implementing countermeasures, then the information will lead to refinement of the next risk checklist.

Table 3 Classification of Ledgers

Ledger	Contents
Issue Mgt	Events that already occurred (items that can be solved within the project) that affect planned QCD
Dependency Mgt	Project and related parties outside the project (cannot be resolved within the project)
Crisis Mgt	Prepare for response as organization during a crisis that project cannot respond to alone
Risk Mgt	Potential obstacles to projects that can be a problem in the future

3.2.4 Risk prioritization and response strategies

In stage 4, risks to be managed are selected, and prioritization and response strategies are determined.

As mentioned above, the risks are potential and may not become explicit. Here, only the risk evaluated as "High" at stage 3 is set as a candidate to be managed. Next, we decide the response strategy for the risk candidate. Response strategy refers to classification as either acceptable, avoid, transfer, or mitigate, according to the characteristic of the risk.

In this research, we define terms as follows. Risks categorized as "acceptable" are ignored because they do not consider countermeasures. "Avoid" and "transfer" mean that projects will not bear the risk due to transmission to third party, even if risk becomes explicit. Therefore, in this research, only risks classified as "mitigate" in the response strategy are managed. These risk counter strategy is explained in Table 4.

That is, the risk rank is judged as "high" in the risk management ledger and the corresponding strategy classified as "mitigate" is the only target. Total impact when the risk becomes implicit is taken as risk values of the project as a whole.

3.2.5 Risk monitoring

In stage 5, the project monitors the risk-status at a progress meeting. Appropriate risk action will be taken if necessary.

In the risk management register, both the trigger and the effect (when they become explicit) are registered. In this case, the trigger is a threshold. When the risk exceeds that threshold, risk will become explicit soon. The effect is amount of time late due to the influence of risk.

Table 4 Risk Counter Strategy

Strategy	Definition
Acceptable	Because the influence of the risk is small, we should not accept measures to reduce risk
Avoid	Remove the possibility of risk occurrence by stopping the cause of threat occurrence or changing it completely in another way
Transfer	Transfer risk to another company etc. by entering insurance
Mitigate	To reduce the possibility of threat occurrence by taking measures against vulnerability and reduce the effect of occurrence

Now we can predict if the project will fail or not in the future, using logistic regression analysis by progress delay and rework time associated with risk actualization. Logistic regression analysis is a statistical method that predicts the occurrence probability of an event from the size of accumulated data. Using risk value as explanatory variable, value that can take only binary (Yes / No) -like occurrence of failure of a project for dependent variable, the probability of the influence on the occurrence of the failed project can be determined.

Organizations that conduct system-develop projects often have similar degrees of difficulty and similar scales. We can also quantify the recoverable period for the construction period if the project is delayed. For example, "If the project period is 18 months, you can recover by the delivery date if it is up to 6 weeks at the completion of the manufacturing process."

Usually, in the development project, we have progress meetings on a weekly basis, during which we hear progress and problems from each member in charge of the project. The PM grasps the increase / decrease of the risk of the week and converts the magnitude of the influence into time if there is a risk exceeding the trigger, and then compares the total of the manually reworked effort due to the manifested risk with the allowable value obtained by the logistic regression analysis. If it is judged that it leads to a delay in the delivery date, it will prevent risk of delays by activating risk countermeasures at that time. This logic is shown in Figure 3.

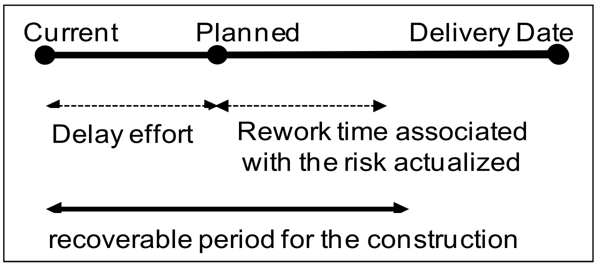

Figure 3 Delay Efforts and Rework Time Associated with Risk Actualized

4. Application evaluation in actual development organization

In Section 4, we explain a case study that the proposal risk management method applied at Company C and evaluated its effectiveness. For the application of logistic regression analysis, JMP® 13 (SAS Institute Inc., Cary, NC, USA) which operates on PC was used.

4.1 Cast Study for embedded system development

Company C has introduced project management using PMBOK for about 10 years. Development projects, basic operation of the project management using the PDCA cycle, is well established.

However, in reality, even though it was called the risk management process, its focus was on creating a risk matrix and leaving a completion record for preparation of assessment evidence. This is a situation that does not lead to effective risk management.

Company C has set the development process standard, which is based on the waterfall model as an organization. Also, at the time of the introduction of the PMBOK, the risk management plan, the creation of the risk management ledger, and the risk assessment checklist are managed within the company. The company mainly undertakes derived development. They focus on delivering in a timely manner in a short cycle. In the cases where the delivery date was delayed among QCDs, the project was set as "failed project." The policy of the organization was to prevent delayed delivery at all costs.

In the risk management plan, PM, SME, and QA participate in, and hold, a risk management meeting at the sales, project planning, basic design completion, and integration test completion stages. Meanwhile, the project held a progress meeting on a weekly basis and operated risk management with risk management ledger. For risks classified as "H" and "mitigate" among them, the impact converted into time when exceeding the trigger.

The development period at Company C is around 6-18 months depending on the scale of development. We calculated the probability to become a failed project by logistic regression analysis on a monthly basis.

As an example, figure 4 is an output of logistic regression analysis by JMP. The horizontal axis of the figure is the number of weeks delayed. Vertical axis is the probability of the project failed. Crosshair in the figure indicates that the prediction probability is 0.42 at the time of 6 weeks which is the intermediate value at Company C. That means, if the project is delayed by 6 weeks, the delivery date will be delayed with a probability of 42%.

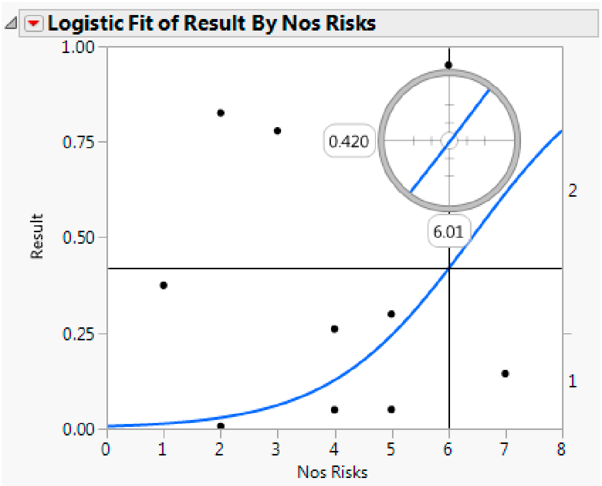

Figure 4 The Causes of Failure and Its Proportion

Specified Probability(Result=1)	Predicted Nos Risks	Lower 95%	Upper 95%
0.2500000	5.041641	3.931390	5.78472
0.5000000	6.415390	5.677829	7.72130
0.7500000	7.789140	6.822950	10.25920

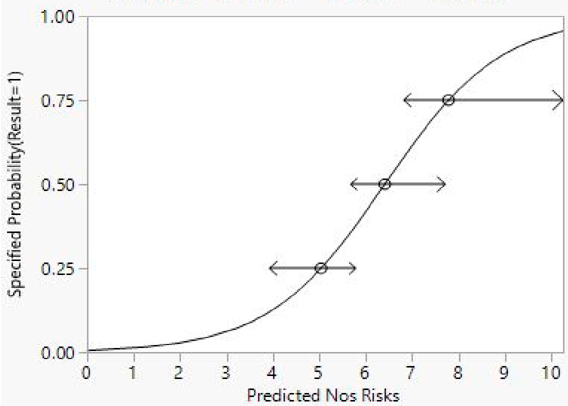

Figure 5 Logistics Regression Analysis and Inverse Estimation

The probability of 42% is hard to use as a psychological milestone to activate risk countermeasures. A value at which the prediction probability becomes 50% was calculated using inverse estimation of logistic regression analysis and it was 6.41. In other words, "If you add a delay of 6.41 weeks the project is delayed delivery with a probability of 50%." Conversely, it means "if you delay by 6.41 weeks you can recover with a 50% chance." This state is shown in Figure 5.

Projects in Company C hold a progress meeting every Monday morning and confirm the progress. If the total impact of risks beyond the trigger at that time exceeded 6.41 weeks, and the risk value tended to increase more than the previous week, they activated risk countermeasures in descending order of influence. The same procedure is carried out at the next progress meeting. If the total effect of delayed progress and risk manifestation exceeded the recoverable range, the project took risk measures so that it fit within the recoverable range.

Recall that Company C's organizational policy is to meet the delivery schedule. It is acceptable to increase the cost of risk countermeasures to prioritize organizational policy. So even when costly, they decided to prioritize meeting the delivery date.

4.2 Evaluation of effectiveness

Figure 6 shows the three-year trend of the delivery delay project at Company C. It is small but the number of projects to delivery time delay has definitely been reduced. Meanwhile, Company C did not introduce any other measures during this time, but the proposed method has been introduced. The analysis it considered that the transition in Figure 6 could be regarded as an improvement effect of this proposed method.

Figure 7 shows the transition of contingency for 3 years after introducing the proposed method at Company C. Contingency is a reserve expenditure fund that can be drawn upon to prevent the project settlement is in deficit. It is preferable not to use contingency funds because it is recorded as profit if not used. In the first year after introducing our proposed method, we consumed nearly 30% of contingency. It has been suppressed to 20% or less in the third year. Because countermeasures are given priority in order of the risk of damage due to anticipated risk, we believe that it contributed to the prevention of major deficit projects. We confirmed that this proposed method has an effect of improving cost as well.

5. Discussion

In this section, we discuss whether the factors presented in Section 2.2 have been resolved.

5.1 Timely and correct risk report

According to the analysis in Section 2.2, the reason for risk countermeasures not being in time is lack of correct criteria for implementing risk countermeasures. The PM conducted correct risk identification by SME and risk tolerance identification by statistical method are conducted properly. Then they implemented risk countermeasures by dynamic criteria according to the project construction term and situation. Since the introduction of this method, the number of delayed delivery projects has been gradually decreasing. The method assumes that timely and correct risk reporting has occurred.

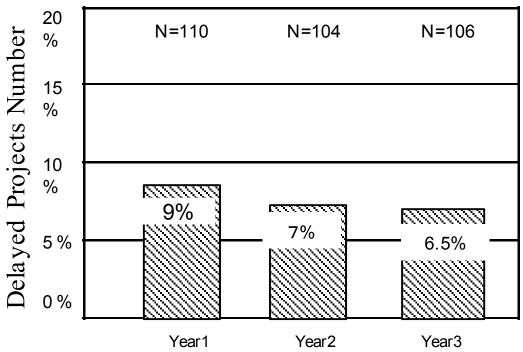

Figure 6 No. of Delivery Delayed Projects

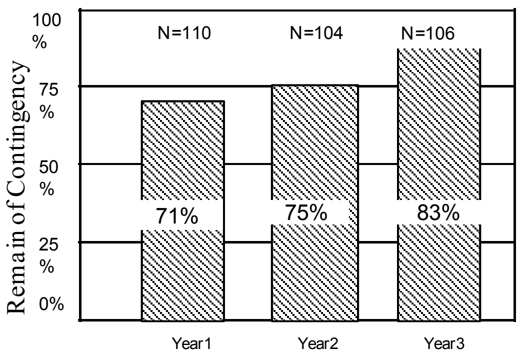

Figure 7 Transition of Contingency Budget

5.2 PM risk judgment skill

The PM does not necessarily become an expert in all technical fields. The SME uses the risk checklist to identify the presence or absence of risk. In the progress meeting, risk is evaluated by consultation of PM, SME, and QA, by judging the magnitude of risk; we corrected for the skill shortage of PM by registering the correct risks and prioritizing them.

5.3 Risk management method in organization

Judgment on the size of acceptable risks and triggering of risk countermeasures depends on the project situation. In this study, the risk tolerance value is calculated by using the statistical method, and the risk management judgment is made dynamically according to the circumstances of the project. By eliminating the subjective judgment of the PM and higher-level management, objective, reliable methods are presented.

5.4 Full visualization of risk

After identifying the risk through SME risk assessment, we monitored the risk by weekly progress meeting and visualized the magnitude of allowable risk by statistical method. Furthermore, the magnitude of the risk effect exceeding the trigger is converted into time; we visualized the possibility of leading to delivery delay. The proportion of discontinuing contingency as before is also declining.

6. Conclusion

In this research study, based on the risk management process, the effectiveness of which has been confirmed, we clarified the standards and acceptable ranges that have been unclear at the site of the development project, and tried to solve the problem that risk countermeasures could not be implemented on time. When we applied the method to actual embedded development projects, we confirmed the improvement effect on the transition of the number of projects with delayed delivery times and the decrease in contingency. The proposed method is thus, potentially effective.

This proposed method can be introduced easily at any organization implementing process improvement. In the future, it is necessary to increase case examples, evaluate effectiveness, and make improvements risk management process.

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Secure Mobile Money System for Myanmar

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There are only few bank branches at the rural areas in Myanmar. The people who live in rural areas have to go near the city when they want to transfer money and when they have to withdrawal money. They have to leave their jobs for going to the town on that day. But fortunately, Myanmar fast grew in mobile penetration rate from around 10% in 2013 to around 80% in 2016. So, we have been considering about the projects of mobile money system for remittance or money transfer especially in rural areas. Although some banks have implemented mobile banking system, it is not applicable to the unbanked people. Most of our people (over 60%) who lives in rural areas have no bank accounts. They resort to informal channels of financial services. So, I decided to develop the secure mobile money system for Myanmar as my project. From the point of security issues, the system is covered transaction security especially with secure network protocol with considering user security and merchant side security. This project will completely equip to take the challenge of bringing financial services to the unbanked and erase of waste of time for financial process for citizen in Myanmar.

Keywords and phrases: Secure Mobile Money System for Myanmar, Mobile Money Transfer, Remittance, Transaction, Unbanked

1. Introduction

1.1 Mobile Money in Myanmar

In Myanmar, most of the banks are trying to deliver their banking services to customers through mobile phones. Mobile banking is a kind of e-banking which may lead to mobile commerce. But unfortunately, the most people from the urban area can use banking services and there is luck or no banking infrastructure in rural areas. According to the global overview report of We Are Social (We Are Social, 2017), urbanization is only 35% comparing total population 54.60 million. So, we are becoming to think about the people of rural areas to get banking services for them. By opening to foreign mobile operators, Myanmar is now developed in telecommunication network. Mobile subscriptions grew highly and now its penetration reaches at 50.56 million comparing with population, it is about 93% which is shown in digital report of We Are Social (We Are Social, 2017). So, we can make banking services to give the people of rural areas via mobile phones. We are considering to give financial services for them with mobile money system.

In global, according to GSMA (GSMA, 2015) mobile money is available in 93 countries (85 %). At which there is a mass of population who lucks formal financial services. At mobile money industry, mobile network operators are playing the important role as service providers. Agent networks are also included in which as an important role. Availability of mobile money service depends on agent networks and mobile interfaces. Regulators, telecom operators, mobile messaging and application software developers, mobile commerce solution providers, payment infrastructure providers, and payment vendors are trying to innovative successful deployment of mobile banking/money in the region. At the launching period, there may have revenue and valuation impact at mobile financial services because fewer customers register and lower usage from existing customers. In the future, however, this mobile money system can remove the challenge of bringing financial services to the unbanked people and can reduce the wasting time for financial process. Adoption to mobile money system and customer usage depends on convenience, usability and security of the system. In this project, we will consider about secure mobile money system for Myanmar.

Myanmar people assume cash is a sign of value and keep track of expenses. Moreover, they are cash preferred society and most of the people are unfamiliar with technology of finance. They are being accustomed with traditional way of billing process and payments also. But there are cash related problems such as small change problem, carrying problem, payment problem, safe keeping problem and also durability problem. These problems can be eradicated by mobile money system. Mobile money or electronic money can be store in a wallet account attach with a mobile number. We have to consider fast, easy and affordable services for them. Crypto cash model, mobile/web wallet, and applications are suggested for mobile financial services. In future, mobile transaction, mobile and digital money, micro money by secure, regulated, reliable services will change the life styles of Myanmar people. Therefore, security issue is one part of important things we should consider when we deliver financial services via wireless network. In transaction, user security, network security and merchant side security will be considered. Here, I would like to approach especially in user security which may suitable for our people.

1.2 Background for Mobile Money Services

Mobile phones are becoming the most used technology in the world. The mobile is enabling people to connect not only with each other, but also with the services and information that they value, in increasingly innovative and dynamic ways. In developing countries described by the world bank (World Bank, 2014) 2.5 billion people are 'unbanked' and have to rely on cash or informal financial services which are typically unsafe, inconvenient and expensive. So, mobile service providers are also now trying to give the financial services via mobile phone such as transactions, bill payment, pay salary, etc. The ubiquity and convenience of the mobile is changing the lives of people of Myanmar. In the future, the unbanked people will be able to use safely banking service by mobile money system instead of informal financial services.

Mobile phones are becoming the most used technology in the world with more than 5 billion described by GSMA (GSMA, 2017). As the mobile market landscape evolves, operators, financial institutions and consumers are rapidly embracing new opportunities. The mobile phone is changing how people conduct their financial activities. Traditional banking infrastructure struggles to make the business model work to serve low-income customers, particularly in rural areas. However, over one billion of these people have access to a mobile phone, which can provide the basis for extending the reach of financial services such as payments, transfers, insurance, savings, and credit. But we have to consider about thinking way of the unbanked people on the finance because most of those people in rural areas have experienced only in cash-in-hand and they will claim secure mobile money system.

There is a big demand for money transfer services in Myanmar. There are huge migrant population between urban areas and rural areas in order to find work and to go to the universities. Some people want to reduce their time for waiting in the banks to get bank's service. They are not always satisfied with banking channels and Myanmar has less banking outreach. So, they need more easy and convenient ways of transfer money. According to these data, they contributed to improve our ideas. We found the project at the remittance by mobile network in the communication field. We intend to conduct thorough research on the viability of the project before launching. Research will help in gaining information related to consumer needs and wants.

We have three solution enablers (business model, technologies, and human resources) to build the hypothesis for this issue. The infrastructure will be needed in solving the issue. It may include in the business model. Training will also be important for the people who will be involved in the project as the human resources. We intend to get professionals to work on the project and where necessary outsource. Especially in the part of technologies from our solution enablers, we will implement biometric parts like face recognition at registration of user information so that they will easily withdraw money at the agents without showing any evident and saving password. We can provide secure mobile money system to the users for their authorization and authentication.

2. Previous Study

Supporting technology for mobile phones: There are unlimited mobile applications with various objectives for mobile phone users. The purpose of mobile financial applications is to be useful in banking services and payments services fast and conveniently. Yan Wang and Tingjie Lu have analyzed the support of technologies from the foundation of wireless user infrastructure, mobile middleware, and wireless network infrastructure for mobile applications (Wang,Y. and Lu,T., 2007).

2.1 User Interface Technology

In wireless communication, Personal Digital Assistant (PDA) or electronic handheld information devices such as mobile phones, tablets which are hardware of the interfaces and the applications or the operation systems are like software interfaces.

2.2 Mobile Middleware Technology

Mobile middleware is like the medium software between the wireless communication and OS (Operating System) of the mobile devices to connect the mobile application. According to Yan Wang and Tingjie Lu's description, this middleware technology becomes important in mobile commerce transaction. The network enabled middleware can optimize the techniques such as header compression, delayed acknowledgements, and concatenation of several smaller packets into one for decreasing the traffic on the wireless networks by Wang, Y. and Lu, T. analyzing on it (Wang,Y. and Lu,T., 2007).

2.3 Wireless Communications

There are three kinds of wireless networks which are system interconnection wireless LANs (Local Area Networks) and wireless WANs (Wide Area Networks). System interconnection is a connection among devices using short-range radio like Bluetooth. In wireless LANs, there is a base station and every device has a radio modem and antenna to access communication. In wireless WANs, it is like wireless LANs but its usable distance is much greater than wireless LANs. The cellular networks are the examples of wireless WANs by Midhun Menon (Midhun Menon, 2013). The general topologies of wireless networking are star topology which is the standard wireless topology, tree topology, line topology, mesh topology, ring topology, and bus topolog. According to Buettrich, S. and Pascual, A. E. (Buettrich,S. and Pascual,A.E., 2006), any wireless implementation is based on one or more than these topologies.

Wireless communication does not need any medium but its path has to clients/master or transmitter/receiver. That transmitter/receiver builds the access point (AP) between wireless nodes and a wired network. Any devices with wireless network adapter or wireless clients can transmit and receive RF signals. There are two modes at basic wireless implementations and which are ad hoc and infrastructure. Ad hoc is independent basic service set (IBSS). In this case, wireless network card (NIC) must have the same SSID (Service Set Identifier) as the access point. It has no need of central access point but it is not scalable. Infrastructure is extended service set (ESS). In this case, central access point is needed and it is scalable. According to Buettrich, S. and Pascual, A. E. (Buettrich,S. and Pascual,A.E., 2006), its clients and AP must use the same SSID.

2.4 Network Technology

Wireless network infrastructure delivers wireless networking by network technology. In the network technology, the protocols are considered. Protocols are the specifications used in communications and internetworking. The traditional standard for internetworking is TCP/IP (Transmission Control Protocol/Internet Protocol). It defines the details of data sending and receiving through network communications hardware such as switches, routers, hubs and adapters, etc. At TCP/IP protocol architecture, there are four layers; application layer, host-to-host transport layer, internet layer and network interface layer. Each layer acts as one or more layers of the seven layers of OSI (Open Systems Interconnection). For the interconnection between the systems, it has OSI standards also. The network architecture is divided by seven layers of OSI. If the interconnections between layers are constant, any layer can be designed the protocol without affecting other layers. The protocols and containing data of each layer are related only the specific layer as stated by Steven Cahill (Steven Cahill , 2010).

The application layer provides the software interfaces to access networking services. It can provide message handling services, file transfer services, remote file services, and remote database access, etc. The presentation layer makes the data format of application to be understanding of the network. It manages for system passwords by data encryption and decryption. The session layer is a connection for data exchange between two nodes on the network and is maintaining communication between them with their processing services and capacity. The session layer will determine which node can communicate first also. The transport layer controls the data transmission flow and error handling. It provides enhancements to the services of the network layer and it is responsible for ensuring reliable data delivery. The network layer is responsible for moving data to arrive the specific network location among internetworks. It translates the logical address into the physical address and then decides the best route for moving data. The data link layer divides the receiving data from the network layer to be transmitted. It can organize the physical layer's bits into frames which are the logical groups of information. It can detect and correct errors also. The physical layer is the physical network structures including transmission media connectors, cables, modems, repeaters, and network interface boards, etc. According to Steven Cahill (Steven Cahill, 2010), figure 1 is shown the working conditions of this seven layers.

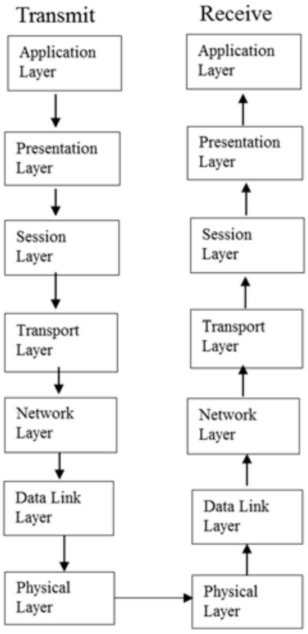

Figure 1 The seven layers of OSI

2.5 Mobile Security

In mobile financial services, it requires the consumer confidence in mobile financial processes. Nowadays, many solutions are developed for high security such as secure identity management, banknote security, etc. In focus of the mobile application, the cyber-attacks can also be occurred. Most of the cyber-attacks are becoming of the application layer as stated by Anand Kalwani (Anand Kalwani, 2017). But at the same time, consumers expect high convenience. So, mobile solution providers are considering about high security such as the password-less authentication with biometrics. It provides secure, scalability and flexible solution in mobile channels but it may trade-off between security and usability. Figure 2 is shown the flow of mobile money application using biometrics.

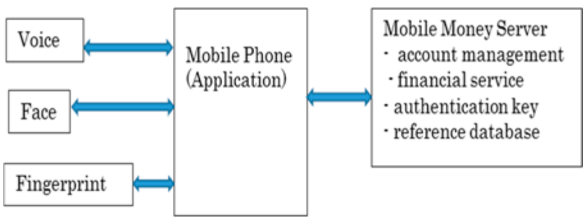

Figure 2 Mobile Money Application Flow Using Biometrics

3. The Process of Mobile Money Services

Mobile money network of agents would be over the rural and urban areas. The types of agent are depending on the amount of deposit money. There are many types of agents such as super-agent, normal agent, and sub agent. The customers of mobile money services can use the service platform with mobile application. The customers can easily cash in to the desirable amount at the mobile money service authorized agents.

For P2P (Peer to Peer) transfer, the customers need to be a registered account and cash in the favorable amount in advanced in order to transfer anywhere, anytime to anyone who might also be an registered customer. Because this project is approaching the secure transfer by biometrics. The customer may be required to do some steps in the registration at first. But it is only for their convenience in password-less remittance.

The customers can easily cash out the received remaining electronic money (e-money) at the nearest agent without going to bank. Moreover, the customers can self-top up their mobile phone or top up others for anytime, anywhere. Customer can buy at online store and the merchant needs to confirm by using mobile money platform. We have to use security and identification solutions on mobile money platform as important parts of financial services such as retail and exchange currency services and also salary transfer and online payment services.

We have already Market Readiness such as mobile penetration, demand from users, and financial legal framework for money transfer. We have to contribute to the actual usage in performance related with scalability, security, reliability, sustainability and maintainability around the processes. In Myanmar, 60 % of the people live in rural areas and most of them have not bank accounts. So, our mobile money project targets those unbanked population. But, the customers might be unfamiliar with this service. In Kenya, M-Pesa, mobile money transfer service with Safaricom, now accounts for 18 percent of Safaricom's total revenues (more than SMS and data combined). According to Cisco (Cisco, 2013), it took 6 years for them to achieve this. This example stresses the importance of being patient and investing in the innovation of ICT.

This project refers to enable regulatory environments to facilitate digital financial inclusion. It aims to support mobile financial services to provide convenient, safe and affordable financial services to the underserved, thereby increasing financial inclusion. Our project will provide for this with secure of biometric parts.

Establishing a suitable business case for the agents is very important to make the mobile money service project sustainable. Human resource management is also needed to give the training and retraining agents for the good service and to train the technology such as face recognition. It can get more user trust with the better service. Our this project prepares to be flexible with the actual user needs. We should make the customers considering about the risks of informal channels of financial services and knowing about the mobile money service associated with reliability and security. Figure 3 is to be provided by mobile money services.

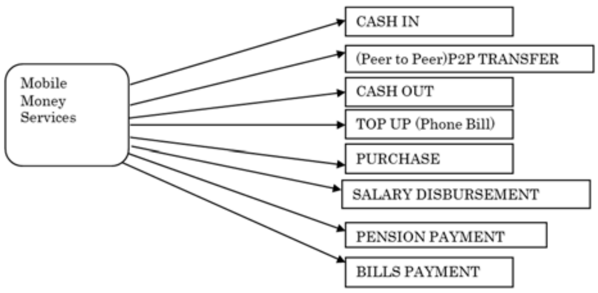

Figure 3 To be provided by mobile money services

4. Advantages

It is convenient for many users as it will be available widely around the country. They can save on time as one does not have to travel for long distances to access an agent or wait in long bank queues. Low transaction charges are pegged on amount of money being withdrawn, while deposits are not charged. Any member of the society can access the service which means it is class-less and especially for unbanked people in rural area. Money in the e-wallet is safe and cannot be withdrawn by a person who has no access to the secret pin and biometric which is uniqueness. Regulation and close monitoring of transactions helps to reduce cases of money laundering. Agents are well trained which plays a part in avoiding delays and possible mistakes on their part. It can be faster than the existing system of money transfer in place. It is closer to customers so the problems of distance has been removed. It is easier to use with mobile phone so anyone can operate/use it for financial services. It is more efficient. By confidence in security, it can provide more services such as loans, credit, payment and savings.

5. Challenges

It has many challenges such as strategic planning and policy challenge, capital challenge, human resource challenge, infrastructure challenge, technology challenge and market competition challenge, etc. Customers may not have initially trust that their money is safe as they have fear of fraudulent activities especially by agents. System outages may occur in the early days and delay or lost transcription receipts might be common. Agents also may not initially be comfortable with the idea of disbursing money. Another problem is rising from agent booth location and registering new customers with biometrics because of unfamiliarity with technology.

6. Conclusions

This secure mobile money solution might allow the trusted relationships with service providers to their customers and retail agents to deploy industry leading services ranging from recharge and payments to mobile commerce or international money transfer. When we say mobile financial services, mobile money, mobile savings, mobile insurance, mobile credit all are included. Security will be applicable in any mobile financial services. As mobile money case, agent outlet is a touching point for users. They are contracted with service providers to facilitate transactions such as cash-in, cash-out for users. Agents can register new customers too. Before using mobile money services, they have to resort informal financial services at which luck in security and reliability. There is available no records of transactions via informal channels which prevents transparency. Informal channel charges vary depending on the amount and urgency. In this project, the consumers can save their time for going banks and can save money for lower charges. They can make transaction with secure authentication and authorization.

We may have many solutions for security, usability and cost. As a basic secure communications, we are using the public key infrastructure (PKI) where one encrypts a message to someone with his public key, and only he has private key can decrypt it. Customers expect more and more convenient. We think about how to develop customer confidence in mobile money services. We moved to password-less authentication with mobile biometrics. When customers request authentication, they can show a biometric such as face, fingerprint, etc., at local devices. They will be checked in authentication key reference database and authentication metadata after that they will be passed into user account management and financial services of mobile money server. Higher security with using biometric can reduce liability risk for transactions and it can prevent critical user information from fraud/theft. It can also prevent unauthorized seeing, copying, changing or any usage of some security relevant part. This project will be beneficial not only for the unbanked but also for the small and medium businesses.

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Integration of Agile Development Methodology and Project Management Tool

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In recent years, it has been required to exploit the explosively increasing IoT data, and the information systems that utilize them must be able to prove and provide the value flexibly and rapidly. However, it is difficult to achieve flexibility and rapidity with the conventional waterfall methodology. In order to achieve flexible and rapid system development, we developed a new methodology based on Scrum, which is known as the de-facto standard framework of agile development. In addition, we made correspondence between typically-used OSS (open source software) and development process because we considered that applying useful software for project management, software engineering and communication strongly encourages rapid development. We also propose an effective use situation of the methodology in projects. In the field of agile development, developers prefer lightweight communication tools such as chat for communication with each other. These tools are effective for increasing the speed of discussions, but the results of discussions are sometimes not organized and it will be difficult to reaffirm the conclusions and reasons later. In order to deal with this problem, we developed an environment to refer to and edit the methodology content on a project management tool. The environment can be used as a platform for tailoring the methodology based on know-how gained during the project and accumulating the know-how as explicit knowledge. We evaluated its usefulness by applying this method to a project and tracking the use situation.

Keywords and phrases: System Development Methodology, Agile Software Development, Scrum, Wiki

1. Introduction

Standardizing development process is very important to carry out a system development project efficiently. Hitachi has a standard system development methodology named HIPACE. We released the first version of HIPACE in 1979. After that, HIPACE has continued to evolve over 30 years while keeping up with industry standards and trends (Sakisaka, et al., 2014). In recent years, we have developed a common base methodology which is the baseline of each methodology of Hitachi Group companies including HIPACE in order to work efficiently with overseas group companies for global projects (Maeno, et al., 2015, 2016).

Recently, the demand to utilize IoT data for business management is increasing. Information systems to realize it need to be flexible unlike backbone systems to keep up with business demands. The waterfall process is not suitable for developing such systems because the waterfall process is based on the premise that system requirements are determined before system design and development. For developing systems that responds to flexible requirements, the agile development process is suitable because the agile development process give more importance to "responding to change" than to "following a plan" (Beck, 2001).

Hitachi group has worked on developing and applying agile development processes incorporating our own expertise. The representative one of them is Hybrid Agile (Hanabusa, et al., 2013). It is a development process model that combines the advantages of waterfall process and agile process. Compared to basic agile development process, Hybrid Agile is more suitable for large scale system development projects, and is based on principle that the scope of systems is determined before starting system development. However, in terms of developing IoT systems, we sometimes develop small systems for PoC (proof of concept) at the system planning phase prior to finalizing the detailed requirements, and perform frequent trial and error and demonstration of data analysis and visualization. In addition, the scope and requirements of the system may be extended after starting the operation of the system.

In order to respond to flexible and rapid system development, we have developed our own new agile development methodology based on Scrum, which is known as the de facto standard framework for agile development, and incorporate it into HIPACE. In addition to common knowledge of agile development and Scrum, this methodology emphasizes the association of development process and support tool.

In this payer, the next section describes the feature of our new agile development methodology. Section 3 proposes an effective use situation when applying the methodology to projects. Section 4 shows the evaluation of the proposed approach in a project. Finally, in section 5, the conclusion of this paper is provided with the summary.

2. Features of our new agile methodology

2.1 Built based on well-known framework

In carrying out system development projects, it is important that project members understand the development process. Our new agile methodology is developed based on Scrum, which is known as the de facto standard framework for agile development in order to make it easy for project members to understand the development process and make projects run smoothly. Figure 1 shows Scrum Events defined in the Scrum Guide (Schwaber, et al., 2016), and Figure 2 shows an overview of our new agile methodology. The "Execute Sprint" in our methodology is the part that means iterations of development, which contains the processes equivalent to Scrum Events. We have added some processes that incorporate our own know-how (Testing, Product Backlog Refinement, and Development Environment Maintenance in Figure 2) in addition to the Scrum Events defined in the Scrum Guide. Sprint 0 is commonly-known process that is performed one time before development to build the development team and environment.

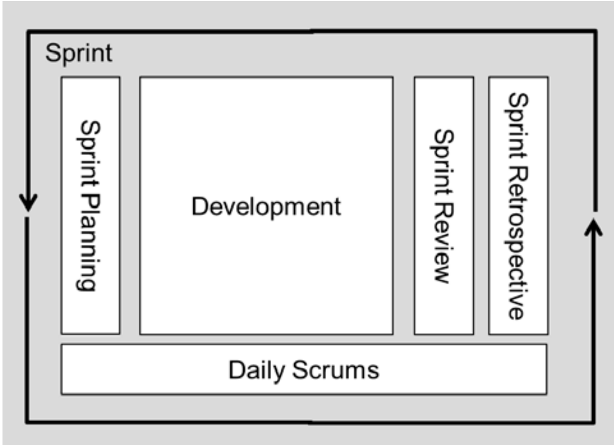

Figure 1 Scrum Events

2.2 Incorporating DevOps in the process

In order to quickly respond to business needs, it is necessary to quickly reflect the requirements in development as the features of the system, and to quickly release the developed features. To achieve that, our new methodology incorporates the idea called DevOps (Allspaw and Hammond, 2009), where system development and operation cooperate to realize frequent enhancement and release. Scrum Guide describes that the development team corresponds to the changing requirements during development by the activity called Product Backlog Refinement, but it is not defined as Scrum Events. In out methodology, we

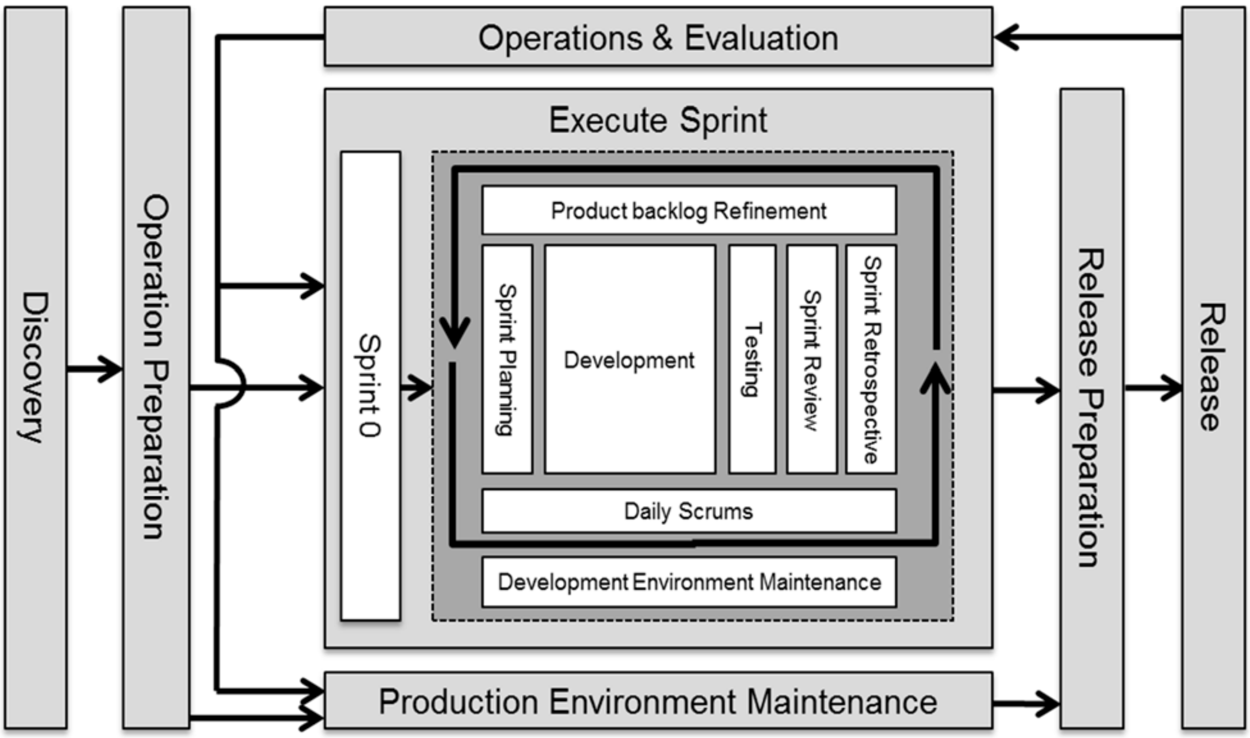

Figure 2 Overview of Hitachi's agile development methodology

have explicitly defined the Product Backlog Refinement process, which is same level process as other Scrum Events, to clarify the procedure for quickly feeding back and releasing the needs and requirements that are gained in the operation of the system.

2.3 Mapping processes and support tools

In order to realize DevOps, it is essential to utilize support tools such as for issue tracking, source code management, build, deployment, and communication among members (Allspaw and Hammond, 2009). We clarified the types of tools to be used and the situations to use for project management and execution. Figure 3 shows an example. We also provided some examples of open source software that is typically used for each type of tool, so that projects can easily select, use and learn those tools.

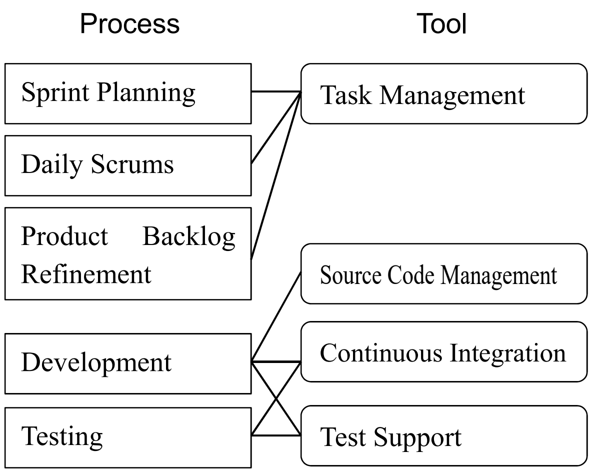

Figure 3 Example of Related tools of processes

3. Our approach for effective use situation

In the field of agile development, developers prefer peer-to-peer and face-to-face conversation or lightweight communication tools such as chat for communication with each other. These methods are effective for increasing the speed of discussions, but the results of discussions are sometimes not organized and it will be difficult to reaffirm the conclusions and reasons later. We approached this issue by utilizing methodology content in conjunction with project management tools. This section explains our approach.

3.1 Our approach for the issue

In order to efficiently accumulate and share knowledge and information in the project, it is important that it is easy to add and edit information, and it is easy to find accumulated information. As a solution to the issue, we have developed an environment to provide methodology contents to the project using the Wiki function included in project management tools. In this paper, we call the methodology content provided in the wiki as "Methodology Wiki". The aims of our approach are mainly the following two points.

(1) Tailoring the standard methodology and sharing rules and knowledge in projects

When using the development process defined by HIPACE, each project should tailor the standard process according to the characteristics of the project and uses it as a project-specific process, rather than applying the standard development process as it is. Providing a methodology as a wiki page makes it easy to edit the standard development process. It also makes it easier to add useful descriptions or tips to the development process based on lessons learned during the project. It also makes it easy to find accumulated information. By using this method, when project members access the Methodology Wiki to know about the development process, they can also see the new know-how gained in the project. In this way, the Methodology Wiki can be used as a platform for tailoring the development process based on the characteristics of the project and the knowledge gained while the project is in progress, and for accumulating them as explicit knowledge and sharing them.

(2) Encouraging improvement of the standard methodology

When improving the standard methodology based on case examples of projects, conventionally, the methodology organizers had to collect the case examples of the project beforehand, and then look for the methodology section to be revised and consider how to revise it. To collect the case of projects, the methodology organizers and project members have a meeting to discuss the know-how that should be incorporated into the standard methodology. Unfortunately, it increases workload of project members because project members need to gather and prepare know-how before the meeting. By providing an editable wiki environment, project members can directly edit the development process defined and described in the methodology. The methodology organizers can collect the know-how gained in the project by comparing the original contents and the tailored contents and check the difference, and use additional contents as a proposal for improvement of the standard methodology. Therefore, our approach can encourage quickly incorporating the know-how gained in projects into the standard methodology.

3.2 Comparison with other methods

We compare our approach with other methods for information sharing and accumulation which was conventionally done in the project.

(1) Comparison with meeting minutes

Writing meeting minutes is conventional method to save the conclusion of the meeting and to confirm it later. However, when project members do not hold a meeting and discuss in a chat tool or peer-to-peer conversation, the meeting minutes is not likely created, and the conclusion is not documented and accumulated.

Our approach helps that project members can accumulate the conclusions and know-how gained in lightweight communication with less workload by writing it in the methodology contents instead of writing the minutes. When tailoring the methodology based on the conclusion obtained by the meeting whose minutes was written, it is a good practice to link to the minutes as reference documents in order to clarify the circumstances in which the know-how was gained.

(2) Comparison with ticket comments

If project members discuss what is directly related to the tickets (or tasks) registered in the backlog, they can appropriately accumulate the results by writing it on the ticket comments. However, for example, project management know-how such as "Schedule the tasks not to spend the last day of each sprint for development work to properly perform sprint review and sprint retrospective." cannot be related to a specific ticket. In addition, if you derive common solutions or criteria from an issue related to a specific ticket, it is not suitable to write it only in comments of the ticket. Our approach can be a solution to share these knowledges with project members.

4. Evaluation of our approach with a project

We applied our new agile methodology and our application approach described in this paper for a project of our company to evaluate them. This section describes the situation of application and its result.

4.1 Overview of the project

This project develops and promotes our company's own services, and is applying the agile development process to achieve lean startup and continuous service improvement. The members of the whole project are about 100 people. The project members are divided into more than 10 sub-teams and are managed by Scrum of Scrums method in order to carry out large scale system development project with the Scrum framework. The sprint term of each sub-team is two weeks. In addition, this project has a PMO team to facilitate Scrum of Scrums, and the work of the PMO team is also based on Scrum. The members of the PMO team are attending each sub-team meeting and are responsible for developing rules in the project and sharing know-how to other sub-teams in order to facilitate the project. Therefore, they are expected to effectively utilize the Methodology Wiki.

4.2 Environment to use the Methodology Wiki in the project

This project uses Redmine for project management. They manage product backlog and spring backlog of each sub-team with the issue tracker

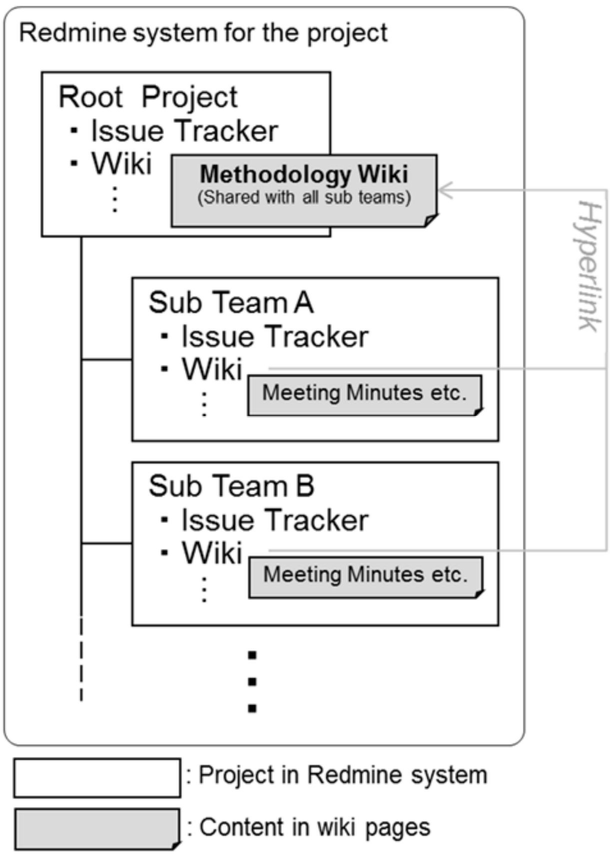

Figure 4 Structure of Redmine for the Project

module, and share information with the Wiki module. Figure 4 shows the structure of Redmine that is used for the project. There is one root project for the entire project, and there are individual sub-team projects. The root project has information to be shared with all sub-team in the project, and each sub-team project has issues and meeting minutes for each sub-team. We provided Methodology Wiki by generating methodology contents on the root project, and set hyperlinks from each sub-team's wiki page to the methodology contents. Each content page of Methodology Wiki has "Tips" part to accumulate and show tips that are gained from the project. Therefore, this environment is expected to be used for the platform for sharing knowledge gained by a sub team to another sub team.

4.3 Result

4.3.1 Customization of the Methodology Wiki

Figure 5 shows the number of added tips after providing the Methodology Wiki.

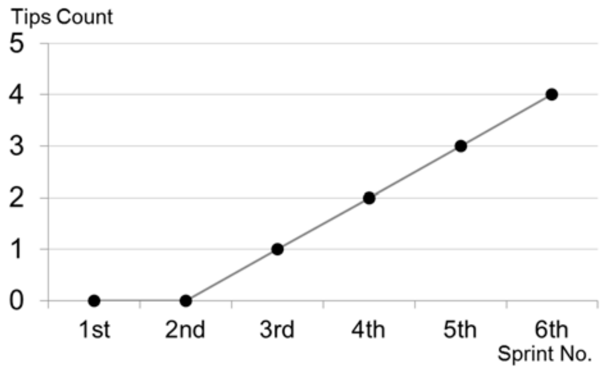

Figure 5 Count of added tips for process

In the first four weeks (two sprints) after the Methodology Wiki was provided, no new tips were written by the project members. The following points are found as the initial problem of providing the Methodology Wiki.

(1) Project members are not conscious of editing Methodology Wiki while they are working on development tasks of the sprint.

(2) Even if a project member found know-how and agreed it with his/her sub-team members, he/she hesitated to write it into the Methodology Wiki, which is shared with all sub-teams. This is because he/she did not know whether it is applicable for other sub-teams.

We took the following measures against these problems to encourage project members to use the Methodology Wiki.

(1) Taking time to organize know-how that is gained in each sprint

Each sub-team organizes KPT (as follows) in the sprint retrospective meeting held in the last day of each sprint.

Keep:	Good actions that should be continued.
Problem:	Problems in the sprint
Try:	Action plans for the next sprint to solve the problems

We decided to take time to organize know-how to be added to the Methodology Wiki as tips in the sprint retrospective meeting.

(2) Writing tips with sub-team's name

We decided to add the sub-team's name when adding tips so that project members can easily write the agreed tips within sub-team. This allows other sub-teams to pick out tips written by other sub-teams when reading tips.

As a result of implementing the above measures, tips written by the project have been increasing since 3rd sprint.

4.3.2 Example of improvement of development team behavior

This subsection shows an example of improving development team behavior and using information sharing with the Methodology Wiki. Figure 6 shows the burndown chart of a sprint in the initial term (called Sprint N in this paper) in one sub-team.

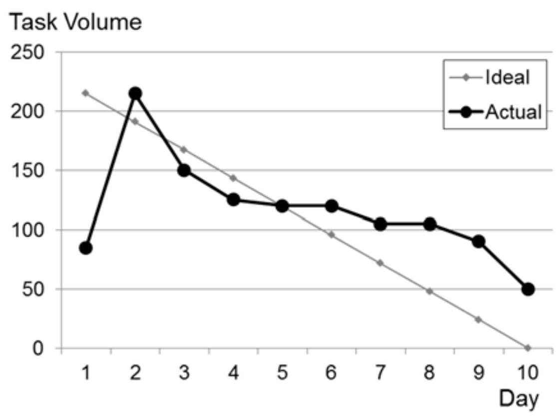

Figure 6 Burndown chart of Sprint N

In Sprint N, the scheduled task did not complete on the last day of the sprint. Team members scheduled their development work until the last day of the sprint, but they cannot spend their time for development work, due to unexpected work, sprint review, sprint retrospective. This situation might cause the deterioration of the product quality and the stagnant growth of the team because sprint review and sprint retrospective might be improperly performed. In order to remedy this situation, team members scheduled their task not to spend the last day of the sprint for development in the next sprint (Sprint N + 1). As a result, team members could complete their development tasks on schedule and could properly perform sprint review and sprint retrospective.

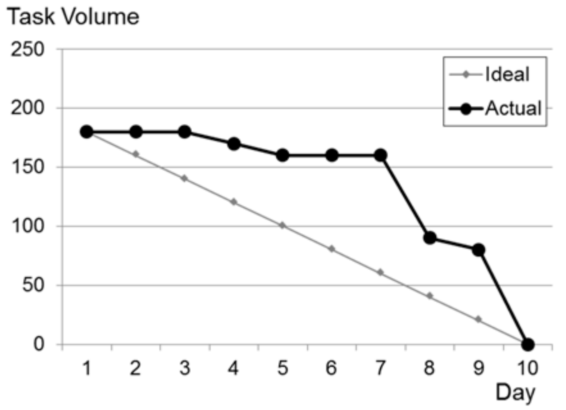

Figure 7 Burndown chat of Sprint N+1

A members of the PMO team who attended the sprint retrospective meeting of this sub-team shared this know-how to other sub-teams by writing a tip "Schedule the tasks not to spend the last day of each sprint for development work to properly perform sprint review and sprint retrospective." into the Sprint Planning process of the Methodology Wiki. As a result, it is expected that similar problems will not occur in this project from the next sprint. Additionally, in this project, the PMO team aims to accumulate one or more tips per sprint, and actively collects measures to improve the project management and execution. It is expected that useful tips will accumulate.

5. Conclusion

In this paper, we described the features of our new agile development methodology to enable the information system to quickly respond to changes in business needs. In addition, we proposed an approach to provide methodology contents as an editable wiki environment on the project management tool as a use situation for applying methodology to projects, and explained the advantage to other methods. We applied our approach to a project of our company, tracked the use situation to evaluate the validity of the method, and reported the results including example cases. As a result, we showed that our approach is useful for project information sharing and improvement of standard methodology. In this paper, the evaluation of the contribution to the project and the growth of the development team by applying our approach are limited to the consideration based on several examples. Our future works include evaluating our approach with quantitative metrics such as product release frequency and sprint velocity, and verifying the effect.

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A Study on the Risk Management by applying Text-Mining Technique

- The Risks concealed in the Conditions of Contract -

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Many Japanese companies in the construction sector remain cautious to invest as historically the GDP growth of the host Olympic country tends to fall sharply in the following financial year. Considering this financial background trend, it is unsurprising that many Japanese contractors are therefore looking to enter overseas construction markets. Japanese contractors have however not always succeeded on overseas projects and have historically faced significant contractual difficulties. In this paper, we evaluate the relationships between of each of the FIDIC conditions of contract by applying Text-Mining technique. By analysis of the resultant network, we then identify the key and most affective contractual clauses and propose possible strategies for risk management.

Key Words & Phrases : Text-Mining, FIDIC conditions of contract, International Projects, Risk Management

1. Introduction

Many Japanese companies in the construction sector remain cautious as historically the GDP growth of the host Olympic country tends to fall sharply in the following financial year (Figure 1); notable exceptions being Atlanta 1996 and London 2012. Following the financial crisis (so-called Lehman Shock) in 2008, there was a significant impact on international projects due to the availability of financing. The situation has now improved dramatically with the highest investment amount ever recorded in 2014 (Figure 2). Due to the post-Olympic Game's uncertainty (Ishimaru2013), we fear many local Japanese construction companies, may look to overseas projects post 2020.

Considering the financial background trend, it is unsurprising that many Japanese contractors are looking to enter the overseas construction markets.

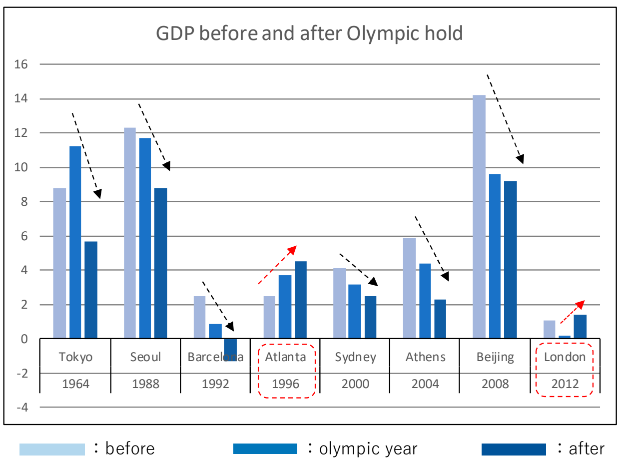

Figure 1 GDP Growth Trend of Olympic Game host countries

Although Japanese contractors have the most advanced construction techniques, such as ICT assisted machine control (recently known also as "i-Construction") & promoted by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), they have not always succeeded on overseas projects and have historically faced significant contractual difficulties.

Understanding the conditions of contracts on international projects is vital, and it is a failure in this regard through misreading and/or misunderstanding that, we believe, may have significantly impacted Japanese contractor's performance in the past.

2. Study Purpose

Japanese contractors have advanced construction capabilities that adopt so called "hard techniques",

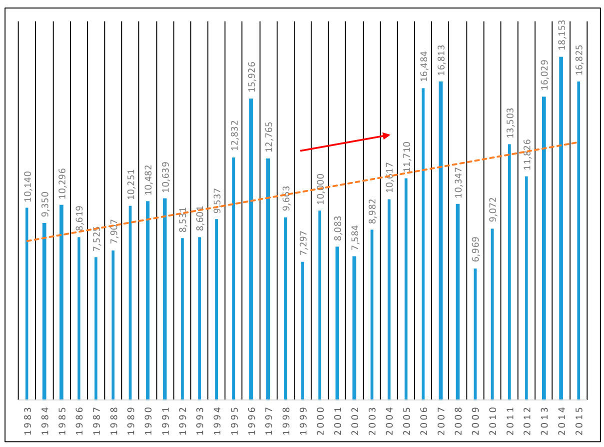

Figure 2 Trend of Awarded Projects Amount in Oversea

however on many overseas projects they have failed to deliver expected results. Some examples being the reported disputes resolution through arbitration on an over 50-billion-yen mega highway contract in North Africa in August 2016, and the contract terminated by the Employer (Drainage Service Department of Hong Kong Government) in 1997 which also went to arbitration.

In contrast to hard techniques, the use of soft skills involving strategic modern management philosophies and concepts are not widely adopted by Japanese construction companies. This approach may impact decision making processes and contribute to the failure to achieve goals and ultimately result in disputes.

In this paper, we evaluate the relationships between requirements of each of the FIDIC Red Book 1999, FIDIC MDB Harmonized Edition 2010, and FIDIC Silver Book 1999 conditions of contract, and the Standard General Conditions of Contact for Japan domestic use (thereafter; SGCC) by applying Text-Mining techniques to develop a conditions network to identify and extract concealed risk factors. By analysis of the resultant network, we then identify key contractual clauses and propose possible strategies for the site manager to minimize or avoid risks that may be encountered on an overseas project.

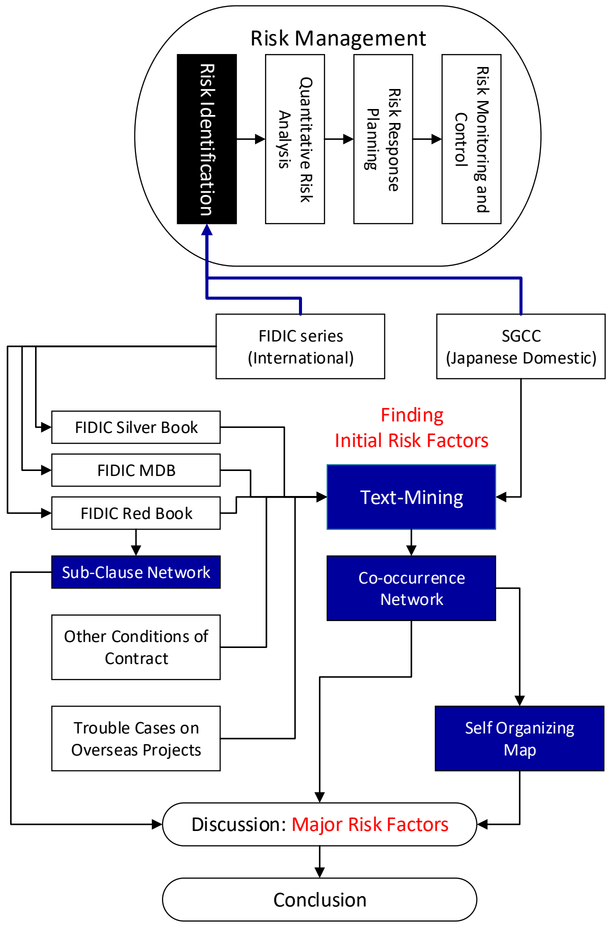

Figure 3 Study Flow

3. Study Flow and Methodology of Study

3.1 Study Flow

The first step of risk management is the identification of a potential event that may occur. Subsequent steps are the evaluation or quantitative analysis of the risk, determination mitigation measures or response planning, and ultimately implementation of controls and reviewing effectiveness through risk monitoring programmes.

In the past, Japanese contractors on overseas projects have experienced difficulties through misunderstanding or misinterpreting unfamiliar Conditions of Contract (thereafter; CoC); this in turn can lead to incorrect risk identification or even a total failure to foresee a significant risk. Resultant management strategies will likely then be flawed, or at best inconsistent with the performance desired, such that even small issues can soon build and accumulate with resultant negative impacts on the project performance.

The study flow we adopted of this paper is depicted in Figure 3 for easy understanding.

3.2 Text-Mining

Two analysis techniques are commonly used to examine mass data, namely; Data-Mining and Text-Mining.

Data-Mining is often used to analyze data collected from complicated social systems such as transportation networks, public facility use, shopping and convenience store usage, and other general habitual trends related to life and daily social activities. As citizens use social systems and networks, activity information is recorded and accumulated continuously. This data can provide valuable insights into social behavioral activities and preferences.

On the other hand, product feedback reaction such as for a music speaker adopting the most advanced AI (artificial intelligence) may be sought through a questionnaire survey. Direct "face value " interpretation of such feedback may not reveal the full picture or opinions, as results can be concealed by reviewers' prejudice to satisfy desired outcomes. Use of Text-Mining for such analysis has advantages in this regards and effectively removes the potential human interpretive element. Text-Mining is a technique to extract valuable information in the form of data from character strings, words and phrases to facilitate subsequent numerical analysis. The data that can be extracted through the evaluation of important texts includes: appearance frequency, correlation of appearance, appearance tendency, and time related appearance, and others. In our studies, this technique was applied to the text strings in the various Conditions of Contract clauses to determine occurrences and facilitate numerical review. To further evaluate criticality and importance, centrality indexes "Between-ness", and the "Eigenvector" were also applied.

3.3 Graph Theory

The paper written and published in 1736 by Leonhard Euler on the Seven Bridges of Konigsberg was the first to define Graph Theory and its use based on written historical records. Graph theory is the study of graphs, which are mathematical structures used to model pairwise relations between objects. A graph in this context is made up of vertices, nodes, or points, which are connected, by edges, arcs, or lines. A graph may be undirected, meaning that there is no distinction between the two vertices associated with each edge, or its edges may be directed from one vertex to another.

The calculation formulas adopted for this analysis are;

$$Between-ness(i) = \sum_{J=1,I=1}^{N} \frac{Gpaths_{j\to i\to k}}{Gpaths_{j\to k}}$$

Where:

$Gpaths_{j\to k}$ is all possible shortest steps from node j to node k; and $Gpaths_{j\to i\to k}$ is the shortest steps from node j to node k passing through node i.

The higher index of between-ness shows the higher bonding/connecting force between each linked node (text), which means those nodes exist as playing important roles.

For n dimension square matrix$A$, when the constant λ and vector $\vec{x}$ are existing and the formula $A\vec{x} = \lambda\vec{x}$ ($\vec{x} \neq \vec{o}$) consists, then λ is the eigenvalue of matrix$A$ and $\vec{x}$ is the eigenvector belonging to λ.

The eigenvector shows where there is high degree indexed nodes (text) just next to themselves. Determined high eigenvector nodes therefore always represent important or key situations.

The effect of text and data mining techniques are different, where: a data mining technique is usually adopted to find the users' aspiration/characteristic, whereas the understanding of providers' conditions are determined through Text-Mining.

In this paper, we intend to provide project managers with some insight into key contract provisions not encountered in Japan to facilitate proper contractual process management when they are working on overseas projects. Therefore, the Text-Mining technique adopted is applied to understand the differences of contractual comprehension between the FIDIC series and Japanese domestic conditions of contract. By applying Text-Mining techniques and Graph theory to develop a conditions network and analysis of the resultant network, we can identify the key and most affective contractual clauses (Higuchi2014) so as to propose possible strategies for contract management and ideas for dispute resolution.

Text-Mining techniques are normally applied to character strings to extract key words, which govern the circumstances/environment within a business process (Nomura2016), (Suzuki2016a), (Suzuki2016b). In our research, we adopted a Text-Mining computer software called "KH Coder" developed by Prof. Koichi Higuchi; the resultant calculated figures are relatively compared using five colour categories, namely: pink (highest), light pink, white, light blue, blue (lowest). In our analysis, we have not only considered the text in the Conditions of Contract of FIDIC series, but also, we have reviewed the relationship network of all sub-clauses using graph theory.

4. Analysis Results

4.1 Analysis of Co-occurrence Network

FIDIC is commonly adopted world-wide as the CoC for international construction projects, and offers seven different formats depending on the type of contract. For example, Red Book (book cover is red) is for contracts designed by the client and constructed by contractor; the Silver Book is for a Turn Key contract where design and construction of the project is done by the contractor until handover to the client. For comparison purpose, our analysis included: (a) FIDIC Red Book 1999, (b) FIDIC MDB Pink Book 2000, (c) FIDIC Silver Book 1999, (d) Japanese SGCC, and some other organizations' documents.

Figure 4-9 shows the Between-ness and Eigenvector of the FIDIC series. The Eigenvector of the

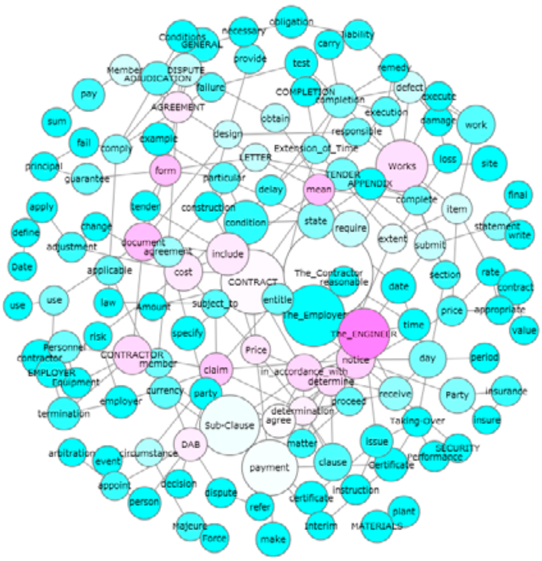

Figure 4 Between-ness of FIDIC Red Book

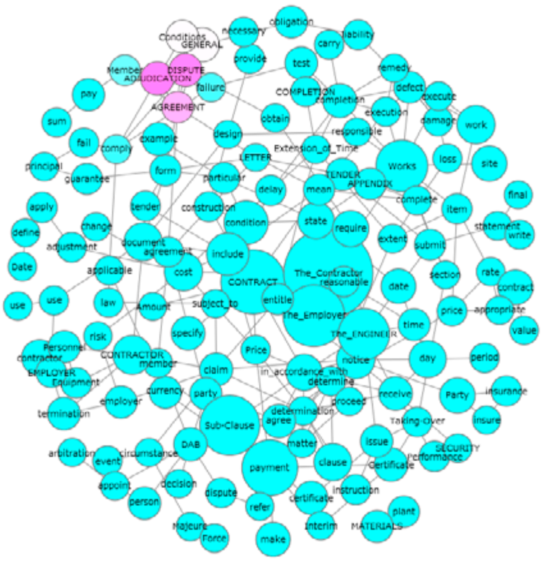

Figure 7 Eigenvector of FIDIC Red Book

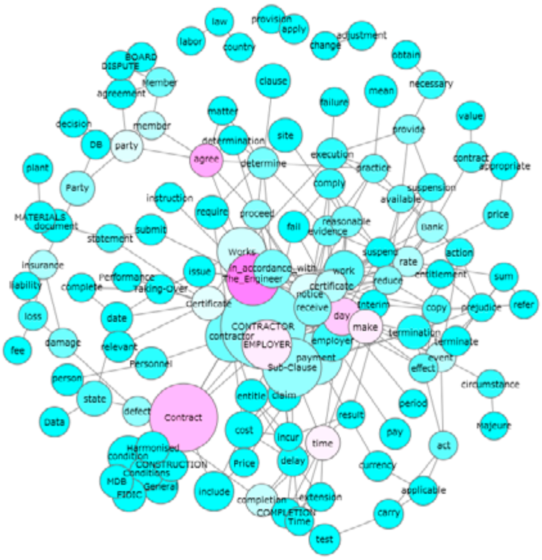

Figure 5 Between-ness of FIDIC MDB

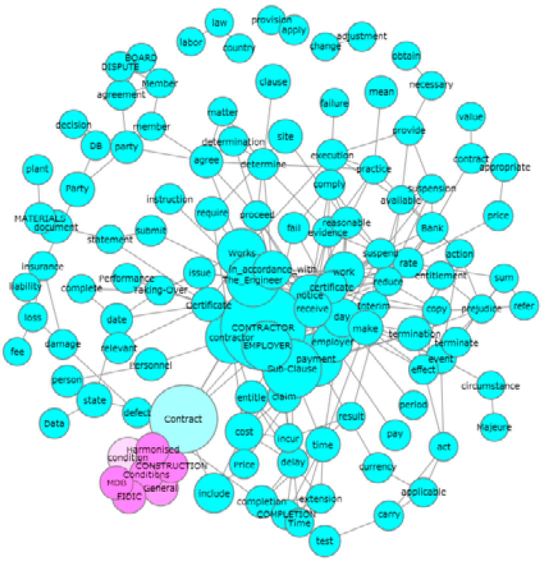

Figure 8 Eigenvector of FIDIC MDB

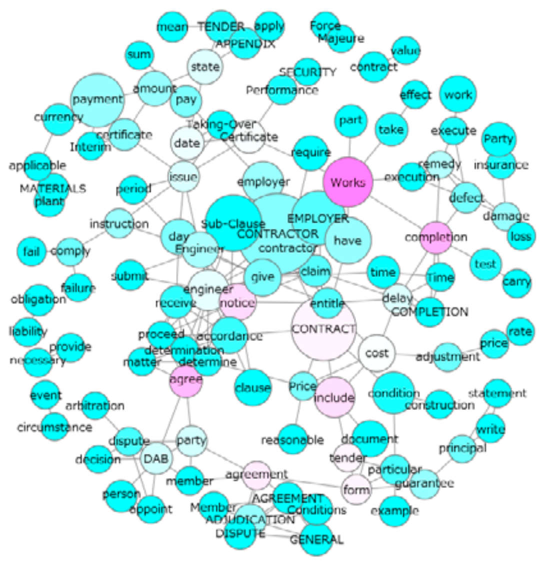

Figure 6 Between-ness of FIDIC Silver Book

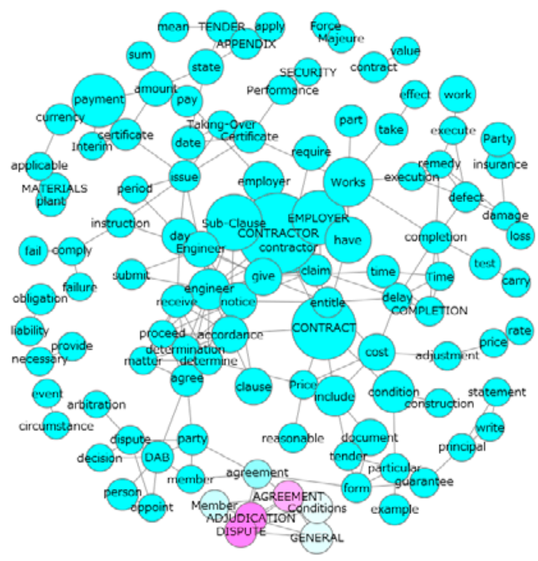

Figure 9 Eigenvector of FIDIC Silver Book

Red Book and Silver Book show similar key words, such as DISPUTE, ADJUDICATION, and AGREEMENT play an important role.

The Eigenvector of FIDIC MDB (which is a modified Red Book), is slightly different due to a bias towards a financing point of view to satisfy Banks, such as the Asia Development Bank and others. Therefore, it is easy for us to understand the differences between the Red/Silver Books and MDB is due to bank financing, although the basic concepts are the same.

Figure 10-11 shows the Between-ness and Eigenvector of SGCC respectively. The Between-ness shows FIDIC and SGCC have very similar texts, such as CONTRACT, WORK, CONTRACTOR, which are clearly important. Differences between the FIDIC series and SGCC however become apparent from the texts extracted by Eigenvector. Here, FIDIC key texts of DISPUTE, ADJUDICATION, and AGREEMENT play an important contract role, whilst SGCC key texts are biased more towards client cost control relating to BUDGET, YIELD & FINANCIAL. This is reflective of The Accountants Law of Japan, which has been controlling the annual government budget on a yearly basis. Large size contracts however will of course span several fiscal years.

In Japan, there are also many contract styles (design-build, design or building only), however unlike FIDIC there is just one form of CoC which has been used for construction contracts since 1950. The initial SGCC was drafted based on overseas contract conditions prevailing at the time, and although some revisions have been made to suit Japanese business practices it has remained relatively unchanged and thus remains similar in style and constitution.

The SGCC therefore has similar key texts like DISPUTE and ADJUDICATION (Clause 52 and 53), however the time limits for the registering claims are not specified. This reflects the Japanese culture and expectations whereby on domestic projects the clients and contractors do not expect to resort to court cases for dispute resolution. As Japanese contractors are accustomed to the SGCC and its associated contract administration procedures/processes, they naturally can face difficulties and challenges when working in the international environment.

4.2 Self-Organizing Map of CoC

In the next stage in our study we segmented similar texts by mass and grouped them for better understanding into a self-organizing map as shown in

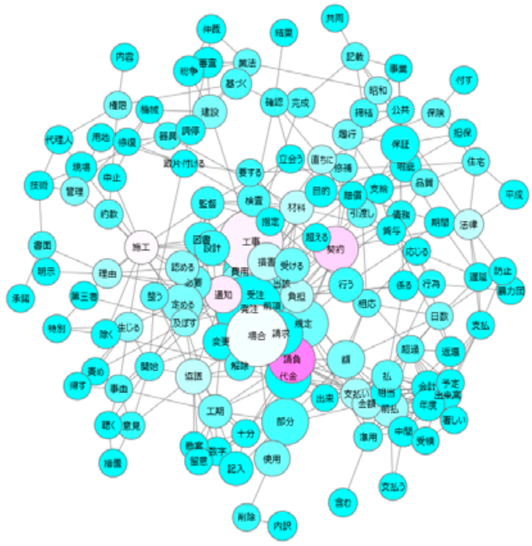

Figure 10 Between-ness of SGCC (Japan)

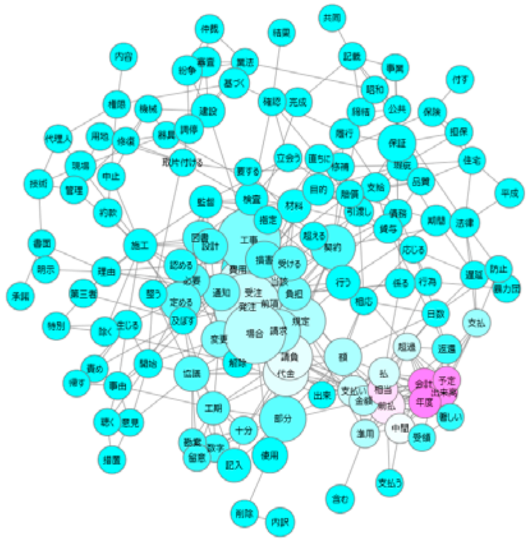

Figure 11 Eigenvector of SGCC (Japan)

Figures 12 to 15. The mass of each text is distributed using Euclidean distances based on the strength of the relation.

When project managers of Japanese contractors manage projects, they will typically rely on their experiences gained on domestic contracts. However, where they are required to manage overseas projects, benefit can also be gained from understanding key contract terminology as also highlighted in Figures 12-14.In particular, key words to note within the self-organizing map of FIDIC conditions are "DAB" "DISPUTE and ADJUDICATION", "Certificate and Performance", "COMPLETION" and "Engineer". It can be noted within the SGCC map that key words associated with payment appear generally on the left side of Figure 15 (blue boxes), whilst those related to Dispute and Adjudication are scattered in other areas,

Figure 12 Self Organizing Map of FIDIC Red Book

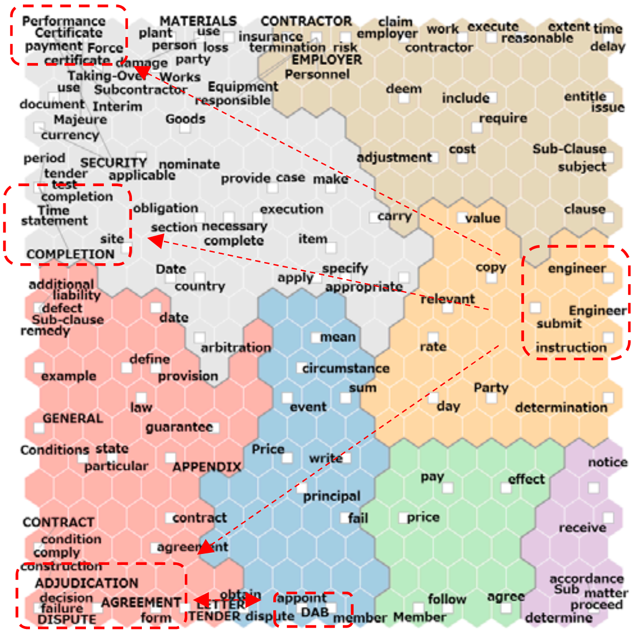

Figure 14 Self Organizing Map of FIDIC Silver Book

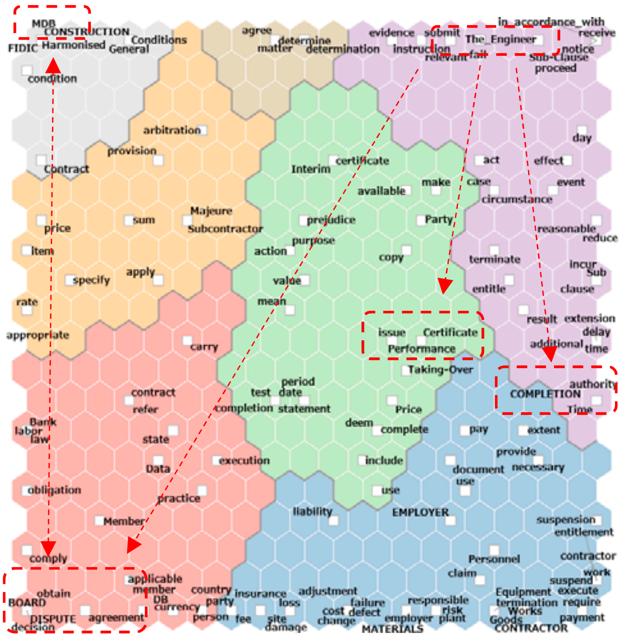

Figure 13 Self Organizing Map of FIDIC MDB

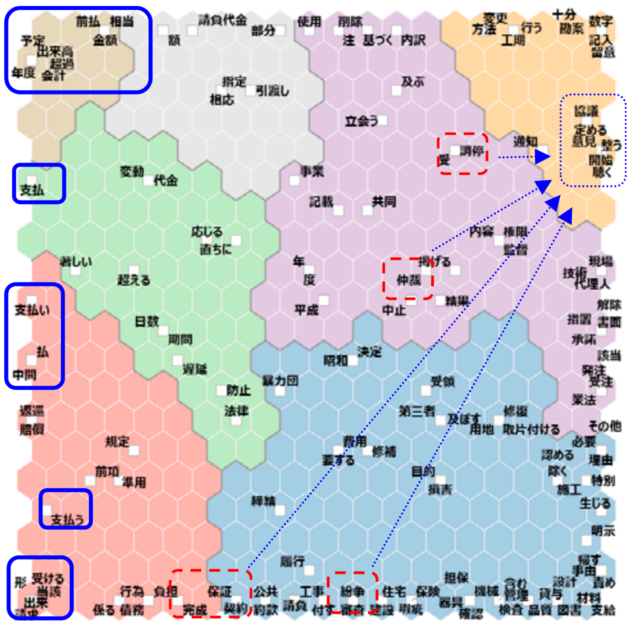

Figure 15 Self Organizing Map of SGCC

side of Figure 15 (blue boxes), whilst those related to Dispute and Adjudication are scattered in other areas, and no equivalent word to "Engineer" is apparent.

Hence, within the FIDIC maps, the Contractual relationship and/or process flow is from "Engineer" to the other key words, such as "COMPLETION", "DISPUTE", "ADJUDICATION", and "Certificate".

It is also noted that as the constitution of SGCC is not related to the contractual processes, the resolving of disputes utilizes negotiation/discussion as shown in the right upper side on Figure 15.

4.3 Network Analysis of FIDIC Red Book Sub-Clause Relationship

The study described in 4.1 to 4.2 evaluates the relationships of each key text within the context of the main Clauses in the CoC. In this section, we focus on the relationships at each sub-clause / sub-sub-clause level.

Based on the FIDIC Quick Reference Guide Red Book (Barr2015), we constructed the sub-clause network model shown in Figures 16 and 17 to analyze relationship concepts. These show the between-ness and the eigenvector calculated respectively, with the s .

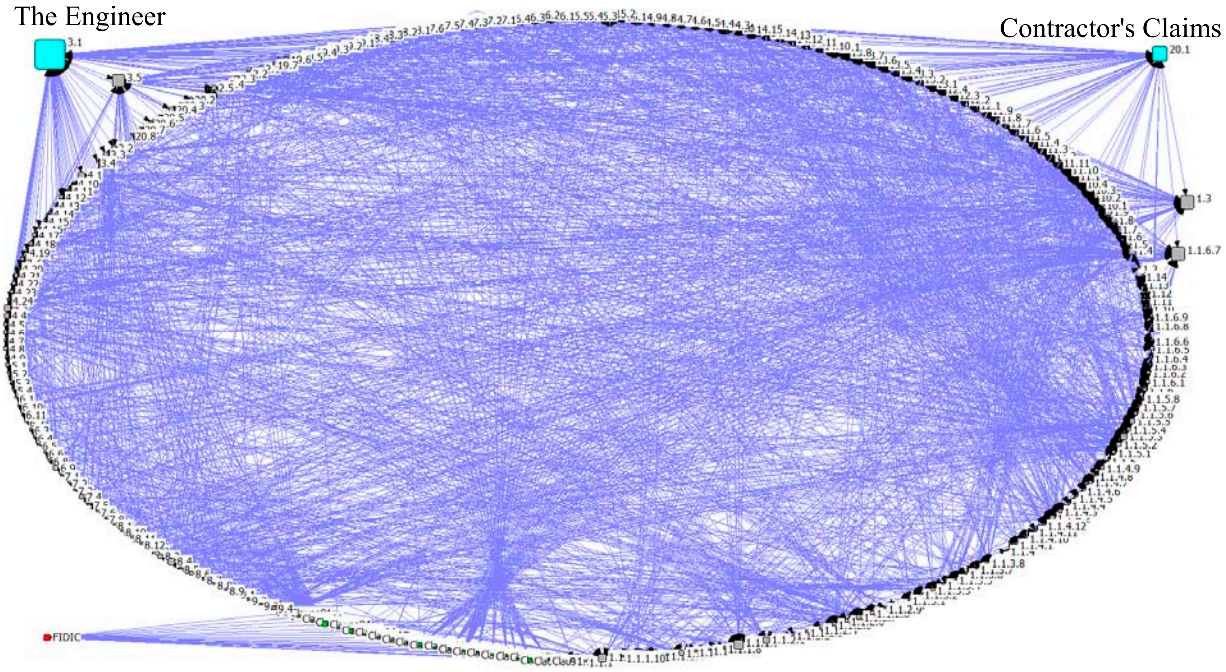

Figure 16 Relationship Network of All Sub-Clauses of FIDIC Red Book (Between-ness)

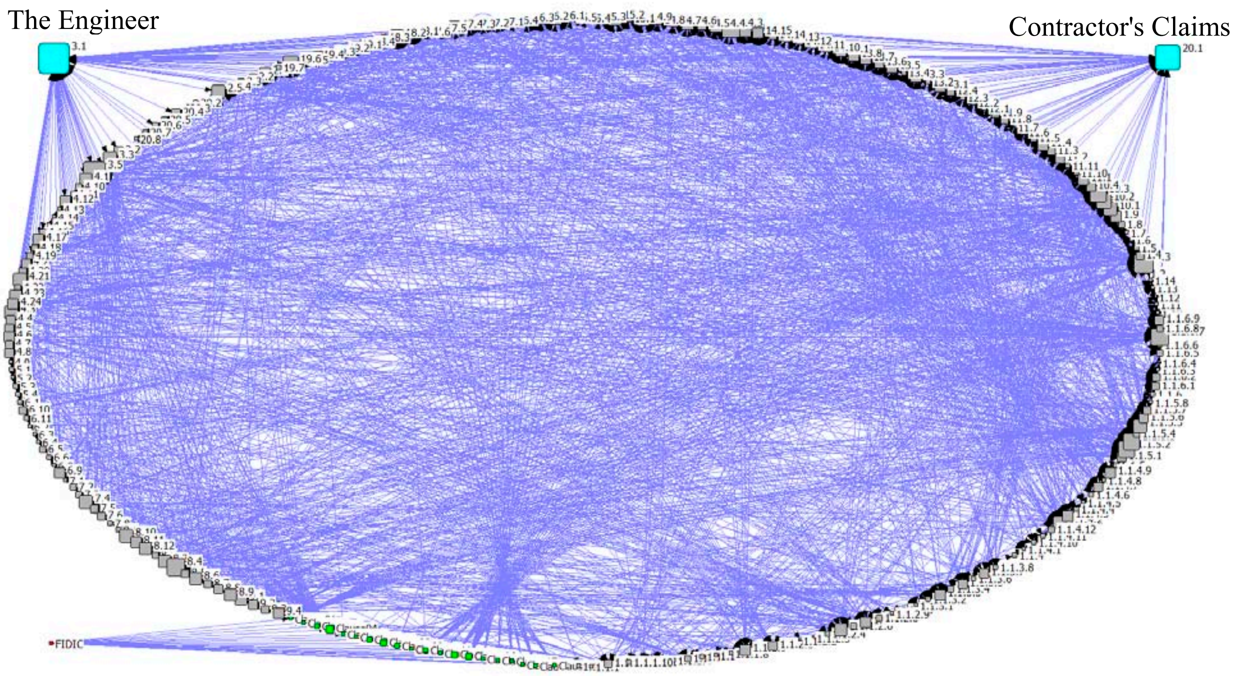

Figure 17 Relationship Network of All Sub-Clauses of FIDIC Red Book (Eigenvector)

size of each node being indicated relatively. The largest node is Clause 3.1 "the Engineer" as shown at the upper-left corner, with the second largest being Clause 20.1 "Contractor's Claims" in the upper-right of both Figures.

In addition, we calculated the between-ness centrality for the same model with results similar to those given by the eigenvector, whereby nodes related to Clauses 3.1 and 20.1 were also dominant.

Based on these findings, it is clear to understand that Clause 3.1 "the Engineer", and Clause 20.1 "Contractor's Claim" play an important role in Contract management for construction projects using FIDIC. It follows therefore that these elements are also key factors for basic risk control.

5. Discussion

5.1 Sub-Clause Relationship

We show in Figure 18 a contractual administration process based on the sub-clause relationship when the Engineer requires to issue a variation order to Contractor. The Engineer has a power delegated from the Employer enabling him to issue variations to the original scope of Contract if/where necessary, though he is not able to change the contract itself. The Engineer has a power delegated from the Employer enabling him to issue variations to the original scope of Contract if/where necessary, though he is not able to change the contract itself. He also has the powers to recommend the termination of the contract to the Employer where he determines this to be a necessary course of action.

There are principally two lines within the contractual administration process relating to "Time" and "Cost" respectively due to the variation. Disputes related "Cost" would not affect contract termination, whereas "Time" disputes on the other hand may result in Contract closure in a worst-case scenario. As disputes and disagreements are normal and generally expected within the life of construction projects, FIDIC Red Book Clause 20 specifically sets out the procedure and contractual processes to be followed for solution/resolution.

From the Text Mining analysis presented in Figures 10 and 11, the conditions related to dispute, adjudication and arbitration do not play important roles in the contract. It is very clear why these conditions are downplayed in Japan, which is also supported by the number of court cases per year (typically around ten cases for every ten thousand contracts tendered out).

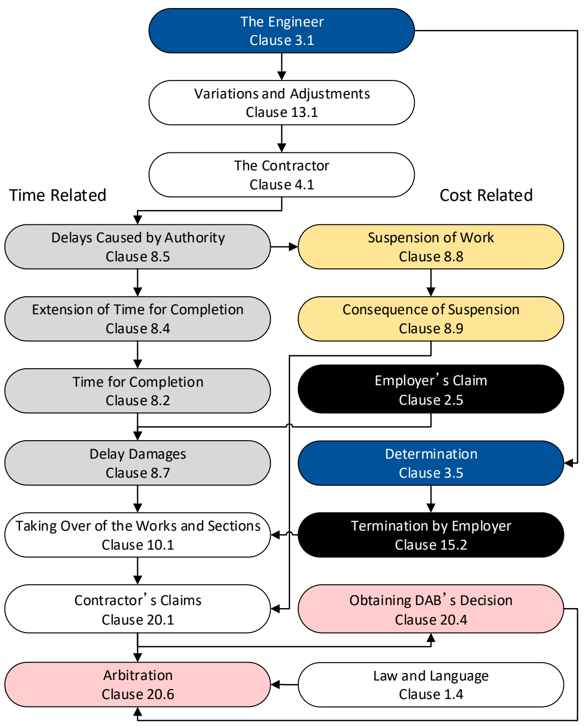

Figure 18 An Example of Sub-Clause Relationship

Although local construction projects issue more or less variations orders to accommodate changes required, most of these are resolved through negotiation and/or discussion with the Client, which is reflected in Figure 15. As long as Japanese contract managers are accustomed the domestic contract management process, they are likely to experience difficulty in understanding and complying with international contract requirements and conditions.

5.2 The other Conditions of Contracts

Furthermore, we have applied the text-mining technique to conditions of contract adopted in other countries/organizations', such as that used by the USA and United Nations for comparison purpose.

It shows that the constitution of these forms of contract are different, though it does not also follow that the risk-associated factors are also different. Figures 19 and 20 show the eigenvector of USA's (EJCDC. 1996) and United Nation's (UNDP2000) respectively.

Figure 19 Eigenvector of USA CoC

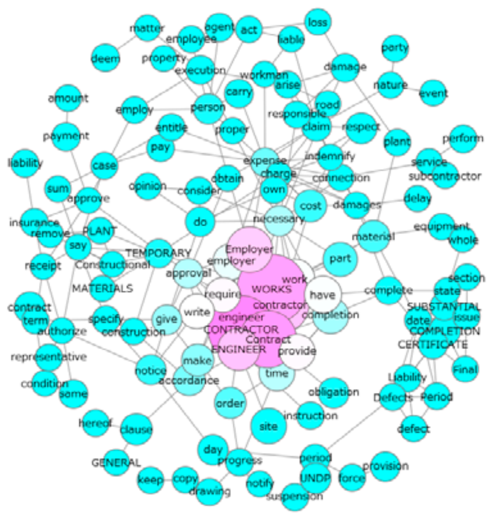

Figure 20 Eigenvector of United Nation CoC

Figure 19 shows that "damage", "loss", "change" and "dispute" seem to play a key role in contract administration.

Figure 20 shows that "CONTRACTOR", "contract" and "engineer" are key functions.

Many types/kinds of construction contract are adopted by Employers worldwide. In many cases the core requirements may follow the FIDIC framework with specific modifications and adaptions to suit local needs, and the requirements of the contracting party concerned. The importance for managing risk is inherent in the relationship between sub-clauses and the Contract time limits specified for each stage; so, it is important to understand Contractual flows like that depicted in Figure 10 from the very beginning of a project.

5.3 Sub-Clause Relationship

Furthermore, the text-mining technique has also been applied to the documents released by Ministry of Land, Infrastructure, Transport and Tourism (MLIT) for cases where Japanese contractors faced difficulties on overseas projects (MLIT2013a) to identify major risk actually encountered.

The MLIT database has many records of cases where Japanese contractors have faced problems on overseas project. Many of the reports if read purely at "face value" are easy to understand, however due to the nature of such reports key reasons may be concealed or hidden within the text. From Text-Ming we are able to determine that (see Figure 20) "construction period", "extension" and "liquidated damage" are key risk factors encountered.

The "initial" risk factors identified relate the differences in constitution of each CoC based on the analysis of co-occurrence networks, self-organizing maps and the sub-clause network. This in contrast to the "actual" risk factors as determined from the comments of overseas projects experienced managers that relate to time management as shown in Figure 21.

5.4 Applying FIDIC

In Japan, the SGCC is the only form of CoC adopted regardless of the type or style of construction contract.

As a result of this it was commonly assumed that Japanese contractors faced contractual challenges overseas due to their lack of familiarization and understanding of FIDIC or other CoC's adopted.

With this understanding and background in mind, MLIT has carried out a trial utilizing the FIDIC Red Book for two years on a road construction project since 2012 (MLIT2012).

However, the contract administration staff and project organization established remained typical of that adopted for local projects and no further trials have been undertaken since the project's completion in 2014. It would seem therefore that the benefits of adopting FIDIC in the local market are inconclusive, although improvements in knowledge of the contractor and client's administrative staff would have been gained. MLIT also noted that the DAB (Dispute Adjudication Board) specified in FIDIC had been utilized on overseas projects and recommended this arrangement for minimizing risk exposure (MLIT2013b). MLIT further noted that where a DAB is specified in the CoC, it should be under the contract administrator's control.

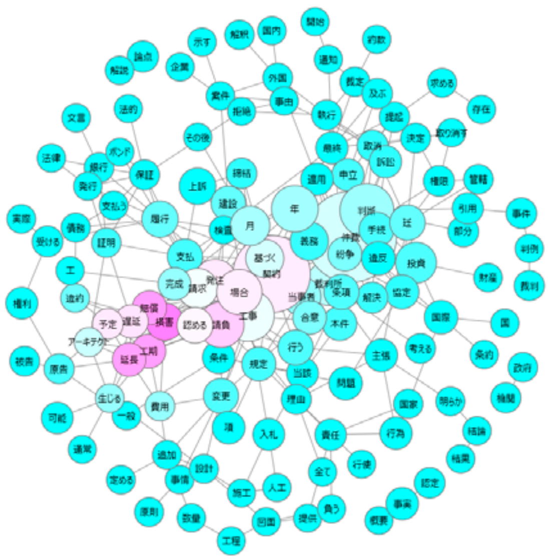

Figure 21 Trouble Cases on Overseas Projects (Eigenvector)

6. Conclusions

There are many kinds of Conditions of Contract specified for construction of projects overseas. Japanese contractors are innovative, creative and are keen to use advanced ICT (information and communication technology) to produce complicated structures under difficult circumstances. Even with the detailed experience and know how, Japanese contractors have faced difficulties in delivering overseas projects in line with expectations. There is always un-certainty for construction businesses in both the domestic and overseas markets, however the SGCC typically used in Japan is incomplete (or at least falls short) in specifying arrangements to deal with unexpected risks/problems encountered during the project.

As a result of this study, we understand that the fundamental concept and principles encapsulated within FIDIC are clearly different. The construction business is complicated with many interactions that must be mastered to be successful which require not only an understanding of concept, but also the circumstances, surroundings and environments that prevail. Contractual risks can be minimized or at least reduced. From our study and analysis it is clear having a good understanding of the processes and relationships associated with Clauses 3.1 & 20.1 ("The Engineer" and "Contractor's Claim") is a fundamental starting point on FIDIC. At the end of each overseas contract, the provision of lessons-learned to establish and develop a data-base open to all stakeholders and interested parties may be of great value.

It is also the un-certainty that un-expected risks evolve and develop larger impacts that seriously challenge contractual management. Japanese contractual procedures do not facilitate for contractors to include the cost for risk preparation within their pricing. Consequently, as long as the actual costs resulting from problems faced can be justified they will only be fairly compensated through negotiation with the Employer. It is very rare for Japanese contractors to quarrel with the Employer in the court, because there is a Clause 18 Mutual Trust in the Construction Act.

As a result of this study, it is highly recommended that Japanese contractors should not only understand the differences between the constitution of the Contract, but also the process of Contract administration under each organization. Possible complications on overseas projects can be un-foreseen by Japanese contractors. This is further complicated where FIDIC (or other reference forms of contract) conditions are carefully reviewed and adapted from contract to contract to address lessons learnt and particular client needs. Japanese contractors bidding for overseas works should establish early on a strategic risk identification team. Such team should not only be engineering based, but include a broad spectrum of knowledge to also encompass financial and economic considerations. This should ensure a comprehensive understanding of requirements and their implications such that contract/client expectations are known and can be achieved.

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The Effective Approach to Utilize Experts at the Initial Evaluation

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For most system development projects, it is important to prevent project delivery delays and cost increases resulting from low initial estimations or inadequate project management. An evaluation of the initial planning at order can achieve results to prevent such issues. Appropriate involvement of an expert further increases the effectiveness of the evaluation. However, there are not many experts who can conduct effective evaluation on such projects. Furthermore, the employment of an expert as a full-time evaluator is difficult because of the additional expense to the organization and adverse effects on other business opportunities. In this paper, I extract and introduce essential factors in evaluating initial planning at order through the participation of in-house experts by referring to actual cases of such evaluations conducted at our company in terms of the participation of experts. In particular, I focus on the preparation for assigning an expert as an evaluator in each case and the important points to increase the evaluator's awareness for the purpose of improving the evaluation quality. I hope the information in this paper will help contribute to the raising of the evaluators' motivation and the attainment of maximum effects from the evaluation within a limited time frame toward the prevention of increases in system development project costs.

Keywords and Phrases: Initial Planning at Order, Third-party Evaluation, Prevention of Cost Increases, Participation of Experts, Improvement of Evaluation Quality

1. Introduction

System development projects are required to complete a system by the delivery date and provide it to the customer under a service contract. Therefore, it is important to prevent project delivery delays and cost increases resulting from low initial estimations, inadequate project management in its development phase, and issues of development regimes.

An evaluation of initial planning at order can achieve results to prevent such issues. However, these need to be considered in order, to obtain the desired results when building such mechanisms. Such considerations would include, for example, taking into account viewpoints for evaluation, methods to select eligible projects, and designing evaluation forms; the selection of evaluators is considered to be a particularly important factor. Significant effects of the evaluation could be obtained by employing highly-skilled experts, who determine the adequacy of initial planning (results of cost estimates, sufficiency of projected risks and the countermeasures, etc.) and provide effective corrective instructions for insufficiencies based on unique characteristics of the projects.

Our Department introduced an “Evaluation of the Initial Planning at Order” in FY2016, and the number of unprofitable projects has decreased dramatically. In this paper, mechanisms of the evaluation of initial planning will be introduced, and then essential factors for the employment of experts observed in the actual evaluations will be discussed.

2. Check Initial Planning with the Standard Checklist

We check initial planning at order by using the checklist standardized across the company since before the introduction of the “Evaluation of Initial Planning at Order.” The evaluations have been conducted by full-time evaluators, who have suggested necessary action plans based on the check results and monitored the processes. (Yamamoto,2002)

2.1 Issues on Check with Standard Checklist

The standard checklist used across the company includes matters that are required to be implemented as the standard process, risk factors, as well as project-common matters having particularly significant impacts on their quality, cost, and schedule based on our experiences as an organization. As a result, the checklist enables us to evaluate all projects comprehensively and an effective check at a certain level has been implemented in past system development projects.

However, with the impacts of rapid advancement of IT technology, a dramatic change of the business environment, and globalization, various changes have started to appear in the risks of system development projects. Consequently, there have been situations in which all the risks cannot be identified with the traditional mechanisms, such as projects having risks that cannot be detected with the traditional checklist or cases in which specific risk factors have remarkable impacts. In some cases, the identification of risks has not always led to the instruction of effective and sufficient actions.

Moreover, longtime operation of this system has caused its formalization, thus leading to the appearance of failures and delays in risk detection or loss of effectiveness of countermeasures. As a result, this has led to the emergence of projects with large increases in costs or delivery delays, and thus the elimination of unprofitable projects has never been completely achieved. The major issues in using the standard checklist are as follows:

(1) Expansion of Technical Risks due to Changes in Development Technique

Adoption of unproven technical factors (migration development, automation development, etc.) causes unexpected risks and risk impacts.

(2) Emergence of New Risks due to Changes in Development Methods

Lack of knowledge on new development methods (agile development, ecosystem development, growth hack, etc.) results in inadequate extraction of risk items and actions against them.

(3) Changes of New Risks due to Environmental Change

Traditional project management or risk hedge methods have become functionally poor due to major changes in customers' business environment and globalization.

(4) Formalization and Losing Substance of Check due to Longtime Operation

- Evaluation of check items has become formalized, which prevents in depth investigation of risks in accordance with the projects.
- Action directives against problems identified have lost substance, and therefore actions appropriate for each project are not considered.
- The response by projects receiving action directives has been formalized and no countermeasures have been taken to achieve an effective level of hedge risks.

(5) Specialization of Evaluators

Over compliance with the standard checklist results in poor check of the projects as a whole.

2.2 Considering Characteristics Unique to Projects

Considering the above-mentioned issues, the types and impacts of risks, methods and timing to respond, and needs for in depth investigation vary depending on the characteristics or business environment unique to the projects. If impacts caused by characteristics unique to projects are large, it is difficult to adequately detect risks with the standard checklist. In some situations, the effects expected from usage of the list cannot be acquired unless evaluation of the initial planning at order is customized so that in depth investigation of risks is enabled.

Countermeasures to the above include individual customization of the standard checklist, or development of a variety of lists by classifying projects based on certain criteria. This time, however, we regard them as urgent issues and for the purpose of continuous response to rapid environment change, we discussed the system of evaluating initial planning at order based on the idea that evaluations through the participation of experts would be effective.

2.3 Issues on Employing Experts

When conducting evaluations through the participation of experts, it is necessary to employ them and to develop an effective involvement framework. However, there are few highly-skilled resources even in a company that is able to determine the adequacy of initial planning (results of cost estimates, sufficiency of projected risks and the countermeasures, etc.) based on the characteristics unique to the projects and give effective corrective instructions. In addition, it is generally difficult to employ such highly-skilled experts as full-time evaluators because this would result in an increase in the burdens of evaluation cost and major impacts on other business opportunities in a broad sense. Moreover, the more highly-skilled they are, the more tasks they have, and therefore they only have a limited time available for evaluation.

3. Organizing Evaluators' Selection Methods and Evaluation Methods

On examination of the system for evaluation of the initial planning at order, the selection of evaluators and evaluation methods, which are considered to be the key, have been organized based on past actual examples. Thus, the logic for the introduction of evaluations through the participation of experts will be described.

3.1 Methods for Evaluator Selection

Although there are certain methods used for evaluator selection, it is necessary to use different methods depending on the status of the organization at the time and the will of the sponsors after considering the advantages and disadvantages of each. When conducting evaluations, in particular, the keys would be the employment of experts and flexible response at the launch of projects.

(1) Full-time Evaluator: Employ evaluators working full-time

<Advantages>

- Enables planned training and motivation enhancement of evaluators.
- Enables flexible response at the launch of projects.
- Facilitates continuous improvement of the evaluation methods.
- Easy to enhance the motivation of evaluators.

<Disadvantages>

- Difficult to investigate evaluation points in depth unless experts are employed.
- Some projects might suffer from a lack of know-how due to their characteristics or details.
- Risks of formalization and losing substance.
- High evaluation cost, especially in the case of employing experts.

(2) Part-time Evaluator: Evaluators working on other tasks conduct evaluation at project launch

(Evaluators hold appointments across multiple tasks.)

<Advantages>

- Enables the employment of evaluators who can respond flexibly to some extent.
- In depth investigation of evaluation points can be achieved if it is related to their current job.
- Costs required for evaluation are limited.

<Disadvantages>

- Arrangement or adjustments of priorities across tasks is necessary.
- Some projects might suffer from a lack of know-how due to their characteristics or details.
- Risks of formalization and losing substance.

(3) Ad hoc assignment: Select evaluators for assignment at project launch

<Advantages>

- Enables the assignment of highly-skilled experts appropriate for projects.
- Enables in depth investigation of project issues according to their characteristics.
- Available at lower costs.

<Disadvantages>

- Evaluation quality varies among evaluators.
- Selection of evaluators and arrangements are necessary for assignment.
- Mechanisms to enhance the motivation of evaluators are required.

3.2 Types of Evaluation Methods

The main evaluation methods involve implementation methods for the system audit and the evaluation methods for software development, etc. In the operation, the method type that should be used needs to be determined by considering the relationship with the evaluators' selection as well, and the combination of multiple evaluation methods also needs to be taken into account to increase its effectiveness.

Evaluation methods and cases which could have positive effects are shown in Figure 1.

(1) Inspection by the Standard Checklist

Conduct a comprehensive check by using the standardized checklist across the company.

Promoting compliance with the standard process has significant impacts when the maturity level of an organization or a project is low and there is less variety in the business models.

(2) Development of the Standard Checklist for Each Organization or Business Model

Conduct a check by using the checklist which is customized according to the characteristics of organizations or business models.

It enables a check to be conducted in accordance with the characteristics of organizations.

On the other hand, an increase in the checklist types creates an additional burden on maintenance.

(3) Customization of the Standard Checklist by a Project

Customize the standard checklist by a project to be evaluated for use.

It creates the burden of customizing the checklist for every evaluation.

(4) Evaluation by Experts

The experts conduct evaluations in accordance with the characteristics of the project based on the expertise. The evaluation is performed through interviews or with questions and answers on comment sheets.

Other tools including the standard checklist can be used as supplementary material.

In depth investigation into risks unique to the project can be performed when the maturity level of an organization is high, or there is a variety of business models.

No	Evaluation method	Cases that could have positive effects	
		Maturity level of the organization	Varieties in business models
1	Standard Checklist	Low	Few
2	Checklist by Organization		
3	Checklist Customized by Project		
4	Experts Evaluation	High	Many

Figure 1 Evaluation Methods and their Characteristics

3.3 Evaluator Selection and Evaluation Method

The effects of evaluations can be increased by setting appropriate evaluation methods in accordance with how to select evaluators. In addition, it is considered that it would be effective to choose which selection methods or evaluation methods to adopt based on the maturity level of the organizations/projects or variations of business models possessed by the organization. Figure 2 shows the relationship between evaluator selection and evaluation methods observed from past cases.

When the maturity level of the organization or the project is high, or there is a variety of business models available, prompting an in depth consideration of the situations of the project, it is possible to conduct evaluations in accordance with the characteristics of the project by an expert evaluation conducted by highly-skilled and full-time evaluators, which is considered to produce the highest effects.

In the case that full-time evaluators cannot be employed, if the ad hoc assigned evaluator is an appropriate expert who is given sufficient motivation, similarly, high effects of the evaluation could be achieved. With this introduction of evaluation of initial planning at order, we have adopted the ad hoc assignment method based on the difficulties involved in employing experts as the full-time evaluators.

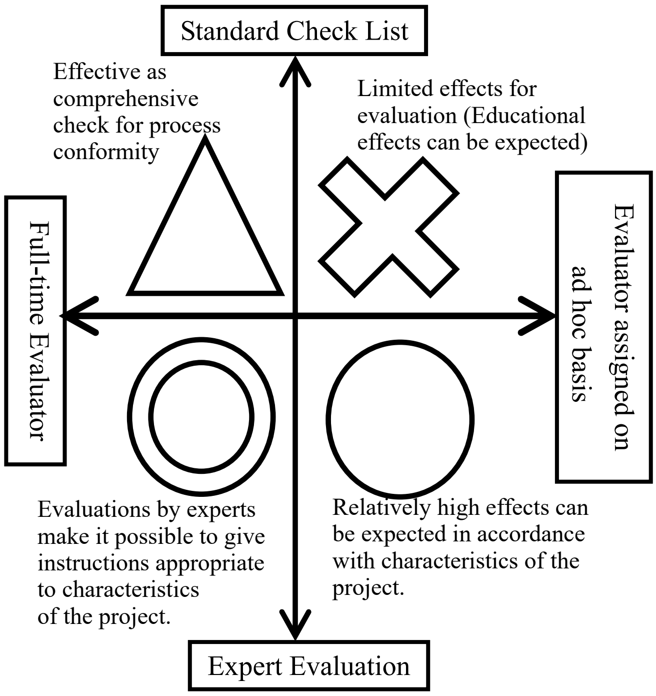

Figure 2 Relationship between Evaluator Selection and Evaluation Method

On the other hand, when the maturity level of the organization/project is low or the characteristics of the project do not need to be taken into consideration, evaluations by the inspection method using the standard checklist would be effective. A formalized evaluation by full-time evaluators enables improvement of comprehensive conformity to the processes, etc. at a certain level.

4. Evaluations of Initial Planning at Order through the Participation of Experts

Based on the issues or situations discussed above, we decided to introduce an evaluation of initial planning at order through the participation of experts as evaluators in each case after designing the evaluation system encompassing evaluation costs, the evaluation quality, restraining effects, and effective corrective instructions. The details of the system are outlined in the following.

4.1 Clarify Purposes and Functions of Evaluations

We require that the evaluation must be conducted before the submission of estimates to the clients to prevent the occurrence of cost increase and delivery delays of the project, etc. This is to evaluate the adequacy of initial planning at order, and to give instructions to correct the planned matters which could cause future loss in the case that initial planning at order is not appropriate. In evaluations, no business decisions including the adequacy of the asking price to customers, etc. are made, but if no corrective action is taken after an initial planning at order is determined as inappropriate in evaluation, functions to prevent internal approval procedures are put in place.

4.2 Assign Evaluators

Evaluators are assigned every time a project is launched to form the evaluation system in which the project characteristics are taken into account.

For the evaluation leader, the head of other organizations that have no interests or qualified in-house person from the executive class is assigned to improve the evaluation quality. Experts in these classes have a strong presence and influence. Therefore, the project side also receives their comments seriously and practical effects can be demonstrated on the implementation of corrective actions.

On selecting evaluators including the evaluation leader, various factors are considered such as their areas of specialty (e.g. business fields, areas of methods, MF System, CSS System, Web System, etc.), experience in similar systems or customers. In addition, independent evaluations and restraining effects are achieved by selecting evaluators who have no direct or indirect relationship with the project. The candidates for the evaluators are given sufficient explanations and a request for cooperation in advance. This gives us sufficient time to make the necessary arrangements including the evaluation schedule, and enables ad hoc assignment.

Matters to be considered in the assignment of evaluators will be described in detail in the next chapter.

4.3 Evaluation Method

Our evaluation method is a combination of the following four methods, and the fundamental point is a face-to-face evaluation.

(1) Document Evaluation (Document Peer Evaluation)

The subject documents are evaluated by evaluators independently. The results of evaluations are filled in the comment sheets as questions and answers to the project.

(2) Check by Professional Organization

A third-party check is conducted by an impartial professional organization when it is considered to be effective based on the characteristics of the project. (Examples of details to be checked: methodological technology, AP Platform, estimating processes, etc.)

(3) Face-to-Face Evaluation

Based on the results of document evaluation and check by professional organizations, all evaluators are gathered together to hold a face-to-face evaluation. The adequacy of the initial planning at order, countermeasures against risks, and the response plan are confirmed through questions and answers based on the explanation given by the project.

(4) Additional Post-Evaluation Check

Matters which have not been confirmed at the face-to-face evaluation are followed up at a later date.

4.4 Selection of Projects to Evaluate

Based on the performance of unprofitable projects in the past, we have organized the characteristics and risk attributes of projects which are likely to be problematic. (Hojo,2008) The selection of projects to be evaluated is determined according to whether the project is applicable to those conditions or not. (Hojo,2009)

Table 1 shows the risk attributes of projects to which we primarily refer.

4.5 Major Evaluation Viewpoints

The viewpoints for evaluations are selected by the extraction of key evaluation points from the standard checklist, and they are modified independently or newly added in accordance with the characteristics of the project. Matters to be discussed are confirmed every time a project is launched to develop an evaluation plan so that focused discussion is held within a limited time frame. Major viewpoints for evaluations are shown in Table 2.

Table 1 Characteristics of Project Risks

Main Risk Characteristics	Major POV
For customers	Novelty, Defining specification, Adjusting specification, etc.
For Business Experiences	Experience in similar jobs, System developed by a competitor, development status in the past, etc.
For Methodological Technology	New methods/technologies, project experience, etc.

Table 2 Examples of POV for Evaluation

POV for Evaluation	Examples of Evaluation Items
Scope of Proposal, Assumptions	Scope of proposal, prerequisites for proposal, restrictions, etc.
Basis for Estimates, Results of Estimates	Size estimates, estimated man-hours, basis and results of cost estimates, etc.
Development Regime	Allocation of roles, scope of responsibilities, employment of expert members, selection of outsourcing contractor, etc.
Customer	Project regime on customer side, allocation of roles, stakeholders, etc.
Other	Project of renewing systems developed by competitor, conversion work, new methodological technology, etc.

4.6 Corrective Instructions given in Evaluation

Considering the details of corrective instructions given at the past evaluations of initial planning at order, they were related to the risk attributes unique to each project. Each corrective instruction is given after discussion among evaluators so that it is made at the level necessary for the project. Instructions for corrective actions organized by each risk attribute are shown in Table 3.

Details of corrective instructions given at evaluations are generally aligned with the risk attributes of the project. In the process of evaluations, however, sometimes comments that were not expected before the evaluation are made based on interviews by evaluators or questions and answers.

Table 3 Risk Attributes and Corrective Instructions

Risk Attributes	Details of Corrective Instructions
For customers	・Clarify role allocation at the customer ・Suggest improvement of the project regime on the customer side ・Clarify how to determine the specification ・Clarify prerequisites for the proposal (e.g. Conditions for re-estimates, responsibility on unconfirmed matters, confirmation on involvement of stakeholders)
For Business Experiences	・Prerequisites for estimates, clarification of schedule ・In depth investigation of risk buffer calculation, instructions for implementing risk management ・Define work processes ・Clarify interfaces with other systems ・Organize development structure, add experts to participate
For Methodological Technology	・Advance verification of response to the introduction of unverified technology ・Confirmation of possibility of sourcing HW, PP, etc. ・Clarifying non-functional requirements (security, performance)

When the project side is not fully ready for the evaluation, comments are often made on general matters as evaluators cannot check or point out details. Therefore, we ensure that the project side is prepared for the evaluation in advance.

5. Considerations for Ad hoc Assignment of Evaluators at Project Launch

In evaluations in which experts are assigned on an ad hoc basis at the launch of projects, the challenges are how to achieve the evaluation quality and evaluation effects. In this chapter, we will introduce the considerations based on our actual examples after the introduction of an evaluation system in terms of improvement of the evaluation quality and expansion of evaluation effects.

5.1 Considerations for Evaluator Selection

When selecting evaluators assigned to a responsible role, at a minimum, he/she needs to be an expert in project management. In addition, the candidate is desired to have experiences in similar projects (similar customers or systems). In order to evaluate projects effectively in a short time, he/she is required to have rich experience in decision making based on the characteristics of his/her projects. Therefore, a person of the department head class, who is believed to be suitable, has been assigned.

On the formation of an evaluation team, it is important to establish the team by clarifying the areas of specialty of each evaluator, and how they can complement each other should be taken into consideration. The following are examples of the area of specialty that needs to be considered for the selection of evaluators.

- Home ground (business field, technical field)
- Experience in negotiating with similar customers
- Development experience of similar systems
- Relationship with other evaluators (including supplementation of know-how, and their chemistry)
- Independence from the subject project
- Availability of schedule arrangement, location for face-to-face evaluation

It is necessary to have a mechanism to grasp the above information of the candidates for evaluators. Moreover, not only officially recorded performance details, but also unofficial information might be useful.

5.2 Advance Preparation for Evaluation

The viewpoints for evaluation should greatly depend on the insights of evaluators, but it is important to clarify those viewpoints for the evaluation and raise awareness towards evaluation to secure the evaluation quality in a limited amount of time. It is necessary for evaluators to start the evaluation after understanding the points and characteristics of the project. In addition, to prevent bias among evaluators and variability of the evaluation quality, a mechanism that controls the overall evaluation is required.

(1) Understanding Characteristics and Profiles of the Subject Project

It is necessary to understand the characteristics or profile of the project in advance through its written briefings or interviews. Then, the reasons why the project needs to be evaluated should be clarified by determining its project risks with reference to past unprofitable projects.

It is preferable that the project information understood is summarized on a profile sheet, etc. so that the concerned personnel can refer to it.

(2) Countermeasures against Biased Evaluation POV and Efforts to Improve Evaluation Quality

The extract of viewpoints for evaluation and project selection must be performed based on consideration for the risk attributes of the projects. On extraction of the viewpoints for evaluation, it is desirable to conduct an in depth investigation of the important items or relevant items of the standard checklist. It would be useful to refer to examples of unprofitable projects in the past.

The viewpoints for evaluation or evaluation items are organized in the form of a checklist for evaluation, or an evaluation agenda, which will be used in an evaluation or for face-to-face evaluation procedures.

(3) Advance Explanation and Awareness Alignment for evaluators

The project materials, the characteristics or profile of the project, viewpoints for evaluation, and agenda, etc. must be confirmed with evaluators to align awareness among them and incorporate their opinions into the evaluation process. It is also desirable to introduce concrete evaluation procedures, steps, examples of comments made in past evaluations, etc.

By aligning awareness towards evaluation among evaluators, their mindset as evaluators can be enhanced, and in addition, using their insights leads to increasing their motivation as well.

(4) Pre-confirmation at Professional Organization
It is desirable to arrange receiving check or suggestions by an in-house professional organization when it is believed that it produces certain effects based on the project characteristics. The check results can be referred to in the evaluation by reporting to evaluators.

5.3 Mechanism to Motivate Evaluators

The motivation of evaluators is important to conduct effective evaluations. Therefore, it is necessary to have a mechanism which incorporates incentives or restraining effects for evaluators.

One such example is to motivate evaluators further by involving management in the evaluation process. Specifically, there is a way to incorporate restraining effects through publicizing the evaluators and the results by retaining the evaluation plan (evaluators, viewpoints for evaluation, etc.) and the evaluation results to be reported to the management. The evaluation system involving management is shown in Figure 3.

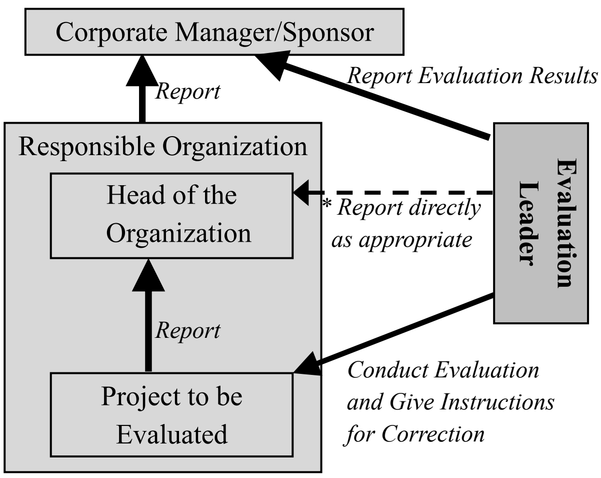

Figure 3 Example of Evaluation System involving Management

In addition, it is effective to set rules in advance that report the evaluation results and corrective instructions are given to them by evaluators directly as feedback, and they have to request re-examination or advice if the project status should worsen after the evaluation.

5.4 Roles of Evaluation Secretariat and its Importance

In the case of assigning experts on an ad hoc basis, a secretariat is essential to achieve both the mitigation of burdens on evaluators and improvement of the evaluation quality, and ensure that preparation for evaluations is undertaken while enhancing awareness among evaluators in a limited amount of time. The major roles played by the secretariat are shown in Table 4.

The main role of the secretariat is to be well-prepared so that evaluations move forward effectively. Therefore, the secretariat provides support to increase the evaluation quality and advance the evaluation effectively. In order to achieve this, it needs to communicate with concerned personnel smoothly while understanding the expertise as an evaluator.

Table 4 Roles expected of the Secretariat

Phase	Major Tasks of Secretariat
Preparation	・Understand and confirm details of the subject projects
	・Prepare for evaluations, coordinate with projects, arrange evaluation schedule
	・Select the evaluation leader and evaluators
	・Align with the in-house professional organizations (technical organizations) as required
	・Collect materials in advance, collect and organize comments from peer evaluation
Evaluation	・Manage face-to-face evaluation, align awareness on evaluation results, summarize evaluation results
Report Evaluation Results	・Report the evaluation results to concerned personnel
Post-evaluation	・Confirm the outcomes of actions implemented based on instructions at evaluation ・Monitor status of the projects

5.5 Side Effects

In the method in which evaluators are assigned on an ad hoc basis at the launch of a project, the following side effects can be expected because experts gain experience as an evaluator.

(1) Awareness of importance of the initial plan at order and further motivation towards the improvement of unprofitable projects have a positive impact on decision making in each organization.

(2) Detailed investigation of initial planning at order or considerations of other projects (estimating methods, attitude towards project planning, etc.) produces beneficial ways in which their own projects can be used.

(3) Collaboration across organizations beyond its past scope can be expected such as application to businesses in which the evaluators are involved, or new collaborations.

6. Conclusions

In this paper, the issues and problems leading to the introduction of evaluation of initial planning at order through the participation of in-house experts, and the actual examples of the evaluations including considerations for the system introduction are introduced. Regarding the method in which experts are assigned in each case, focus was placed on the keys for its introduction and securing evaluation effects in terms of improvement of the evaluation quality.

In designing an evaluation system, it is necessary to understand the situation of the internal organization appropriately including the maturity level of the organization or project while paying attention to external environment changes. Moreover, it is essential to make it sustainable while achieving balance between the evaluation effects and their cost. Also, given the recent rapid change of the business environment, flexible management of the system is required by maintaining pace with those changes. Therefore, continuous maintenance and improvement of the evaluation system should be implemented to respond to it.

At this time, the evaluations are mainly conducted in financial project. However, the specific evaluations in the other fields, such as service sector, communication and broadcasting sector, are getting increase. The future issue is that we should make appropriate evaluations depending on the project situation (in different fields). Flexible trials in a cross-sectoral evaluation are our new challenge. Furthermore, considerations of strengthen collaboration with legal section need to respond to change in a new business model. On conducting the third-party evaluation, I believe that referring to this paper will contribute to achieving the best effects in a limited amount of time and reduced cost, thus improving the evaluation quality.

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A Consideration on Conflict Process Based on Collectivism

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In the process of establishment/implementation of projects which involve multiple organizations, conflicts occur on a daily basis on any organizations or departments. The purpose of this study is exploring the properly process to converge the conflicts between organizations. I have picked up and analyzed some cases of conflicts, using a flow chart and action process chart to express a process of convergence dynamically. As a result, I have gained the hint that there are a stage of approach to let people build cooperative relationships and a stage to handle the concrete problems to converge conflicts practically.

Key Words & Phrases: Conflict, Group bias, Multi stakeholders, Key personnel

1. Introduction

Various conflicts exist in the process of establishment and operation of a project. Even if we say conflict, various cases of conflicts can be seen in the causes and scenes, such as emotional conflicts in individuals and that arising from differences in thinking among organizations.

In projects involving multiple organizations, conflicts between organizational units or between organizations occur at the stage of their establishments and implementations, and they are considered that the success rates of projects and projects will be greatly affected by conflicts.

Differences of recognition and interpretations of contracts between key personnel are considered to be the cause of conflicts. However, the convergence of conflicts are also under their control. Therefore, skills to deal with conflicts properly and to converge are required for them.

Regarding the project, although various measures have been implemented, such as strengthening organizational side by introducing PMBOK and P2M, and training of project managers and engineers with specific specialized skills, a great improvement in the project success rate has not been found yet. Currently, the factors of success / failure of projects are not so simple just to be associated with the individual skills of project managers (Horikami 2009).

In addition, although conflict management has been implemented in other fields such in negotiation and social psychology in Japan, we can't find so many debates in the fields of project management at present. (Fujii, Konosu 2005).

In this study, I have defined conflicts as "obstacles in carrying out projects". The purpose of this study is to examine the actual process of dealing with and converging the conflict, from the viewpoint of occurrence and convergence.

2. Previous studies

In classical research, "conflict" has been analyzed by mainly focusing on conflict that occurs between employees and managers in organizations of the "West", or between individuals and departments, based on the "multidimensional viewpoint" such as the type and factor of conflict. However, research on conflict has not been conducted actively in the field of organization theory since the 1980s. One of the reasons may be the difficulty in focusing on conflict itself and better results may be expected if analyzed in relation to other organization concepts (Takahashi 1982).

When comparing conflict studies between western countries and Japan, we find that the focus is on individualist and collectivist culture. In other words, members of organizations in western countries tend to follow an individualist culture, while Japanese members are likely to follow a collectivist culture, in which it is desirable to place emphasis on maintaining cooperative relationships among members.

In a collectivist culture, we tend to have a strong idea that members have to place importance on "maintaining cooperative relations". (Shishido 2013). Based on the findings above, it can be concluded that interactions from "collectivism" have some influence on conflict occurrence and convergence, and are related to a convergence process, when focusing on conflicts occurring between departments in organizations or multi-stakeholders in Japanese organizations.

2.1 Conflict Process

Needless to say, managerial behavior is

indispensable for the convergence of conflicts occurring inside and outside in an organization during a project contract and an implementation process. Therefore, such approach method is also required for conflict management.

Conflict management has a conceptual framework of conflict perception and experience, diagnosis of source, and management. (Takahashi 1982).

Regarding the conceptual framework of conflicts, it is mainly discussed in conflict research on organization theory. Stephen (2009) presents a process of conflicts that is thought to evolve through four major stages as an example of existing research for cross-functional coordination of organizations. The process of conflict consists of four stages which are existential confrontation, perception, personalization, action and result. In the first stage (existential confrontation), a condition which is responsible for the occurrence of a conflict exists, in the second stage (perception), the parties are influenced by a conflict condition and perceive it, in the third stage, intentional action is taken towards others to reach out to them based on the conflicts that they have perceived, and in the fourth stage, as a result of the action an interaction is found.

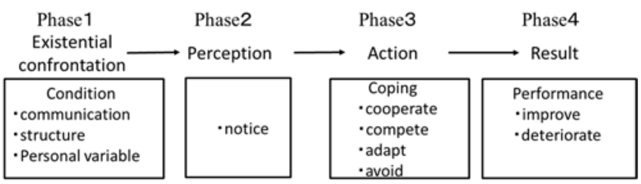

Figure 1 Conflict Process

The administrative action in conflict management can be seen as the “action” stage in the conflict process as described previously. Therefore, it can be appropriate to focus on this stage from the viewpoint of conflict management. Although, administrative action is performed by project managers and other administrators, cooperation by stakeholders is indispensable. However, most of the conflicts that arise in the process of establishing or executing the project do not converge through cooperation, and it seems that there are many conflict cases which develop into other conflicts. The concept of “internal conflicts” may apply to the conflicts arising between different organizations called multi-stakeholders. However, conflicts arising among stakeholders are different from conflicts occurring in the organization. So it is difficult to imagine that the process presented by Stephen (2009) does not necessarily apply to the conflicts arising among stakeholders.

2.2 Outline of research on collectivism

I will provide further insight into the establishment and continuation of a cooperative relationship to conflicts occurring inside and outside of an organization by approaching it from a collectivist viewpoint as previously described.

In particular, considering collectivism from an organizational point of view, I believe that “group bias” about which the field of social psychology has conducted many demonstration experiments, provides us with some hints about the convergence process of conflicts. It is said that “group bias” is based on social identity formed through self-respect of the individual or group cooperation heuristics resting on mutual-beneficial relationship. In other words, it may be recognized that the interpersonal behavior of members related to a group is recognized as a tendency to act cooperatively with the inner group, but non-cooperatively with the outer group, and is thought to be a factor promoting the occurrence of conflicts between stakeholders.

In social identity theory, it is stated that cooperation arises because individuals define themselves by belonging to groups and their preferred groups as a proof that they have evaluated their groups positively. On the other hand, in group cooperation heuristic theory it is said that collaborating with each other within a group is perceived to be advantageous to oneself, because individuals expect that other members also want to cooperate within the group thus leading to cooperation within the group. In other words, it can be assumed that cooperative bias occurs within a group when individuals capture the groups positively, or mutual cooperation with members in the group can be expected.

According to a study by Masahara and Kugitani (2006), it is shown that a clear distinction between inner group and outer group leads to “inner group illegitimate privilege”. On the other hand, it is speculated that the experience in the same group and the similarity of the group categories are factors that reduce the clarity of the boundary between the inner group and the outer group. Factors that reduce the boundary between groups occur during the group formation process and various social scenes.

2.3 Group bias and conflict convergence

As already mentioned, cooperation arises from the positive evaluation of the group to which individuals belong and their expectation about mutual benefits. This can be regarded as that a group bias arises among members who recognized the framework of belonging to the same group by reducing the boundary. In other words, in order that group bias called cooperation occurs, it is necessary that individuals recognize that they belong to the same group. For this reason, it can be considered that cooperation may arise and may lead to the convergence of conflict if a sense of "group" occurs among members of multi-stakeholders connected through key personnel or project managers, or departments within the organization. Based on these findings, I collected the cases of conflict occurring between organizations, and analyzed these cases according to the conflict process to verify the convergence mechanism of a conflict which occurred due to group bias.

3. Case Study

I have collected 10 conflict cases occurred in transactions and projects in which trading companies intervened as intermediate organizations from the viewpoint of occurrence and convergence.

Table 1 Cause of Conflict Case

	Conflict Case
①	Assessed price for repairing was not that committed
②	Sudden changes of manufacturer's opinion
③	Working budget was not approved
④	Specification was different from that proposed
⑤	Discrepancy in interpretation of contract
⑥	Difference in organization policy
⑦	Perception gap for performance
⑧	Excessive export control
⑨	Additional costs incurred from the changes to the specifications
⑩	Estimation amount was beyond what expected

The conflict cases collected occurred between stakeholders in the establishment and implementation phase of the power plant equipment repair project in the electric power industry during the period from September 2015 to June 2016.

I have collected the occurrence points of conflict, and processes of convergence from e-mails, minutes and observations.

3.1 Methods

In order to grasp the occurrence of conflict perception by members statically, I have created a flow chart that covers all communication processes in organizations of all affiliated companies, and created an action process chart of individuals to dynamically express the consciousness and action process after they recognized the conflict. By using these, I have detected the factors that are considered to be the group bias or interactions from the behavior of stakeholders confirmed at each stage of the conflict process.

3.2 Results

Among the 10 conflict cases, I focused on case (1) and case (7) which are affected by group bias and eventually brought good cooperation.

3.2.1 Analysis for Case 1

Background:

Assessed price for repairing was not that committed by the user's key personnel.

Existential conflict:

Within the user organizations, there is a discrepancy of the necessity for repairing the equipment and the budget between the user's head office and the site.

Recognition:

Although, the key personnel of the power plant/user s ide and the trading company had agreed about the repair price, it was not reflected into the assessment from headquarter of the user.

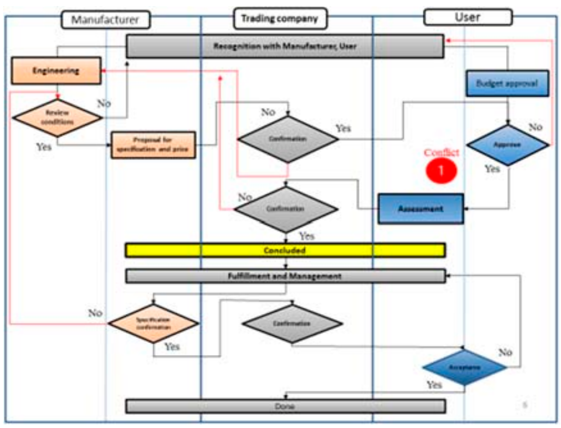

Figure 2 Case 1 on the Flow Chart

Action:

The key personnel of the trading company who had experience of similar repair cases in the past explained the situation to the user side personnel who understood the necessity of repair and let him/her explain it to the key personnel.

The key personnel of plant maintenance understood the situation and the necessity of repair and actual budget at the time, and explained to the key personnel of the headquarters the legitimacy of repair and budget. The information about the past repair work was shared between the head office and the site.

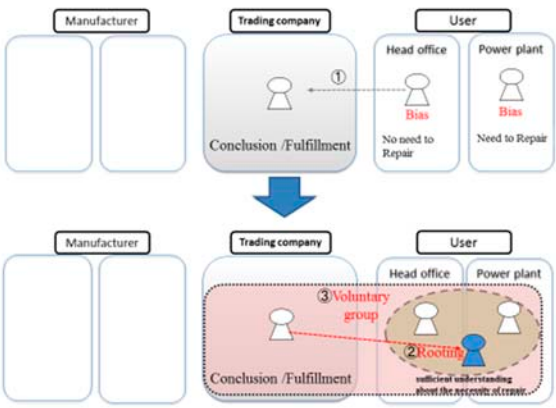

Figure 3 Case 1, Conscious Action

Result:

A repair agreement was concluded with the amount initially agreed between the key personnel of the site and the trading company because they have obtained sufficient understanding about the necessity of repair from the key personnel of headquarter.

3.2.2 Analysis for Case 7

Background:

Perception gap for performance of new equipment

Existential conflict:

The user had upgraded the equipment, but the performance did not improve as proposed. There were differences in opinion between manufacturer and user regarding the cause.

Recognition:

The manufacturer side sales person insisted that up-grading was properly performed and the cause of failure to reach the performance was in the user's equipment. The user insisted that the equipment itself had defect and requested a good reason and a recovery proposal from the trading company that mediated it.

Action:

The trading company asked the key personnel who conducted the construction work on the user side to reconfirm the data of the survey of the peripheral equipment provided to check for compatibility before the introduction of the equipment.

On the other hand, the key personnel of the trading company directly requested the manufacturer's engineer to identify the process of engineering when introducing the equipment via the colleague who is closely connected with the manufacturer's engineering team. Based on those confirmation items, stakeholders continued sharing information and confirmations.

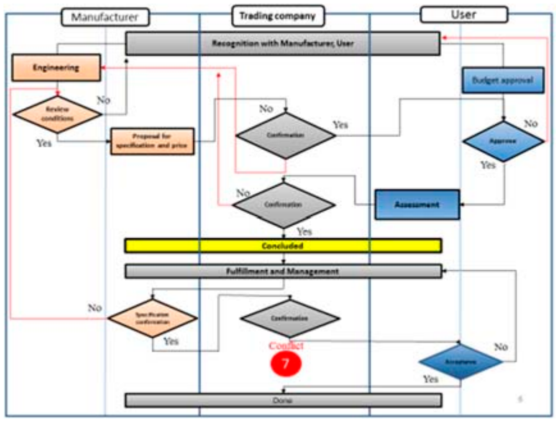

Figure 4 Case 7 on the Flow Chart

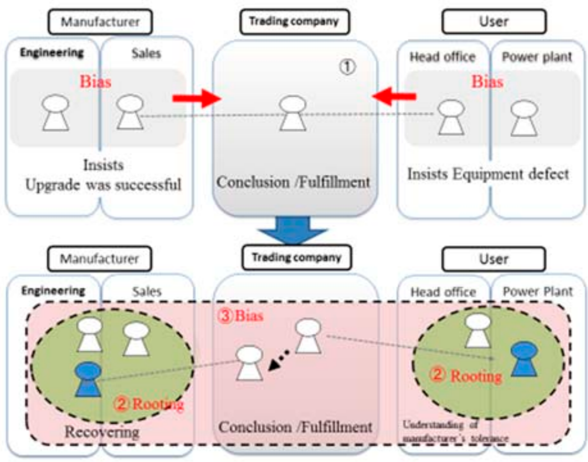

Figure 5 Case 7, Conscious Action

Result:

The manufacturer side confirmed that some part of the design of the introduced equipment was changed compared with the original. On the other hand, it was also confirmed that the information for peripheral equipment provided from the user side was insufficient. As a result, the user headquarters took down the assertion of the defect and at the same time the manufacturer started recovering the performance.

4. Consideration and construction of the model

The points which are common in the two cases as a result of the analysis are as follows:

Firstly, the trading company recognized the conflict after the key personnel of the partner organization had addressed it.

Secondly, in order that some action is taken toresolve the conflict , a state is established in which all concerned parties recognized a common purpose. I will consider the two points mentioned above from the viewpoint of group bias.

The first point is that conflicts had occurred among stakeholders, because the key personnel has expressed the intention "to justify the group they belong" to the stakeholders, despite the fact that contents of contract committed with stakeholder was not understood or shared insufficiently within the organization. One of the elements that regulate each other's behavior between representatives of departments within an organization is the officially prescribed duty. That person only moves around in accordance with the role defined by the organization, and his/her behavior is regulated to some extent by the fact that he/she is a member of the group. (R · Break). The key personnel tends not to try to secure the profit of all stakeholders but to ensure the profit of the group to which he/she belongs and to avoid the risk of damage, by keeping the cooperative attitude only within the group he/she belongs. In other words, it seems that the consciousness of justifying group intentions and actions is affected by group bias only within the framework of department or organization.

In case one, the conflict had occurred because the user's headquarter and the key personnel of the site had expressed their intention to the trading company, following the role defined by the department, and did not communicate sufficiently with key personnel of other departments, or did not verify the background of the trouble.

The second point is that after the conflict was recognized, the key personnel of the trading company worked behind the scenes with a so-called "key persons" from the stakeholders and leading engineers who knew the background of the past, before taking action to resolve the conflict. In other words, by "lobbying" to key persons who did not belong to members whose "role is already defined", information and background knowledge that the member did not possess had been shared. As a result, the boundary between stakeholders was reduced and a situation to unify their goal was build. According to Iriya (1969), a group is mainly summarized into the following organizations. One is an organization in which members who behave differently are unified under a certain order and are operated by regular interaction in order to achieve its purpose, which is called an "organizational group". The other is called a "voluntary group, or non-organized group" which is formed by temporary or spontaneous associations for a certain purpose, different to the "organization group" mentioned above.

When applying the two cases, a state where consciousness and behavior are regulated by being a member of a group, and an organization is composed only of members to whom project roles are assigned, in other words, the state where members are dragged by the public role such as contract or rule, and the group bias acts only within the framework of the organization, can be regarded to be equivalent to an "organization group". On the other hand, a situation where members recognize stakeholders of other organizations and departments as the same group, in order to take appropriate countermeasures , in other words, reducing the boundaries between groups by involving the key persons, and each stakeholder moves towards solution on its own without being dragged by the contract or rule framework, can be regarded as a "self-stood group"

4.1 Supposed Convergent Process

In both cases, a group bias influenced departments and organizations to which a key personnel originally belonged. However, due to the approach from the trading company (rooting behind the scenes), the members of each stakeholder tended to compromise with other groups while leaving a group bias at each division and organization group. In other words, a psychological / self-stood organizational system was formed that is different from the system to follows rules based on contracts and commitments, and that can happen to members who peform the role. It can be regarded as that a self-stood organization was generated by the approach from the trading company (rooting behind the scenes).

From the above, I could confirm there are two phases in the process of action for converging the conflicts, the phase to builds a (self-stood) framework towards cooperation, and to take into consideration of concrete measures against the conflict. Conflicts among groups occur when group bias influences the inside of each groups. Convergence behaviors mainly consists of the phase of building a (self-stood) framework towards cooperation and considering concrete measures. When comparing the above with the Stephen's (2009) conflict process model, the following process model can be considered.

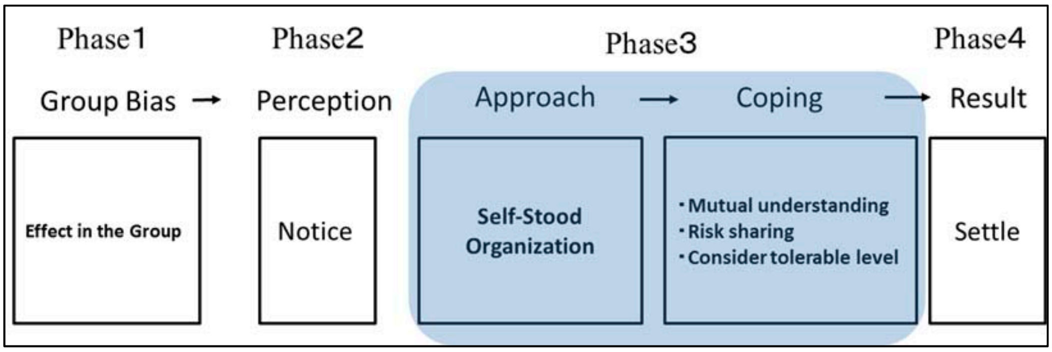

Figure 6 Supposed Convergent Process

5. Conclusion

In this study, I have analyzed the conflict cases that occurred between multi stakeholders during the establishment of a project contract and performance by adding a collectivist viewpoint to the convergence process in existing conflict studies.

As a result, I could gain an indication that the action against conflict convergence may be composed by a "stage of approach" which makes a cooperative framework aligning the stakeholders' eyes and a "stage of taking countermeasure" which solves concrete problems. However, behaviors seen from the cases were limited to establish a system by approaching/involving stakeholders. In addition, conflict convergence needs to be regarded as a series of processes from its precedent state, cognition to action.

Starting with the points confirmed in this study, I would like to take other approaches to analyze conflict convergence as a future issue.

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B21

Speed up and coordinate project's supply chain by using harmonized configuration management system: an application to thermal power plant projects

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Reducing Project Risks in Technical Aspects by “Technical PMO” Activities

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The complexity of system development has been increasing with diversification and advancement of requirements for computer systems these days. In particular, system development technologies are changing rapidly, leaving projects with more technical risks. To prevent such potential problems in system development, it is crucial to take measures for risks not only on the managerial side but also on technical aspects. In addition, it is vital to carry out specific activities needed (referred locally as "Technical Project Management Office (PMO)" activities) to reduce risks at an early stage such as proposal and project planning. We have targeted non-functional risks and carried out the Technical PMO activities to reduce technical risks in upper processes. In the respective proposal, planning, designing, and implementation processes, we review the plan and design and receive some advice from the IT architect and other specialists from a non-functional perspective, which reduces risks. If necessary, upper-level management would be involved in making a decision to solve critical problems. These proactive activities have been carried out for two years so far, and contributed to lowering risks of over 70 large-scale projects having a high degree of technological difficulty.

Keywords and Phrases: Knowledge Management, Technical Risks, Project Management Office, Technical PMO, Non-functional Requirements

1. Introduction

The complexity of requirements for computer systems has been increasing these days along with the difficulties of system development. The core systems that the IT sectors of enterprises have been maintaining are getting older and have become so-called legacy systems. These systems often cause a lot of problems when replacing them with new ones. However, more and more enterprises try to build entirely new systems; aiming to gain a competitive edge in their industries. They consider such technologies will play a crucial role in boosting their businesses (see Figure 1).

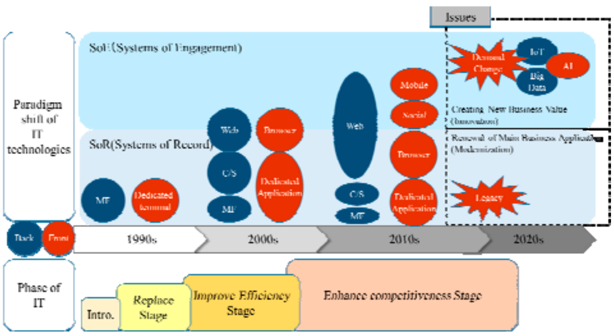

Figure 1 IT technologies and user’s aim (IPA, 2016)

Moreover, technologies are changing dramatically and rapidly. Formerly, many computer systems comprised a simple set of hardware, operating system, and middleware, which were provided by a few vendors even if they were open systems. Nowadays, open-source software and cloud services are becoming widespread; offering more choices to enterprises. The technical degree of difficulty and risks are high when trying to develop computer systems to achieve a customer's high demand using various products, services, and open source software. Projects that do not take appropriate measures against technical issues would fall into serious unexpected failures. In addition to the project management perspective, technical issues and risks should be clarified at an early stage of system development.

We have been carrying out specific activities (referred locally as "Technical Project Management Office (PMO)" activities) to deal with these issues. We are mainly targeting non-functional risks and carrying out the activities to support projects that are trying to reduce technical risks in upper processes. Antinyan et al. stated that a technical risk is the degree of uncertainty on the magnitude of difference between the actual and optimal design solutions (Antinyan et al. 2014). Technical PMO activities play a similar role in the Center of Excellence framework (Project Management Institute, Inc. 2013).

2. Enterprise PMO and Technical PMO

2.1 Technical PMO activities

To clarify the problems described below at an early stage, the Technical PMO team verifies the project plan and deliverables. The team attempts to determine how to mitigate risks or to solve the problems.

- Lack of technical premises that should be described in the proposal
- Proposing non-functional requirements written in a request for proposal (RFP) as they are without verification of feasibility
- Lack of essential topics that should be described in the system requirement document
- Uncertainness of capacity planning
- No proper plans to verify compatibilities of new technologies or products

2.2 Role and position of Technical PMO team

We discuss the role and position of Technical PMO in an enterprise PMO organization (see Figure 2).

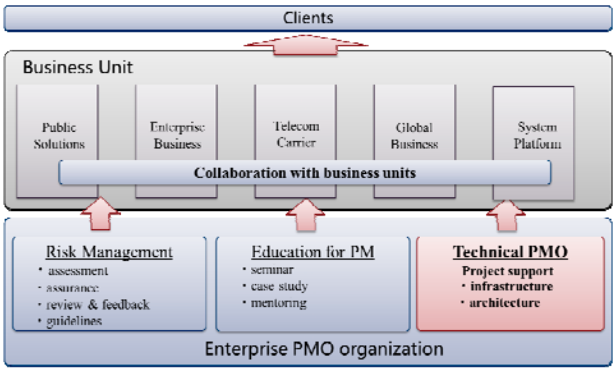

Figure 2 Role and position

The enterprise PMO carries out an assessment of important large projects that often have big budgets and monitors each project to clarify how it is being properly implemented and managed. These are the activities mainly related to project management.

The Technical PMO activities are carried out by Technical PMO team members. They are a small part of the enterprise PMO organization. If the enterprise PMO finds a project with significant technical difficulties and risks, the Technical PMO team would try to find out how to mitigate risks and solve the problems. These collaborative works are important. Due to deficiencies in management and project planning, technical issues may remain unresolved. Therefore, evaluating projects from both managerial side and technological side is effective.

Some business units that carry out the actual projects have a similar team or organization in charge of technical assistance. When the project requires proposals to be sent to clients or requires task implementation, this kind of team will usually support the technical side of the project. If necessary, Technical PMO works with the team in the business unit to solve the problem. Technical PMO deals with large-scale projects that have significant difficulties and risks.

On the other hand, we have a department that develops our own hardware and software products (hereinafter referred to as “product division”). When each project employs our own products, the project will normally ask the product division for their support.

In the past, many projects used to adopt their own products for their client’s computer systems. Therefore, each project could reduce the number of technical risks by collaborating with the product division.

As explained in the Introduction, it has become more common to develop a computer system using a combination of our own products, Open-source software (OSS), and other vendor’s products these days. Consequently, it’s becoming difficult to reduce the number of risks by only collaborating with the product division. Each project has to develop a system suitable for the clients’ needs by combining various products and OSS.

The Technical PMO team overlooks the entire project, trying to determine the technical risks and reduce the number of them by collaborating with the product, OSS, security, and network divisions.

2.3 The objective of Technical PMO activities

The policies of the enterprise PMO organization that the Technical PMO team belongs to are as follows.

- Detecting project risks at an early stage and preparing countermeasures
- Deterring project risks and prevention

The Technical PMO team supports each project so that the project team can prevent the problems by themselves in addition to reviewing and assessing (see Figure 3).

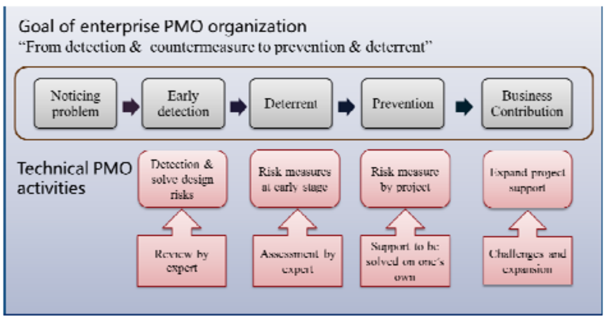

Figure 3 Technical PMO activities and stage

2.4 Overview of Technical PMO activities

Technical PMO not only reviews and checks proposals and deliberables but also shares in-house best practices and knowledge and introduces in-house resources (see Figure 4).

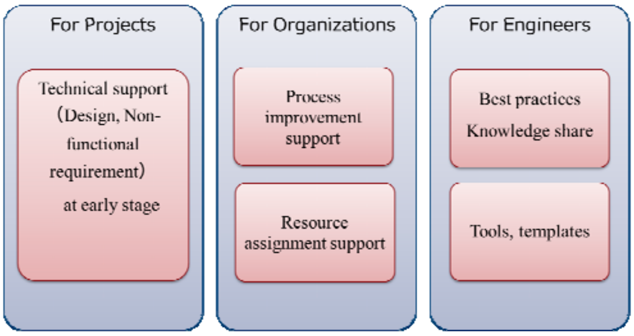

Figure 4 Support contents of Technical PMO

From the lessons learned from past failure cases, we consider many significant problems are caused by inadequacies in upper processes: the architecture, quality of design documents, products and technologies to be applied, and development process. Therefore, Technical PMO evaluates the project from the following viewpoints. And these activities are intended for mainly upper processes such as proposals, requirement definitions, and basic design (see Table 1).

a) Evaluating system configuration and architecture for functional / non-functional requirements.

The configuration of the system to be proposed and designed must be consistent with the functional requirements, and be configured to satisfy non-functional requirements.

b) Evaluating design document of business applications.

The description granularity of business application requirement definition documents and design documents must be appropriate. Comprehensiveness must be ensured, and consistency between documents must be maintained.

c) Evaluating technologies (new technology or product, business application package software) to be applied.

Adequacy of the technologies to be adopted and their compatibility to requirements must be confirmed. In particular, prior verification and training should be appropriately planned for technologies and products that have not used so far.

d) Evaluating development process

Appropriate development processes for business applications and system infrastructures must be selected. Development processes should be appropriately tailored to fit the characteristics of each project on the basis of in-house system development standards. Appropriate software tools to improve productivity are planned properly.

Table 1 Viewpoints / processes

Viewpoints	Proposal / planning	Requirement Definition	Basic design
Evaluating system configuration and architecture for functional / non-functional requirements.		✓	✓
Evaluating design document of business applications		✓	✓
Evaluating technologies (new technology or product, business application package software) to be applied	✓	✓	
Evaluating development processes	✓	✓	

3. Examples and achievements of Technical PMO activities

Technical PMO has been operating for about two years and supported over 70 large-scale projects with a high degree of technological difficulties, which contributed to reducing the number of risks found and recovering projects that had problems. Examples of actual cases are shown below. These cases show how significant problems and serious risks were detected by Technical PMO activities and prevent serious project failure in advance.

3.1 Case 1: Proposal, Project planning

System development of large-scale network and infrastructure virtualization (proposal)

- Problems (to be solved): Processing methods written in the proposal alone do not satisfy the requirements.
- Measures (we implemented to): Clarify the requirements written in RFP and present a draft proposal of the missing processing methods.
- Problems: The compatibility of the system configuration for non-functional requirements is unknown since the rationale for determining it is unclear.
- Measures: Instruct the project how to organize assumptions to determine system configuration.
- Risk reduction (we achieved to suppress of): The underestimation caused by inadequacy of system

configuration, and occurrence of serious design errors.

3.2 Case 2: Evaluation of system configuration and architecture compatibility for functional / non-functional requirements

Full-scale renovation project (requirement definition, basic design)

・ Problems: Non-functional requirements are not exhaustively defined.
・ Measures: Renew the project to organize and clarify the non-functional requirements and present improvement ideas. Review design documents and present a corrective plan for the unclear parts.
・ Problems: Design documents have not been designed to meet the target performance.
・ Measures: Clarify the processing model of the business application and carry out the performance verification. For system infrastructure, confirm that it can satisfy the requirements by carrying out the performance verification.
・ Risk reduction: Insufficient requirement definition causes the system development that does not meet customer's requirements.

3.3 Case 3: Quality improvement of design process

a) Large-scale renovation project from mainframe to open system (design)
  ・ Problems: The existing system performs complicated processing, so many processes cooperate on the mainframe. This may cause certain omissions when designing a new system.
  ・ Measures: Instruct team to visualize the operation of the system by describing sequence diagrams in detail.
  ・ Problems: Existing system is composed of a sole mainframe while the new system divides processing into multiple servers. This may cause the recovery process to become complicated in case of failure.
  ・ Measures: Present a draft architecture that simplifies the recovery operation.
  ・ Risk reduction: Missing processes and resulting design errors. Complicated operation in case of failure.

b) Replacing a system developed by another vendor (design)
  ・ Problems: While giving priority to external design, business process and data flow are not clarified. This may cause an unachievable specification.
  ・ Measures: Instruct the project to firmly determine the business process and data flow.
  ・ Problems: Consistency of entire system is not well verified. There is a possibility of numerous errors occurring during integration testing or system testing.
  ・ Measures: Determine whether the contents of the design document are appropriate as the inputs of the integration testing and system testing. Address problems in detail and present an improvement plan.
  ・ Risk reduction: Project failure due to the unachievable system design, which is attributed to the lack of knowledge of the existing system.

3.4 Case 4: Improvement of source code quality

Large-scale renovation project (development phase)

  ・ Problems: Many bugs were discovered in unit testing. The quality of the source code may not have been secured. When Technical PMO evaluated the code, many problems, such as descriptions inducing a memory leak, were found.
  ・ Measures: Similar problems may exist in other source code. Therefore, we decided to check all source code files. A third-party CDI team of an affiliated company checked all source code. We prioritized the detected problems and their remedies and incorporated the repair plan of the source code into the original plan.
  ・ Risk reduction: Unexpected system failure caused by memory leak and frequent occurrence of fatal errors

3.5 Case 5: Evaluation of technologies (new technology or product, business application package software) to be applied

a) Evaluation of business software package software (requirement definition, basic design)
  ・ Problems: The project verified the FIT & GAP of the business application package software specified by the client. As a result, the FIT rate was high, but it was based on a very rough analysis to verify whether there was a function corresponding to the business package.
  ・ Measures: Instruct the project to verify FIT & GAP on the basis of a more detailed analysis and evaluate compatibilities.
  ・ Risk reduction: Unexpected increase in

development costs due to optimistic estimation.

b) Architecture change in a large-scale call center system renovation

- Problems: Renovation of the call center system (about 7000 seats) to change existing PBX to SIP servers. This plan has large risks because all the corresponding components should be changed.
- Measures: In collaboration with product vendors and related divisions, we implemented operation checks of major call flows and clarified the difference with the existing system. During this evaluation, inconsistencies between components were detected and resolved before the testing phase.
- Problems: Some project members have little experience, which could lead to quality risks at the design phase.
- Measures: We Participated in a project review and incorporated improved quality at the design phase.
- Risk reduction: Occurrence of serious errors in testing phase due to inconsistencies of components.

3.6 Case 6: Evaluation of technologies (new development tool) to be applied

Applying a rapid application development tool to renovation project

- Problems: Applying a third-party rapid development tool was requested by the client. This tool is rarely used by any other in-house projects, and suitability is unclear.
- Measures: We investigated the issues and suggestions when applying this tool. We also surveyed cooperative companies who were well-experienced with this tool and incorporated them into the project. In the project, some applications were developed on a trial basis and their compatibility preliminarily verified. The project applied the rapid development tool only in areas where there is a merit to be applied, and reduced the risk.
- Risk reduction: Unexpected low productivity and incompatibility, due to lack of knowledge.

4. Skills required for Technical PMO activities

To implement Technical PMO activities properly, the skills of members are very important. The following skills are considered necessary for Technical PMO activities.

a) Analyzing

Skills to detect issues that may occur in requirement definition and design phase by evaluating project deliverables and plans on the basis of knowledge and experience of system development or specialized fields.

b) Planning

Skills to study countermeasures against issues and formulate execution plans. Skills to develop standards for design and development.

c) Monitoring

Skills to monitor the implementation of countermeasures and to develop countermeasures against new issues and problems.

d) Facilitation

Skills to maintain management standards such as progress management and issue management, facilitate project members so that they can work smoothly, and encourage communication.

5. Challenges and expansion of Technical PMO activities

Technical PMO activities require experience and expertise. Experts having proper expertise are always in short supply. This shortage causes problems when we cannot support projects at certain times. To solve this problem, strengthening organization cooperation is needed. Clarifying and sharing viewpoints to be checked is essential to allow us to support projects more smoothly.

Along with the diversification of customer needs and increasing projects in the SoE(System of Engagement) domain, we need to expand Technical PMO activities from conventional the SoR(Systems of Record) domain to the SoE domain.

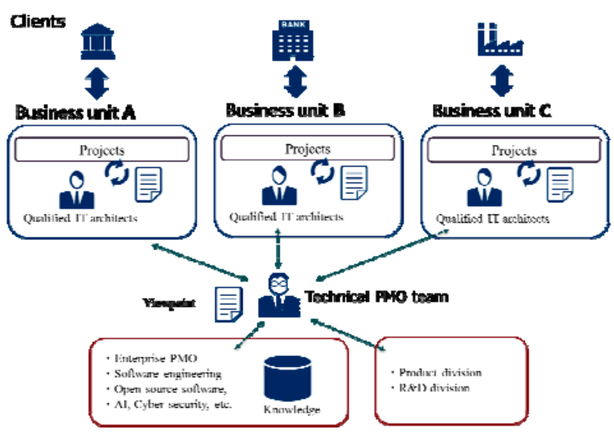

Figure 5 Strengthening organization cooperation

Further discussions about the challenges to the expansion of Technical PMO activities are as follows (see Figure 5).

a) Promote organization cooperation
Promoting organization cooperation is needed, which makes it possible to assign experts in a timely manner. Especially for the SoE domain, it is essential to support areas that need a high level of expertise, such as AI, big data analysis, security, and open source software, that always needs the latest information.

b) Cross-sectional utilization of in-house experts
Experts who have in-house technical qualification are needed to implement Technical PMO activities and to contribute to other projects. Simultaneously, we will offer them good opportunities for their own growth.

c) To clarify and expand viewpoints
Clarifying the viewpoints to be checked in a project and share them with the project side. This eliminates misunderstandings and missing checks. This will enable someone with limited skills to check without omission.

d) Accumulation of knowledge and information sharing
We store knowledge and technical information obtained through Technical PMO activities into the document-based database. This will enable many projects to easily obtain knowledge and information.

6. Conclusion

Through Technical PMO activities, we have contributed to reducing the number of risks in large-scale projects, but up to now have only been contributing to a fraction of many in-house projects. Further expansion to contribute to more projects is needed. In addition, we have been mainly making efforts to address risks in the SoR area, but efforts to address those in the SoE area are also urgent.

Acknowledgements

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A Study of Effective Team-Development Activities for a Multinational Virtual Team

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As global projects continue be an inevitable part of business life, it is becoming increasingly necessary to build a team with multinational resources. Particularly in the case of virtual teams, where members are located around the world, it is commonplace for communication gaps to exist and this can lead, in some cases, to a level of distrust amongst team members due to differences in cultural backgrounds and values, language, workplace environment, working conditions etc. Such situations sometimes cause teams to perform at much lower levels. In the case of the multinational virtual team in which I participated, all members promoted a climate of mutual and pro-active cooperation within the team, sharing skills with each other by cross training and performing team-building activities. As a result, we witnessed direct improvements in work efficiency and a significant reduction in overtime hours. This study describes the positive impact of team development activities that could be deployed on other multinational projects.

Keywords and phrases: Team-Development, Team Performance, Cross Training, Multinational Virtual Team, Communication Gap

1. Introduction

As work-style transformation has become more prevalent recently, team development remains an old and new challenge especially in multinational projects where team members with different cultural backgrounds have to rely on communications via teleworking.

Mr. Hiroyuki Kamba, former PMI chairman of the PMI Japan chapter, described in his research paper that "When I cooperate with the PMI Asian chapters, there is no other country that recognizes the globalization of projects as an urgent issue other than Japan. However, cross-cultural communication is still a big issue in Asian countries, and how to integrate members with different motives into projects is also a challenge" (Kamba, 2013).

According to a survey targeting more than 1,300 employees in about 80 countries, 85% of respondents indeed work in virtual teams without face-to-face meetings with other members, and 48% of their teams include members who are outside their own countries (RW3 LLC, 2016).

Project teams in global environments sometimes encounter miscommunication among members due to cultural differences or inconsistencies in worktime, which results in a decrease of team performance.

In August 2016, the author participated in an in-house global project aiming to improve the "Global Business Opportunities Management System", and became a member of a virtual team across seven countries. Although the author has experienced many Japanese domestic projects in the fields of SI, SCM, etc. previously, this was the first engagement with a global project consisting of multinational members of different nationalities, cultures, and sense of values. It was especially challenging, communicate with the team in his second language, which is English.

However, the project lead formed the team by demonstrating outstanding leadership and the team members, in different nationalities and cultural backgrounds, coped with and solved the challenges caused by the multinational virtual team nature of the project.

The findings obtained from this project could be used to help other project teams as a case study for improving communication and performance among multinational members in virtual teams.

2. Potential Issues in a Multinational Virtual Team

2.1 Project Overview and Organization

Our business unit has a routine task of generating analysis reports for sales activities. This project extracts business opportunity information from customer relationship management systems (CRM) of each different management unit which are widely spread across geographical regions. The information gathered is then integrated into the analysis system (Figure 1).

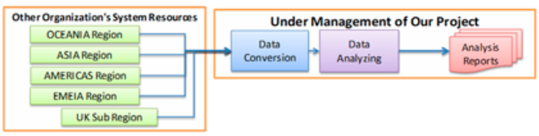

Figure 1 System Structure Diagram

It had already been 6 years since this system launched. There were some issues in the mapping between the data items of each region and in the aggregated figures in the analysis system, which means that there were issues in data accuracy. It had been decided that the report generated by this system would be provided to corporate management the following year. The objective of this project was set to review the data items of the system in cooperation with the CRM system administrators in each region. This project had to improve the reliability of the report by fixing an outdated data aggregation process within four months.

The project team consisted of members from Germany, the United States, United Kingdom, Australia, Singapore, India, and Japan. The German leader, Indian analytical report designer, and the Japanese author of the analyzing system platform administrator formed the core team in the project, and conducted a telephone conference call once or twice a week, occasionally communicating with the other team members and stakeholders when necessary as Figure 2.

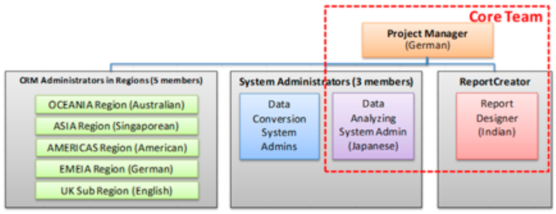

Figure 2 Project Organization Chart

2.2 Challenges of The Team Members

Virtual teams in the initial stage are more vulnerable to mistrust than face-to-face teams. The reasons are: lack of formal introduction to team members, lack of geographical proximity of certain members to others, and the fear of having comments unduly criticized by other team members with whom one has not had the opportunity to build an in-person relationship (Ferrell, J.Z. and Herb, K.C., 2012).

In the initial stage of our project, communications between team members were limited to the minimum. Each member mainly received instructions or requests from the leader, and completed those tasks by the next meeting.

Although a RACI Matrix in the human resource management plan defined the roles and responsibilities of each member (Figure 3), when facing a task with unclear ownership, errors or omissions sometimes occurred due to insufficient communications and in some cases, reworks were necessary.

Project Activities or Deliverables	Project Manager / Leader	CRM Admins in Regions	Data Cnversion System Admins	Data Analyzing System Admins	Report Designer
Plan Phase Activities					
Define Work Items	R/A	C	C	C	C
Create Schedule	R/A	C	C	C	C
Create Communication Plan	R/A	C	C	C	C
Create Additional Plans	R/A	I	I	I	I
Execute Phase Activities					
Team Building	R/A		A	A	A
Build Deliverables for Survey	C	R/A		C	C
Build Deliverables on Cnv. System	I		R/A	C	C
Build Deliverables on Anz. System	I		C	R/A	C
Build Deliverables on Reporting	I		C	C	R/A
Create Status Report	R/A		R/A	R/A	R/A
Control Phase Activities					
Perform Change Mgmt.	R	C	A	A	A
Review & Modify RACI Matrix	R/A	C	C	C	C

Figure 3 RACI Matrix

In addition, the author was obliged to work overtime for a telephone conference call with North American team members.

When looking back to the project, the issues in our team can be summarized into the following two points:

a) Communication Issues: Impacting team performance by miscommunications between members due to cultural differences or reserved personalities/shyness.
b) Time Difference Issues: Difficulty in the real time and immediate communication for the working time difference due to office locations.

3. Effective Team-Development Activities for Multinational Team

Teamwork is an important factor for success of any project, and high team performance can be realized by encouraging open communication and by proactively making opportunities for team-building to create mutual trust among team members. Especially in global projects, such effort is essential to foster and maintain a team culture where each member works autonomously and collaboratively.

The *PMBOK® Guide* describes some skills and activities as tools and techniques in the project team launch stage (Project Management Institute, 2013). In this project, we picked up three out of seven tools and techniques: Training, Team-Building Activities, Recognition and Rewards (Table 1). The reason is that because it neither requires particular education and preparation, nor incurs costs. Therefore, our team could make decisions of introduction and application of those by ourselves without getting approval from the project sponsor or owner.

Table 1 Tools and Techniques in the Project Development Stage

Tools and Techniques	Description	Addressed to
Interpersonal Skills	behavioral competencies that include proficiencies such as communication skills, emotional intelligence, etc.	
Training	all activities designed to enhance the competencies of the project team members	communication/ time difference issue
Team-Building Activities	professionally facilitated experience designed to improve interpersonal relationships	communication issue
Ground Rules	rules for establishing clear expectations regarding acceptable behavior by project team members	
Colocation	placing many or all of the most active project team members in the same physical location to enhance their ability to perform as a team	
Recognition and Rewards	award or reward decided formally or informally during the process of managing the project team often through project performance appraisals	communication issue
Personnel Assessment Tools	tools helping assess the team preferences, aspirations, how they process and organize information, how they tend to make decisions and how they prefer to interact with people etc.	

The following descriptions explain what specific activities were taken for each tool and technique adopted in this project.

3.1 Training

In order to improve communication in the team, we decided to conduct some specific and focused cross-training. We selected the training themes by considering each respective members' skills and their roles and responsibilities in the project (Table 2), and then organized and performed regular sessions once a week by assigning each member alternately as a lecturer. We prepared relevant documents, presentation slides, etc. and held a mixture of lectures and workshops with screen sharing for the other members.

Table 2 Responsibilities and Necessary Skills, Training Conducted in The Project

Member	Roles & Responsibilities	Necessary Skill	Training Theme	Alternative Member
Leader	Data Manipulation / Analysis	Excel Analyzing (Pivot Table, Slicer, Function), Automation (Macro, VBA)	Excel Data Analyzing Techniques	Report Designer
	Suggestions based on Analysis	Statistical Analysis, etc		
	Report Creation	Excel Basic Operations	Monthly Report Creation Process	Report Designer (partly)
	Report Sharing Web Site Management	CMS* Tool Operation	Report Management Team Site Monthly Operation	Report Designer
Report Designer	Report / Dashboard Design	Reporting Tool Configuration/Operation	Dashboard and 4 Types of Reporting	Leader
	Report / Dashboard Implementation	Template Configuration, Customization	How to develop/implement Report and Dashboard	Analyzing System Admin

Through these cross-training sessions, all of the members started to understand the other members' tasks. It fostered the atmosphere of voluntarily cooperation each other.

For example, during the "Define Data Items" process in the Design phase, we had to review and update a large number of "Opportunities Data Reporting Views" repeatedly.

As it was not routine work, we needed to discuss and identify additional tasks and determine who should own them. We did this by telephone conference and it required team flexibility including one of the team members working overtime because of the large time difference. As a direct result of the cross-training, other members attended the call on his behalf which meant he was able to minimize the amount of overtime he would have otherwise had to work. (Figure 4).

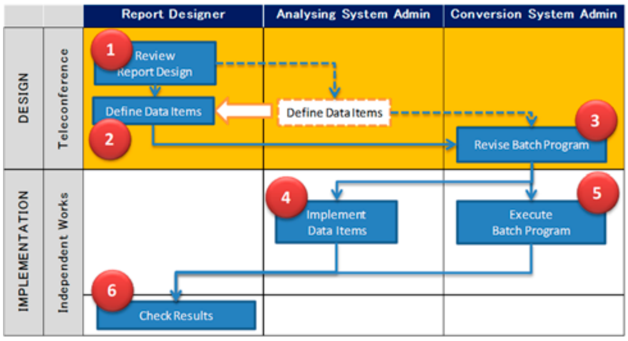

Figure 4 Report Revision Process

As a result, our team sometimes could adjust each member's roles and responsibilities or bind processes in a timely manner. These changes made our team collaborative as to cover the other member's task voluntarily during his absence beyond the scope of the RACI Matrix defined in the project planning process.

3.2 Team-Building Activities

The objective of team-building activity is to help individual team members work together effectively. Team-building strategies are particularly valuable when team members reside in remote locations without the benefit of face-to-face contact (Project Management Institute, 2013).

In our case, each member gave a "self-introduction presentation" in the project start-up stage, and reported "private events in their last weekend" at regular meetings.

The activities' detail and the effects are as follows:

3.2.1 Self-introduction presentation

Each member created presentation material which focused on personal information: history, culture, events, holidays, cultural backgrounds in his country, his own work environment, family structure, how they spend time on their holidays, hobbies, etc. Then we gave the presentation one by one for an hour separately from regular meetings.

The time difference and holidays in each country are usually considered as important factors for planning the project schedule and the delivery date. However, the direct and indirect impacts of each member's work environment, functional organization, work style, etc. are unlikely to be taken into account in a real project. As a result, project tasks were sometimes interrupted and delayed due to the influence from work environments or the functional organization. It may have caused distrust or emotional conflict among team members.

Additionally, each member's work environment varied considerably:

- The German leader telecommuted at home, communicated with other parties in addition to our project team such as his boss and colleagues by phone or e-mail. Therefore, he had no difficulty in working in a virtual team;
- The North American team is composed of members of a department that supports the customer and in-house systems, and the total man-hours for this project was determined on a monthly basis, which means they could not support us flexibly;
- The Indian member worked as the leader of the ICT service delivery facilities for customers, and it is common to work by talking with customers via telephone. In addition, his engagement in this project was sometimes interrupted by the

responsibility to correspond to customers; and

- The author, (who is Japanese), was obliged to report to functional managers separately from the project team, following severe working time rule. In some cases, instructions from the functional manager caused conflicts with the project work.

Generally speaking, if project leads assign tasks or invite to meetings without considering the difference of each member's work environment or working conditions, it may cause a feeling of inequality in the team.

However, understanding the work environment and work-style of each member in detail can solve certain level of issues. For example, when the project work load increases from the functional organization, the project lead and the function manager can consult with each other and adjust priorities appropriately.

3.2.2 "Private event report" in weekly meetings

Communication that is not directly related to the work and emphasizes facilitation of human relations is called "informal communication". Many research programs in this area have been conducted using the influence of informal communication on team productivity, office work, etc. This kind of communication has effects to reduce loneliness and alienation at satellite offices (Nakatani, M. and Nishida, S., 1994). The *PMBOK® Guide* also describes that such communication can help in building trust and establishing good working relationships (Project Management Institute, 2013).

Our team put in place the rule that all the members report on how they spent their weekend in our regular weekly meetings before starting discussions such as project progress and problem sharing. Each team member shared their private event information, such as a wedding party, children's entrance examination, a date with his partner, family trips and so on. The more informal communication grows, the less hesitation exists among members to raise formal requests or questions about the project work. As a result, the work efficiency was improved.

3.3 Recognition and Rewards

Although not stated as the project communication plan, our team got into the habit of doing simple exchanges such as "Thank you" or "Good job" in e-mail or chat, when someone in the team sent an interim outcome or responded to a question from other members.

The *PMBOK® Guide* states that team member's motivation increases by official and informal rewards, and it has an effect of enhancing team performance (Project Management Institute, 2013). However, besides holding official rewarding ceremonies, we can maintain or enhance each member's motivation by recognizing the importance of daily ordinary communications such as greetings by email or chat.

In addition, in the case of a virtual team like us, it can also become a form of prize for motivating each member to provide opportunities for face-to-face meetings, although it is not considered as a reward usually. If you continue in a project for half a year and have weekly meetings all through the project duration, it is natural that you really want to meet, talk and have a lunch or dinner with the other team members. Such "real" communications will further strengthen the bonds between team members after going back to a virtual team structure.

3.4 Communication Plan Update Based on the Time Difference

In our project, if all team members were going to participate in a teleconference, some members had to stay and wait in their office after regular working hours (Table 3).

Table 3 Working Hours and The Time Differences

overtime

Country	Germany	India	U.S.A	Japan
Time Diffrence	0	+4.5 hours	−7 hours	+8 hours
Time	9:00	13:30	2:00	17:00
	10:00	14:30	3:00	18:00
	11:00	15:30	4:00	19:00
	12:00	16:30	5:00	20:00
	13:00	17:30	6:00	21:00
	14:00	18:30	7:00	22:00
Meeting time	15:00	19:30	8:00	23:00
	16:00	20:30	9:00	0:00
	17:00	21:30	10:00	1:00

The solution our team took was that the German lead and the Indian member were substituted to the author during the meeting. They had understood the necessary knowledge for the author's scope of work by sharing the skills in the cross training which is described in "3.1 Training" in this paper. Then one of them shared the discussion points and the author could smoothly catch up and resume the task from the next working day.

4. Evaluation of our team's activities

4.1 Approach to communication issue

The *PMBOK® Guide* refers to Jensen Tuckman's model as an example of team development level (Project Management Institute, 2013). When the communication improvement activities in our team are mapped on the model introduced in his paper (Figure 5), it seems to have had the effect of promoting the stage transition of Forming, Storming, and Norming respectively: self-introduction presentation and private events report for leading Forming stage to Storming;

cross training for uplifting Storming stage to Norming.

Figure 5 Tuckman Model and Team-Building Activities

This tendency can be seen clearly by mapping each stage of Tuckman's model onto the project duration and analyzing the relationship between the counts of chat exchanges, regular meetings and the volume of interim outcomes.

Our team mainly received requests by emails for tasks on interim outcome, questions about it, progress confirmation, and delivery as formal communication. In addition, chat was also used among members whose working hours' overlap, as a means for confirming and asking questions on unclear points. Communication by chat is more effective and immediate than email; and tends to create more informal communications, such as frank greetings and status confirmations. In the analysis, chat conversations are counted as informal communication.

During the project, regular meetings were held eight times a month, except during the Christmas season at the end of the year. Meanwhile, the number of informal communications by chat increased from 12 times immediately after the project started to approximately 30 times in October and November. Along with this, the volume of interim outcomes had grown sharply from 17 to around 40. As the stage grew from Forming to Storming / Norming, the volume of outcomes increased.

In addition, it can be seen that as the trust between the members had been increased, even when the total number of communications decreased when the leader was absent in the Christmas season, the number of interim outcomes was kept to a similar level without significant impact on the volume of deliverables (Figure 6).

Figure 6 Effect of Informal Communications to Productivity

4.2 Approach to time difference issue

Cross-training was conducted in September and October to share skills and from November, the German leader and the Indian member could cover the discussion on "Data Analyzing System" operations which was originally the responsibility of the author in the meetings with the North American team. As a result, participation in the meeting was reduced from 4 times in October to once in November, with an overtime reduction from 20 hours to 4 hours as seen in Figure 7.

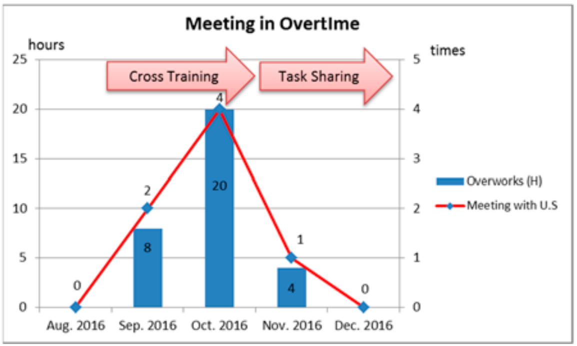

Figure 7 Effect on The Overtime Reduction

Since the amount of time that was previously wasted by attending the meeting, the author was able to take charge of new tasks such as verification and implementation of the new analysis tool. We had an expectation that this tool would make some existing work processes streamlined and generally improve productivity of the analysis.

5. Conclusion

In the early stage of this project, internal conflict and the issue of member isolation were concerning due to the communication gap based on differences in nationality and culture. However, our team implemented some team development tools and techniques like cross training and team-building activities which led each member to understand mutual culture, workplace environment and the respective skills of each other. As a result, the volume of interim outcomes increased.

From the view point of QCD, it seems to be a waste to take time for team-building activities, but from a long-term perspective, it is a meaningful activity that fosters a culture whereby members mutually cooperate autonomously and this leads to improved work efficiency.

Each activity applied in this project could be adopted in other multinational projects and virtual teams partially or fully, to great effect.

However, for team-building on a large-scale project with a large number of members, it is necessary to consider how effective each activity is, and what kind of adjustment or improvement is needed. For example, the more team members there are, the more difficult it will be to implement "private event report" at regular meetings.

We are planning to share and publish these team-building activities as a human resource management plan template in the organization library or repository, and apply them to multinational projects with different conditions such as size, participating member's location, cultural background, etc. for further verification.

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Effect of Power Distance on Project Management Motivation in Thailand

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This study investigated the indirect effect of power distance on motivation among project management staff in Thailand. It was first assumed that power distance generates three negative situations: office politics, conflict, and injustice; and such three negative situations lower motivation among project management staff. There were 69 survey respondents from Thai public and private sectors and possessing project management experience. It was found that power distance does not encourage office politics, conflict, and injustice. However, it was found that office politics and conflict significantly affect work motivation. Meanwhile, injustice only has partial impact on work motivation. Additional findings were also drawn out from the same series of survey questionnaire. It was found that power distance, on the other hand, encourages silence behaviour and decreases voice in a project team. Also, it was found that task and interpersonal conflict positively correlate with each other. An effective management of task conflict can also lower interpersonal conflict at the same time. Finally, it was also found that office politics encourages interpersonal deviant behaviour among project management staff.

Keywords and phrases: Project Management, Motivation, Power Distance, Office Politics, Conflict, Injustice, Employee Silence, Voice, Interpersonal Deviant Behaviour, Thailand.

1. Introduction

Motivation has been proven as a crucial factor contributing to both individual and communal accomplishments. Likewise, motivation plays an important role in project management success. It enhances positive perspectives about tasks and relationship within a project team as well as increases productivity among team members. Therefore, scholars and experts are increasingly interested to investigate various aspects concerning motivation in order to provide useful suggestions for creating motivation among individuals in organisations. In addition to motivating environment and practices, factors reducing motivation have become the subjects for several studies and researches. The reduction of negative factors against motivation are also emphasised in parallel with the focus on motivation enhancement.

Culture can either bring about or suppress individual motivation and active participation in one society. Likewise, it is possible that some cultural dimension(s) may affect motivation of people in the project team. In this regard, the study aimed at the impact of power distance towards project management motivation in Thailand, and the investigation into power distance was limited to which at a workplace level only. Geert Hofstede, a Dutch social psychologist and one of the famous cross-cultural researchers, introduced ‘power distance’ as one of the cultural dimensions playing important roles in shaping particular behaviour and mindset at work. Power distance is the acceptance of unequal distribution of power and different status in one society. Although not as high as other countries in Asia, Thailand still possesses quite high score of power distance (64). The study involved a major assumption on power distance’s contribution to the three negative situations: 1) office politics; 2) conflict; and 3) injustice, and an assumption on the three negative situations’ impact on project management motivation. Apart from the major assumptions, additional hypotheses were also developed in order to find more interesting results from the same series of survey questionnaire. The additional hypotheses covered the influence of power distance on silence and voice behaviour in a project team, the relationship between task and interpersonal conflict, and the influence of office politics on interpersonal deviant behaviour.

2. Literature Review

2.1 Self-Determination Theory (SDT) and Motivation

Motivation is an invisible force that drives people to act or achieve something (Sakhaee 2016). Self-Determination Theory or SDT refers to the field of study emphasising the enhancement of individual motivation across disciplines. It is believed that conditions favourable to individual senses of autonomy, competence, and relatedness generate the most effective and high quality motivation, including willing participation in activities, better performance, persistent determination, and creativity (Self-Determination Theory, n.d.). Self-Determination reflects a sense of choice at the beginning and then encourages individual regulation actions align with certain goals (Deci et al. 1989, p. 580). SDT introduces two main types of motivation: 'Autonomous' and 'Controlled' motivation (Gagne et al. 2015, p. 178). Autonomous motivation emerges when an individual perceives his/her choice (Schmid and Adams 2008, p. 61). In comparison with controlled motivation, autonomous motivation is more effective in terms of increasing desirable functioning (Gagne et al. 2015, p. 178). Controlled motivation rather focuses on an action influenced by external factors i.e. supervisor's demand, deadlines, but autonomous motivation is from inside on the basis of willingness and personal fulfilment (Gagne and Deci 2005 as cited in Schmid and Adams 2008, p. 61).

In terms of project management, project team's commitment plays an important role in the overall success, and a key contributor to the project team's commitment is "motivation" (Linton 2014, p. 261). Peterson (2007, p.60) also indicated that motivation encourages and stimulates people and project team to achieve significant accomplishments. According to Yang (2009, p.17), it is suggested to create a proper environment for a project team in order to motivate the team members to perform at a high level. Also, project objectives that are align with team member's values will yield higher job satisfaction – which increases the level of team member's motivation (Linton 2014, p. 261).

2.2 Power Distance

Power distance demonstrates different levels of power distributed to members of organisations and institutions (Hofstede 2011, p. 9). In other words, it demonstrates how people in one society accept different status among themselves and unequal possession of power. High power distance in workplace is reflected through the relationship between superiors (project managers) and subordinates (team members). The superiors are most powerful while the subordinates are less powerful and have responsibilities limited to operational works (Sriput 2014). An organisation with high power distance tends to emphasise the importance of multilayers of command, and the employees are supposed to observe the directives and orders without any question raised against them (Hofstede 2010 as cited in Sriput 2014).

There is no evidence directly indicating that power distance has connection with motivation in project management. However, there was a research paper on the investigation of power distance impact in a similar way – where Sriput (2014) investigated the power distance impact on work engagement. The research found that a large power distance suppresses work engagement in an organisation; the organisation, therefore, is suggested to increase the work environment with smaller power distance (Sriput 2014). Motivation and work engagement shares some common characteristics. For example, motivation and work engagement involves persistence, especially when one faces work difficulties, or like a sense of achievement in motivation, work engagement also refers to a sense of belonging to an organisation as a result of individual significance realisation, enthusiasm, inspiration, and challenges.

2.3 Office Politics

Office politics (elsewhere: organisational politics or workplace politics) is the way to manipulate power and exploit people for specific purposes. Put differently, it is "how to hurt people" in order to achieve certain things (Daud et al 2013). In order to accomplish some certain goals, one may struggle to obtain power or authority, as well as establish specific relationships with people in the organisation. As a result, the acquisition of power and interpersonal connection may form politics climate or intensify the existing politics in the office. Power distance provides unlimited power for superiors to direct subordinates, and the subordinates are supposed to be passive and unable to raise any questions (Khatri 2003). In other words, it is possible for the superiors to manipulate their power and exploit their subordinates by virtue of power distance. Therefore, it is assumed that power distance may have connection with office politics in some aspects because it enables the superiors to exercise their full power to govern and control subordinates to do things under their commands.

Drory (1993 as cited in Daud et al 2013) revealed that the perception of political atmosphere encourages employee's negative attitudes. Also, when people experience politics in there office, they tend to lower their power and inevitably follow top management's commands (Daud et al 2013). This situation will decrease creativity and innovative thinking among organisational staff (Dhar 2009 as cited in Daud et al 2013). Motivation is a positive factor advantageous in working like creativity and innovative thinking. It originates from personal insights and specific senses.

Thus, while increasing negative attitudes, political perception may automatically suppress a positive factor like motivation. For instance, in case of Thailand, office politics happens everywhere and is seen as a game that people have to deal with (Rees 2015). Therefore, it is possible that motivation may be overlooked or lower when people focus only on "how to survive or get through office politics". Additionally, job satisfaction is another contributor to higher motivation. However, the study of Ferris and Kacmar (1992, pp. 105 – 106) found that while office politics increase, job satisfaction decreases.

2.4 Conflict

Conflict reflects a contentious situation when there are disagreements or a clash of personality among social entities (Barbuto Jr. and Xu 2006, p. 4). The literature on conflict suggests the negative correlation between conflict and team satisfaction. De Dreu and Weingart (2003, pp. 744 – 745) confirmed this correlation in their study, showing that both task and relationship conflicts negatively affect team satisfaction. In Thai culture, conflict is strongly perceived as a negative situation that must be avoided. One of the explicit examples introduced by Pimpa (2012, p. 40), where the avoidance of conflict and uncertainty is one of distinctive characteristics in Thai public sector system. Additionally, Pimpa (2012, p. 40) pointed out the avoidance of feelings and opinions in the public space because of power distance lying within Thai governmental system. When conflict with the superiors occurs, power distance significantly influences on how people perceive and have a particular attitude towards such conflict. More importantly, such conflict affects the relationship between the superiors and subordinates. Liu et al (2013) stated that problematic relationships between the superiors and subordinates are likely to negatively impact the well-being of staff and organisations, and according to Parker et al. (2014, pp. 4461 – 4464), occupational well-being helps to lower workplace burnout and boost work engagement, as well as job satisfaction.

2.5 Task Conflict

When teamwork approach has been more adopted by various organisations, team conflict also has become one of considerable issues challenging effectiveness in the team (De Dreu and Weingart 2003, p. 741). In more specific definition, task conflict refers to the situation where two (or more) people cannot proceed with task due to disagreement in needs, behaviours, and attitudes (Grimsley n.d.). Task conflict involves two or more mutual and beneficial effects, and quality of group decision is the first priority (Simons and Peterson 2000, p. 102). In the past, a lot of literature emphasised the negative aspects of task conflict (Brown, 1983; Hackman & Morris, 1975; Pondy, 1967; Wall & Callister, 1995 as cited in De Dreu and Weingart 2003, p. 741). However, De Dreu and Weingart (2003, p. 151) argued that such old-school view is limited to only one side, and with effective management strategies, task conflict could be also useful for teamwork. Also, Simons and Peterson (2000, p. 102) added that task conflict rather has connection with desirable outcomes in group decisions, and in comparison with those not having task conflict, the groups going through task conflict are likely to do better in decision-making since task conflict enables team members to realise and cognitively understand about issues they face.

The conflict mentioned earlier in 2.4 is rather in the category of "interpersonal conflict" – where personal animosities and individual dissatisfaction are involved, not group fulfilment and achievements. Task conflict and interpersonal conflict exist on the two opposite sides. Simons and Peterson (2000, p. 102) pointed out the difference where task conflict leads to effectiveness in decision-making, and interpersonal conflict leads to inefficiency and poor decision-making. Nevertheless, these two types of conflict frequently synchronise. Overell (2009) stated that the two types of conflict usually occur at the same time; in other words, when a group encounters task conflict, interpersonal conflict will come along with. Therefore, the effective management of task conflict can concurrently handle with interpersonal conflict.

2.6 Injustice

Basically, injustice (elsewhere: inequity or unfairness) refers to unequal treatment or discrimination towards particular person or a group of people. Injustice may also appear in forms of harassment, abuse, or work bullying (Okechukwu et al. 2014). Fujishiro (2005, p. 149) indicated that perceptions of justice from superiors positively correlate with employee well-being. Furthermore, Pinder (2014, p. 122) stated that superiors' temper and concealing their emotions towards subordinates enhance the perceptions and experience of injustice.

Injustice comes along with power distance. In high power distance culture, people become accustomed institutionalised injustice and accept hierarchical order and inequalities of power as desirable norm (Khatri 2003). According to the study done by Gudykunst and Ting-Toomey (1988 as cited in Johnson 2008), unlike those in low power distance environment, people in high power distance environment seemed to be less frustrated and stressed as they accepted injustice and did not perceive injustice as a threat. Nevertheless, the studies by Gudykunst and Ting-Toomey (1988) and Johnson (2008) were conducted in many years ago. Some current circumstances e.g. higher levels of education, different generations, or increasing globalisation may influent the different views on injustice in spite of high power distance environment, and the impact of injustice on project motivation.

2.7 Employee Silence and Voice

Employee silence refers to the state that employees choose to keep their opinions on critical issues at work on their mind and not to report them to their supervisors (Tangirala and Ramanujam 2008, p. 37). Employees are valuable resources playing important roles of active learners, creators, innovators, and organisational success achievers (Beheshtifar et al. 2012, p. 275). Additionally, they can contribute to sharing valuable information, opinions, and concerns, to their supervisors in the following aspects: 1) work performance tactic; 2) things to be avoided in workplace; 3) the implementation of particular decisions; and 4) the determination and execution of organisational policies (Rego 2013 as cited in Costa Pacheco et al. 2015, p. 293). Nevertheless, a number of employees remain silent at work and avoid express their opinions and concerns regarding issues in the organisation (Beheshtifar et. al. 2012, p. 275). One of the reasons behind employee silence is psychological safety – where employees are afraid of taking risks on their own after voicing their opinions in organisations (Edmondson 2014 as cited in Costa Pacheco et al. 2015, p. 293).

Many researches show that employee silence poses negative effects on desirable organisational achievements (Aylsworth 2008 as cited in Beheshtifar et. al. 2012, p. 277), and the situation of silence may generate different consequences varying according to different motives behind it (Pinder and Harlos 2001 as cited in Beheshtifar et. al. 2012, p. 277). Once employees collectively remain silent about critical issues, employee silence transforms itself to a greater extent – organisational silence (Morrison and Milliken 2000 as cited in Beheshtifar et. al. 2012, p. 276).

High power distance generally bestows privileges and utmost authorisation to people in higher positions (Bialas 2009 as cited in Umar and Hassan 2014, p. 671), and this situation embraces the atmosphere of silence to some extent (Umar and Hassan 2014, p. 671). Beheshtifar et al. (2012, p. 281) indicated that frequently, it is believed that employees lack enough required experience to see what are critical issues as well as are not supposed to handle things due to a lack of authority. In their study, Huang et al. (2005, p. 471) confirmed that power distance encourages employees to remain silent and not express their opinions. Also, Rhee et al. (2014, p.715) revealed that according to their research participants, power distance encourages employees not to voice their opinions on problem solutions at work.

Voice refers to the state of being able to openly and informally communicate about opinions, concerns, recommendations, and information about issues at workplace to authorised people able to take relevant actions (Detert & Burris 2007; Morrison 2011; Tangirala & Ramanujam 2008; Van Dyne & LePine 1998 as cited in Morrison 2014, p. 174). Proposing recommendations on innovative changes, suggestions for improvement at workplace, and comments on standard procedure amendments are the explicit examples of voice in organisation (Lynch 2010). The target audience of voice can vary according to situations where it could be supervisors, co-workers, or the others outside the organisation (Morrison 2014, p. 174).

Brockner et al. (2001, p. 301) indicated that various studies indicated that cultural norms, among other things, lower people's responses to voice. Additionally, they confirmed the influence of power distance on the atmosphere of voice – where people in high distance power environment voice their opinions less than those in low power distance. Also, Umar and Hassan (2013 as cited in Umar and Hassan 2014, p. 670) emphasised that employees' ability to raise their voice and make useful recommendations relies on how supervisors support them to do so in organisations. The supervisors' authoritativeness and distant relationship between the supervisors and employees create difficulties in raising voice and intensify the atmosphere of silence (Umar and Hassan 2014, p. 678).

2.8 Interpersonal Deviance

Interpersonal deviance is one of the elements under workplace deviance; it refers to perverting behaviour that poses a threat or damage to individuals within one organisation (Bennett and Robinson 2000, p. 349). Interpersonal deviance and other forms of workplace deviance are intentional actions that jeopardise organisational norms and endanger the well-being of organisational members (Bennett and Robinson 2000, p. 349). Negatively deviant behaviour causes serious problems to many aspects in the organisation. For example, it causes damage to operations, productivity decrease, the breaking of relationship in workplace, or harms to organisational staff and customers (Muafi 2011, p. 126).

Researches indicated that there are a variety of reasons behind interpersonal deviance among employees such as dissatisfaction, perceived injustice, behavioural imitation, or even excitement seeking (Bennett and Robinson 2000, p. 349). Muafi (2011, p. 125) revealed that dissatisfaction strongly encourages employees to leave the organisation, and company disrespect towards employees negatively affect individual performance among operational staff, as well as leads to deviant behaviour in the organisation. Additionally, Nasurdin et al. (2014, pp. 246-247) pointed out that office politics actively motivates employees to engage in deviant behaviour. They explained that office politics intensify rivalry and the exploitation of power and policy, and consequently, the level of stress at work goes up and triggers deviant behaviour among employees.

3. Methodology

3.1 Population and Sample

Research respondents are project managers or project management personnel i.e. project team members, programme manager, etc. in the private and public sectors of Thailand. Initially, there were 77 participants answering the survey. However, it was found that there were missing data in the survey, and only 69 respondents completed all items in the survey questionnaire. Forty-nine point three percent (49.3%) of respondents are male, and fifty point seven percent (50.7%) of respondents are female. The range of respondents' ages was divided into four major groups: 21-30 years (15.9%); 31-40 years (30.4%); 41-50 years (36.2%); and 51-60 years (17.4%). A vast majority of respondents hold Master's degree (65.2%), and the rest of respondents hold Bachelor's degree (30.4%) and Doctoral degree (4.3%) respectively. All respondents are Thai. A vast majority of respondents speak Thai (97.1%), and the rest speak Thai and English (2.9%). Most of respondents are from the public sector (89.9%), and only 10.1% of respondents are from the private sector. Respondents are from different professions i.e. foreign relations and international cooperation, engineering, finance and accounting, etc. Fifty-five point one percent (55.1%) of respondents are operational staff, and forty-four point nine percent (44.9%) are managerial/supervisory staff. The range of respondents' experience in profession varied as follows: below 1 year (1.4%); 1-10 years (42%); 11-20 years (31.19%); 21-30 years (10.1%); 31 years or more (8.7%); and N/A (5.8%). Also, the range of respondents' experience in current organisation varied as follows: below 1 year (4.3%); 1-10 years (46.4%); 11-20 years (31.9%); 21-30 years (13%); and 31 years or more (4.3%). Around 5.8% of respondents have been in their current teams for less than 1 year. Meanwhile, 73.9% of respondents have been in current teams for 1 to 10 years, and 20.3% of them have been in current teams for 11 to 20 years.

3.2 Research Hypotheses

The research was aimed to find the negative influence of power distance on motivation at PM work circumstances. However, such influence was not assumed as the direct impact. On the other hand, it was assumed to encourage three negative situations playing the role as mediators in this context. There were seven main hypotheses to be tested in this research, and all of them were set forth according to the connections among power distance, office politics, conflict, injustice, and work motivation. The main hypothesis of this research was put in the last order because the conclusion under this hypothesis depended on the identification of correlations between power distance and the three negative situations, as well as correlations between the three negative situations and work motivation. The main hypotheses appear as follows:

H1: Power distance encourages office politics;
H2: Office politics lowers work motivation;
H3: Power distance encourages conflict;
H4: Conflict lowers work motivation;
H5: Power distance encourages injustice;
H6: Injustice lowers work motivation; and
H7: Power distance negatively affects work motivation because it encourages three negative situations: office politics, conflict, and injustice.

Additional hypotheses were developed as follows:

AH1: Power distance increases silent behaviour and lowers voice.
AH2: When task conflict exists, interpersonal conflict also exists; and
AH3: Office politics encourages interpersonal deviant behaviour.

3.3 Data Collection and Analysis

Online survey was used as a tool in data collection. The questionnaire for this research was originally prepared in English and then was translated into Thai. The Thai version was proofread and certified by a person having good knowledge in Thai and English. Upon ethics approval, the two versions of questionnaire were uploaded to Qualtrics, and a survey link was sent to organisations employing project managers or other project management staff.

All questions were adapted from reliable sources and previous studies. The reliability values of questionnaire items are shown in form of Cronbach's Alpha and more than 0.7.

Table 1 Reliability Statistics

Items	Cronbach's Alpha
Power Distance	.720
Perceptions of Office Politics	.842
Interpersonal Conflict	.855
Task Conflict	.918
Justice Perception	.922
Work Motivation	.745
Employee Silence	.856
Voice	.811
Interpersonal Deviance	.875

Linear Regression Analysis and Pearson Correlation Analysis were applied for data analysis. Linear Regression Analysis is effective in terms of providing an overview of complete correlation between variables in the research (aspects to be tested in the research). Meanwhile, Pearson Correlation Analysis assists in identifying notable correlations even though the hypothesis is statistically rejected due to insignificant value concluded in Linear Regression Analysis.

4. Results

According to Hofstede (n.d.), Thailand scores 64 on power distance index – quite lower than the average score of other countries in Asia. However, the acceptance of inequality, different status, and the structure of command is still prominent across Thai society. In this research, the average score of power distance is 2.66 out of 5 (51% approximately) and still regarded high and consistent with the previous theory.

4.1 Power Distance vs Office Politics (H1)

Office politics are divided into five aspects: 1) General Political Behaviour; 2) Go Along and Get Ahead; 3) Co-Workers; 4) Supervisors; and 5) Pay and Promotion. Linear Regression Analysis shows that the significant value equates .350 ($P > 0.05$) between office politics and power distance. Therefore, the cause-effect relationship between office politics and power distance is not found, and the hypothesis 1 is statistically rejected.

4.2 Office Politics vs Work Motivation (H2)

For PM motivation, the measurement questions are adapted from "work motivation scales", and "work motivation", in this regard, represents PM motivation. Linear Regression Analysis shows that the significant value is equal to .000 ($p < 0.001$). Therefore, the cause-effect relationship between office politics and work motivation has been found, and the hypothesis 2 is statistically accepted.

Table 2 ANOVA (Office Politics vs Work Motivation)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.454	1	3.454	14.817	.000[b]
	Residual	15.618	67	.233		
	Total	19.072	68			

a. Dependent Variable: Work Motivation
b. Predictors: (Constant), Office Politics

4.3 Power Distance vs Conflict (H3)

Conflict, in this regard, refers to "interpersonal conflict" where the evaluation focuses on this type of conflict at project team level. Linear Regression Analysis indicates the significant value at .125 ($P > 0.05$). Therefore, power distance has no significant correlation with interpersonal conflict, and the hypothesis 3 is statistically rejected.

4.4 Conflict vs Work Motivation (H4)

Conflict significantly correlates with work motivation. Linear Regression Analysis demonstrates the significant value at .007 ($P < 0.01$). Therefore, the hypothesis 4 is statistically accepted.

Table 3 ANOVA (Conflict vs Work Motivation)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.006	1	2.006	7.877	.007b
	Residual	17.066	67	.255		
	Total	19.072	68			

a. Dependent Variable: Work Motivation
b. Predictors: (Constant), Interpersonal Conflict

4.5 Power Distance vs Injustice (H5)

For injustice, the questions are adapted from "Justice Perception" and divided into four sub-aspects: 1) Procedural Justice; 2) Distributive Justice; 3) Interpersonal Justice; and 4) Informational Justice. Linear Regression Analysis shows that the significant value is .643 ($P > 0.05$). Therefore, the hypothesis 5 is statistically rejected since a correlation between power distance and justice perceptions is not found.

4.6 Injustice vs Work Motivation (H6)

Linear Regression Analysis indicates that justice has no correlation with work motivation. The significant value equates .086 ($P > 0.05$). Therefore, the hypothesis 6 is statistically rejected.

4.7 Power Distance vs Work Motivation (H7)

In statistical aspect, it is unable to completely conclude that power distance indirectly affects PM motivation (in other words, work motivation). The overall picture of Linear Regression Analysis indicates that power distance cannot obviously yield negative office politics, conflict within the team, and injustice.

4.8 Power Distance, Voice, and Employee Silence (AH1)

Linear Regression Analysis shows that power distance has a significant correlation with employee silence at the value of .014 ($P < 0.05$), as well as a significant correlation with voice at the value of .015 ($P < 0.05$). The two significant values confirm the effect of power distance on employee silence and voice.

Table 4 Power Distance vs Voice

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.736	1	2.736	6.256	.015b
	Residual	29.299	67	.437		
	Total	32.035	68			

a. Dependent Variable: Voice
b. Predictors: (Constant), Power Distance

Table 5 Power Distance vs Employee Silence

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.568	1	2.568	6.385	.014b
	Residual	26.947	67	.402		
	Total	29.515	68			

a. Dependent Variable: Employee Silence
b. Predictors: (Constant), Power Distance

4.9 Task and Interpersonal Conflict (AH2)

Linear Regression Analysis confirms the correlation between task and interpersonal conflict whereby its significant value was equal to .000 ($P < 0.001$).

Table 6 ANOVA (Task and Interpersonal Conflict)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.742	1	6.742	18.035	.000b
	Residual	25.046	67	.374		
	Total	31.788	68			

a. Dependent Variable: Task Conflict
b. Predictors: (Constant), Interpersonal Conflict

4.10 Office Politics vs Interpersonal Deviance (AH3)

Linear Regression Analysis shows that office politics has significant correlation with interpersonal deviance, with significant value at .018 ($P < 0.05$).

Table 7 ANOVA (Office Politics vs Interpersonal Deviance)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.730	1	2.730	5.923	.018b
	Residual	30.885	67	.461		
	Total	33.615	68			

a. Dependent Variable: Interpersonal Deviance
b. Predictors: (Constant), Office Politics

5. Discussion

5.1 Correlations between Power Distance, Office Politics, Conflict, and Injustice

Linear Regression shows that power distance does not have cause-effect relationship with office politics, conflict, and injustice. In other words, power distance does not generate office politics, conflict, and injustice. Nevertheless, Pearson Correlations still indicate some interesting connections between them as seen in the following examples.

In terms of office politics, superiors' absolute power in decision-making decreases the influence of one particular group at workplace ($r = -.236$, $P < 0.05$). However, less communication or consulting with subordinates causes people to leave the organisation or team ($r = .207$, $P < 0.05$). This happens because a lack of communication emphasises a perception that hard work is not strong enough to buffer superiors' power or bias.

In the aspect of conflict, when subordinates are prevented from questioning the reasons behind superiors' decisions, the contentious atmosphere in the team increases due to suspicion of the other's behaviour ($r = .354$, $P < 0.01$). Another example is a positive correlation between an avoidance to assign important tasks to subordinates and tension in the team ($r = .291$, $P < 0.05$). This also implies that the tension derives from a lack of trust in team members' abilities.

Despite obviously insignificant value in the whole picture, some examples of correlations indicate that power distance can yield negative influence on justice to some extent. For example, the prevention of subordinates from questioning superiors' decisions increases more exploitation of communication for individual needs ($r = .321$, $P < 0.01$). Additionally, the study also has found that superiors tend to avoid the assignment of important tasks to subordinates potentially influencing procedure outcome ($r = -.348$, $P < 0.01$). In other words, an avoidance to assign the important tasks is also intended for the restriction of particular people's engagement in procedure.

5.2 Impact of Office Politics, Conflict, and Injustice on Work Motivation

The negative impact of office politics and conflict on work motivation has been proven and confirmed by Linear Regression. Also, Pearson Correlations support the proof of hypotheses on such impact. For instance, in the aspect of office politics, when people perceive "influential group" in a workplace, they tend to have lower motivation because they feel excluded from that place ($r = .394$, $P < 0.01$). Additionally, if consistency in pay and promotion is high and free from political agenda, people will put best effort in task performance ($r = -.320$, $P < 0.01$). In terms of conflict, Pearson Correlations show that when people perceive 'jealousy/rivalry' and 'tension' in the team, they also start feeling less motivated ($r = .347$, $p < 0.01$; $r = .459$, $P < 0.01$).

The perceptions of justice are not significantly influential on work motivation but have some partial correlations. For example, there is a negative correlation between the justice statement "I can express my opinions and raise my concerns during any organisational procedures (i.e. the determination of policies, performance assessment and promotion, the review of executives' actions)" and the work motivation statement "I don't feel motivated because I'm wasting my time at work," ($r = -.306$, $P < 0.05$). The analysis demonstrates that if people are allowed to engage in procedure, they will have higher motivation. Additionally, it has been found that people are motivated at work when they have the rights to appeal in procedures ($r = .357$, $P < 0.01$).

5.3 The Impact of Power Distance on Employee Silence and Voice

In addition to Linear Regression, Pearson Correlation Analysis also confirms the effect of power distance on employee silence and voice. It has confirmed that power distance increases silent behaviour. For example, when supervisors are absolute decision makers, employees start to be more silent rather than asking for information they want at work. ($r = .255$, $P < 0.05$). If supervisors avoid asking for their opinions, employees do not mention potential issues at work. ($r = .247$, $P < 0.05$)

Meanwhile, power distance suppresses voice among subordinates or project team members. For instance, when supervisors are absolute decision makers, employees challenge mistakes and failure to follow protocol to a lesser extent. ($r = -.240$, $P < 0.05$), or if supervisors are absolute decision makers, employee avoid voicing their concerns if perceiving potential issues at work. ($r = -.368$, $P < 0.01$).

5.4 Task and Interpersonal Conflict

Linear Regression confirms the synchronisation of task conflict and interpersonal conflict. Additionally, Pearson Correlations indicate that an effective management of task conflict can help in decreasing interpersonal conflict at the same time. For example, watching out for each other reduces personality clashes in the team ($r = -.278$, $P < 0.05$). Meanwhile, balance in work shift reduces tension and jealousy in the team ($r = -.330$, $P < 0.01$; and $r = -.311$, $P < 0.01$).

5.5 The Impact of Office Politics on Interpersonal Deviance

Office politics encourages people to engage in interpersonal deviant behaviour. Additionally, Pearson Correlations indicate various factors under office politics fostering interpersonal deviant behaviour as follows:

- Where there is an influential group that everyone is fear of, verbal abuse and certain bully i.e. making fun of someone at work, or saying something hurtful, increase. ($r = .301$, $P < 0.05$; and $r = .270$, $P < 0.05$) This implies that when people perceive their high power, they tend to inflict pain to the weaker;
- People tend to ignore the others' feelings when they define their own standard. For example, the statement "In my workplace, people define their own standards if not specified," positively correlates with "I cursed someone at work", whereby the significant value

is .010 (P < 0.01) and correlation amounts to .309;

- Fairness in pay, promotion, and reward can also determine certain deviant behaviour. For example, the statement "In my workplace, supervisors carry out pay and promotions unfairly," positively correlates with "I played mean prank to someone at work," and "I acted rudely to someone at work," (r = .270, P < 0.05; and r = .239, P < 0.05). This implies that when people perceive unfairness, they tend to act improperly to release their anger.

Nonetheless, some correlations may need other mediators or involve other alternative reasons to explain more. For example, "In my work place, people who voice opinion do better," positively correlates with "I make fun of someone at work," or "I acted rudely to someone at work," (r = .251; P < 0.05, R = .249, P < 0.05). It is quite hard to identify how these correlations happen even though voice and opinion is actually favourable to work. Perhaps, it would be a result of "ego" which is increasing in parallel with self-confidence gained after speaking up.

6. Limitations

The major weakness of this research is the volume of data and samples. Previously, the author expected to obtain data from at least 100 respondents, but finally, only 69 respondents completed all items in the questionnaire. Another noticeable limitation is that the different proportion of respondents. For example, there are 62 respondents from the public sector, but only 7 respondents are from the private sector. This affects the importance of interpretation about specific mindset and group thinking. Moreover, a long line of questions has become an issue causing withdrawal from the survey. The questionnaire contains 12 major topics and 203 questions, and the respondents dropped the survey due to a load of questionnaire items to be responded.

7. Conclusion

Power distance does not encourage office politics, conflict, and injustice but has some correlations with them in some specific aspects. Therefore, power distance does not indirectly affect motivation. Nevertheless, power distance still yields negative impact on voice and encourages silence within the team. The suggested solution is to facilitate a more positive and egalitarian environment. To achieve this, project managers and project management organisations can consider exhibiting more care, supporting voice among team members/employees, and increasing proactive engagement. This helps to reduce the power distance between executives, project managers, and project team members, as well as improve the relationships between individuals at workplace.

This study has also found that office politics and conflict negatively affect motivation. Meanwhile, injustice does not significantly affect motivation but still has some correlations in specific aspects. Moreover, it has been found that office politics encourages interpersonal behaviour at workplace as well. Although office politics may be unavoidable and may be difficult to eliminate completely, project managers and project management organisations, therefore, can consider the adoption of some alternative buffers to it. For example, lower the intensity of office politics by strengthening procedural justice and ensuring transparency of decisions and processes within the project and organisation as a whole. Last but not least, to enhance the effectiveness of conflict management, this study suggests project managers and project management organisations apply effective task conflict management in the team and across the workplace because task conflict management can also solve interpersonal conflict simultaneously.

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The Effect about Implementation of the Project Management Case Training

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Recently, in the field of System Construction, division of work has been developed to improve productivity. Then, a project manager tends to be immobilized on the specific age group. In the result, when younger age staffs who will bear the next generation come up to a certain age, they are appointed to a project manager without enough practices. This tendency is increasing. Therefore, the lack of their risk management skill is provoked schedule delay, cost increase and degradation of the quality, and those issues make a trouble project. To handle this problem, it is important for them to gain experiences at several sites, but as the timing of receiving orders is not always appropriate and mismatch of the individual specialty with each project, it is difficult to let them experience projects as originally upbringing plan. By these reasons, we developed new training program named "Project Management Case Education" in which a senior manager who have managed a large-scale project worked as a lecturer. In this training, based on the past cases, the Lecturer tells them what they should keep in mind and the efficient way of risk management when start-up period of project. Furthermore, on the purpose of simulating project management, participants were divided into groups and discussed with the risks of problem which had been occurred in a project. This paper reports on the detail of "Project Management Case Education" and the evaluation.

Key Words and Phrases: Case Education, Risk Management, Project Management Review, Simulated experience

1. Introduction

Being divided into specialized labors of working advances for a productivity improvement investigation by the recent systems construction, and a project manager (PM) tends to immobilize it in the mid-career employees. As a result, it comes to often become PM when the employee of the young group taking the next generation reached the constant age without having an opportunity of enough project management practice. Therefore cause "schedule delay" "cost price increase" "deterioration of the quality" by "the lack of risk management", and a case becoming the trouble project occurs.

It is important that the young group really does experience on the site to deal with these problems, but the project experience of the upbringing plan street is difficult to deal with these problems because an order timing and the mismatch of the individual specialty occur. Therefore we developed "project example education" ("example education") by the senior manager who experienced PM of the large-scale project in the past in cooperation with Hitachi Information Academy Co., Ltd. ("Hitachi IA") in us. Explained a past project example to a base about the point to keep in mind at the time of the project setup and risk management technique by this education. Furthermore, for the purpose of project simulated experience, programed it to learn project management technique by every team discussed the risk of the problems that occurred by a project.

2. A background and process of the education development

As for the conventional information system development, the development of the mainframe was the main constituent. Therefore stable project management was possible to some extent by carrying out a formulated development procedure steadily. In addition, a lot of employees of the entering a company were able to choose PM from an abundant talented person for a bubble boom, too. In addition, it was the environment that could bring up the young group of the lack of experience in conjunction with on-site practice. However, in late years quality pursued in PM increases, and upbringing cost increases a limit in severe management environment. Furthermore, there is the case that each carries out work as for the project member technically in a tendency to increase because the development technology accomplishes rapid progress. Therefore young group has declined opportunities to contact with PM who manage the project for overlooking it. As a result, it's increased that the mid-career employees which reached the fixed age is appointed to PM without passing through enough project experience.

A failure project by the poor project

management came to occur in this way. This phenomenon appears with a case starting a project in insufficient project planning by a project setup and a process of upper reaches, and becoming the risk measures delay by omission of grasp / underestimate of the risk of the project in particular(Ichiyanagi,2013). In these case, it is too late when a trouble was detected, it follows that enormous losses occur. We developed example education for next PM newly to improve this loss and supported upbringing of new PM and decided to aim at the project success rate improvement.

3. Enforcement summary of the example education

This chapter summarize an enforcement of new developed education, and surveyed training.

3.1 A purpose and the enforcement point of the example education

This education was intended to plan project management technology tradition from tacit knowledge by experience intuition and courage(KKD in Japanese) to explicit knowledge by added new knowledge(K)(K+KKD). In addition, it was intended to do project simulated experience through a real project example(Sakagami et al,2010). Therefore, by this example education, we carried out a lecture about risk management according to PMBOK(R) in the first half. As for the latter half, aimed at the simulated experience of the project, discuss the risk management based on the sample project as a group of around five person, and made a presentation about discussion. The enforcement points of the example education are as follows.

(a)The enforcement number of times: By the same program twice (7hours / time)
 1st: Thursday, February 18, 2016
 2nd: Thursday, June 23, 2016
(b)The number of the student attending a lectures
 1st: 9 person
 2nd: 15 person
(c)Program
 Look back on PMBOK(R) guide general statement 60 minutes (Hitachi IA)
 Case study I (recognition and documentation of the risk) 120 minutes (Hitachi IA)
 Case study II(thinking in a viewpoint of PM) 240 minutes (we)

3.2 The choice and announcement of the student

Selection criteria for students was set as the next PM candidate that is supposed to be appointed as PM within a few years. In addition, the attendance guidance to the office announced it by the education attendance email of all companies. As a result, the evaluation of the first example education had been high, and it followed that the second reached capacity after an announcement immediately.

3.3 Program constitution of the example education

The program of the example education was three divided sections. The summary of every sections are below.

(1)Look back on PMBOK(R) guide general statement

In this section, reviewed the overall system of PMBOK(R) in the classroom learning and explained the importance of K+KKD.

Carried it out mainly on the explanation of Hitachi group and our project management system as a basic concept in the first half. Made much of the correspondence by the particularly upper process in that and carried out explanation mainly on the following.

(a)"Is organized" from "the belonging to the person" project management
(b)"plan emphasis model" project from "a problem processing type"
(c)harden a scope early and make a feasible plan and carry it out in a controlled state

Explained it mainly on importance of the risk management and the correspondence method to a risk in the latter half. Because young person PM could not often recognize the difference between risk and problem, we aimed at the recognizing anew of " the risk is the thing that outbreak was uncertain and phenomenon to influence a project when it occurs ". Furthermore we explained "forestalling management is important to the risk management". Therefore clearly distinguish between "a risk phenomenon" and "a risk state" and explained that it was important that the reasoning did the risk phenomenon that might occur from the situation (risk state) that occurred now in future".

(2)Case study I (recognition and documentation of the risk)

This case study was carried out according to the following procedures.

(a)Reading of the example text and extraction of the risk
(b)Describe a risk and a countermeasure to a risk

management sheet
(c)Discussion in the team
(d)Result presentation by each team

The purpose in this case study was the acquisition of the skill which "share the risk with a stakeholder by extracting a risk, and expressing it in a sentence precisely", based on an example offered from Hitachi IA. After a team discussion, made the presentation by each team, but at this point, a lot of risk expression was still vague. Therefore the lecturer pointed it out by a method for a question so that it became the description removed the vague nature.

(3)Case study II (thinking in a viewpoint of PM)

This section was the biggest theme of the example education. The example that we chose was really the trouble project that occurred in us, and senior manager in charge of PM there really explained it based on a true experience.

The purpose of this section was thought in a viewpoint of PM and set it "what PM should have done". The risk analysis of the case study divided it into 2 cycles and carried it out on this occasion. The reason that we divided into 2 cycles is because we assumed remaining in the analysis of so-called "textbook level" which is general and lacks concreteness and a thing remaining in in objective, "beautiful" analysis from the outside not a viewpoint of PM in the discussion of the first cycle. Then for the purpose of deriving the analysis that stepped more after a discussion of the first cycle, the lecturer explained that in the origin of the risk which each team selected in the discussion, the project team risk was existed. And, in the risk analysis of the second cycle, a problem showed that "stand in the viewpoint of PM and examined a concrete solution" again.

This case study was carried out according to the following procedures.

(a)Case study reading
(b)Risk analysis team discussion (the first cycle)
(c)Team presentation (the first cycle)
(d)Feedback of the lecturer
(e)Risk countermeasure team discussion (the second cycle)
(f)Team presentation (the second cycle)
(g)Feedback of the lecturer

At the educational end, a senior manager told own failed experience straightly, and informing why a wrong decision was done.

The summaries of the case study are as follows.

[Summary of the case]

A large-scale project by the manufacturing industry that we accepted an order of. The project delayed by the lack of the project team, the frequent occurrence of a defect, the change of specifications, a large number of inferior quality outbreak at any time. As a result, it became the cut over approximately seven months late. Furthermore, specifications changes were frequent after cut over and took it by convergence more for half a year.

In addition, PM of this project participated in it by positioning of sub PM as a support worker at first from the other section, but the positioning was in an uncertain state. However, he will integrate a project with the trouble expansion as official PM.

4. The change of risk analysis contents

The change of the risk analysis of case study II is analyzed below.

A risk and the measures that the risk analysis of the first cycle lacked concreteness according to original assumption were presented. Then the senior manager supplemented information on the risk that each team presented what kind of situation it was actually. Next, risk in "the project setup phase" appointed by PM just after that and examining a countermeasure, on this occasion project team arranged it mainly on a risk, and showed a problem again to examine a more concrete solution. Still further, lecturer told "it rose in the viewpoint of PM" and examined it. As a result, a change was seen by the contents of the second cycle for risk countermeasures. Show and consider the change of risk analysis contents by the second example education that carried out on June 23, 2016. Table 1 shows the risk analysis of first cycle. Table 2 shows the contents of the risk management of the second cycle.

Consider a change about the risk analysis contents mentioned below.

First it included the following feature in the risk shown by the 1st cycle, and it was as assumption at first.

(a) Main request is the improvement for the stakeholder except PM. (lack of the viewpoint of PM)
(b)Measures contents do not have concreteness, and there is not it what you do by a real project. (lack of the concreteness)

Table 1 Risk analysis (1st cycle)

#	Risk event	Countermeasure
[Group1]		
(a)	Uncertain customer's required specification	Carry out a product demonstration early
(b)	Quality assurance can't be done with an application design	Extend an application design period
(c)	Project team non-security	Team reinforcement request of developer
(d)	Delay risk of the developer	Resident in the managers of the developer
(e)	Lack of customer business knowledge	The exclusive duty of the customer person in charge
[Group2]		
(a)	The project team of the developer is insufficient	Exclusive duty of the key person of the developer
(b)	PM is other departments and there is not authority.	Change a department and authority reinforcement.
(c)	An application design policy is uncertain. There is the quality risk of the later process	Make the policy of the application design clear
(d)	The results of the developer include uneasiness	Explain a development policy
[Group3]		
(a)	The project team is insufficient	Rearranging of the setup project team
(b)	Schedule delay	Re-schedule
(c)	The management ability of the developer is unclear	Carry out a regular meeting and take measures of the problem early

Table 2 Contents of the risk management (2nd cycle)

[Group1]	
(a)	Change department of PM officially
(b)	Estimate the cost price of the project again and get approval in the company.
(c)	Hold a meeting with a customer executive early, and get the cooperation of the customer
(d)	Get approval of the project planning again
[Group2]	
(a)	Change department of PM officially
(b)	Examine project withdrawal
[Group3]	
(a)	Change department of PM officially
(b)	Ask a well-informed person for review participation by an application design
(c)	Extend an application design period

On the other hand, as for the countermeasure to a risk shown at the second cycle, there was the following characteristic.

(c)Change to a viewpoint what PM should do (risk in the PM viewpoint)

(d)A countermeasure is realized more, and change to an action of real PM (concrete solution)

These changes are as assumption at first. Through project simulated experience, we judge the effect of the example education to have been provided at the point such as upbringing of the ability "to think about in a viewpoint of PM". However, there was not an answer that "PM identified a document with one's eyes again and performed a review of the project planning based on a resource and a schedule" as the answer that we finally found. It was an ideal to arrive at this answer, but unfortunately was not able to finally arrive until the answer.

Inferring this, the team did not think about risk so deeply in a discussion because this education was a lecture form, and to gather neatly the discussion under the time constraints.

5. Contents of the feedback

After team presentation of the second cycle about a risk and measures, a senior manager carried out feedback based on a true experience. The contents of a feedback are indicated below.

(a)PM do seriously till the last if appointed.

(b)Confirm project planning with one's eyes if appointed PM and make it.

(c)If everyone thinks " (The last person in charge) isn't myself.", a project stops.

(d)Even if we thought "It was somehow.", it wasn't carried out, so "It was impossible to be somehow."

(e)As for the risk management, beginning is critical (The judgment to withdraw is not possible other than the initial stage.)

How the student felt a result of the example education in the next chapter.

6. Enforcement result

6.1 Analysis from a student questionnaire (satisfaction)

From a student questionnaire result, we analyze result of the example education.

Identified satisfaction about an attendance result in Figure 1 and Figure 2. As a result, all the student become "great satisfaction" or "satisfaction" about the student satisfaction with the first time. It was all affirmative about other evaluation item. Equally, even the 2nd time is all the members "great satisfaction" or "satisfaction" but 1 person answered "average" about the student satisfaction. From this result, we judge that this example education was able to achieve enough outcome. On the other hand, the first satisfaction tended to be lower than the second. Because this was able to extract a project team risk in risk analysis of the first cycle at the time of case study II of the second education enforcement, it assumes it with a factor that the investigating of the detailed risk was possible.

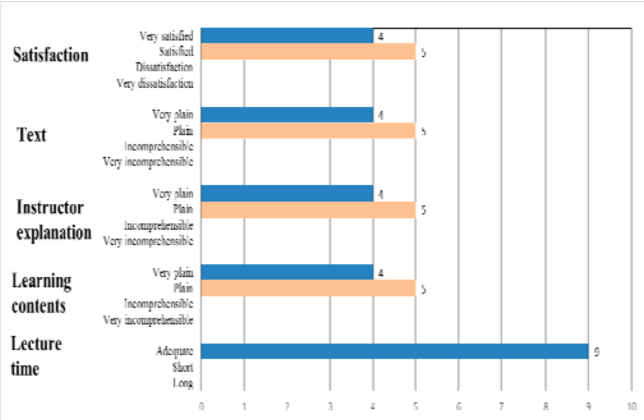

Figure 1 1st student questionnaire result

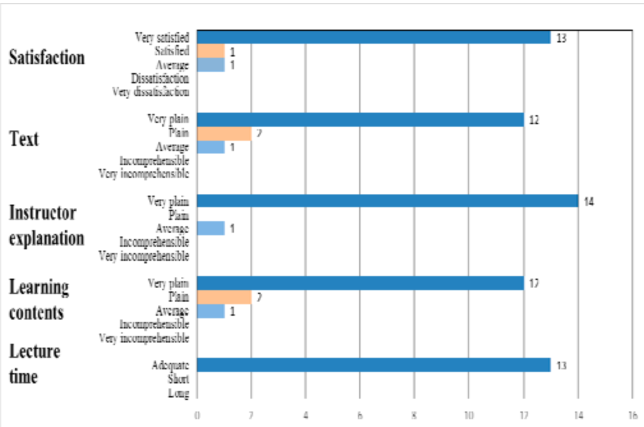

Figure 2 2nd student questionnaire result

6.2 Analysis from a student questionnaire (opinion)

Analyze the contents about the result of the free entry column(opinion) to do student questionnaire. As the item which is common to these opinions, it is given "to have been easy to work on a problem because the in-house case was made a subject ". Because we assume what we experience by ordinary duties a subject, we understand that there was the sympathy for problems. We judge it to have started enough result even if we consider it from a purpose of this example education "project simulated experience". We judge enough result to have appeared even if we consider it from a purpose of this example education "to perform simulated experience of a project".

[1st time]

(a)For a true example, we were able to think deeply.

(b)There was not PM experience, but was good for the future.

(c)We were able to enjoy it in interesting topics very much.

[2nd time]

(a)For a subject, there was a sense of reality than the normal training and was able to consider company example as oneself.

(b)We want to work for the consciousness that "oneself does".

(c)The last story is impressive, and oneself wants to be conscious well, too.

(d)It was studied very much.

(e)It was very profitable by the close contents by an in-house case.

(f)A case was the lecture which is close and often understands.

(g)An in-house case was the case I tend to consider.

Figure 3 Opinion from attendance questionnaire

7. Improvement matter for the enforcement result

We already carried out the example education twice. As a result, the deflection with a section to attend positively and the negative section is seen. We judge that an attendance rate of the section which is skeptical about a project management system is lower. PM stimulates problem solution while being pressed for time every day in the site of the project. Therefore it feels the document making of the project management meeting in the company to be with a burden, and it can understand the uniformity to be skeptical about a project management system. But an original project management meeting is the system to share risk and support PM systematically in an office(Okamura and Shima,2011,Izumi et al,2012). Therefore we think a project management office section has to inform of the institutional purpose and a utilization system furthermore to an office.

In addition, we illustrated by this example education mainly on "self-help effort of PM".

However, PM stimulates problem solution while enduring much pressure on the site. It may follow that we force a burden to PM by the explanation of only about "self-help effort of PM". So we explain what kind of support can make the company and the organization for a project in the second half by example education after next time, and think that it is necessary to explain it therefore what kind of skill we demand from PM.

8. Conclusion

This report discussed the need and a background of the example education that carried out and arranged it about enforcement program contents. In addition, as the effect, we analyzed about two points (1) change of the risk analysis contents of the participant, (2) the satisfaction by the questionnaire of the attendance result.

About the change of the risk analysis contents of the student, we carried out risk analysis over 2 cycles, and an effect appeared to the second cycle by supplementing the viewpoint for the risk. Improvement of the attempt will for the problem and be realized in the analysis as a result of questionnaire example education with a sense of reality were able to by adopting a company's example.

As a result, we can judge that the simulated experience of the project aimed for at first was able to be realized.

However, it must not end for a self-responsibility theory only for PM in enforcement of the in-house education that featured the theme of a failure example. We recognized that improvement conscious of this thing was a problem. It was expected to be reflected in the lecture it's expected to put into effect after next time about this problem, and judge it to have been able to clarify it by analysis of this paper.

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The 3-Steps Approach for preventing from the leak of the requirements in system reconstruction

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Abstract: System reconstruction business migrating from legacy system to new system has been growing. For system reconstruction project to be successful, it is important to examine both of the parts which we want to change and don't want to change in the current system and incorporate into the requirements and specifications to new system.

But some parts which we don't want to change are not focused and not incorporated into the requirements and specifications in the method of the conventional system construction.We have developed the 3-steps approach in Requirements Definition (RD) process to solve the problems with the method of the conventional system construction. This approach consists of extracting requirements not to change in the current system (STEP1), checking contradiction and difference between requirements(STEP2) and consensus building(STEP3).We adopted it to our system reconstruction project in 2015. As a result, we achieved the our goal in QCD and the earlier system migration. We describe the approach in Requirements Definition process in the system reconstruction and its effect through the case study in our project. We consider it will be very useful for other system reconstruction projects which are expected to increase future.

Keywords and phrases:System reconstruction, the method of the requirement definition

1. Introduction

In recent years, the business restructuring business that shifts from the existing system to the new system is expanding. Due to changes in customer service and innovation in ICT technology, the environment surrounding corporate information systems has undergone significant changes. On the other hand, existing systems that have repeatedly added or repaired functions are becoming big and complicated, and it is not possible to respond flexibly to changes in the environment. According to the survey report for domestic enterprises (Ministry of Economy, Trade and Industry), as shown in Fig. 1, the proportion of companies that reconstruct existing systems is higher than the proportion of newly constructed companies.

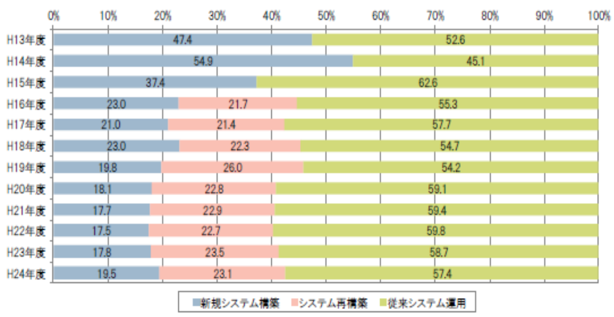

Figure 1 Information system initiatives

The most disliking users who use the system in system reconstruction is that they change to places they do not want to change. The point applies to the operation of the system largely from the work flow to the details in the system. In the system reconstruction, changes accompanying the transition to the new system are inevitable. However, the user's sense of resistance to change makes system reconstruction difficult.

In order to reduce the sense of resistance to change of users and lead to successful system reconstruction, it is important to identify "parts to change" and "parts that you do not want to change" from the current situation and incorporate them into requirements and specifications of the new system. Normally, "part to be changed" comes up as a requirement, so it can be captured relatively easily. On the other hand, "parts that you do not want to change" is hard to come up as a requirement, and because you do not pay much attention to how to proceed with conventional system construction, it is often not included in requirements or specifications. As a result, unintended changes occur in the operation of the business flow and the system, the specification change frequently occurs at the time of user testing, there is a lot of dissatisfaction of the user even after the actual operation, and there is a situation that the system switching does not proceed.

In order to prevent leakage of requirements hidden in this "part not wanting to change", I considered a three-step approach in the requirements definition process. "Clarification of the thought on the current system" (STEP1), "Following thoroughly the parts that you do not want to change" (STEP2), "Early sharing of changing parts" (STEP3). In STEP1, we will interview the users to think that they do not want to change from what we would like to change with current work and systems. In STEP2, we consider measures to drop things you do not want to change into the requirements of the new system and keep it unchanged. In STEP3, we will feed back to users the parts that must be changed due to the restrictions of technology, period etc, and form consensus. With this approach, we thought that it is possible to minimize changes unintended by the user and to reduce the sense of resistance to the new system.

I practiced the approaches of the requirement definition process that I thought in a system reconstruction project (hereinafter referred to as "this project") in charge. Through the three-step approach, this project realized the early business shift to the new system after complying with the QCD target.

In this paper, we discuss the approach and its effect in the requirement definition of system reconstruction through the case of this project. In chapter 2 we describe the problem of system reconstruction project, and in chapter 3 we describe the problem solving method and effect which we practiced in this project.

2. Issues of conventional methods in system reconstruction

2.1 Acquisition of User Requests <Issue 1>

The purpose of system reconstruction is diverse. However, as shown in Fig. 2, the satisfaction level of the user with respect to the reconstructed new system is less effective compared with other purposes.

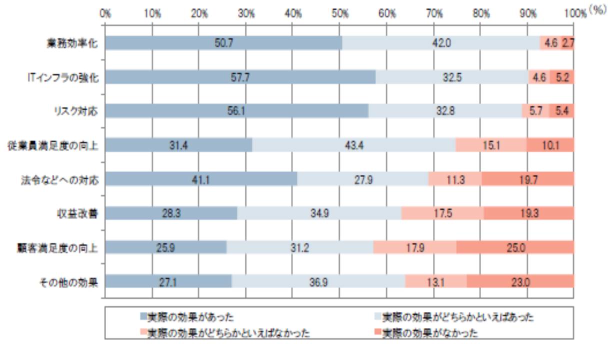

Figure 2 Percentage of companies with actual effect of IT investment (Ministry of Economy, Trade and Industry)

This is because it is more difficult to extract the user's requirements in the system reconstruction than that of the new system construction.

In system reconstruction, users' requirements can be roughly classified into the following two.

Classification 1. Operations that want to change the current system specification

Classification 2. I want to follow the current (do not want to change) business, system specifications

When considering the new system, classification 1 can be cited as a requirement with almost no leakage. It is because the user is easy to recognize the part to change and consciousness that it must be mentioned as a requirement works.

On the other hand, Class 2 often leaks out of requirement. Because there is a current business flow and system, it is cleared up with one word "same as current", and users are not conscious of requiring detailed requirements. Also, in the conventional method in the requirement definition, many requirements corresponding to Category 2 were missed. In the conventional method, we have begun to examine the requirement which was cited as a requirement. Even in checking for the omission of requirements, we often focused on those falling under category 1 and rarely got conscious about category 2. In the system reconstruction project, since the current operation and system are the basis, there are many requirements that originally fall under category 2. Therefore, if proceeding with the conventional method, more system leakage occurred in the system reconstruction project.

2.2 Deviation from User Request <Issue 2>

Combining the user's requirements with the specification review results of the new system, it can be classified into the following four quadrants. (See FIG. 3)

Quadrant 1. There is a request that I want to change from the current, specification changes Part

Quadrant 2. There is a request that I do not want to change from the current, but the specification is the part that will change

Quadrant 3. There is a request that I do not want to change from the current, specifications change Straw-free part

Quadrant 4. There is a request that I want to change from the current, but specification changes unacceptable part

Among them, in quadrant 2 and quadrant 4, there is a gap in user request and specification change. It is necessary to share this part with users early and to form consensus about this part.

Figure 3 Changes in user requirements and specifications

As described in Problem 1, since the user's request "part that you do not want to change" is often leaked by the conventional method, it is impossible to find the displacement of the quadrant 2 at the stage of the requirement definition and specification review. This gap is detected after the trial stage of the new system of the user and the system main operation. As a result, specification change often occurs immediately before the operation, the project is torn down, dissatisfaction with the new system becomes large, which causes the change to the new system not to proceed after the operation.

3. Problem solving method and effect

3.1 Problem solving method

In order to solve these problems of the conventional method in the requirements definition process, we considered that the three-step approach method is effective and applied it to this project. The examples that I practiced in this project are described below.

3.1.1 Clarification of user's thoughts <STEP1>

First of all, clarify the part that the user wishes to change and the part that the user does not want to change for the current system. This is necessary to extract the requirement of the part that wants to follow the current issue mentioned in task 1, and it is carried out at the initial stage of the requirement definition.

In this project we interviewed users. In doing so, in order to make it easier to make a comment more, hearing was conducted in the form of "Where are you satisfied with the current system and unsatisfactory parts?". In this interview, I hit a place I feel that I do not want to change "satisfied part", I hit a place where I feel that I want to change "unsatisfactory part".

Compare the contents of this interview with the initial requirements of the system (purpose of system reconstruction) and drop it into the requirements of the new system. When dropping into requirements by only the contents of the hearing, there is a fear that they may deviate from the original purpose of the project, so it is always necessary to think in line with the initial requirements. In addition, since the contents interviewed by the user may indicate the operation itself of the current system, it is necessary to consider requirement in consideration of what essentially can be achieved when the requirement is made.

In this project, as a result of the above approaches, 17 system requirements were extracted. This was not the initial requirement set by the persons in charge of the IT department, which were all related to the operability of the system.

3.1.2 Following the part that you do not want to change <STEP2>

Next, we examine specifications to follow the part that the user feels unnecessary to change from the current system. In this process, the purpose is to distinguish what can be captured and what can not be captured, from the viewpoint that the user does not want to change to the current system. As these requirements strongly contain the user's feelings, additional consideration such as alternative proposals is required for those that can not be taken in. Therefore, it is desirable to carry out this process too early.

In this project, many of the requirements listed by users concerned the screen layout and operability of the current system. Therefore, "screen design policy" (Fig. 4) was created before examining the screen layout of the new system. By forming a consensus with the user using the screen design policy, we succeeded in extracting the missing requirement and examining the screen layout without reworking.

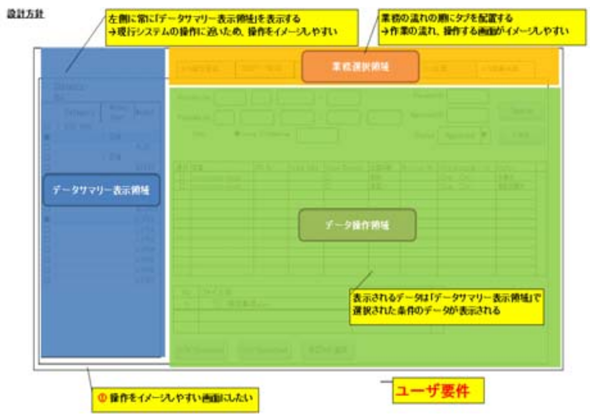

Figure 4 Screen design policy

3.1.3 Sharing change points <STEP3>

Finally, as the system is rebuilt, share the part that changes from the current with the user. When sharing, it is necessary to pay attention to the above-mentioned user request and change in specifications. (See FIG. 5)

(1) Unchanged from the current part (quadrant 1, 2) Where is the part (quadrant 3, 4)?

(2) The part where the user request and the change are mismatched (elephant Where is the limit 2,4)?

(3) What are the reasons for shifts and what are their alternatives?

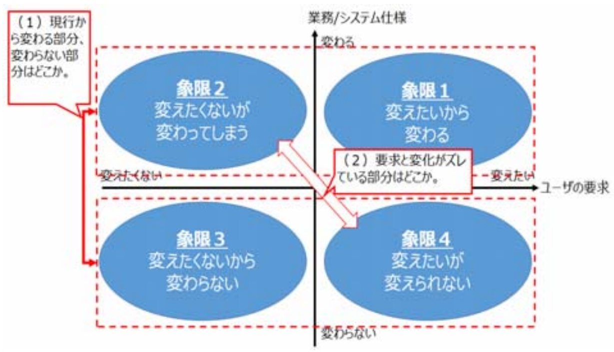

Figure 5 Change point share point

Particularly in the case of requirements corresponding to quadrant 2, due to realization of other requirements and project restrictions, requirements and specifications are mismatched, so it is often difficult to realize the requirements. On the other hand, if you proceed with the project with inadequate consensus building, it will directly lead to dissatisfaction with the new system and cause the project to crumble. Therefore, it is important to form consensus at this stage.

In this project, "Work Walk Through" was held as a place to form consensus with users. In the work walkthrough, we confirmed the flow of work and how to use the new system at that time, using a simple work flow and the image of the system screen. Through this work walkthrough, the user was able to confirm the point of change from the current time and also agreed by explaining the portion where the request and the deviation occur to the user.

3.2 Effect

The effect of applying the three-step approach to the requirements definition process of this project is described below.

By the interview with the user conducted in Step 1, it was possible to extract the leaked requirements as shown in Table 1 at the beginning of the requirements definition process.

Table 1 Result of extracting requirement by hearing

要件抽出元		要件数
(1)	当初設定要件	34 件
(2)	ユーザヒアリングで得た要件	
(2) -1	現行から変えたい部分	3 件
(2) -2	現行から変えたくない部分	14 件
	全要件	51 件

Among these requirements, in the conventional method focusing only on the change from the current, 14 cases corresponding to (2) -2 can not be extracted, and the effect of the approach focusing on the part not wanting to change from the current It can be said.

Also, by clarifying the point of change from the current system, the difference between the request and the new system specification in the efforts of Phase 2 and Phase 3, it is necessary to set the occurrence of specification change request to 0 at the user trial stage of the new system I made it. At the time of establishing the system so far in the customer, about

10 cases of specification change necessarily occurred, which caused troubles after actual operation due to hand reversion immediately before actual operation and correspondence of specification change. From this, it can be said that the approach practiced in this project is effective not only in the construction project itself but also in operation startup after the actual operation.

4. Conclusion

In this paper, we describe the problem of the conventional method in the requirements definition process of the system reconstruction project, the three-step approach method to solve this problem, and the effect of applying this approach to this project and describing it. In addition to achieving the QCD goal set at the start of the project, this project realized a complete business shift to the new system within one month after the actual operation, and is carrying out a stable system operation. By applying the method described in this paper to the requirements definition process, we believe that minimizing the resistance to users' new system by preventing missing requirements has become a point of project success. By using the method shown in this paper, it is cleared up with the word "same as current" in the requirement definition of system reconstruction, leaks the requirement of the part which does not want to change from the current, which can cause rework in the later process It can extract it. We believe that this method can be applied regardless of the size of the system reconstruction project, which is more and more, and also applicable to the project being promoted now.

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Waste identification and analysis for project management performance improvement

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Rapid UX Design Process for Planning Phase in SI Projects

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In order to successfully execute a Solution Development / System Integration Project, it is important to clarify the customer's issues and goals in the initial phase of the project, and to have a mutual understanding about them among the project members. NEC group encourages activities for creating innovative ICT solutions using a design method called User Experience design process (UX design process) in the initial phase of SI projects. The UX process is one of the effective processes for innovation based on users' perspective. However, to apply the UX design process in a real SI project, a large amount of time and resources is needed since the UX design process involves time consuming activities such as observations of the users' behavior and interviews in order to learn about their requirements. To solve this situation, we proposed a customized UX design process. This new process includes the following significant improvements: (1) observing only a few number of people and business tasks, and using workshops to complete the necessary information, (2) executing activities from analyzing the user tasks to generating solution ideas by two workshops. We applied the customized UX design process to a co-creation project with one of our customers. The result of the application showed a high satisfaction level of the project members and the customer. In addition, we also clarified the actual improvement to this customized UX design process.

Keywords and phrases: UX Design Process, SI Project, Behavior Observation, Co-Creation Workshop, Customer Journey Map

1. Introduction

In order to successfully execute a Solution Development / System Integration Project, it is important to clarify the customer's issues and goals in the initial phase of the project, and to have a mutual understanding about them among the project members. However, it is difficult for customers to detect their issues and make plans of solutions for improvements by themselves, since IT technologies and business models are becoming more advanced and complex. To resolve this situation, IT vendors and their customers often jointly research the customers' business issues and create innovative solutions for the issues, which often referred to as co-creation activities.

Recently, a method for creating values that focuses on essentially desired experiences by users is considered as the method for creating innovative and variable solutions (Yamazaki et al., 2012). The experience of services or systems by users is defined as the User Experience (UX) (Roto et al., 2011). The NEC group has encouraged activities for creating innovative

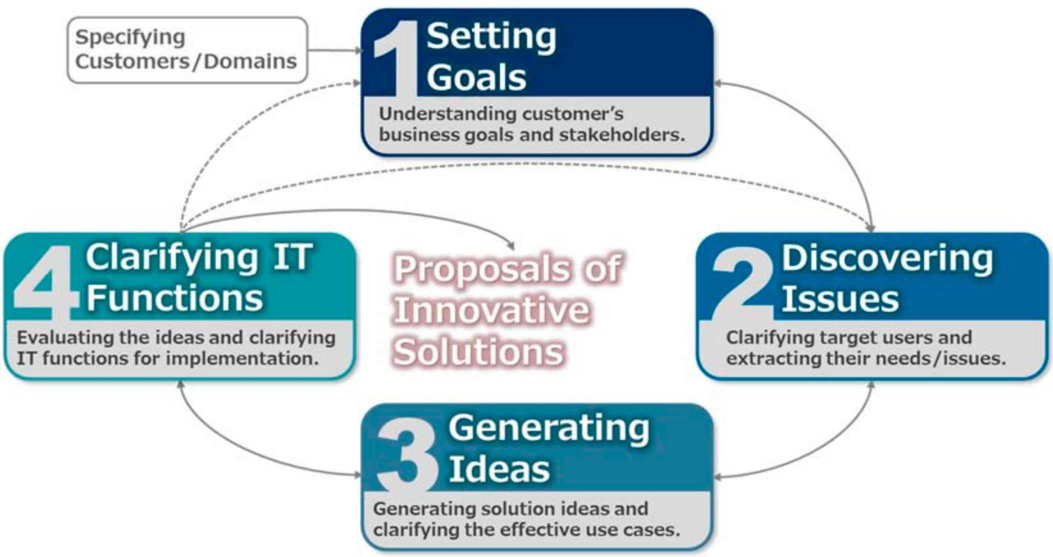

Figure 1 Outline of the UX design process encouraged by the NEC group.

Table 1 Activities of rapid UX design process

Step	Activity	Tools	Time
1. Setting Goals	1-1. Deciding the project goal	---	2 hours
2. Discovering Issues	2-1. Making a persona	Interview	Half day
	2-2. Learning business tasks	Behavior observation method, Interview	Half day
	2-3. Analyzing persona's issue (workshop #1)	Brain storming, Customer journey map	3 hours
3. Generating Ideas	3-1. Diverging and converging ideas (workshop #2)	Brain storming, Customer journey map, Two axis method	3 hours
4. Clarifying IT Functions	4-1. Evaluating ideas and clarifying IT functions for solutions	---	2 hours

ICT solutions using a design method called User Experience design process (UX design process) in the initial phase of SI projects. We, the NEC group, defined the UX design process based on the best practices of our past activities, and applied it to several SI projects of the NEC group (Ide et al., 2016). Figure 1 shows an outline of UX design process encouraged by the NEC group. The UX design process is based on the Human Centered Design process (HCD process) and a design process for applying the HCD process to the planning phase of projects (ISO 29241-210, 2010). The UX design process assumes some activities such as interviews for users and observations of users' behaviors in the planning and requirement definition phases in order to clarify the issues, needs, and solutions for improving target systems or services. In addition, it also includes executing workshops to generate ideas, discuss the issues, needs, and solutions with stakeholders.

2. Challenge of the UX design process in real project

Many related works have verified the effectiveness of UX design process (Buley 2013, Ando 2016). However, the UX design process in a real SI project demands a large amount of time and resources since the process assumes many iterations of making and verifying hypotheses to refine its outputs such as solution ideas and designs. For example, activities for user survey such as user interviews and behavior observations require a lot of resources. In addition, when applying the UX design process on co-creation projects with customers, it also takes much time to arrange meetings for reviewing and making consensus. On the other hand, due to rapid changes of business and project scales, demands of rapidly applying the UX design process to plan and design services with small resources have been increased recently, despite some inaccuracy that it may have.

In this study, we aim to improve the current UX design process in order to plan and design solutions in a short span of time. We have customized activities of the current process and verified the effects of the proposed process by applying it on a real co-creation project with our customer. This paper describes the proposed UX design process and also reports the improvement points for further efficient design process through the case study. The contribution of this study is to expand the application range of the UX design process. We found that the UX design process can be applied to SI projects that could not afford much time and resources. We also clarified points for more improvement in the proposed UX design process through the case study.

3. Method

In previous cases where we applied the UX design process on SI projects, it took about three months to complete the activities from Step. 1 to Step. 4 shown in figure 1(Ide et al., 2016). In this study, we customize the current process to complete all steps for one and a half months. In particular, we select essential activities in each step and rebuilt the process. Table 1 shows the customized UX design process.

First, all project stakeholders discuss and decide the target issues and goals of the project. This corresponds to "Step 1. Setting Goal" in figure 1. For defining the target issues, describing a concrete issue such as "improving the number of transactions by novice workers" are preferred to an abstract issue such as "business efficiency" or "sales growth". Formats of the final outputs should be agreed among the stakeholders during this step.

In “Step 2. Discovering Issues,” the persona method or the behavior observation method is used in order to specify and describe about the target users, and analyze the users’ tasks and issues. In “Step 3. Generating Ideas,” solution ideas for the issues clarified in Step 2 are generated conducting workshops. Finally, in “Step 4. Discussing IT Functions,” the ideas generated in Step 3 are evaluated from the viewpoint of the achievement of the goals set in Step 1. Later, actual IT functions to implement the ideas are discussed.

One of the significant improvements is to restrict the time of the behavior observation and the interview to a half day (activity 2-2 in table 1). Another improvement is to complete the activities from task analysis to generating solution ideas by carrying two workshops (activity 2-3, 3-1 in table 1). To compensate the reduced thoroughness due to the shorter observations and interviews, a manager who is knowledgeable about the target tasks should participate in the workshop of task analysis in activity 2-3. In the workshop, the manager adds more information about the typical tasks and also the observed tasks. Moreover, to analyze tasks and generate ideas efficiently in the limited time, each workshop is restricted to three hours and at most two workshops can be conducted.

4. Case Study

This chapter describes a case study of applying the updated UX design process introduced in table 1. A customer of the target project was a vender. The project was about improving help desk supports in the customer. The project team consisted of an improvement planner of business tasks from the customer, a field manager of the help desk tasks, a sales person, a system engineer and UX experts including the authors.

4.1. Setting Goals

In the initial phase of the project, all stakeholders discussed the target issues and the goal for two hours and made a decision about them. From the result of the discussion, the target issue was defined as “an improvement of the quality of help desk tasks executed by workers who were responsible for both help desk tasks and other tasks”. The target goal was defined as “clarifying effective solution ideas corresponding to the issues”. The main target users were defined as workers whose responsible tasks were help desk supports and other tasks.

4.2. Discovering Issues

Next, we modeled the target users by using persona method (Buley, 2013). This activity corresponds to activity 2-1 in table 1. Persona is a fictional personality which represents the targeted user groups. In this project, we interviewed four people who were engaged to help desk support section to create the persona. The interview lasted one hour for each person. We designed the following interview items by referring to Babbie (2013).

- <u>Work styles</u>:
  average of daily working time, engaged time and frequency of the help desk tasks on a day
- <u>Skills of the help desk tasks</u>:
  working years, roles in the business, average number of transactions on a day
- <u>Skills of using IT technologies</u>:
  types and frequency of using IT devices individually
- <u>Motivations for the tasks</u>:
  degree of satisfaction to the help desk tasks and its reasons, future goals

We discussed the interview result and made a persona of the target user. The personality of the persona had the following features: the persona executes the help desk tasks once a month, the average number of his or her transactions on a day is less than the number of other workers’ transactions who are experts and engaged to the tasks every day, he or she asks experts about unknown things, the level of skills of using IT technology is middle and the persona hopes working as a team leader in the future.

Then, we surveyed the target tasks, namely the help desk tasks, by using the behavior observation method in order to extract issues that the target users had. This activity corresponds to activity 2-2 in table 1. The behavior observation method is one of qualitative research methods based on ethnography (Yamaoka, 2008, Babbie, 2003). This method can collect qualitative facts by observing human behaviors in the fields of life, services, and works. In this project, we defined the observation targets as three workers. One of them was a worker who corresponded to the target persona and the others were workers who didn’t correspond to the persona. Two investigators observed the behaviors and works of one worker for two hours by using the shadowing technique. Here, we observed experts’ works in order to understand the help desk

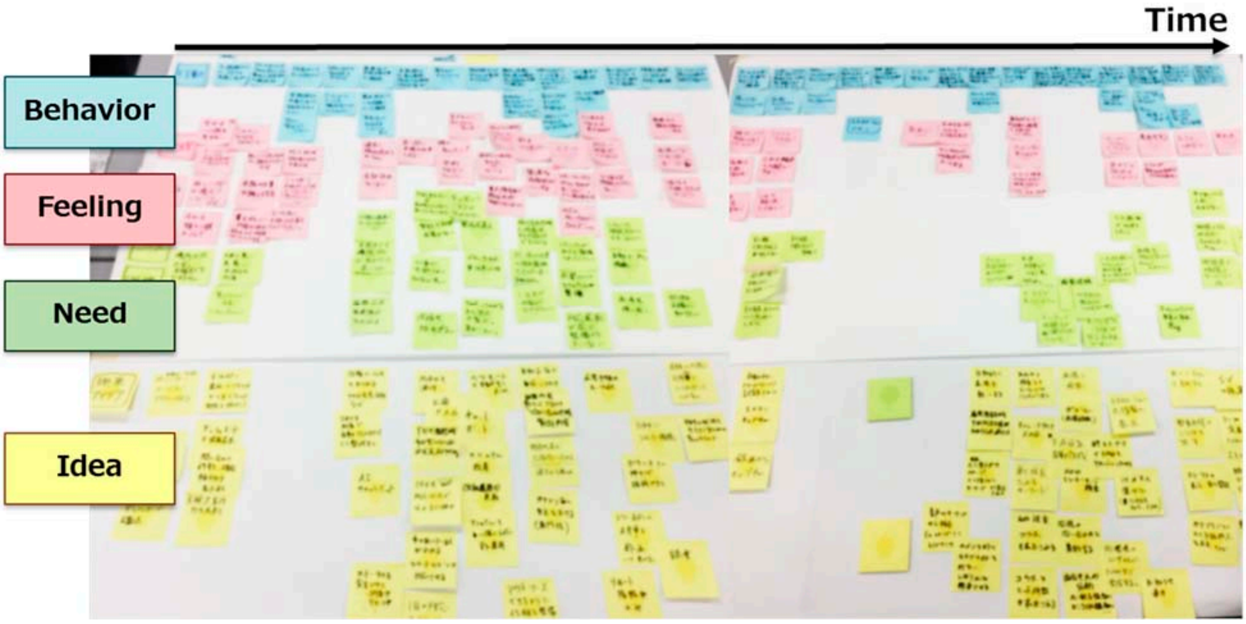

Figure 2 An example of customer journey maps about the persona's task.

tasks and compere the tasks done by experts to those done by the target users.

After the behavior observations, we shared the results and analyzed the persona's tasks in the first workshop. This activity corresponds to activity 2-2 in table 1. The stakeholders from the customer and NEC participated in the workshop. In the workshop, participants wrote down the observed behaviors in a chronological order by using a customer journey map to visualize persona's tasks. In addition, they interviewed a field manager of the help desk tasks about typical persona's tasks that were not observed during the observation and add them to the map. By doing this, we could expand the range of task analysis and improve its thoroughness by the addition.

4.3. Generating Ideas

Next, we discussed and extracted the issues from the customer journey map where the persona's tasks were visualized. This activity corresponds to activity 2-2 and 2-3 in table 1. Then, we generated solution ideas to the issues and added them to the journey map in the second workshop. This activity corresponds to activity 3-1 the table 1. Figure 2 shows a part of the customer journey map after generating solution ideas. The work flow of making the map is as follows:

- w1. Visualize persona's representative tasks chronologically based on the results of behavior observations and interviews from field manager of the tasks (The blue post-it part in figure 2).
- w2. Generating ideas of the persona's feeling by brain storming method (Maeno, 2014) among stakeholders (The pink post-it part in figure 2).
- w3. Discovering needs and issues corresponding to the feelings generated at w2 by brain storming method (The green post-it part in figure 2).
- w4. Generating solution ideas corresponding to the needs and issues discovered at w3 by brain storming method (The yellow post-it part in figure 2).

As a result, our project team was able to generate 83 solution ideas.

4.4. Clarifying IT Functions

In this step, we classified similar ideas into 18 groups and evaluated each group and decided its priority. This activity corresponds to activity 4-1 in table 1. We used the two-axis method (Maeno, 2014) to evaluate ideas. We set the axis as "effectiveness" and "feasibility" and put the ideas on the plane with the two axis and evaluated them. Figure 3 shows an example of ideas put on the plane with the two axis. The workshop participants discussed and decided solution ideas that will be implemented with a high priority by using the plane. For example, the idea G1 allocated at upper right in Figure 3 has a high priority since it is expected to have the best effect from the both viewpoints of effectiveness and feasibility. The participants discussed such things and selected three ideas (G1, G2 and G3) as those to be implemented preferentially in this project. In addition, they discussed and clarify necessary technologies, systems and functions to implement the

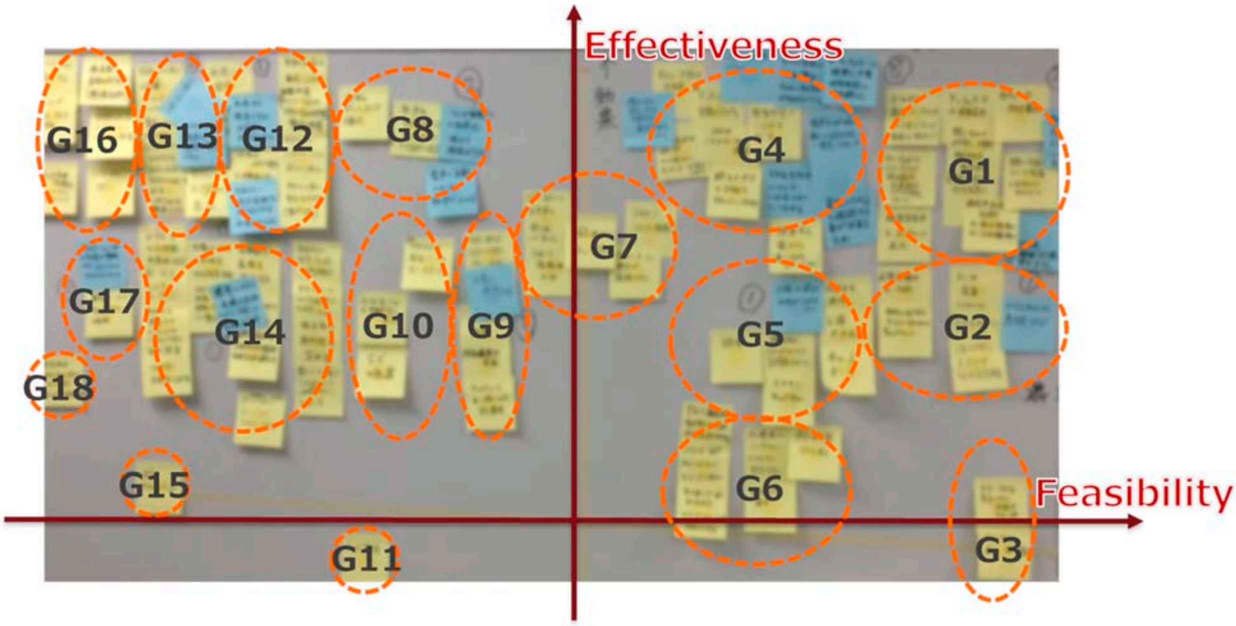

Figure 3 Example of mapped idea groups in an effectiveness-feasibility plane.

ideas.

5. Discussion

In this chapter, we discuss the effects and improvement points of proposed UX design process, which have been clarified by applying the process to a real project.

5.1. Effects on Customer Satisfaction

We carried out all the defined activities with the customer although the execution time of the process was short. It made sharing discussion contents and forming consensus among the stakeholders become relatively easier. It also made the customer's satisfaction becomes higher. According to the results of questionnaire filled by the customer after the project, they were very satisfied with the process of discussions and the results. Moreover, they asked us to apply the UX design process on other projects a couple of month after the project was over. These results suggested that the proposed UX design process enhances customer satisfaction.

5.2. Improvements in Activity Levels

Through the projects, it can be clarified that some activities should be simplified while some activities should have larger portion of time. For example, the activity of making persona can simplified by reducing the number of interview targets and items for persona definition. In contrast, the activity of generating solution ideas needed more time. Some workshop participants mentioned that they could have more kinds of ideas if they had more time after the workshop. We used only customer journey map to generate ideas but we should introduce and combine other method to generate more ideas in the workshops. Method to facilitate workshops for generating ideas will be one of the future works.

5.3. Key Factors for Further Efficiency

For more efficient UX design process, selection of project members is a key factor. For example, generating ideas and having discussions would be more smoothly if people who were familiar with technologies concerned to the solutions had participated in the project. The task analysis would also be more smoothly if people who were familiar with target tasks or designed the tasks had participated in the project. Defining standards and policies for selecting members is also a future work.

6. Conclusion

NEC group encourages activities for creating innovative ICT solutions using a design method called User Experience design process (UX design process) in the initial phase of SI projects. In a real project, applying the UX design process demands a large amount of time and resources since the UX design process involves time consuming activities in order to learn about their requirements. To solve this situation, we proposed a customized UX design process and applied it to a real project of improving help desk tasks to evaluate the proposed process. As a result, we obtained the following findings:

- It took one and half months to complete the UX design process. It was half amount of time in a previous project.
- We could easily make a consensus with the customer and obtained a high customer satisfaction by executing all activities with the customer.
- The activity of making persona can be simplified while the activity of generating solution ideas should be given more time for higher customer satisfactions.

We would like to apply this process on projects in other domains and improve it continually. Then, we would like to contribute to creating innovative services provided by the NEC group.

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Construction of Check List for the purpose of Risk Management of Service Business

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Recent software development is shifting to service business such as SaaS(Software as a Service) rapidly, which provides one software product to plural customers, unlike the conventional project such as order type SI(System Integration) which is specialized for every customer. Unlike SI which manages individual project, service business is needed to consider the overall service to be a "program" from the point of view that how it collects the fund by later service operation and plan the overall optimization of the program. Therefore, in service business risk management, the assessment viewpoint different from conventional SI should be included in check list used for risk assessment. We illustrate by this report about the making the check list for the purpose of risk management in service business. At first we built a structure called RBS(Risk Break Structure) which had plural risk segments and classified risks into the segments. Then we extracted check items necessary to identify risks of service business and classified them into each segment of RBS. In use of the check list, we found problems that there were risks unrelated to the character of the service business and that the overhead of the assessor is high because of the much number of the risk items, and we developed functions that deleted unrelated items or showed only necessary items according to the assessors' role and the service phase. As a result of applying to the actual project, it was shown that risk extraction of service business and reduction of work load are realized.

Keywords and phrases: Service Business, Program, Risk Management, Check List, Risk Breakdown Structure

1. Introduction

Failed projects have a major influence on corporate management, and efforts to make projects successful are important issues for companies. Risk management is one of efforts to lead the project to success. As a method of risk management, risk assessment using a checklist is carried out(Smith, 2002). We have been working on risk management using checklists in order-based business(Toyama, 2002)(Yokota, 2006)(Yokota, 2012).

Meanwhile, with the recent change in business environment, cloud service business like SaaS (Software as a Service) is rapidly expanding in the software development field. Such service business does not create a system that satisfies the customer's request unlike the conventional SI (System Integration) business, but investigates the market demand appropriately and invests back after investment. In the case of such a pre-investment type business, the check list based on the factor that impedes the achievement of QCD (Quality / Cost / Delivery) like the conventional SI business is not sufficient as the risk management, and the entire service as a "program", and it is necessary to optimize its entirety. More specifically, since the success or failure of each project and the delay affect the progress and policies of the entire project, it is necessary not to individually optimize each project but to think about overall optimization aiming at the maximum profit of the program. Therefore, although risk management is indispensable also in the service business, the checklist should include a different evaluation viewpoint from SI.

In this paper, we describe a checklist aimed at risk management in service business. Specifically, we describe the method of creating the checklist and the filtering function based on the load reduction at the time of operation.

2. Risk management in service business

2.1 Difference between service business and SI business

As shown in Figure 1, the SI business receives orders from customers and delivers it after constructing a system that satisfies the expectations of customers.

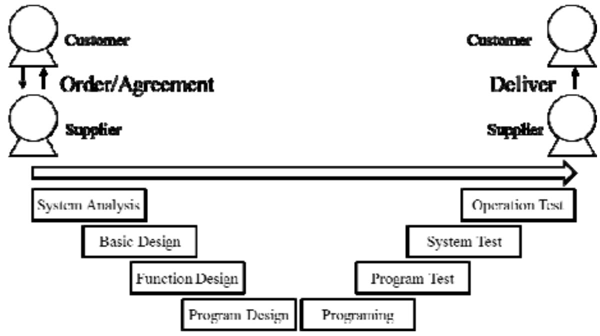

Figure 1 Characteristics of the SI project

Meanwhile, in the service business, after the company has conceived and planned the service itself, it will explore the customer in the number of development and operation as a basis for implementing the service. As shown in Figure 2, in the service business, there is a significant difference from the SI project in that it needs to be "priority investment" and "investment recovery after operation start".

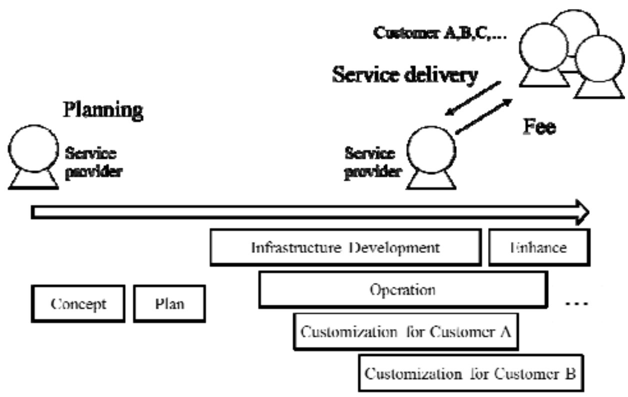

Figure 2 Characteristics of the Service business

Regarding investment in particular, the external environment of the market etc. will change, so it is necessary to constantly monitor the situation and review business goals as necessary. In addition, as development such as enhancement and customization is carried out in parallel, it is also necessary to optimize the whole project.

From the above, in the risk management of the service business, the following viewpoints not found in the SI project are necessary.

1. Viewpoint of project concept / plan for judging and improving the appropriateness of upfront investment
2. Viewpoint of Management that monitors constantly changing external environment and takes appropriate measures
3. Perspective of lifetime profit and loss management for investment recovery after the start of operation
4. Viewpoint of overall service business including multiple development and operation

2.2 Promotion phase of service business

As shown in Figure 3, the life cycle of the service business can be broadly classified into "Concept", "Plan", and "Development / Operation.

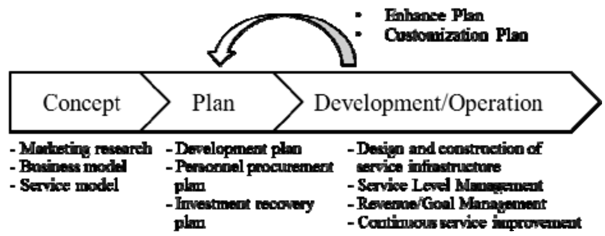

Figure 3 Phase of service business

In the "Concept" phase, Service provider conduct market research, build business models, and so on. As services generally require upfront investment, it is very important whether there is demand when services are realized. Therefore, it is necessary to conduct risk management focusing on whether the current project is consistent with the management policy of the establishment or its company or whether it is a "winning" service against the environment.

In the "planning" phase, Service provider will carry out development plans, staff procurement plans, investment recovery plans, etc. In this phase, we will concretize the plan, so we need to evaluate the risk from the viewpoint of the relevance of the plan and the feasibility of the service.

In the "Development/Operation" phase, work such as design and construction of service infrastructure, service level management, incident management, profit/target management, continuous service improvement occurs. Service must continue to provide services, not completion when launching business. Therefore, needless to say that operation is important, it is necessary to conduct risk management from the viewpoint of usage fee setting, investment recovery monitoring, continuous service improvement, and the like.

2.3 Necessity of management at the program level

In the cloud service business and other fields, take a form of investment such as service infrastructure based on planning and strategy, and take a business form to collect after service in. In addition, it is necessary to continually improve service after customer service and customer trends and other company trends. In order to secure revenue in this fee type business, it is necessary to manage lifetime profit / loss of project group as a whole, such as investment project and expansion project, which is not only profit and loss of individual project.

Meanwhile, in Figure 2, "service infrastructure development", "infrastructure operation", "customer customization", etc. can be regarded as a project aiming to achieve QCD. Figure 4 shows the relationship between individual projects in the service project.

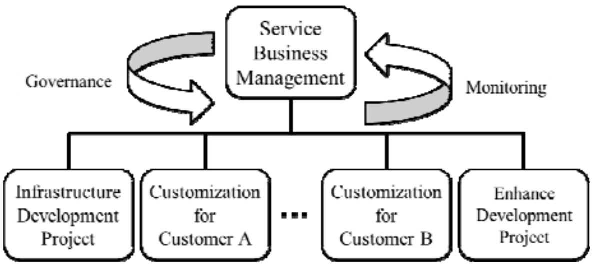

Figure 4 Project group in service business

In the example of Figure 4, service items are developed in "service development project", and deployment to individual customers is handled by "customer correspondence project". Here, it is considered that the service development project may also be launched as a separate project for each function. In this case, elements to be managed include "service development project", "multiple customer project", "service operation project", as well as planning, execution and monitoring of the entire business as a service business.

In this case, managing the service business is equivalent to handling this project group as a program of one service. Management of the entire project needs to be managed as "service business management" based on the situation of individual projects.

Although there are multiple projects in the program, each project is managed for the purpose of managing the QCD, and for the program, the person in charge of the service business will manage the achievement of the benefit from the viewpoint of the entire project.

We think that this way of thinking can also be applied to risk management. Based on this idea, the scope of risk management in the service business is the program level part of Figure 5.

Regarding risk management, at the program level, we evaluate factors that impede the realization of benefits, but individual project level evaluation information is unnecessary and how the impact of QCD and revenue results on individual projects at the program level I want to grasp. For the entire project, it is necessary to link program level and project level information.

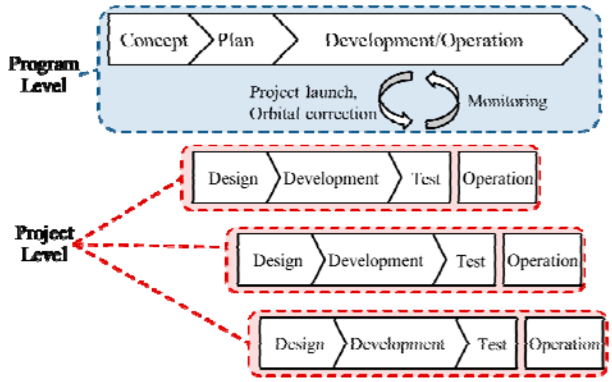

Figure 5 Risk management scope of service business

3. Policy of check list preparation for service business

3.1 Scope of checklist

The checklist aimed at risk management of the service business should include the viewpoint necessary to identify the risk of the entire service business. However, the risks of the projects constituting the service business shall be covered by the check list for the conventional SI, and it is outside the scope of this check list. That is, it becomes a check list at the program management level in Figure 5.

3.2 Target business type

The service business is not always promoted only by a single business provider. We think that we have the following patterns as our service business.

- ✓ Single service provider:
  We procure and promote everything within service providers or related group companies.
- ✓ Joint venture, Collaboration:
  Establish a consortium with other companies.
- ✓ Participation as a vendor:
  Countries, local governments and others lead the service business, and vendors operate it.

Since the risk to be considered differs depending on each pattern, it is necessary to deal with it.

3.3 Viewpoints necessary for risk management

We believe that the following two perspectives are necessary for risk management of service business.

- Perspective to be held down as management
  Risk that there is no need to consider afterwards once the task is executed like a regular standard.
- Viewpoint of situation grasp
  Risk that may occur again after resolving once like schedule delay.

We extract items necessary for risk management as "check items".

3.4 Scope of checklist

3.4.1 Building of risk breakdown structure

When preparing the checklist, it is necessary to prevent missing viewpoints necessary for risk management and enhance coverage. Therefore, we decided to organize the check items by the structure that classifies the check items for each of the divisions divided into multiple parts. This structure is called RBS (Risk Breakdown Structure).

3.4.2 Design for identifying problem areas

In order to make it possible to easily identify the problem part in promoting the service business, the second hierarchy (Level 2 of RBS) was designed to correspond to 1 to 5 in Figure 6.

1. Risks related to the business itself

   We identify risks from the viewpoints of whether the business to be realized is correct or whether there is no problem in target setting.

2. Risks related to implementation methods / measures

   We identify risks from the viewpoints of whether our company can do the process to realize the project or whether it is ready to promote the business.

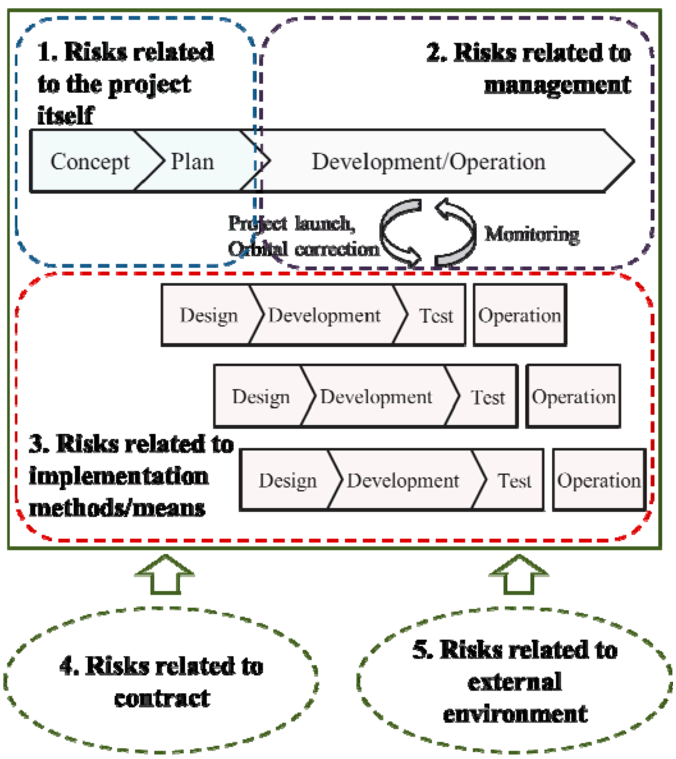

Figure 6 Structure of the second hierarchy

3. Risks related to management

   We identify risks from a viewpoint such as whether they can be executed effectively and efficiently, or whether they can be properly controlled on the execution.

4. Risk related to contract

   We identify risks from the viewpoints of whether measures are taken against risks relating to contracts with other companies or service business entities.

5. Risks related to external environment

   We identify risks from the perspective of whether we are grasping external factors that impede business promotion.

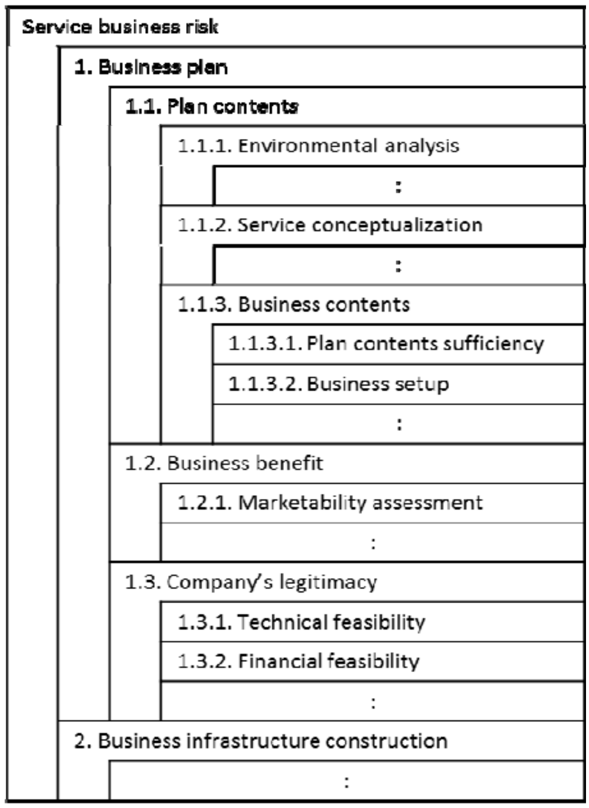

Figure 7 Sample of RBS

3.5 Building of checklist

As a result of subdividing the upper hierarchy and constructing RBS, it became a maximum of six hierarchies. Check items in the checklist were linked to the items in the bottom layer. As shown in Table 1, check items gave points for answer options and answer choices as well as questions. The score is given to the answer choice and quantifies the risk of the service business from the total score of all check item scores.

Table 1 Sample of checklist

Check Item	Answer Choices	Score
Do you analyze external environment (politics, economy, society, technology, competitors, etc.) surrounding the service business by means of PEST or 5F analysis and organize “menace” and “opportunity”? (As an example, in case of service business having a great influence from legal system revision, can you grasp the time and scale of the revision?)	Completed.	0
	Partly finished.	50
	Not yet.	100
	Unidentified.	100

We gathered information on internal and external risk factors and created checklist check items.

4. Development of support function

4.1 Issues in operation

We applied the created checklist to the service project of the actual project and verified the possibility of omission and the usefulness of each check item. The target of verification is two projects in the planning / planning phase and two projects already in the operation phase. Based on the review results, we reviewed the necessity of the check items and carried out a brush up such as correcting the contents, and created a check list of 335 items.

On the other hand, it became clear that there are the following issues in checklist operation in the review.

a) Items unrelated to the target service

There are check items that are irrelevant depending on the service business. For example, in the case where a service provider promotes business independently, there is no contract and the check item concerning the contract is irrelevant.

b) The number of evaluation items

As mentioned above, it is pointed out that the total number of check items is 335 items, and the burden on the evaluator is high.

Both of them are concerned with reducing the burden on the evaluator during check list operation. Therefore, we adopted the concept of the dynamic generation function of the checklist which filters the check items according to our previous research, the project situation.

4.2 Filtering function for check items

A) is an indication about items that are not related to the subject case and it can be eliminated when the subject matter is confirmed. On the other hand, as for the case B), it is necessary to filter the check items from the viewpoint of lowering the load at the time of evaluation although it is necessary as the subject matter.

(1) Filtering by Characteristics

Check items that are unrelated depending on the characteristics of the service business are considered unnecessary and must be deleted from the checklist before the first implementation of risk assessment. Specifically, a key for searching for check items having characteristics is set and searched, and non-applicable items are permanently deleted from the check list. As a result of checking the checklist, it was confirmed that filtering with the key shown in Table 2 can efficiently delete irrelevant items.

Table 2 Key for filtering by characteristics

Key	Overview
Overseas business	Overseas projects have risks such as environments and languages not found in domestic projects.
Partner	Collaborative managers have a large influence on the service business from the standpoint of financing, such as jointly investing in the service business. There are risks such as contracts when there are joint management, such as the business pattern.
1st user	The 1st user has a great influence on the service business in that it relates to the formulation and change of the required specification, and there is a greater risk than the user after 2nd.
Construction	In the case involving the construction of a data center etc., there are risks such as geological conditions of the site.

(2) Filtering by Phase and Role

Although the number of check items is large, it is not always necessary to evaluate all the items at once. As an example, it is difficult to evaluate risks related to operations when the service business is still only the planning stage. From this, we need a function to present only the necessary check items according to the service phase.

The difference between “Filtering by Characteristics” and “Filtering by Phase and Role” will be described using the example of Figure 8.

The former is an example of narrowing down cases specialized for domestic, and unnecessary check items #3 and #6 are deleted in domestic cases. The latter is an example of narrowing down by the planning phase, and check items #4 and #5 related to the other phases are hidden.

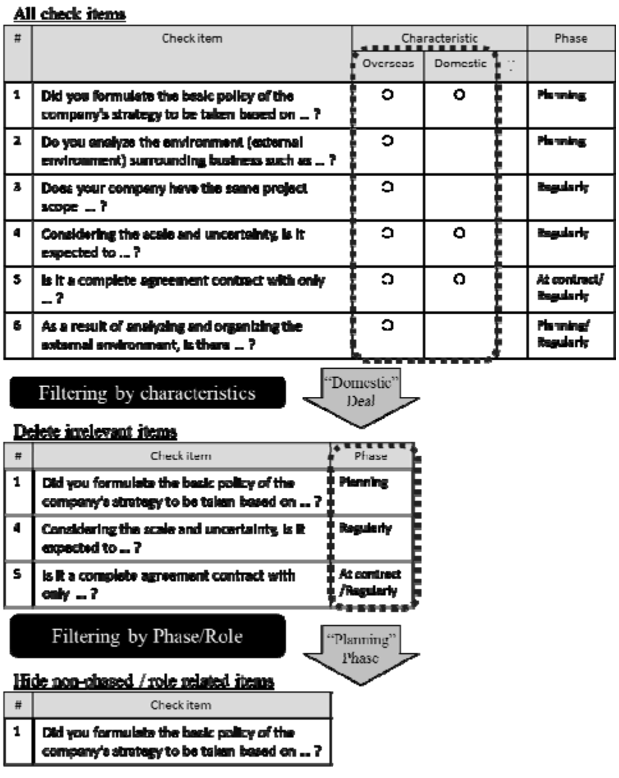

Figure 8 Filtering function

5. Conclusion

We constructed a checklist aimed at risk management in the service business and examined filtering to reduce the evaluation load of the checklist.

Regarding the checklist construction, we constructed RBS by dividing the risk into multiple categories and classifying the risks by category. In addition, we extracted the check items necessary to identify the risk of the service business and classified it into each category of RBS.

As concerns the filtering of the check items, we examined the filtering function to present only the appropriate check items according to the characteristics of the service business and the phase of the service / role of the evaluator.

Future works are as follows.

- Risk management by this checklist should be carried out in-house and brushed up.
- Invent of a mechanism to grasp the risk of the entire project service level which constitutes the service business as the risk of the entire service sucked up.

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Project Management for ID Projects: Comparative Study on Japan's ODA and ADB Projects in Indonesia

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Countries in Southeast Asia have developed, in recent decades, because of financial support from international donors such as the United Nations (UN), the Asian Development Bank (ADB) and the Japan International Cooperation Agency (JICA). Multi-lateral development banks and bilateral agencies, as donors, play a significant role in countries' economic development by implementing international development (ID) projects, which differ from commercial conventional projects. Such projects are generally affected by completion delays even if final costs are within the planned cost, despite project scales. This paper focuses on ID projects in Indonesia, the largest country in Southeast Asia. In particular, ID projects, which are concessional loan projects, funded by ADB and Japan's Official Development Assistance (ODA) are examined and compared from the viewpoints of the findings of previous studies, that is, the paradox of delay and cost overrun, and of project scales and delays. In addition, the paper considers whether ID projects in Indonesia are unique.

Keywords and phrases: International Development Projects, Comparative Study, Project Management, Indonesia

1. Introduction

Many bilateral and multilateral organizations have implemented international development (ID) projects in developing countries. ID projects have some unique features. Through these projects, both social issues and economic issues are addressed, and many stakeholders are involved (Ahsan and Gunawan, 2010; Ika, 2015; Ahsan, 2012; Otsu et al., 2002). Thus, the overall benefits of ID projects are not only economic ones. From this viewpoint, ID projects differ from conventional projects. Many ID projects aim to improve infrastructure, e.g. construction of power stations, transmission lines, bridges and roads, which are the foundation for economic growth. There is an abundance of literature that argues that economic and social development in Asia has been achieved as a result of infrastructure development. ID projects have therefore played a significant role in development.

However, according to Ahsan and Gunawan (2010), ID project management is very different to conventional project management in which a triangle of scope-cost-time factors is considered as crucial (Kerzner, 2009). If the completion of a conventional project is delayed, the project cost is usually likely to increase accordingly.

The views expressed in this paper are those of the author(s) and do not necessarily represent the official positions of JICA.

However, current literature suggests ID projects that suffer completion delays and do so with final costs under the initial estimated cost of the project. Kaimasu et al. (2016) suggest that this can be applied to the previous study, which investigated Japan's official development assistance (ODA) loan projects as ID projects. There is also another finding from the previous study that completion delays can be seen in most projects regardless of project scale.

ID projects contribute to economic and social development in Asia, but can suffer completion delay within initial project cost estimation. This study also focuses on ID projects in Indonesia where numerous projects have been implemented and where sufficient details of projects can be evaluated in detail. This paper addresses three key issues. First, the paper confirms whether the findings of the previous study are applicable to ID projects in Indonesia. This paper examines and compares concessional loan projects funded by the Japan International Cooperation Agency (JICA) under the Japanese Government and the Asian Development Bank (ADB) in Indonesia.

Second, this paper attempts to clarify an ID project feature of Indonesia. In the previous study, the main reasons for project delay were slow administrative, procurement processes, etc. These systems are different between governments where some government administrative procurement procedures can affect whole project schedules and costs. This is a relevant risk management feature of ID projects in Indonesia.

The final key question focuses on what issues should be taken into account for ID projects in Indonesia and what potential risks can be anticipated. The unique features of Indonesian ID projects from two organisations are highlighted, where it is also helpful to account for project contingencies when ID projects are planned. This paper will address these three issues by a comparison of JICA and ADB projects in Indonesia.

2. Definition of ID projects and related issues in Indonesia

There are two types of ID projects, grant-based technical assistance (TA) and financial assistance including concessional loan projects. (Kaimasu et al., 2016; Ika et al., 2010) Large-scale economic infrastructure is usually improved in recipient countries through the provision of concessional loans provided by JICA and ADB as lending agencies. Prior to the implementation of ID projects, a Loan Agreement between lending agencies and borrowers is signed. After commencement, project owners then procure consultants and contractors before substantial works commence in accordance with JICA and ADB guidelines respectively. Upon completion, an evaluation process of projects' results is undertaken based on five criteria, relevance, effectiveness/impact, efficiency, and sustainability (i.e. the Five OECD-DAC Evaluation Criteria).

2.1 Development issues in Indonesia

Indonesia is the largest country in Southeast Asia with many pressing development needs. The Indonesian Government has a number of long and medium term plans, and currently is implementing a national medium term national development plan 2015 - 2019 (Rencana Pembangunan Jangka Menengah Nasional), focusing on environmental as well as economic development. As such, the country has continued to develop in the past two decades both socially and economically. The World Bank indicates that Gross National Income (GNI) per capita for Indonesia was USD $580 in 2001, and increased to USD $3,400 in 2016. One reason for this achievement is the technical and financial assistance provided from various donors.

2.2 Japanese ODA projects in Indonesia

In 2015, the Japanese government pledged ODA loans worth over JPY 1 trillion yen, equivalent to approximately USD $10 billion which increased to JPY 2 trillion by 2016.

For the Japanese Government, Indonesia has been one of the largest recipients of ODA loans since the program began in 1968. For the past 15 years, the average annual commitment amount was JPY 88 billion. The total amount of the loans including non-project loans was approximately JPY 4.83 trillion. Figure 1 shows the proportion of Japanese ODA loan projects to Indonesia based on project number as of 2016.

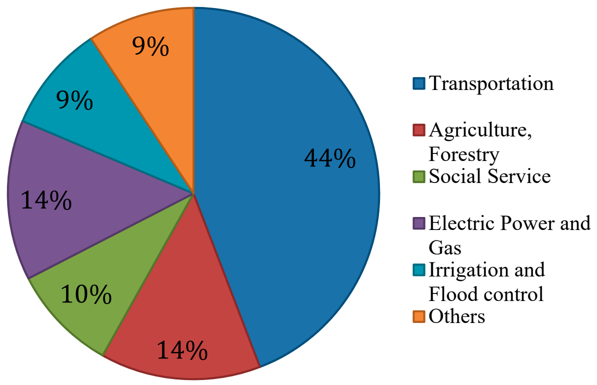

Figure 1 Proportion for sectors for ODA loans

Source: JICA

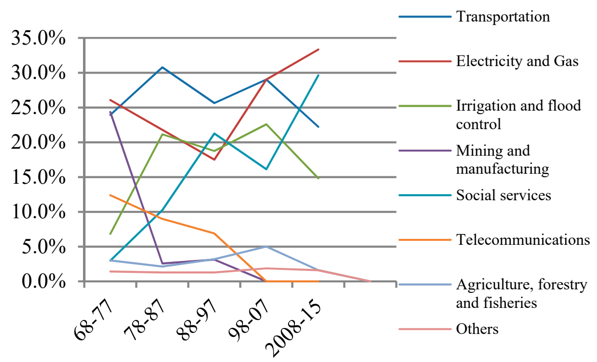

Figure 2 Trends of ODA loans by sector

Source: JICA

Nearly half of the Japanese ODA loan projects are categorised under transportation sector. In the past two decades, as shown in Figure 2, more projects for social services were carried out than before, but their project costs were generally low. The number of projects for electricity and gas was almost the same as for social services, however, the scale of electric power and gas projects were much larger. Thus, more loans were directed and spent on infrastructure.

2.3 ADB projects in Indonesia

ADB has also assisted Indonesia through loans, technical assistance and grants to the total of USD $33.5 billion, including a large amount of concessional loans. Over the past 15 years, pledged loans totalled over USD $16 billion with an average initial loan of approximately USD $150 million. Figure 3 shows the proportion of ADB loans based on project numbers, with ADB categorising some projects in multiple sectors. Even though ADB's categorisation differs from the JICA, ADB loan projects appear to be more diverse than JICA. This can be explained by ADB's mission to tackle poverty eradication. Rauniyar and Kanbur (2010) point out that a comprehensive approach towards social development contributes to effective poverty reduction through ADB loan projects in Indonesia. In this sense, such projects in Indonesia are not exceptional.

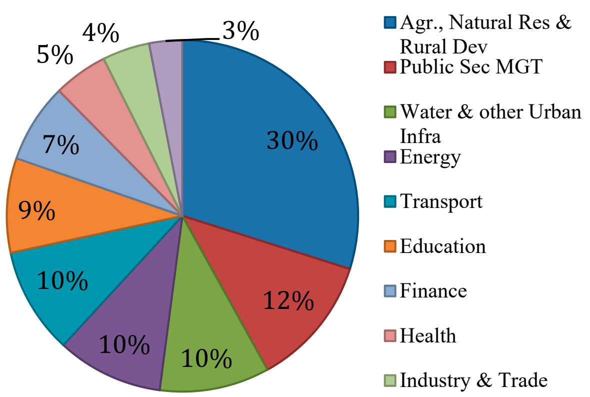

Figure 3 Proportion of ADB assistance to Indonesia by sector

Source: ADB

Some projects are also co-financed with The World Bank and bilateral development agencies, including JICA.

3. Research procedure

Research procedures are described in this section. The data to examine ID project results in Indonesia in terms of viewpoints of project management are taken through ex-post evaluation reports published by JICA and completion reports published by ADB respectively. Ex-post evaluations are made by JICA three years after completion, whereas ADB also conducts project evaluations twelve to twenty-four months after completion.

3.1 Methodology

As for Japanese ODA loan projects, forty-nine samples are picked up from its ex-post evaluation reports conducted and disclosed between 2007 and 2015. As for ADB's loan projects, one hundred seven samples are picked up from its completion reports evaluated and disclosed between 2000 and 2015. In total, this study examines all disclosed one hundred fifty-six evaluation reports by JICA and ADB.

Five criteria are always used to evaluate these projects' results. Efficiency draws particular attention to differences between actual schedule and cost, and initial estimated schedule and budget. These two items are parts of three vital factors for project management, quality, cost, and time.

In a previous study, Kaimasu et al. argued the relationship between project scale and efficiency. USD $200 million projects are regarded as large-scale projects, with small-scale projects typically below approximately USD $20 million. The number of 'small-scale' projects, however, is rather low. It is hard to argue definition of project scale through past literature as there exists no agreed the definition of 'small-scale' concessional loan projects. In this research, categories for small, medium and large-scale projects are below USD $50 million, between USD $50 and USD $200 million and over USD $200 million. In addition, medium-scale projects are divided into two categories, USD $50-100 million and USD $100-200 million.

3.2 Overview of Data

An overview of the two institutions reveals a wide difference of contexts in which financial assistance has been provided to Indonesia under the auspices of the JICA and ADB. ODA loan projects have mainly contributed to improving economic infrastructure while ODA loans have played a significant role in assisting the social services sector in Indonesia. Trends in the provision of assistance have changed in the past 50 years where JICA focuses on large-scale infrastructure where as ADB covers social service sectors as well, which typically involves more stakeholders. loan projects.

The target projects are classified in Table 1. As shown in Table 1, 20% to 25% of total loan projects are large-scale projects. Likewise, 15% to 25% are small-scale projects.

Table 1 Project number based on their scales

	ODA projects	ADB projects
Small-scale	8	25
50 – 100 million	12	26
100-200 million	13	28
Large –scale	16	28
Total	49	107

Source: JICA and ADB

Fourteen projects are classified under electricity sector, representing the single largest project item. Agriculture, engineering, roads, and flood control follow. In terms of ADB's target projects, the top five sectors are agriculture and natural resources, transport, gender, environment and health. Project proportions for ODA and ADB differ from their own overall figures.

There are also exceptions that exclude some projects from the target projects, one example where twenty programs were carried out in one project, and another three programs for JICA projects. There are also Financial Intermediary Loans called Two-Step-Loans (TSL). Under this scheme, JICA would lend concessional loans to a ministry of finance in a recipient country. As fund at the ministry of finance loans are mobilised. These types of loans should be taken into account in the efficiency of projects.

3.3 Results from the reports

A total examination of all project reports found that although most project completions were delayed, final costs of projects remained within estimated costs. This is a general tendency for ID projects, which this section examines in further detail.

There were forty-nine projects for Japanese ODA loan projects but only five projects were completed within the initial estimation, with four projects classified as programs, which were close to Development Policy Lending. There was only one project, Lahendong Geothermal Power Plant Project, which was completed within planned cost and time. In other words, the actual project duration was 71 months from 73 months, the estimated duration. The planned cost was JPY 7.007 billion, but the actual cost was JPY 5.6 billion. The seven projects' completion was also delayed and the final cost was over the initial estimated cost.

The average figure for Japanese ODA loan projects in Indonesia is that approximately 75% were delayed in completion but the final costs were not over-run. Average planned project duration was 78.18 months but actual average project duration was 93.58 months. The average planned cost was JPY 18.49 billion but the average final cost was JPY 14.86 billion.

Out of one hundred seven projects, nineteen ADB projects were completed within planned time and cost. Six projects were named as programs with eleven projects disbursed in one day, and demonstrated a necessity to follow complex procurement procedures based on Indonesia's legal system and ADB guidelines. Eight projects consisted of component work including consulting and civil works. These components increased project complexity. Another eight projects also showed time and cost over-run regardless of project size. Approximately 75% of ADB projects were finished with some delay but without cost over-run. Average planned project duration was 55.69 months and actual period was 70.47 months. Average planned cost was USD $ 209.94 million and actual cost was USD $ 167.90 million.

In the previous study, eighty random ODA loan projects implemented all over the world and much literature were reviewed. Many of the reports suggested reasons for time over-run due to government actions, including slow administrative supervision and insufficient bidding documentation. These points have also been noted in reviews of JICA and ADB reports. In the next section, the paper will argue points related to problem statements.

4. Findings and Discussions

4.1 Application of the two findings

From the results of Japanese ODA and ADB loan projects, the paradox of delays and cost overruns are applicable for ID projects in Indonesia to the first finding that was argued in the previous study. Approximately 75% of all projects' completions were delayed but the final costs were below planned costs. In the previous study, forty-one of the eighty projects were time over-run but cost under-run, in comparison with selected ODA loan projects in Indonesia with project delays and cost over-runs.

Table 2 shows causes of project delays, with the most common reason attributed to procurement. Bureaucracy in recipient countries is also an essential critical factor (Ahsan (2012). In Indonesia, the size of governmental departments and agencies are large because of an existence of coordinating ministries. The Coordinating Ministry of Economic Affairs is one example, which needs to coordinate related ministries on particular issues. This large bureaucracy delays project schedules. As a result, only one Japanese ODA loan project was finished within both planned time and cost.

Table 2 Causes of Project Delays

Reasons	#
Procurement Delay	62
Slow Civil Work & Land Acquisition	40
Natural Calamities	21
Government Lengthy Procedure	19
Local Politics	16
Loan Approval & Disbursement Delay	15
Others	24

Source: Ahsan (2012)

The second finding is the paradox between project scale and delays, which can also be applied to ID projects in Indonesia. Figure 3 and Figure 4 present efficiency between time and cost. On the vertical axis, values show the ratio of planned and actual times. On the horizontal axis, values show the ratio of planned and actual costs.

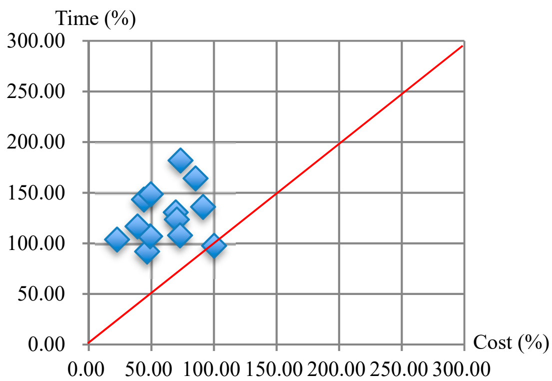

Figure 3 Efficiency of ADB's small-scale projects

Source: ADB

In Figure 3 and Figure 4, the dots appear scattered at random, however, the overall results of projects' efficiency are time-over-run and cost-under-run, as most projects are above the 45-degree line. There was one project, which was completed with delay and cost over-run in Figure 4.

Figure 5 and Figure 6 describe project efficiencies of Japanese ODA and ADB large-scale loan projects respectively. Even larger projects were mostly delayed and under planned cost. This tendency can be seen in Figure 5 and Figure 6.

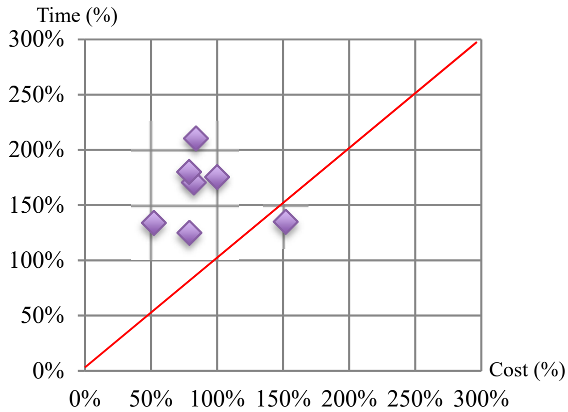

Figure 4 Efficiency of ODA's small-scale projects

Source: JICA

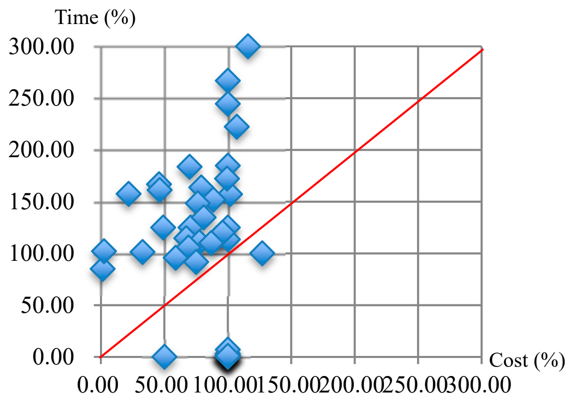

Figure 5 Efficiency of ADB's large-scale projects

Source: ADB

The results recorded of large-scale projects between planned and actual times are wider than with small-scale ones as observed in Figure 3 and Figure 5. In short, the projection of implementation for large-scale projects seems more difficult which is applicable to Japanese ODA loan projects. In addition, more large-scale projects were finished with cost-over-run and time-over-run. This means that the risks and uncertainty for large-scale projects are higher than for small-scale projects, even if the number is small.

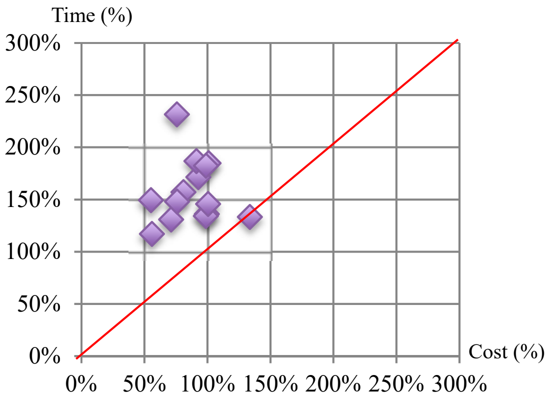

Figure 6 Efficiency of ODA's large-scale projects

Source: JICA

4.2 Features for ID projects in Indonesia

This study focuses on ID projects in Indonesia and represents a second study to investigate unique features of ID projects in Indonesia. As previously stated, the number of efficient projects of Japanese ODA loan is small compared to the number of ADB projects completed within planned time and cost. Project scales vary among these projects with some large-scale ADB projects' disbursement made in just one day. Disbursement administration is easy for both parties while these loans closely follow policy lending. Commitment charge can also be another factor.

Ahsan and Gunwan (2010) examined ADB projects in four countries where the ratio of projects with the efficient performance was small, which is also comparable in this study. Indonesia has huge bureaucratic bodies, which often requires coordination to implement a project schedule, which can be time-consuming. Ahsan (2012) concludes that time and cost variance is a significant factor, which also applies to Indonesia. However, further research via interviews or quantitative surveys is still needed.

4.3 Comparisons between JICA and ADB

Some ODA large-scale loan projects are split into several phases, by the way of 'time-slice'. Time-slice aims to raise the accuracy of forecasting project implementation. However, there were few ADB projects titled phases from the list of completion reports. Instead, ADB could adopt the Multi Tranche Financing Facility (MFF). ADB (2015) states that the MFF facilitates long-term partnerships between ADB and its clients (p. 1, Operation Manual of Bank Policies), and that ADB paid more attention to programs than stand-alone projects. In many instances, ADB projects prepared various modalities to help realise a program approach. Evidence of this can be seen by the number of programs listed, which totalled twenty out of one hundred seven projects.

Project performance is different between Japanese ODA and ADB loan projects with more ADB projects achieving performance in terms of efficiency. Some substantial policy lending increased project efficiency. ADB's focus on tackling poverty likely increased its stakeholders, but performed well in terms of efficiency. One of the reasons for this performance was the result of its approach. On the contrary, few are not applicable. There are few large-scale projects, which operate under a financial intermediary loan where the disbursement is a small amount from the original loan. The completion report for Small Medium Enterprise Export Development Projects, for instance, highlighted a key point that domestic banks, which join the project as participatory banks, prefer to use their own resources. As a result, it is hard to describe this as a successful project.

Most projects were also delayed with the most common cause being the result of delayed recipient government procurement procedure and land acquisition, as shown in Table 2. Presumably project-type loans have similar tendency between Japanese ODA and ADB loans. Thus, loan types can be a factor, which decides to differ in project performance. On the other hand, financial intermediary loans can be easily administered but some of these projects were also delayed. Consequently reviewing secondary data is of limited use for in-depth analysis, so further research is still needed.

5. Conclusions

This paper focuses on Japanese ODA and ADB loans in Indonesia as a comparative study of ID projects. In the previous study, there are two findings of a paradox of delay and cost overrun, and a paradox of project scale and delays. In conventional projects, project completion delays result in a project cost increase. However, this appears to be not applicable to ID projects. In the previous study, more than 80% of the Japanese ODA loan projects in the world were not completed within the initially scheduled period. In addition, fewer than half of all projects were completed within the initial planned cost. This tendency was also seen in ID projects in Indonesia. In addition, the scale of Japanese ODA and ADB loan projects did not appear to affect project performance. Therefore the two findings of the previous study appear to also apply to ID projects in Indonesia.

Different recipient countries show different project performance. Most ID projects in Indonesia were delayed in completion. Cost variance and schedule variance can be different among countries. The main cause of project delays is related to recipient government action including procurement and land acquisition. In Indonesia, the bureaucracy includes numerous large departments and agencies, including coordinating ministries, which leads to project delays. ADB also focuses its attention on poverty projects, which are more multi-sectoral and thus involved more stakeholders. However, these projects were completed efficiently. ADB projects have demonstrated different modalities to implement projects in an efficient way. In some programs, projects are implemented where stakeholders can be involved in projects at the early stage of planning, whereas Japan's ODA projects seem to be more represented by stand-alone projects. Project management is likely to be more difficult for these projects. This can be another assumption and scope for future studies.

This study examined ID projects in Indonesia. Reviewing secondary data is of limited use for in-depth analysis, so further research is still needed.

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A Study of Important Points about Operational Design in Information Systems

- The Sensible Suggestion Presented from IT Service Manager to Development PM -

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TCO (Total Cost of Ownership) reduction in maintenance and operation is one of main problems for information system divisions. We think that the improvement of operational design can lead to TCO reduction. When we analyzed the cause of troubles that occurred by incompleteness with operational design, it has emerged that development PMs regard customer requests as more important tasks than operator requests and they leave problems that will bring about big influence at the operation phase. Therefore, we suggested six points of operational design that are often slighted by development PMs and operation divisions receive big damage. In this paper we report a study of important points about operational design in information systems.

Keywords and phrases: Risk Management, Scope Management, Operational Design, TCO Reduction, Maintenance and Operation

1. Introduction

The rate of budget for maintenance and operation of information systems in Japan is very high at about 80 percent (Japan Users Association of Information Systems, 2014).

Information systems have recently been charged with a mission to seek higher profits and to improve customer satisfaction by making full use of the latest technology for new business models such as Big Data, AI, Industry 4.0, and Fintech, etc. in addition to the contribution to BPR (Business Process Re-engineering). Thus, there is a strong demand for an increase of the investment ratio to more “Offensive IT Investment” rather than “Defensive one”. (NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc, 2015).

Therefore, TCO (Total Cost of Ownership) reduction in maintenance and operation work of “Defensive IT Investment” is one of main problems for information system divisions.

We are all Project Managers (IT Service Manager: hereafter called as IT-SM) in charge of maintenance and operation divisions of each different commercial or internal information systems and members of one group in mentoring development systems called as “IT-SM Development School”, in which experienced IT SMs (mentees) provide young IT-SMs (mentors) with skills and know-how.

For example, the breakdown examination of maintenance and operation costs for information systems in NTT DATA Corporation shows that operation work to manually complement service operation, the unmounted part at the time of system development accounted for about 30 percent. ((Eguchi et al., 2015), (Nakajima et al., 2017), and (Kubota et al., 2017)). The tendency with a lot of service operation generally applies to other information systems. Therefore, we focused the reduction of manual operation work that causes the increase of operation costs, and we supposed most of manual operation work occurred by incompleteness with operational design. We think that the improvement of operational design at system development can lead to TCO reduction.

On the other hand, Sawada (2005) states that “operational design should be performed from the upstream stage (rough design, detailed design) in the system design phase to prevent the increase of maintenance and operation work, duplication of effort, rework, and unacceptable matters”. Furthermore, as for the reason why development division became impossible to deal with operational design, he also points out as follows: Unlike in the past where operation was made during development, after much value is placed on productivity and working roles are separated, the ability of operational design has decreased and the operation cannot be currently considered. As a result, the development division does not understand the operation, whereas the operation division does not understand the system. In this sense, it is desirable that both divisions should deal with the operational design bringing together with individual skills of each role.

In this paper we report a study of important points about operational design in information systems.

2. Precedents

By the examination results of the precedents on improvement of operational design, it was found that research and standardization activity were performed with the following two perspectives.

1) Extraction of exhaustive operational design items and preparation/utilization of guidelines

   Sawada (2005) recommends identifying key words necessary for operational design, preparing a listed operational design check sheet for design confirmation items, and integrating scattered rules and regulations to the Operational Design Guideline.

   TIS Solution Link Inc. says that standardization of operation should be advanced through the implementation of the system development based on the Operational Guideline.

   INTEC Inc. eliminates arbitrary factors by humans as much as possible with the complete process standardization and implements company-wide activity to bring the operational quality of information systems to the attractive level (Nagao et al., 2005).

2) Establishment and utilization of guidelines specializing in the current topics such as BCP and information security

   National center of Incident readiness and (Strategy for Cybersecurity, 2013) established "IT-BCP Guideline Creation Manual of Central Government Ministries and Agency" and relevant materials in response to increased awareness of the importance of BCP after the Great East Japan Earthquake.

3) (Information-technology Promotion Agency, Japan, 2014) established "System Design Guide for Thwarting Targeted Email Attacks" with the growing concern about information security against targeted email attacks in the world.

3. Issues

As indicated in the previous chapter, exhaustive operational design guidelines are prepared and topics for the current important operational design are published as standardized materials. Consequently, it is thought that development PMs can easily obtain these guidelines and understand exhaustive operational design items.

Nevertheless, there are various problems in the actually operating information system sites as below.

1) Problems occur in the cause-check and handling because error messages and logs are unclear.
2) Operation status become tight because too many error messages and logs are generated even when it is not in an error condition actually.
3) Labor costs exceed the budget due to too much maintenance and operation work (by manual tasks).
4) So many monitoring items take too much time.
5) Insufficient description and ambiguous expression in the Design Document cause problems in the cause-check and handling.
6) Pending issues (open questions) in the development phase still remain during operation.

Even though exhaustive operational design guidelines are provided as mentioned in Chapter 2, development PMs cannot handle them under the completely covered conditions due to the restriction of Quality, Cost, and Delivery (QCD) in the system development. Some parts of the design may be excluded based on the priority. IT-SMs fully understand this kind of development PMs' distress.

Table 1 Evaluation Criteria

Influence on users	Influence on users if problems occur (System-used company, Customer)
Influence on the company	Influence on the company if problems occur (SIer, mainly operation division)
Probability	Probability of problems
Development costs	Costs when countermeasures to prevent problems are implemented in the system development (before cutover).
Repair costs	Costs when countermeasures to eliminate problems are implemented in providing the service (after cutover).

However, looking from IT-SMs' perspective, questions now arise: whether development PMs have misjudged the priority, or paid no attention to the necessary operational design.

Table 2 A list(the excerpt) identifying problems caused by defectiveness in the operational design

ID	Large Category	Middle Category	Small Category	Problem	Suggestion	Development Costs	Repair Costs	Probability	Degree of Influence (User side)	Degree of Influence (Operation side)
1	Service Design	Design/Coordination	Preparation and Succession of Service Design/Package	When monitoring messages, an operator received instruction (request) to disregard as a temporary solution list via e-mail from Development Group. As a result, operator's work by visual monitoring is increasing.	Operational design of monitoring work (specifying time) is required so that the same messages can be branched to be automatically disregarded, not manually, if they are intentionally delivered. ⇒ ・If possible, Development Group temporarily stops delivering unwanted messages. ・Improve the operation system so that Development Group can enter a request to the indication tab, not via e-mail request (scheduled in FY2017).	High	High	High	Small	Large
2	Service Design	Design/Coordination	Preparation and Succession of Service Design/Package	Many messages in the critical section are generated. It is the idea that messages are tentatively generated in the critical section without detailed examination/classification, and then their handling should be considered. This is correct in safety. However, Operation Group would like Development Group to stop outputting a large number of fake error messages. Also, output of a large number of critical messages requires their handling.	**There are many wasteful tasks in message monitoring. They must have unavoidable reasons at an early stage of development. However, its review has not been made on a voluntary basis after a certain time.** ⇒ ・In the operation meeting, Operation Group asks Development Group not to notify an operator of messages without requiring handling by operator (continued work). ・Specifically, Operation Group instructs Development Group to improve Hinemos monitoring setting without work by operator among on-calls generated in the past.⇒Operation Group always accepts and responds to the improvement from Development Group (several cases/month). ・By performing monitor setting for unknown errors in advance, Operation Group (operation and maintenance) changed the operation to the flow that no on-calls occur originally from the one caused by on-calls according to an interview with Development Group.	High	High	High	Small	Large
3	Service Design	Design/Coordination	Preparation and Succession of Service Design/Package	When contacting a person in charge about messages (in the critical section) monitored by operator, an operator often received instruction that handling is unnecessary. *As for the monitoring flow of unknown errors, after an error occur, an operator provides a person in charge with an on-call and then receive a request of monitor setting from him/her.	There are many wasteful tasks in the message monitoring. They must have unavoidable reasons at an early stage of development. However, its review has not been made on a voluntary basis after a certain time. ⇒ ・In the operation meeting, Operation Group asks Development Group not to notify an operator of messages without requiring handling by operator (continued work). ・Specifically, Operation Group instructs Development Group to improve Hinemos monitoring setting without work by operator among on-calls generated in the past.⇒Operation Group always accepts and responds to the improvement from Development Group (several cases/month). ・By performing monitor setting for unknown errors in advance, Operation Group (operation and maintenance) changed the operation to the flow that no on-calls occur originally from the one caused by on-calls according to an interview with Development Group.	High	High	High	Small	Large
4	Service Design	Design/Coordination	Preparation and Succession of Service Design/Package	The delay monitoring is set in the job-net job. However, the following points have not been considered. ・There is no action definition when any delay occurs. ⇒When receiving delay information at midnight, an operator does not know how to handle it. After all, only the way is to rely on the specific person who is familiar with it. (In spite of monitoring delay, how to handle any delay has not been considered. It is the same problem as abnormal cases) ・The validity of delay monitoring is unclear. ⇒The setting remains as it was at the early stage of development and the validity on the actual operation has not been re-examined. As a result, when an alert rang, its timing has been meaningless or unreasonable and strict monitoring has been set in some cases (As mentioned above, when detecting any delay, if considering how to handle it, the monitoring definition must be met with the actual condition. However, this has not been prepared)	【Ideal situation】 Actions must be clearly defined when any delay occurs (whether to notify the delay and continue monitoring, or to immediately terminate to move to the next job). 【Reason for gap occurrence】 Since there are contents being difficult to define at the early stage of development, they depends on the values placed on feeling. A person in charge of operation should have been involved in the design, and setting based on the realistic hypothesis to a certain extent should have been conducted. In addition, after starting operation, regular status confirmation and definition review should have been performed. However, they had hardly been operated actually.					

Therefore, we, site operation PMs (IT-SM), decided to identify various problems related to the operational design, analyze their characteristics, and extract the necessary operational design items in the development with deep insight as experts at maintenance and operation.

4. Factor Analysis

The problems caused by the defectiveness in the operational design in the several operation sites of information systems were sorted out, classified and judged with five evaluation criteria (Table 1), and then analyzed with broad knowledge as experts at maintenance and operation. In fact, they should be evaluated using specific values such as total costs and person-month, etc. However, since the accurate calculation is difficult, the evaluation criteria are weighted based on a three-level scale (Large, Medium, and Small) through consultation among the authors. A list (the excerpt) identifying problems caused by defectiveness in the operational design is shown in the Table 2.

The three analysis results and studies from the Table 2 are indicated below.

Analysis Result 1) ・・・ Table 3

Table 3 Analysis Result 1)

Total of Influence: Large	Q	C	D	Total (cases)
Influence on users	3	0	0	3
Influence on the company	7	11	0	18

- Focusing on "Influence on users" and "Influence on the company", the latter has an overwhelmingly larger number of cases.
- In addition, by classifying on the viewpoint of QCD, many problems are found in Quality (Q) and Cost (C) of the company (Operation side).

Study 1)

- Development PMs appropriately deal with users (customers)' issues.
- However, they treat handling in the development as low priority for issues that their successor, the operation division may soon encounter once entering the operation phase.
- They do not handle problems of Quality (Q) and Cost (C) that the operation division may soon have in the development.

Analysis Result 2) ・・・ Table 4

Table 4 Analysis Result 2)

Total of Probability: High	Small	Medium	Large	Total (cases)
Influence on users	10	0	0	10
Influence on the company	0	6	4	10

- As for Probability = High, the analysis of the influential degree shows that although there is no influence on users = Medium and Large, there are a lot of influence on the company = Medium and Large.

Study 2)

- As was expected, development PMs are user (customer)-oriented.
- While appropriately dealing with users (customers), they pay no attention to operational design items which may cause trouble in the operation division in the future. Or they transfer the said items without handling as a low priority to the next phase even though they are aware of them.

Analysis Result 3) ・・・ Table 5

Table 5 Analysis Result 3)

Development costs are cheaper.	43%	26 cases
Development costs are nearly equal to Repair costs.	50%	30 cases
Repair costs are cheaper.	7%	4 cases

- Development costs are cheaper at a rate of about 43%. Repair costs, those during operation phase are cheaper at a rate of only 7%.

Study 3)

- The degree of importance in the operational design is proved to be high.
- Incorporation in the system development is cheaper in most cases.
- Proper handling in the operational design will
- result in the cost reduction as a whole from development to operation even if development PMs do not easily lower the priority of the issues in the development and also development costs are a little over the budget.

5. Points regarded as important in the operational design

The six points about the operational design, which have a big influence on the operation though development PMs often underestimate, are shown below.

5.1 Point 1: Optimization of messages (to stop unwanted messages)

In the system development, it is frequently observed that a large number of messages more than necessary are output on a screen or log displayed at the time of application error.

a) They must be effective as debug information in the development.

b) It means for preventing incident detection errors caused by outputting no message. PMs need courage to stop currently output messages because they are concerned about the delay in find problems by the so-called “excessive erasing”.

c) Due to the characteristics of try-catch syntax such as Java etc., there is an incident that cannot be determined whether to be significant or insignificant at a very early stage of the actual operation period when an exception occurs.

The above is considered as main reasons.

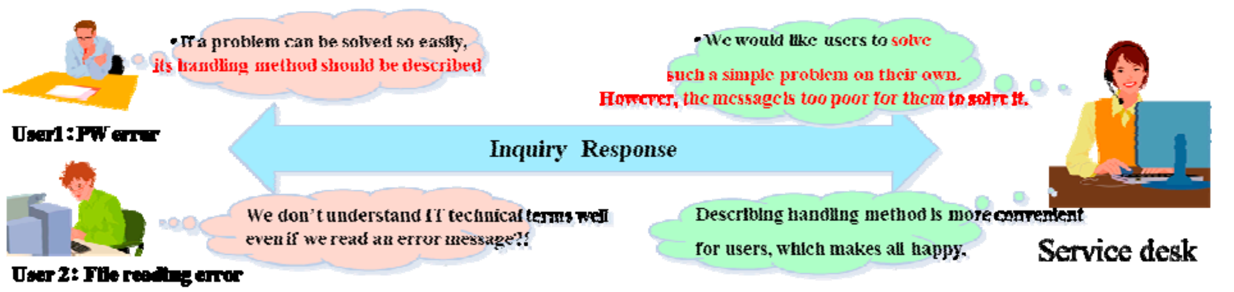
Consequently, since development PMs treat reduction and optimization of error messages as a low priority, a large number of error messages have often been left in the output state. Operators take much time to investigate and confirm those messages that can be nearly ignored, which eventually leads to tightness in operation costs.

Development PMs should enhance the design to output only appropriate messages and release operators from basically unneeded confirmation work. They should design for stopping useless message output in the system development.

5.2 Point 2: Message for users to solve problems on their own

As shown in Figure 1, if receiving a poor error message, users do not know the cause of the error and what to do next. As a result, they must inquire a service desk about it.

Development PMs should promote message design to prompt users to solve problems on their own for releasing a service desk from wasteful inquiries.



	Poor error message	Main handling method	Good error message
User 1	On the login screen, “Login ID/PW are incorrect. Enter correct ID/PW”	Is NumLock on? Is CapsLock on?	On the login screen, “Login ID/PW are incorrect. Is the case sensitivity correct? Please confirm NumLock or CapsLock. If still NG, please contact *****”
User 2	When reading a file, “R****-E11*_Medium error”	Re-save a file to another CD.	MSG-ID：R***-E11* Re-save a file to another CD and then try it again. If still NG, please contact *****”.

◆ Message design for users to solve problems on their own should be promoted!

◆ Service desk should be released from wasteful inquires!

Figure 1 Message design for users to solve problems on their own

5.3 Point 3: Automation of stylized manual tasks

As indicated in Figure 2, when taking over tasks from development to operation, there are a lot of maintenance and operation work based on manual tasks.

From the viewpoint of service quality and TCO reduction, design must be implemented with awareness of automation of the maintenance and operation work in the development.

5.4 Point 4: Matters that are often omitted in the operational design

As mentioned in Figure 3, when identified design items that estimate omission/discrepancies can be easily generated in the operational design, environment configuration, and maintenance/operation, and also that are difficult to collect costs from customers in the operation phase, it is found that design in the facility and equipment aspects corresponds to the above matters. Development PMs are aware of IT-related matters but tend to pay no attention to the above aspects. These costs are too high to repair and reconstruct after entering the operation phase and the cost collection from customers is often difficult. That is why development PMs should consider them as important.

5.5 Point 5: Capacity design

As described in the previous section, development PMs also often pay insufficient attention to the capacity design. Once performance trouble or capacity shortage occurs in the operation phase, early recovery would become more difficult and repair costs would be generated.

They must ensure the following procedures and should not reduce work quality and quantity related to the capacity design in the development.

- A performance test should be conducted with an actual system based on the high load (a peak period) in the actual operation
- The calculation basis of preconditions/assumed service volume at a performance test should be clarified.
- The system usage for the next few years should be estimated and safety factors should be included in the design.

5.6 Point 6: Internal control-conscious design

Financial Accounting System, Human resource and wage/Attendance management system, Business management system, and Electronic request for approval, etc. may be often specified as target systems for SOX Act audit.

When taking over tasks from development to operation, there are a lot of operation work based on the manual tasks.
From the viewpoint of service quality and TCO reduction, automation of operation work is important in the development.

	Concrete case	Benefit to be gained	Risks not to be handled
Case: A	Recovery process should be automated when trouble that can be stylized occurs.	Temporary recovery from trouble occurrence can be seamlessly conducted and service continuity can be secured.	Manual work takes much time for recovery.
		Eliminating manual tasks leads to prevention of human errors. Working time by manual can be reduced.	Secondary damage by working mistake. Increase of costs by manual operation
Case: B	Backup & garbage process for past data and work data should be automated.	Performance degradation is avoidable. Disk space shortage is preventable. Information leakage is preventable.	Performance degradation by wasteful data Disk space shortage error Increase of storage costs Information leakage
		Costs for regularly and continuously generated manual tasks can be saved.	Increase of labor costs Trouble occurrence by operation mistakes

Figure 2 Automation of stylized manual tasks

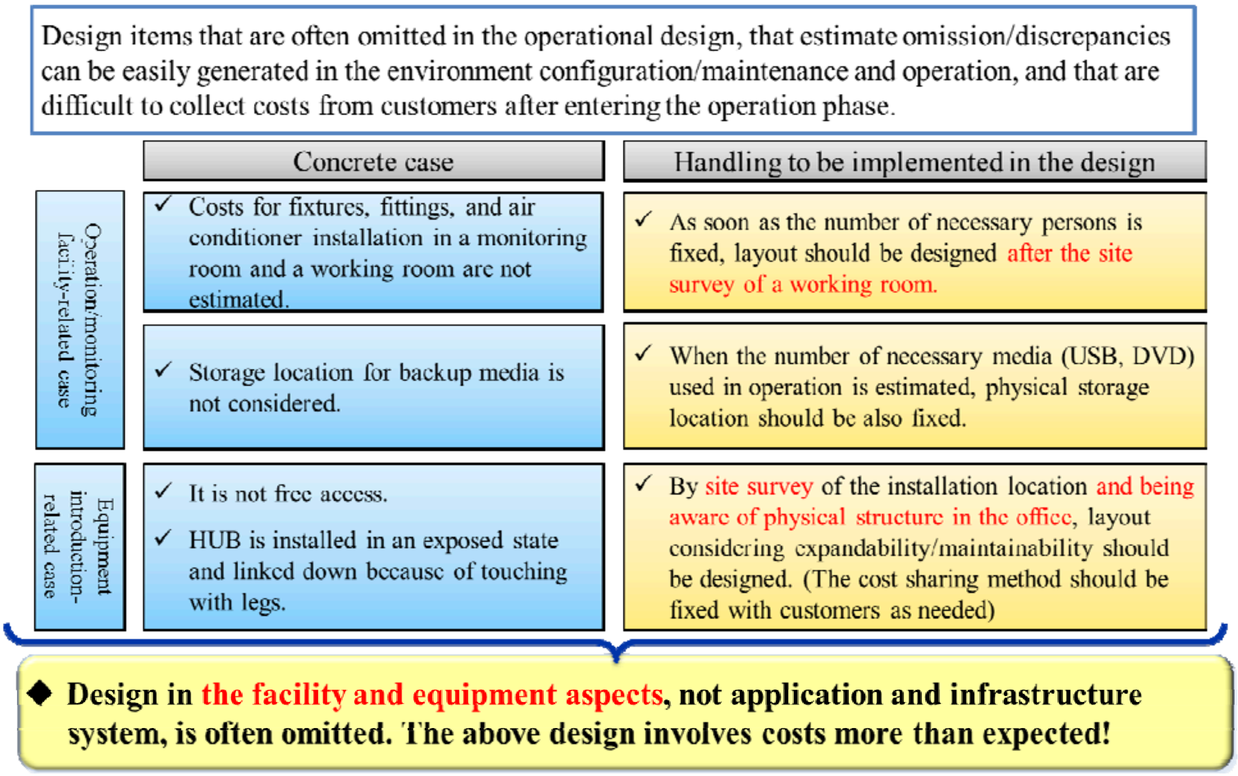


Figure 3 Matters that are often omitted in the operational design

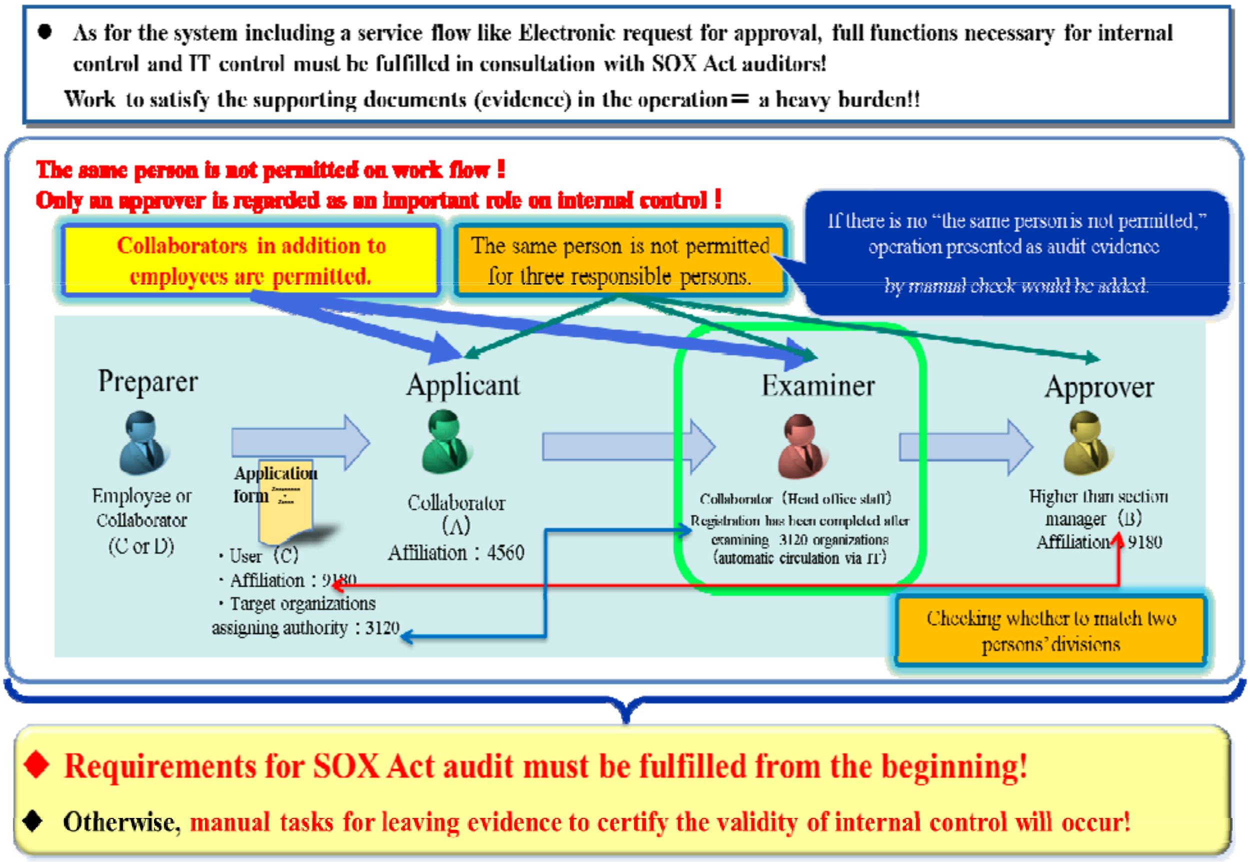


Figure 4 Internal control-conscious design

Accordingly, for example, it is essential for the system having service flows to fulfill full functions necessary for the internal control / IT control in consultation with SOX Act auditors in the design. If entering the operation phase still under the incomplete condition, work to satisfy the supporting documents (evidence) in the operation (manual tasks to leave the evidence for certifying the validity of the internal control) or an empirical analysis task to certify that there is no fraud in the financial statements would impose a heavy burden on the company. (Figure 4)

6. Conclusion

This paper has presented a study of important points about operational design in information systems.

We identified various problems related to the operational design and analyzed their characteristics. The analysis reveals that "development PMs often lower the priority for their successor, the operation division, while firmly supporting users' (customers) issues" and "if their outstanding issues being left for various reasons can be solved in the development, the costs would become cheaper than those for issues postponed to the next phase, considering as a whole process from development to operation".

Furthermore, we have reported six points regarded as important in the operational design. We clarified operational design items to be surely achieved even though it is impossible to cover all of them in the development. Finally, future issues are listed below.

1) Expansion of sample data collection
   Problems caused by operational design must be also collected from other systems to improve variation of points regarded as important in the operational design.
2) Information deployment to other divisions
   How to efficiently deploy important points in this organized operational design must be discussed.
3) Effectiveness measurement
   After achievement of important points in the operational design, effectiveness of each points must be quantitatively evaluated compared to the case where the above points have not been implemented.

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How to Exploit the Strength of the Architect in System Development Projects

- "An Instruction Manual on using the Architect" for Project Managers -

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In a system integration and development project, the lead architect is in no doubt one of the most important stakeholder in the team. Nevertheless, the role of an architect is often poorly defined and especially for senior management, inadequately understood. In fact, a lead architect is more than only a technical advisor. An architect can help the project manager to plan and run a project in a holistic approach. The job of an architect is not limited to build architecture for the computer system. He can use his IT knowledge to advise the project manager on technology trends on product selection and decision making. He can also contribute to the project on project planning, requirement management and risk management concerning architecture. He can also help the project manager to lead the team to set goals and making technical directions. In this paper, the architect as a project resource will be characterized in terms of behavior and conception ability. How the lead architect can contribute in a system development project will be shown from the project manager's viewpoint. Competence of the architect was mapped onto the project management knowledge areas to show the interdependency between the project manager and the architect on critical project tasks. Suggestions were made on how to bring out the full ability of the architect, and how the project manager and the architect can cooperate in a consistent way to achieve a project success. The instructions described in this manual has been applied to multiple projects and got genuine compliments from project managers.

Keywords and phrases: what do Architects do, how to Co-work with the Architect, Relationship between Project Manager and Architect

1. Introduction

In the information technology world nowadays, when it comes to delivering information systems, the project team is expected more from the client including better user experience, better performance and scale faster. The best experience today will become the minimum expectation for the experience the client wants tomorrow. It is too hard for the project manager to manager the project team as well as to establish a prospective vision using cutting-edge technology for the client at the same time.

The project manager needs a person, who can translate the needs of the customer into system requirements, and draw a clear picture of the future system with all the requirements included that the client can understand.

The project manager will also like someone, who can interpret the IT buzz words to something that he can understand and help further conversation with the client. In all these situations, the architect is one of the best selection for the project manager.

As the partner of the project manager, the architect can advise the project manager on IT stuffs and help to bridge the gap between the client and project manager on technical matters.

More important, on occasion the architect communicates with the client on behalf of the project manager on making directions, especially on technical matters.

Concurrently, the architect is an excellent problem resolver. He can take advantage of his IT skills, communication skills, consultation skills, and experiences to identify risks and solve problems. Also, he is skilled at logical thinking, which can help to decompose complex business issues into manageable units, that the project manager can manage to make more accurate assessment and decision.

However, based on our research (done between 2017/6/25 ~ 2017/7/5 survey results from 88 IBM system engineers and IBM system users), only 38% of the project managers in software development projects claims that they understand what exactly the role of an architect is, and only 48% of the architects considered their roles were understood and their skills fully exploited (Figure 1, Figure 2). It is only too true that project managers are using the architect resource ineffectively, and more than a half of the architects are forces to do unintended tasks.

In this paper, the role of the architect will be described. Suggestions are made on project management tasks define in ISO's "Guidance on project management" (ISO 21500:2012). Following these instructions, we hope project managers can assign the right job the architect.

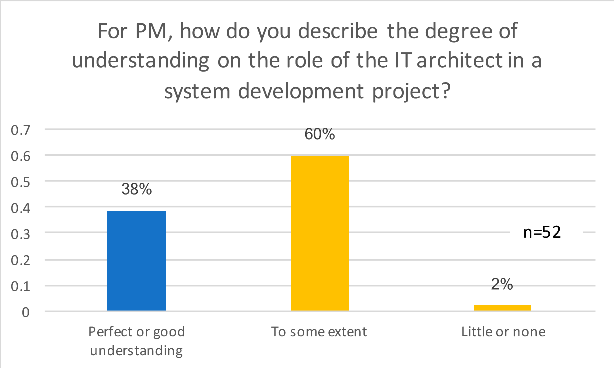

Figure 1 How the PM understand the architect

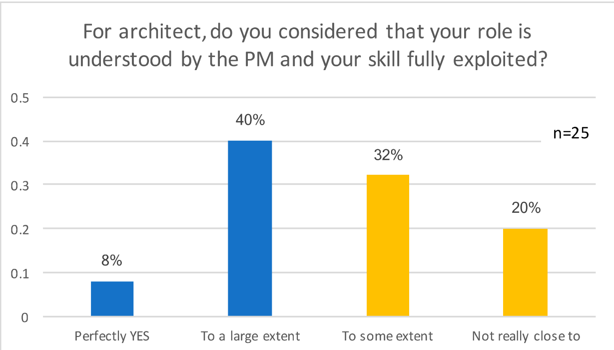

Figure 2 How the architects feel they are understood

2. Definition of architect

So, what is an architect in system development? Similar definitions can be found in SEI and Eeles. (SEI, Carnegie Mellon University.)(Eeles, P.)

In general, an architect is a person who leads teams to define the structure of solutions and architectures to address client business problems. The architect must understand client needs, apply industry knowledge, and leverage appropriate business elements and information technology to address those needs, and must present alternative solutions to meet the client needs identified.

Some of the characteristics of an architect include,

- Architectural thinking
- Define workable solution
- Use methods and tools

More details will be given in the following sections.

2.1. Architectural thinking

Given a problem domain, the architect is able to express the problem from different view or perspective. He can explain how these views are related to each other, and apply architectural techniques and principles to solve the problem.

In case where multiple options are on the table, the architect mediates opposing viewpoints and negotiate equitable solutions to ensure successful and stable outcomes. The architect is capable of maintaining the integrity of the solution while simultaneously serving the needs of multiple stakeholders of diverse needs.

2.2. Define workable solution

As described by Nikonorov (Nikonorov E.), the architect is capable to demonstrate an understanding of architectural decisions and their impacts into solutions that have been realized to a project or engagement. He is responsible for the decision made. He is also responsible to assure the solution is workable and avoid hypothetical architectures that cannot be practically realized.

2.3. Use methods and tools

On defining solutions to a requirement, the architect seldom define the process from scratch. Instead, the architect is eager to use industrial standard methods, process and tools to ensure repeatability and success.

3. Types of architect

There are many types of architect in a system development project. Depending on their roles and duties, there are enterprise architect, application architect, security architect, network architect and so on. In order to assure that the architect is capable to apply architecture capabilities effectively within the context of the company's business requirements, for instance, architects of a IT company are specialized into the following categories:

- Business architecture
- Application architecture
- Enterprise architecture
- Technology architecture
- Data architecture

Specializations define additional knowledge, abilities, and experience that are required for the architect to accomplish his job in a specific area.

Even though we need architects from more than one category, in a realistic project, it is often unnecessary to bring all the architects into the team. Rather, for small to medium size projects, most of the time an architect with multiple roles that assigned as the technical lead will be a good choice for the project manager.

4. Architect task in project lifecycle

In a system development project, both the architect and project manager bring people together and direct the team to accomplish some kind of work.

The architect provide vision on how the system should be, and make sure that the team are doing the right things, whereas the project manager ensure that the team are doing all things right aligned with the schedule.

In a typical software development project, although the architect is usually employed from the beginning of project delivery, the architect can help the team in various aspect before delivery, that is, from the early stage of the sales process.

4.1. Sales

In the sales process, after opportunity is identified and validated, the architect helps the proposal development team to develop solutions. He will understand the business and needs of the client, and develop solution options and delivery approaches to meet the requirement. He will make estimation on project task proposed and figure out the risks contained. It is impossible to develop a sound proposal without the architect.

4.2. Delivery

It is always true for all projects that a success delivery is not guaranteed. The architect plays a very important role to increase the probability of success by making use of his talent. Here we are going to describe the major tasks done by the architect from project start to system service-in.

4.2.1. Project initiation

At the beginning of the project delivery, the architect will establish the initial technical environment, which include selecting tools and setting up the development environment for the development team. He is also responsible to validate technical solution for the delivery. In order to determine the readiness to complete the technical work products and deliverables for the project, the architect will perform a technical readiness assessment to review and validate the technical solution using tools such as check sheet or customized questionnaires.

Another important task of the architect is to deploy the process and create a working WBS. At the very beginning of the project, the architect is responsible for briefing the team on the development method adopted. This provided the team an overview on how to do the project and ensure that the team has the required level of understanding of how to apply the method on this project. In most cases, a working WBS will be created and shared with the team as their common understanding.

4.2.2. Solution outline

In the solution outline phase, the main task of the project team is to outline the artifacts to the solution in a consistent manner. The architect helps the team to understand the complexity of the solution so that the team can link the solution to key business objectives.

While the business analyst concentrates his work on marshalling the business functions, the architect takes care of the non-functional requirements, such as system capacity, performance, security and maintainability, to ensure that they are sufficient to meet the other validated requirements already identified in the solution outline phase.

At the same time, the architect is responsible for the development another important artifact - the test strategy. The test strategy documents the general direction of testing. It describes the full lifecycle of the testing approach and is indispensable for a cost-effective team approach to testing.

At the end of the solution phase, the project manager confirms the accomplishment of the work done with regard to project milestones, take measures to keep the project on track, and evaluate the validity of the project estimation. The architect supplies the project manager with feasibility information in a technical point of view (IEEE Computer Society 42010-2011).

4.2.3. Macro design

In macro design phase, the project team will complete the solution requirements and architectures, and prepare for more detailed program specification and constructions performed in later phases.

The main task of the architect is to develop a technical solution for the project. The following task will be included.

- Refines the non-functional requirements from the solution outline phase, and use it to understand the complexity and performance requirement of the system that are key elements of the architecture design.
- Establishes principles, standards, design pattern guidelines for the team as to improve the efficiency and productivity of the development team and to provide a basis for consistency.
- Details the component model, which defines the interfaces and component specification of the system, to enable estimation, release planning and deployment of the design work.
- Selects infrastructure product by reviewing and selecting commercial products for use in creating the physical architecture of the system.
- Details the operational model, which defines the system components attributes and their configurations.
- Develops technical Proof of Concept(POC), to analyze area of unknown complexity or requirements, and to investigate the viability of new technologies which in turn, mitigates risk.
- Conducts viability assessment, which is a review on the system being developed to verify its ability to meet technical requirements and the likelihood of it being delivered in time and on budget.

Another task of the architect is to develop the data design. The following task will be included.

- Defines data model with respect to the data requirement of the application. Through top-down analysis of the entity-relationship model, the architect defines the data model in such a way that the structure of the data underlying an application by which the processes reference, access, and use the data is clearly articulated.
- Define data format and model for system messaging.
- Develop data migration plan to document included what to migrate and how to migrate the data.

4.2.4. Micro design

In the micro design phase, detail program and data specification will be developed. In this phase, most of the task will be executed by the application development team. The architect will mainly lead the following tasks:

- Finalizes the application and data model defined in the macro design.
- Develops the master test plan to describe what will be tested, how will the test be carried out, what kind of resources and tools are needed, and what is the test schedule. The architect will also assure that the testing plan is in consistent with the development environment.
- Details solution development plan, plan for the construction and deployment of the solution. This includes software distribution planning, deployment packaging and source code maintenance planning.

At the end of the macro design phase, the architect with the project manager and other experts will consolidate the work products produced.

4.2.5. Build

The mission of the build cycle is to construct programs, data, and various project materials to implement the target solution.

The task of the architect in the build cycle is insignificant. Most of the project tasks will be executed by the development team.

4.2.6. Deploy

In the deploy phase, the developed systems will be installed in the production environment. User acceptance testing and user training will be performed.

In this phase, the main task of the architect is to perform the production readiness review (PRR). PRR is held prior to system installation to verify that the system is ready to be installed into production. The major steps in the PRR review process are:

- Planning for the Preliminary Reviews of the Deliverables
- Inspecting Deliverables
- Preparing for the Formal PRR Review
- Conduct the PRR
- Establishing the Production Readiness Baseline

After the PRR, all the entrance criteria are in place to support on-time system deployment and the readiness of the post-production lifecycle support organizations is verified.

4.3. Follow up

In the follow up phase, the project manager confirms the client that their expectation is met or exceeded. If so, it is very likely that the project team can get another new opportunity. In that case, there will be a new start over for the architect.

5. Architect skills in project management knowledge areas/subject groups

In this section, we are going to examine how the architect skills are related to project management processes. According to ISO21500:2012, project management processes can be mapped cross-referenced to process and subject groups.

Process where the architect can contribute most to a beneficial effect are marked underlined written in *italic* as shown in Table 1

5.1. Integration

The integration subject group includes all the process required to identify, define, combine and coordinate various activities related to the project.

Table 1 Project management process where architect skills are applicable (in *italic*)

Subject groups	Process groups				
	Initiating	Planning	Implementing	Controlling	Closing
Integration	4.3.2 Develop project charter	4.3.3 Develop project plans	4.3.4 Direct project work	4.3.5 Control project work *4.3.6 Control changes*	4.3.7 Close project phase or project 4.3.8 Collect lessons learned
Stakeholder	4.3.9 Identify stakeholders	-	*4.3.10 Manage stakeholders*	-	-
Scope	-	*4.3.11 Define scope* *4.3.12 Create work breakdown structure* *4.3.13 Define activities*	-	4.3.14 Control scope	-
Resource	4.3.15 Establish project team	*4.3.16 Estimate resources* 4.3.17 Define project organization	*4.3.18 Develop project team*	4.3.19 Control resources 4.3.20 Manage project team	-
Time	-	*4.3.21 Sequence activities* *4.3.22 Estimate activity duration* *4.3.23 Develop schedule*	-	4.3.24 Control schedule	-
Cost	-	4.3.25 Estimate costs 4.3.26 Develop budget	-	4.3.27 Control costs	-
Risk	-	*4.3.28 Identify risks* 4.3.29 Assess risks	*4.3.30 Treat risk*	4.3.31 Control risk	-
Quality	-	4.3.32 Plan quality	*4.3.33 Perform quality assurance*	4.3.34 Perform quality	-
Procurement	-	4.3.35 Plan procurements	4.3.36 Select suppliers	4.3.37 Administer procurements	-
Communication	-	4.3.38 Plan communications	4.3.39 Distribute information	4.3.40 Manage communication	-

5.1.1. Control changes

Change management includes processes require to control all the unforeseen changes that arise during the project and may jeopardize quality, cost and delivery. All the changes must be under control. When the client requests a change, it may affect the project schedule, work procedures or work products. The architect can estimate the magnitude of the change and handle changes concerning technical works effectively.

5.2. Stakeholder

The Stakeholder subject group includes process to identify and manage the client, project team and other influencers.

5.2.1. Manage stakeholders

The purpose of manage stakeholders is to understand the stakeholders, especially the client, of what they need and control their expectations by developing mutual trust and understanding. The project manager uses his management skills such as escalation the issue to a higher authority, employ alternative strategy, or negotiation technique. On the other hand, the architect can resolve the client’s issues using his technical knowledges and skills, which would be extremely effective when the client is looking for a solution using technologies.

5.3. Scope

The scope subject group includes process that identify and define only the tasks and artifacts that is required. It is important to assure that the team are not going to work out of scope.

5.3.1. Define scope

While the project manager focuses on the entire project scope, the architect concentrates on optimizing the tasks on a technical point of view. For example, are the functions included in the design are absolutely necessary to fulfill the business needs? Is the system architecture verified not duplicating any existing features? Are the development teams not creating over engineered software source codes? It is often the architect who can determine the situation the best.

5.3.2. Create WBS, define activities

Although the WBS is created by the project manager, the architect is more adept in breaking technical activities into manageable tasks. Also, the architect can supply information to arrange the task consistently.

5.4. Resource

5.4.1. Estimate resource

On project resource estimation, the architect supplies the project manager with information such as workload estimation on activities, team productivity data and equipment list for software development.

5.4.2. Develop project team

Develop project team includes motivate the team on project activities, and improvement of performance of the team members. The architect can take the lead in setting good examples for the team to follow.

5.5. Time

In the time subject group, the architect can help on sequences activities, estimates activity duration, and develops schedule. These activities are closely related to the scope subject group. Please refer to 5.3.2 for details.

5.6. Risk

As mentioned in chapter 3, the architect is good at identifying and mitigating risks by using his technical skills and experiences. During risk planning, the architect is responsible to define the strategy and activity for responding to technology related risk and opportunities when they occur. The project manager works closely with the architect to assure that no risk is left behind, and no opportunity is neglected.

5.7. Quality

The purpose of perform quality assurance is to review the work products created in the project that the quality requirements are met. The architect use tools and techniques in the review process to ensure optimum, fast and complete operation.

6. Practical scenarios

We have shared our knowledge on using the architect with other project teams and project managers. We have got many feedbacks and comments. The following case examples were successful and validated our claims on how to use the architect.

6.1. Case 1: Architect as Project Management Office (PMO) lead

In brief, the PMO is a group of member established within the project, dedicated to providing various project management functions to the project. These "functions" vary greatly from project to project. Most PMOs track projects, manage risks and issues, and facilitate communication and team collaboration. Some PMOs also establish standards and track quality. Normally, most of the PMO members are selected from project management job role. Whenever project issues occur, the PMO team acts passively; issues are feed backed from development teams to the PMO team, and the PMO team supply the information to the PM and the client. This makes sense when project is in normal state.

But in our case, everything was an extreme. The project was delayed and subsequent problems occurred. The client was asking for immediate response, and the development team was busy debugging and solving problems. Project issues had to be report ASAP to the PM and the client. Solutions had to be developed with minimum help from the development team. We suggested the project manager to put architects in the PMO to form a "Technical PMO" team.

Unlike the legacy PMO, the architect handled technical information unaided. They acted actively to collect information, found solutions and reported to the managements on their own. They gave answers to the client in a logical and timely manner. It was not long for the PMO team to find out the cause of the situation; it was the communication deficiency between the development team and the client, and the PMO was not able to fill the gap efficiently. Thanks to the endeavors of the architects, the project was put right on track again.

6.2. Case 2: Architect as proposal leader

Another example was about proposal document creation. I was assigned to make an assessment on the proposal document created by the proposal team for a local machine manufacturer. At a glance, the proposal fulfilled most of the requirements described in the client's RFP, but it took no long to discover the problems. First, there was no technically skilled person in the proposal team, and second, the proposed solution is not sufficiently verified.

Software and hardware proposed were based on product catalogue data, compatibility of software and hardware were not verified. I recommended an architect to help the project manager to lead the proposal team on product selection and architecture design. After a month's work the proposal team won the bid.

7. Conclusions

Architects are responsible for defining the structures of complex solutions and architectures to address client business problems. They identify client needs, apply industry knowledge, and leverage appropriate business elements and information technology to address those needs and transfers skills to others through their works.

Senior architect provides innovative ideas and strategic direction, working across multiple business units and geographies. It is very important for the project manager to understand this point.

I hope this paper can help project managers on using architect resources, and at the same time, more architects will be doing their jobs happier.

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The Lean Project Manager: Applying principles from Lean manufacturing to the project management practice

A human approach to project management.

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Six-Sig.com company

Recent experimentations have shown that Lean, a Japanese born, quality-management philosophy, can be applied by project managers to increase their productivity and maximize the value delivered to their customers. A Lean framework for project managers relies on the following elements: The clear and complete identification of the customers of project management processes; The identification of waste generating areas in project management, and strategies to counter them; The necessary competencies to be effective as a project manager and a mechanism of self-improvement, for the project manager as well as for the organizations. Such framework would be deeply anchored in Lean principles that are centered on respect for people and value for the customer. Lean tools and methods can bring traditional project management techniques to a new level of productivity, by removing the non-adding value elements and by re-centering the efforts on the customers. In this article, the author proposes to present some experiments that lead to the creation of the framework, the framework itself and the early results of its introduction in a project management environment. It will propose to project managers or project team members useful tricks to increase their productivity and the satisfaction of their customers with six easy principles and four productivity hacks.

Keywords and phrases

Lean thinking, project management practice, capacities and skills of the project manager, culture change.

1. Introduction

Project Management is nothing new. Evidence of advanced management techniques, like scheduling, budgeting, and resource planning have been found in projects as early as the building of Egyptian pyramids or the Chinese Great Wall. Throughout History, project managers have been called many things, like "Grand Architect" or "Main Engineers" as they were usually cumulating both domain specific techniques (like building architecture) and project management techniques like planning and follow-up. Only in the recent (50) years the degree of specialization necessary for the realization of projects has led to the separate discipline (and art) of project management. The subordination of the “technicians” to the project manager has created a heavy concentration of responsibilities upon this role. New types of constraints have also appeared that project managers need to take into account: The emergence of standards and rules specific to project management, that need to be followed, the growing demand for transparency and auditability of project expenditures, the multiplication of communication channels and the associated thirst of information from the stakeholders, the acceleration of our economies and societies. All these aspects have created a burning feeling of pressurization for the project manager.

This situation has become clear in the “lab” my team and I have access to: the European Commission. With my expert colleagues from the Centre of Excellence in Project Management (CoEPM²), we have created an entirely new project management methodology that is being used for internal projects since 2012 (Note 1). This was a unique opportunity because we could control the theory, the dissemination material, the teaching and the application of the method to real projects, coaching real project managers in the field and checking what was working and what wasn’t. This experience led to draw one clear conclusion: the project manager is the key to project success. Many studies, infographics and surveys present the top 3, 5 or 10 reasons for project failure, highlighting here communication issues or poor requirement management there, scope creep, poor management of customer expectations, lack of management support, etc. However, who’s responsible for all those areas? The poor project manager! This is what is asked of modern project managers: Work with low budgets, cut in the middle of the project anyway, limited staff or shared resources, project managers are often short of everything, they are even short of time very often. We needed a response to managing the scarcity of resources and getting the most out of what we have. Remember what I have said about project success: it is largely at the hands of the project manager. It makes the project manager the most valuable resource of the project, so it should also be spent wisely! We need to help project managers and the Lean philosophy seemed the natural choice for this (Note 2).

2. The Lean model

Surprisingly for a methodology team, we chose a philosophical model to complement our offer and shape the future of our method. Born in Japan and grown by Toyota from the 1950’s, Lean seemed the perfect approach for our overloaded project managers:

- A systemic approach to maximize value and remove waste;
- A concept centered on people and respect;
- An embedded improvement mechanism;
- An abundance of literature on the topic and some in-house knowledge.

The idea of leaning project management is not new but has been itself scarcely documented, and most of the time a tooling approach has been used. Experience in Lean transformations in the industry (GE, Boeing) has shown that the correct approach is the human approach: "Building people before building cars." This aspect was also key to the introduction in our rather rigid environment: rules, methods, and tools can take longer to change and it seemed to us we could dispense Lean thinking to our project managers quicker.

3. The Lean Project Manager Framework

Lean is vast and we had to focus on its core values to identify what we needed to tell our project managers to make a change.

3.1 Customers identification

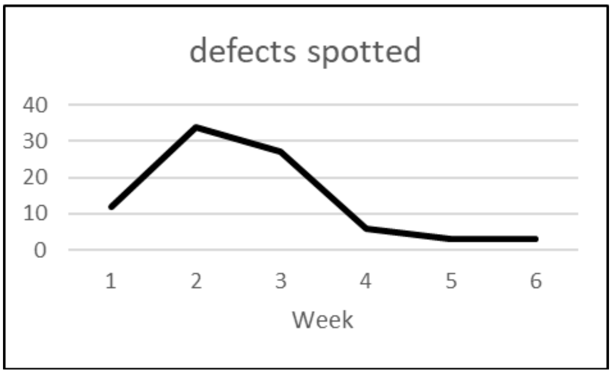
Lean is an approach to quality, and quality is defined by customers. Lean proposes to increase the value we bring to them. The first thing to understand is the need to identify who are the customers of the project management practice. Believing they are only the project customers would be a mistake. So, who are they? Traditionally we can identify three types of customers:

1. The project customers. They are obviously impacted by a bad project management practice, but indirectly: a bad practice means the project is not delivering all the expected benefits.
2. The project manager's organization, hierarchy, and direct managers. They obviously expect, in return for the delivery of the project, a form of compensation. If the project is poorly conducted, this compensation might be reduced or removed completely. In some situations, they even might have to compensate the project customer! They are, therefore, a customer of the project management practice.
3. The third type of customer is, I believe, the most important one: the project manager him/herself! Simply because he or she has expectations on what this project will bring regarding personal growth, interest, career advancement, skills learned, etc. It would be very sad to complete a project with the first two customers happy and the project manager not, because it has not brought him/her any step further down the path he/she wants to walk.

Three customers, three definitions of value. The trick of being a Lean Project Manager is to question yourself for each activity: To which customer is this bringing value to? If the answer is none, clearly the activity should be labeled as waste and removed.

3.2 Hunting the waste

Lean categorizes waste in several types: defects, extra processing, waiting, transport, motion, overproduction, inventory. Once we had the three customers identified, I used our project office to collect data on waste. We created a "waste board" with the seven categories where all people involved in projects could report anything that looked like a waste. Two amazing things happened next: First, there was a huge energy around the waste hunt, everyone started to collect a lot of reports and the board started to fill out quickly. And then, suddenly it slowed down quickly and stopped. Not because we lost momentum, but because all we could find was most of the time already on the board: we realized that waste in projects is mainly (80%) centered around only three topics: meetings, project documentation and reporting.



Graph 1 waste defects reported per week

1. Meetings: Over a period of six weeks we asked meeting attendees on a sample of projects to rate anonymously the value brought by their meeting from 1 (low value) to 5 (high value). The average rating was 2.2 which tended to confirm the findings of the waste board. We categorized the meetings between information meetings and decision-making meetings. The first category is the usual team meetings and status report meetings. The recommendation of the framework is to eliminate these as much as possible and replace them by one to one interactions (status reporting) and media channels for diffusion of information. For decision-making meetings, the recommendation is to maximize the value by sending clear agenda ahead of time, ensuring the presence of the decision maker(s), adjourning the event as soon as the decision is made and sending minutes within 24 hours. Agile stand-up meetings were allowed as is.
2. Project documentation: It is very often too much or not enough. There are three kinds of documents. What we call the insurance documents: the contracts (like a project charter) that bind people on what to do and what not to do; the management plans that describe the project rules (for issue escalation, change control, resource allocation, etc..). Then there are the communication documents: we use them to coordinate your project, give tasks to the team (work plan, task lists, schedule) or reports. The third type of documents is control documents: the ones we need to stay in control of the project like risk logs, financial reports, acceptance notes... For each category of document, the lean recommendation is to negotiate with the three customers what is needed for the project, and how detailed it should be. Don't hesitate to question your project management office on why they ask to fill this or that when we fail to see the value. Maybe that document is not relevant to the project at hand. For the projects we could audit, we estimated that, in average, between 20% and 30% of the documentation produced was never read by anyone.

3. Project reporting: One common mistake, in the absence of a clear list of KPIs given by the customers, is to track too many metrics: this is a waste by many standards: Most are not read nor used nor understood by the customers, so the effort to track and present them is clearly extra processing. Different customers often mean different reporting tools or formats, hence duplicating the efforts to produce the reports (again extra processing). The recommendation is to take upfront discussion with all customers on the relevance of the KPIs and asking what they want to see, and then, as much as possible, use a pull mechanism for reporting: making the data available and having a tool that present to customers only the data they want, when they want it.

3.3 Building people

Another interesting observation is that the chosen project management methodology, all things apart, has little influence in itself on the project success rate of an organization. Variations of this rate are usually caused by the project managers themselves, how well they did in applying the method (or lack of) and making the best of it. This is something also confirmed by our "lab" experience in the European Institutions: after creating a new method, we set out teaching it and coaching the project managers who used it. However, most of the questions that required our intervention were rarely on the method itself. After all, we had built a comprehensive documentation, a community of practice, a training path so that project managers could tap directly into these resources by themselves for the technical questions. Most of our work, let's say 80% to please Vilfredo Pareto, was people related: how could they interact better with others, what could they do for themselves to perform better? This discovery led us to channel our efforts to a more personal approach to project management: the need to supercharge our project managers with soft skills rather than hardcore technical skills emerged. A model of competencies was built to focus on the core skills needed:

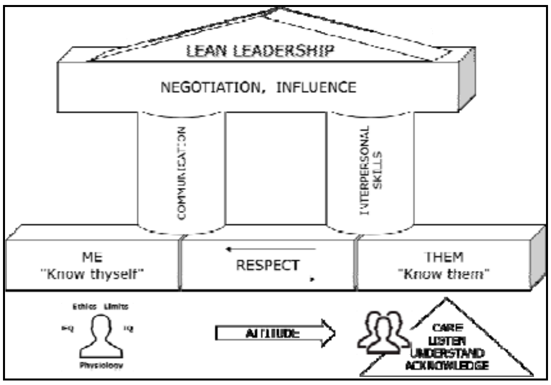


Figure 1 House of soft skills

A strong and solid base made of yourself, the others (team members, customers, managers, stakeholders) and in the middle a Lean cornerstone: the "Respect" value. Resting on this are our two pillars, communication, and interpersonal skills. At the top, we find two important skills for project leaders (because yes, a lean project manager is a project leader!): Negotiating skills and influencing skills. All needed to support fully Lean Leadership.

1. Me – "Know thyself": An introspection is necessary to obtain the knowledge of our state of mind, our limits (ethical, biological, psychological, emotional, intellectual), what drive us. How resistant to stress are we? Do we like what we do? Why are we engaging ourselves in this project, what is our personal goal, how far can we go to reach this goal? These elements are key to draw a baseline of our capabilities, and also to set targets for improvement. Finally, the simple exercise to analyze ourselves helps tremendously to understand the behavior of others.
2. Respect: The cornerstone of the Lean philosophy. It is recommended at all times to respect people and their work, knowledge, experience and behaviors.
3. The others: It is recommended to establish a hierarchy of other people and stakeholders to be able to size the effort of the project manager in the relationship. A simple model is proposed: *Acknowledge* is the first level with the least investment in the relationship: the project manager acknowledge the existence of the person, that this person might have needs, and that these needs will be addressed on a best effort basis. *Understand* is the level of people where the project managers need to invest more time in understanding their needs fully in order to satisfy them. *Listen* is the level people have when they can have immediate attention of the project manager when they have something to say (e.g. the project customers). *Care* is the category of people in which the project manager must invest most of its efforts (project team for example).
4. Communication: The usual suspect in most of post-mortem analysis of failed projects, communication is always a good candidate for self-improvement routines (kaizen). We recommended enforcing the use of a communication plan as proposed by the methodology. Caution, as not to lean communication in the wrong sense (communicating less) as lack of communication is also a form of communication.
5. Interpersonal skills: Among them, we can find core skills. *Team leadership* in the lean sense, that is building small, empowered and autonomous teams as described in the Toyota way. *Conflict resolution* using the hierarchy of stakeholders. *Reputation management* as this will be key to support the negotiation and influencing parts. *Time management*: very strong recommendation is asked to all people to be on time (in the morning, at meetings, on deliveries). *Organizational and political savvy:* Emphasis is put on onboarding procedures of new project managers to make sure they know how the organization works, who has got decision power etc. *Customer centricity*: here we speak about the project's customers, to ensure maximum satisfaction of the end customer.
6. Negotiation: We recommend to project managers that they build negotiation skills through internal

and external training, as well as using pre-defined negotiation frameworks.

7. Influence: We explain what are the mechanisms of the influence, where it comes from (the three sources of power – personal, interpersonal, organizational) and how they can be used in projects.

The whole purpose of the model is to provide a chart for the project managers, give them a direction on how to progress individually. It is used as a basis for post project discussions to create personal kaizens actions. This, of course, on a voluntary basis.

3.4 Principles

Instead of imposing more rules to follow, we produced six principles we wanted the project managers to use as guidance.

1. The no-meeting principle: Say no to a meeting unless we ensure to minimize the waste: it is a decision-making meeting and it is well prepared.
2. Customization principle: A methodology is always generic; even one developed within an organization for a set of particular projects: it will never be 100% adapted to the project at hand. A control structure often comes with the methodology (governance body, project office...) that will ensure we follow the methodology. Moreover, most of the time for these control structures, following a methodology means filling out certain documents in a certain order. The first responsibility of a project manager is the correct and reasonable use of the resources at his/her disposal. The project manager needs to fight the pressure to fill in any unnecessary document: don't make an outsourcing plan if we do not plan to outsource anything (I have seen a 20 pages document describing exactly this). Be smart in doing this: the idea is to make the methodology better and more flexible, but the primary responsibility is with the project. Involving the people from the methodology office (or whatever control structure) in the leaning effort is always a good idea.
3. The checklist principle: As much as we can be awesome in critical situations, we can certainly be dumb when it comes to simple and repetitive actions. That is where checklists come into play. They are also a catalyst for delegation, for empowering people while keeping a certain amount of control, they foster collaboration and more important they put back people in the (pilot) driver seat instead of letting projects be run by protocols or machines. The recommendation is to use checklists as much as possible.
4. The measuring principle: Reports and decisions are based on assessments and measures we make: progress on a project, budget consumption, etc. Measuring the wrong thing, or being wrong on what we measure, will lead to waste. Not only you should carefully select what you want to measure (and this has to be agreed with the three customers), but you should also be very thorough in describing how you intend to make the measurements: This is called an operational definition. Below a quick summary of the steps for meaningful measures:
   - Choose what and how (operational definition) will be measured;
   - Decide what the normality is and what the tolerance is for the measure;
   - Make a measure that can be trusted;
   - Decide whether it is needed to take corrective actions or not.
5. The pull reporting principle: the idea is to let the customers pull whatever info they need from the data generated by the project team. This implies a single repository for the data, a smart, automatic report generation tool and a lot of clear communication upfront to properly set expectations. Such setup requires tools, software and time to configure them and learn how to use them properly. The idea is that actuals (efforts, progress, measures) are entered only once. All report consumers can then log into the system to monitor the KPI that make sense to them, and not be on the project manager's back during the entire duration of the project. This sounds expensive: integrated software that proposes these features are not cheap nor simple to deploy. However, there are often some smart compromises, and your creativity can help.
6. The fail and learn principle: Our society still sees evil in failures. Project teams are fired when projects fail. It is a big mistake because probably that team just achieved a huge learning exercise. Too often a failure ends up in a finger pointing exercise, and this is not healthy of course: it destroys quickly all the trust and bonds you might have built within the team during the project. It will be hard to rework together again. Being Lean means acting altogether: you succeed or fail as a team. The recommendation is to celebrate project ends whatever the outcome, and be thorough in the lessons learned exercise.

3.5 Organizational aspects

Any introduction of Lean in an environment represents a cultural change: Lean is much more than a simple toolset that can be added to the list of existing tools and methods in use in an organization. Lean transforms the way people think first and then proposes some tools to implement the Lean vision. To enable this cultural change there is a need of support from all levels of the hierarchy and sometimes to adapt the organization itself to the Lean practice. Historically speaking, the project managers in our "lab" mostly evolved from other disciplines or field of activity and took some project management courses as the result of a career move or management decision. What was typical is that they often kept doing a mix of activities in parallel of their project management duties and never really considered doing exclusively project management. On the other hand, Lean hints clearly toward a segregation of duties and a specialization of the work force. The model of our "lab" is strongly functional and hierarchical as described in the general project management literature. We had to transform and a new structure has been put in place by the management, based on pools of specialized resources: project managers, architects, business analysts, developers… The initiative called "New Delivery Model" has been introduced in March 2017 and is being implemented since. The goal is to create a lean structure oriented toward customer satisfaction: the customer is at the start of the vision and all delivery processes and teams are serving this purpose.

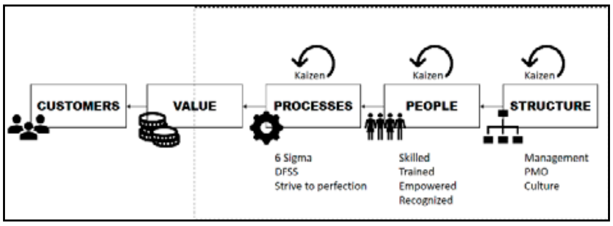


Figure 2 Lean organization structure

3.6 Improvement mechanism

Lean is not a magic wand to be waved so that everything becomes perfect in no time. Although it encourages to aim the perfection, it relies on small, concrete and doable increment steps toward perfection: kaizen. These are the tangible elements of the continuous improvement cycle we promote through the quality handbook of the COEPM². In this model, the project manager drives improvements at his or her level. The organization and its management become enablers of the improvement, by providing to the project manager what he/she needs to achieve the kaizen (training, material, time). Coaching sessions are offered to project managers to help them set achievable goals, using the methodology framework for technical skills or the house of soft skills.

3.7 Results

The Leap approach has been recently introduced in our "lab, " but it has already yielded some spectacular results (the first one being a surge in the availability of the meeting rooms!) The human approach to project management promoted through Lean had a lot of benefits on the moral of the project managers. We also offered some productivity hacks directly from our observations:

1. Be on time: at meetings, when leaving meetings, to send reports, work, talks, etc… Not only this is a mark of respect for people but it magically creates time for everything.
2. Drink water: Taking care of your hydric levels allows focusing better on the essential work to be done.
3. Exercise: Taking care of the project manager's health is taking care of the project's most important resource.
4. Delegate: Also known as "Empower" in Lean jargon, a powerful tool to build trust, respect and results.

One clear lesson from Lean is the specialization of the resources. To be efficient in work, work must be standardized and people need to be trained on it. To enable this the entire organization needs to evolve and be structured around this principle. The realization of that led to review the internal organization and the creation of specialized structures (talent pools) within our entities with people specialized in project management, in architecture, in development, etc.

Finally, the combination of these changes started to produce an increase in (project's) customer satisfaction, although no projects using the Lean approach have been completed yet at this time.

4. Conclusion

The entire experience had the benefit to trigger a lot of discussions on the well-being of the project managers, how they should be prepared, their career path and aspirations. We have opened a door on a new path, a new way of managing projects and we are now determined to see where it leads. Until we get there we can draw several conclusions to the experiment:

- The first is the good news that Lean can be applied to the project management practice. Not that this comes as a surprise, because the principles of Lean can be applied everywhere, but it was rather easy to apply using a methodological approach to identifying first the customers and then the value flow to them. It means that the whole experiment can be reproduced and is transposable to other organizations. The fact it was doable in such a rigid hierarchical and functional structure is promising as well.
- The sources of waste in project management are not infinite. Our initial intuitive expectation was that we were facing an incredible amount of work to catalog all the sources of waste in such a broad field of practice. The experiment of the "waste board" showed that after several weeks it was always the same issues being reported and that common root causes could be found. Out of a dozen of causes identified, only three of them were at the origin of nearly 80% of the reported waste.
- We have gathered strong evidence that an increase in project manager quality results in the increase of project quality. Knowing that, our experiment can only encourage others to have a human approach to project management. As stressed in the study, the project manager is a very valuable resource in the project. This means it should be handled with all the care usually used in case of rare and valuable resources. A project manager that will feel valued will increase naturally the productivity and output of the project team.
- The good recipe to introduce Lean in the project management practice is to start with the people (the project managers themselves) and to involve all management levels to support the initiative.

Notes

(Note 1): PM² is the generic, internal project management methodology in use at the European Commission and within several other European Union Institutions. It offers a lightweight methodology, a training and certification path and a coaching package for project managers. It has been released to the public with an Open Source license in November 2016 under the name Open PM².

(Note 2): Lean is the name of an approach to quality that was developed by Toyota between 1945 and 1975 and is known there under the name of Toyota Production System. It promotes the maximization of the value offered to customers through waste reduction techniques.

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Challenge to Nation-wide and Ultra-short-term Project in a Rapid Growing Market

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In January 2016, NEC Vietnam has won retail project from one of the biggest retail company in Vietnam. The SOW of this project is to develop POS System with its backend functions, integrate with SAP IS Retail through IDOC interface and deploy to existing 49 supermarkets & 762 convenience stores. The biggest challenge of this project is to deploy nationwide POS System and conduct the Operation Training for nearly 5000 cashiers in 105 days after customization; data migration, testing, trial run & pilot go live phase. Project duration is totally 10 months including system deployment to all stores and in fact all major project milestones have been acceptance successfully and highly evaluated by customers. On the other hand, this was made possible by experiencing many issues a long with project life especially in nationwide deploying huge number of chain stores in short duration project, human resource management, working process & communication. This paper will focus on sharing the challenge in system deployment and effective methods taken from project management that were useful in creating best results in order to meet customer's requirement. Also we will explain how issues arise and be resolved during project time line.

Keywords & Phrases: Scope, Clear Procedure & Communication Flow, Progress Management and Risk Management

1. Introduction

1.1 About NEC Vietnam

NEC Vietnam Engineering Division located in both Hanoi city & Ho Chi Minh City, Vietnam, is part of NEC Vietnam Co., Ltd. (NEC Vietnam), which was established in 2006, then as a subsidiary of NEC Soft., Ltd. (NEC Soft) and NEC Corporation (NEC) located in Tokyo, Japan. Our main targeted areas of business are:

- Providing a bundle of services from software development to system integration.
- Providing full range of software development from getting requirement, design, implementation and deployment with high quality and cost effective, with strong resource pool and gained know-how from doing projects for customers in Japan and Asia Pacific region.
- Providing technical support, presale, post sales and turnkey systems for local customers with high quality, labor reduce and improve the efficiency for customer's business.

1.2 About A Group (real name is already changed) customer

A Group customer was founded in Eastern Europe by an ambitious group of Vietnamese youths. This company began with food production and quickly found great success with the instant noodles brand. In 2000, Owner returned to Vietnam with ambition to contribute the country's development.

Few years ago, A Group officially entered the field of retail market in Vietnam with planning to open 10,000 more stores by end of 2019.

1.3 The need of speed deployment POS System for our customer

Since A Group entered Vietnamese retail market by continuously buying existing supermarket chains from other local companies.

Comparing with other big retail competitors, A Group entered quite late so their long term development strategy is to expand its retail network as quick as possible. The growth strategy has been to lunch massively convenience stores, they opened few stores per day with an arm to quickly gain market share.

Until June 2016, they owned 50 supermarket chains and nearly 1000 convenience stores which are managed by old technology POS & ERP system. Existing system could not able to meet their operation's requirement; they faced several problems in master data management, inventory management, sale registration and performance…

With rich experience in deploying POS System, NEC solution was selected. After customization, customer required NEC to deploy the system quickly in 2 months only.

During contract negotiation phase, customer already said and reminded sometimes after that: “If can not GO Live on time then GO Out”. By this expectation & request from customer, NEC self-confidently believe that “We can do” although there are several challenges.

2. What are the Challenges?

From beginning we found that this is a big challenge project because of the below major points.

- With requirement definition, retail business is new field from customer so it is difficult to ask for providing clear business operation process. It might take time to get agreement on the blueprint documents.
- This is complicated & company-wide project organization, project members come from several countries like: Japan, India, Malaysia & Vietnam.
- Project schedule is very tight comparing with NEC’s experience (mainly in Japan retail market).
- To utilize existing infrastructure for deploying new NEC system. It might take time to survey and test to make sure new system can run on existing hardware.
- Existing network infrastructure is not stable. Need customer to upgrade the network with Ring topology.
- Nation-wide deployment in short time, long distant for transportation, no airport in province side (only in 02 main cities).

3. How to manage project successfully

Taking on a role as Project Manager for this project is not simple when looking at above challenges, beside the traditional method of project management that are required for Project Manager to have a number of skills and qualities around communication, decision making, delegation and risk taking… but also needs to focus on dealing with day-to-day below challenges that arise from managing projects, communication & collaboration…

3.1 Communication

As said in the beginning, there are 49 supermarkets and 762 conveniences stores need to deploy in 105 days, it means we need to deploy 3 supermarkets or near 20 conveniences stores per day. In order to do so huge number of staffs might need for site survey, rollout, support in the go live day and after that. This organization structure was laid down the relationships between various positions in the team. The different levels in this structure have to communicate with each other in a systematic manner to avoid confusion, misunderstanding or chaos. Below figure 1 will show how is the communication flow with using Command Center as central point to coordinate all levels. We do always suggest project team to have emphasizing simplicity, directness and face to face conversations even with customer as much as possible in order to understand the demand of customer. At regular intervals, need to reflect on how to become more effective and adjust its behavior accordingly.

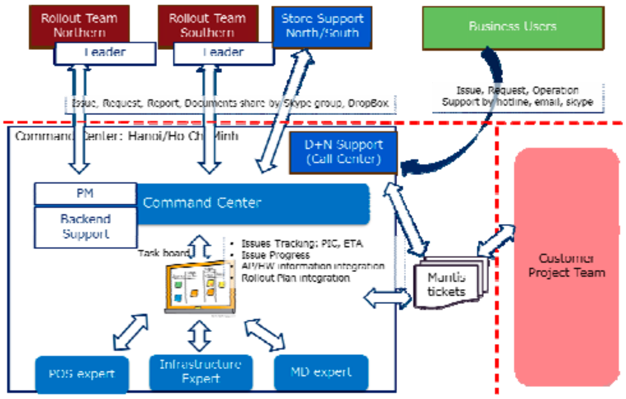

Figure 1 Communication Flow of project during POS System Deployment

3.2 Clear Procedure

Because those stores are still operating with legacy system and customer only allow each store to close 01 day for changing to new NEC system. Within 01 day, there are several steps for preparation like stock-take, data migration, and master data preparation for new system, infrastructure survey, rollout new system, testing and go live in the next day. With that requirement, as Project Manager, we understand that we need to plan carefully with detail checklist and procedure. Also we need to prepare some scenarios and its contingency plan to make sure that there is no issue or mistake happened in rollout day and store could go live with new system successfully. Below figure will show some example of Task & Communication Procedure:

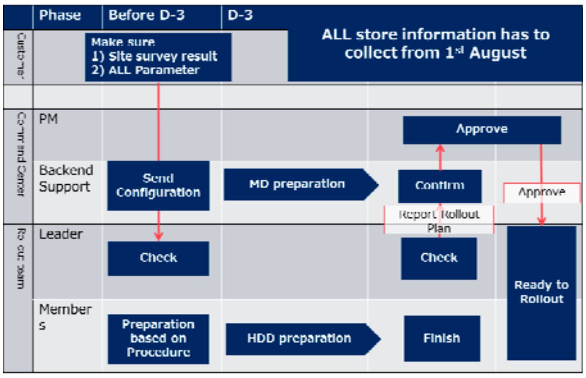

Figure 2 Task & Communication procedure on D-3 days

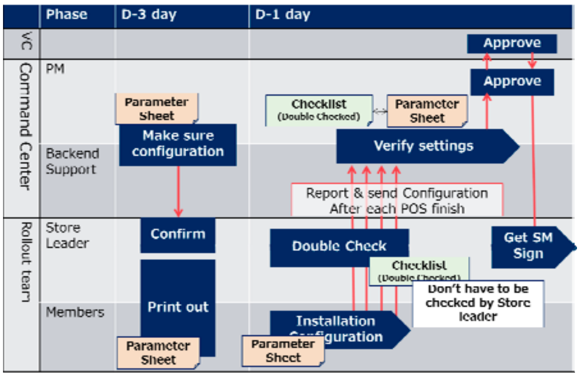

Figure 3 Process to make sure configuration

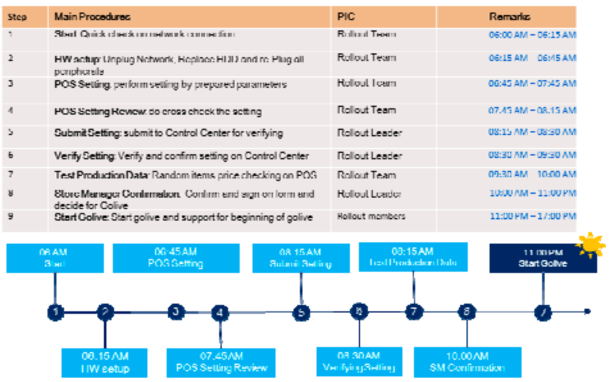

Figure 4 Detail POS System Deployment Procedures

3.3 Cross functional and self-organization team

As there are a lot of deployment places which are far away from project working site so cross functional and self-organization teams are necessary. Those teams are groups of people with different functional expertise working toward for achieving defined outcome & goal. They do need to move continuously from this store to other store, from this province to other province, they take risks and initiatives for preparing, conduct the training for end users at the site, deploying, and go live support. This methodology is not only applying in deployment phase, but also we apply in development phase also.

3.4 Online Collaboration

Since working locations are in different place, different stores so traditional collaboration type is not efficient. In this case, we think about Online Collaboration type. Recently we have been successfully managed on several projects using some free online collaboration software like Skype, Dropbox, Google docs and Mantis Bug Tracker. It will help all team or group of members collaborate the work together with transparency information, share the issues members are facing, how to solve from expert team and what is decision from Project Leader in real-time over the internet. All the document and instruction also could be shared through Dropbox & Google Docs to members at once.

Figure 5 Sample of promoting online collaboration through free software

3.5 Utility Remote and Virtual Work

By deploying nearly 20 stores per day with several teams in different missions, we must need to build expert team with key members who can help all members to solve the issue at once if it happened, control the quality and decide if store is ready to go live or not and also need to monitor if any member does not follow the defined procedure in each step.

Problem is that we could not send those key workers to each store for supporting cause of limitation number of key members and stores are far away each other. Based on that remote work are necessary and more efficiency.

On the other hand, As a Project Manager within a multi-national company we may have to manage a team that is spread out across Vietnam, Japan, India and Malaysia. These virtual teams bring with them their own challenges, from the very simple time zones, to the more complex language barriers.

3.6 Managing changes and definitions of Scope (project scope & product scope)

Most of failure reasons of project are ambiguity of requirement definition, poor scope definition and change request management. Make it clear and sign with customer in the beginning is mandatory.

And also we do keep in mind that change request from customer is inevitable. As a project manager, we need to analyze all Change Request and then communicate how it will impact to the project and there are any alternatives plans that may be acceptable.

With traditional methods called waterfall or cascade. The project manager and team rely on detailed specifications, precise and validated by the customer. The project team then works tirelessly until delivery of the entire project.

Unfortunately, it leaves no room for unforeseen events and changes. The customer is always disappointed with the outcome because their expectations have changed, the context has changed, or the objectives have changed. In short, unforeseen events took place involving delays and additional costs.

So how to recognize the change at once and adapt with that is to involve customer from the beginning to the end of project

3.7 Progress Management

From the beginning, we do all understand this is ultra-short-term project plus customer sometime change the context or objective. Based on that, what is the effective way to monitor the progress, we have some rules for communicating status and progress as below:

- With rollout team, do update the working status by discussion tool (skype) or call to hotline in every 2 hours.
- Using Task board which locate in the Command Center to update the status of deploying in sites from all rollout teams. Task boards have sticky notes with user story titles in at least four columns: To Do, In Progress, Accept, and Done. It will help anyone even customer who walks by can see a high-level status of which steps are done and which stores are ready for go live.
- Daily 15 minutes meeting with team to review what have been done, what need to do today and what are the problems need to solve.

With high level management or customer: frequency update daily progress by email, holding date and participant of regular weekly meeting with customer; form of progress information; and "Problem management table"; operation rules

Below master schedule is the part of detail plan which described & clarified the inputs, outputs and milestone of each phase.

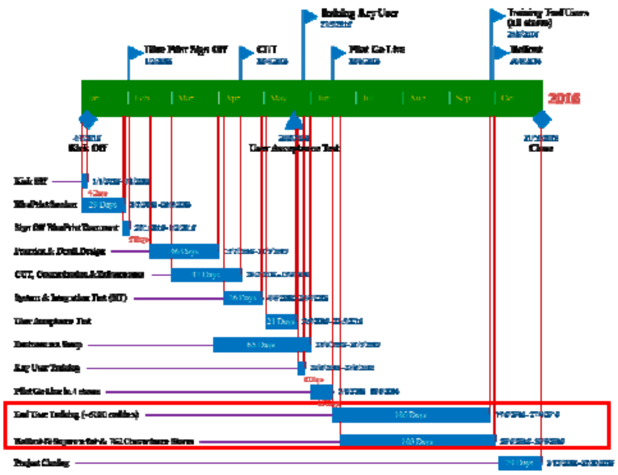

Figure 6 Master schedule of Project

As described in the beginning, in this paper we only focus on red rectangle part of above master schedule where how we managed to quickly deploying POS system to all 49 supermarket & 762 convenience stores in short time.

☆Important key word: scope, clear procedure & communication flow, progress management

☆Achievement points:

- Organize suitable project teams: this is key factor to lead deployment successfully in short time. Each time has its role but they can support each other across. Team foundation keeps the relation between members horizontally and vertically. Following teams were created and proved the effective implementation:
    + Rollout teams: there were some teams for deploying in different areas.
    + Training team: centralize training by areas and sometimes conduct the training directly in the deployment site.

+ Command center team: centralize support all teams. This center helped solved the issues occurred during deployment in stores. When the issue occurred and solved for some stores, it was informed to remaining stores to avoid the same issues happened.

- Speedy expanding team & training new resources for deployment: we did train for trainers then we can have a lot of trainers in a short time. This allowed us to provide training for huge number of end users.
- Good preparation for deployment: in preparation, we focused on creating deployment procedure. When the procedure created, we did rehearsal from deployment member. During the rehearsal we calculated time spent for each step and adjust any missing to update to new version of the procedure. We conducted the rehearsal for updated new version until there was no issue or missing step.
- Collaboration and cooperation: we kept good communication between each member in project team and customer's project team to ensure that all understand the scope, deliverable milestones and keep those deliver on time with high quality and avoids missing any requirement.
- Customer's readiness: we spent much time in doing site survey with customer and review their readiness.
- Third party cooperation (HW, infrastructure): we had to cooperate tightly with third party in order to make sure their delivery meet overall timeline.
- Progress review and monitoring: daily review meeting is mandatory. Through the meetings we could recognize any problems and make decision immediately.

4. Risks Management

It is indispensable to take risk management to the project activity to make the project succeed in such an environment.

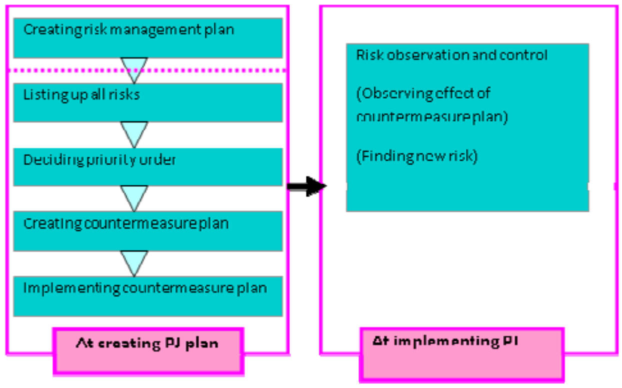

Figure 7 Procedure of risk management

Following points were focused and monitored strictly during implementation: risk; timeline; cost; resources; quality; communication…Among them, risk management aspect was highlighted by top management and we recognized some risks and we did cover all of them:

- Lacking resources: team members resigned, replacement of partners'. To avoid the risk we did always focus on how to keep key member of each role and the replacement for it. For every key role, we prepared at least 1 replacement and assigned to work as a normal member to support others during deployment.
- Overload for team members: To avoid members to work overload, we assigned members to work by shifts in order to have strong support to end users. Find some ways to motivate members.

Table 1 Example of Risks Management Table & Contingency Plan

	Risk	**Impact (EVENT)**	**Preventive / Corrective Action**
1	No internet connectivity at Store (ISP) - Short Period e.g. 1 hour	POS cannot downsream Master Data	Engineer can copy master data from HQ server and upload to POS
2	No internet connectivity at Store (ISP) - Short Period e.g. 1 hour	Sales data cannot upstream to HQ server	- POS will buffer the sales data in offline mode, and automatically upstream the sales data when connection available - Request for

			backup internet connection due to high transaction volume
3	ITS AP failure	MD Batch cannot generate master data, lead to no data to be send to POS	Validate ITS web service every 4 hours to ensure service availability
4	FTS AP failure	POS cannot download master data	Engineer can copy master data from HQ server and upload to POS
5	POS AP failure	Sales data cannot upstream to HQ server	- NEC deploy 3 POS Servers in HA mode
6	…	…	…

5. Conclusion

This is the first big deployment project in retail business we implemented in Vietnamese rapid growing market. From this successful project, we gained a lot of experience in project management. Beside the traditional methodologies of management that we applied then we also could find out a trend of project management in the coming years, especially for large scale project with nation-wide deployment in ultra-short time and in rapid growing market like Vietnam.

5.1 Utilize agile methodology not only in development phase but also other phase.

Most of project managers have heard about agile method, especially in software development life cycle. I do recommend utilizing this method in SI service phase also. It is more pragmatic than traditional methods is, the agile method involves more the customer taking into account the evolution of customer's need. It is more flexible and effective approach that allows greater responsiveness to customer demands.

5.2 Change the management way

With traditional way, we may always complete project by the pyramidal management, sometimes this vertical hierarchy where a project manager, he is fearful with all members, try to impose his directives and his mood to small things at any time. I propose we should change the management way to collaborative management. There must be constant and continuous interaction and communication between the functional groups, project personnel, executive management, subcontractors, and most importantly, the customer, to have a successful project. For the project and team, at least we could see some benefits as below:

- More collaboration
- More flexible organization
- A more autonomous team
- Great adaptability.

Finally, there is one effective way to promote the collaboration is to use of collaborative project management software so that leader and members are always staying connected everywhere and all the time. It also centralizes all work on a single platform.

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How Scrum Improves Productivity of System Development Project

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Scrum is an Agile framework created as a faster, more reliable, more effective way to create software. This paper explains which mechanism of Scrum will help improve productivity, and what should be aware of when applying Scrum in a software development project. First, dividing the project scope into smaller Scrum Sprints that are easy to grasp the whole picture can reduce the change requests due to unclearness of specification. Second, the shorter duration of Scrum Sprint in comparison to Waterfall project makes it easier to remember work content in a Sprint. Third, Sprint Retrospective can improve the way of development in a Sprint. Finally, communication efficiency is improved by appropriate team size and non-verbal communication among Scrum team.

Keywords and phrases: Agile, Development Standards, Productivity Improvement

1. Introduction

The purpose of this paper is to clarify why Scrum will benefit to the system development project from productivity perspective. Scrum is an Agile framework, and is based on experience and knowledge of various development methods. Scrum is determined as 'a framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value' (Schwaber and Sutherland, 2016). Actually, as a result of applying Scrum in a project in which the author of this paper participated, approximately 12% workload reduction as compared with the project estimate done in Waterfall assumption could be achieved. Therefore, many organisations want to utilise Scrum, however, they have not adopted Scrum yet. In Japan, although nearly half of organisations want to implement Agile or iterative development, only 26.6% of them applied them in 2016 (Figure 1).

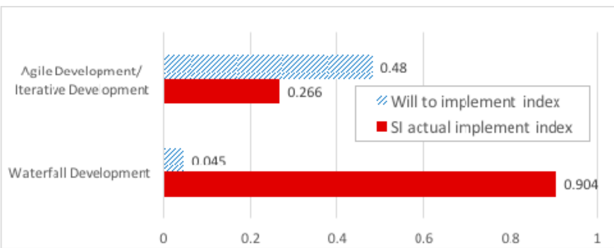


Figure 1(Indices of Technology Implement (2016), JISA, 2017)

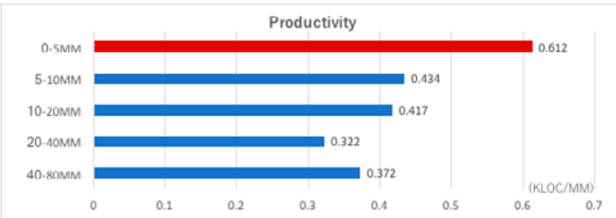
This paper summarises how the mechanism of Scrum exerts its effect in view of productivity, based on survey and project experience. In order to apply a Scrum development, in our programme, the reason why Scrum are reasonably better than Waterfall was asked by the project stakeholders. Despite the fact that there are many books and papers on how to implement Scrum, few explains the theory of "why is Scrum better than Waterfall" in terms of productivity. Thus, this paper will explore that perspective and help ease the burden of applying Scrum. As summarised in Figure 2, 'Several concepts with agile development provide a major paradigm shift from the traditional waterfall model and are worth pointing out to readers new to agile' (Gruver *et al.*, 2013, p.6). Conversely, for project stakeholders, a paradigm shift requiring much effort is inevitable to apply Agile. This can be said as a major factor impeding the application of Scrum. As Schwaber (2007, p.5) mentioned, 'The effort required to adopt Scrum is huge, and only enterprise with compelling reasons will make the effort', this paper explains which mechanism of Scrum will help improve productivity; miniaturisation of projects, reduction of project term, acceleration of retrospection, and communication efficiency. In addition, this paper also explains what should be aware of when applying Scrum in a software development project in terms of improving productivity.

Waterfall	Agile
Waiting until everything we thought we needed in the beginning is done.	Start delivering code to the customer with the most important features first.
Having a lengthy integration and qualification cycle.	To make sure at any point the code is close to being ready for release and what is developed has high quality.

Figure 2(Agile vs. Waterfall, Gruver *et al.*, 2013)

2. Miniaturisation of Projects

Figure 3 showed the result of totalling productivity for each project in the application management programme of the insurance information system in which the author of this paper has been participating. In these projects, development productivity is evaluated based on the workloads (Man-Month) required per modified 1,000 lines of code (KLOC). In projects with small development scale, change requests did not occur. On the other hand, on large scale development projects several to tens of change requests had occurred and Q&A transactions for specification confirmation was in progress during the project had occurred frequently. Although the difficulty level and characteristics of projects that greatly affected the productivity of a project vary individually for each project, the trend was that the smaller the project size, the better the productivity of development.



Project Scale	0-5MM	5-10MM	10-20MM	20-40MM	40-80MM
Productivity (KLOC/MM)	0.612	0.434	0.417	0.322	0.372
Number of Projects	44	9	6	15	10

Figure 3(Productivity by Project Scale in 2016 in an Application Management Service Project)

Sprint is 'a time-box of one month or less during which a "Done", useable, and potentially releasable product Increment is created' (Schwaber and Sutherland, 2016). When applying Scrum, it is necessary to divide what should be done in the project so as to be achieved within a limited Sprint period. As a result, a large-scale project is transformed into many small projects in the form of Sprint. The smaller the project, the clearer the tasks to be done on the project at a detailed level because it is easy to grasp what to do in the whole project.

One of the advantages of miniaturising the project by applying Sprint and clarifying the tasks to be done is to reduce the number of pending issues. For smaller projects, the number of tasks to be done will also be limited. If there are matters in the limited tasks that have not been decided, the negative impact on the project will be relatively large. For this reason, project stakeholders will try to resolve pending items at an early date. In fact, unclear points of specification were detected at the Sprint Planning on the first day of each Sprint in our project. Moreover, Schwaber and Sutherland (2016) wrote that 'no changes are made that would endanger the Sprint Goal' during the Sprint. This means that everything to do is definite at the time of starting Sprint, and not to respond to change requests during Sprint.

There are the following two advantages in view of productivity by deciding what to do at the start of the project and not changing the specifications on the way; reducing the cost required for rework and the cost for switching tasks. Rework is 'the additional effort of redoing a process or activity that was incorrectly implemented in the first instance or due to changes in requirements from clients' (Ramdoo and Huzooree, 2015). If the things to do are decided from the beginning, it is sufficient to do the work once. However, if the things to do is decided later or the things to do change, the cost of working halfway is wasted. This is a disadvantage of reworking from the viewpoint of productivity, 'software specialists spend about 40 to 50 percent of their time on avoidable rework rather than on what they call value-added work, which is basically work that's done right the first time. Once a piece of software makes it into the field, the cost of fixing an error can be 100 times as high as it would have been during the development stage' (Charette, 2005). Thus, by excluding rework, factors that reduce productivity can be eliminated, resulting in improved productivity.

Another element to be considered is task switching cost. Task switching cost occurs when trying to execute two or more tasks simultaneously or alternately. 'Doing more than one task at a time, especially more than one complex task, takes a toll on productivity', and 'even when people had to switch completely predictably between two tasks every two or four trials, they were still slower on task-switch than on task-repeat trials' (American Psychological Association, 2006). In a software development project, various tasks exist during executing project activities, and it is difficult to avoid occurrence of task switching cost. Particularly, in the case where there is an undecided task or when the change in use is done halfway, it is necessary to add an unplanned task such as a meeting or investigation. Even if a change request is not applied as a result of the coordination, the task switching cost is incurred because the scheduled task is suspended in order to consider whether to change the specification. However, by reducing the project scale into smaller Sprints in order to make it easier to eliminate pending issues and adopting operations that do not change what to be done in the middle of Sprint, it will be possible to reduce the frequency of task switching and the total cost of task switching during Sprint.

The point to be aware of in Scrum is the order of prioritisation when dividing the project into Sprints and considering which Sprint to be started with. Generally, The Agile project prioritises Sprints with higher business value. However, when considering from the viewpoint of productivity, priority is given to those whose requirements are fixed. Whether to prioritise productivity or project value should be taken into consideration when maintaining the Product Backlog Item (PBI). Also, since the purpose of reducing the size of the project is to encourage confirmation of requirements, productivity does not necessarily improve with Scrum when all the requirements of the project are finalised. If Waterfall development allows to plan to efficiently digest large scale project tasks, indirect costs such as project management can be relatively reduced by economies of scale. Therefore, when considering whether to adopt Scrum, the degree of requirement determination of the whole project should be considered.

3. Reduction of Project Term

It is generally to be prolonged the development length in proportion to the project size though the period of software development project varies according to the characteristics of the project. In a Waterfall project, each phase of the project such as design and implementation phases are arranged in a linear fashion, and each step works with the output of the previous step as input. That is, the work of each process is performed whilst following the work contents of the previous process. Meanwhile, the longer the project, the longer the duration of each phase of the project. Therefore, the time elapsed since the completion of the previous phase also becomes long. In larger Depending on the size of the project, the project members may have to look back on the tasks that were completed several months or more before doing the work.

On the other hand, in Scrum, as mentioned in Chapter 2, large projects are divided into small Sprints. Schwaber and Sutherland (2016) recommended that 'Each Sprint may be considered a project with no more than a one-month horizon'. Therefore, when splitting a large project into small projects, projects of short duration should be repeated instead of multiple small projects running in parallel (Figure 4). In addition, 'Each Sprint has a definition of what is to be built, a design and flexible plan that will guide building it, the work, and the resultant product' (Schwaber and Sutherland, 2016). Therefore, even if each process in a Sprint is performed linearly like Waterfall, it is possible to perform the work of the next process less time from the completion of the previous process.

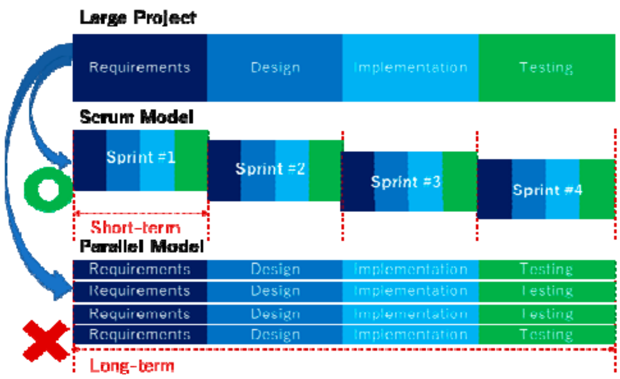


Figure 4(The ways to splitting the large project)

The longer the time passes from the completion of work, the harder it is to recall the details of the completed work. Ebbinghaus' past research found 'a consistent pattern to the decline of his ability to recall these words over time' (Meacham, 2016), that is well-known as Ebbinghaus Forgetting Curve (Figure 5). In order to look back on the contents of the work as an input during development activities, to take a long time to refer to the contents of work that has been carried out ahead of time is required, because a lot of things has gone outside the memory. Conversely, the shorter the duration of the project, the less the cost of looking back on the previous task. The limitation of the duration of Scrum within one month can reduce the cost for reminding the previous tasks. In our project, the duration of one Sprint was defined as fourteen days, shorter than usual Waterfall projects. In Sprint Retrospective, most project members felt it easy to look back on what they did.

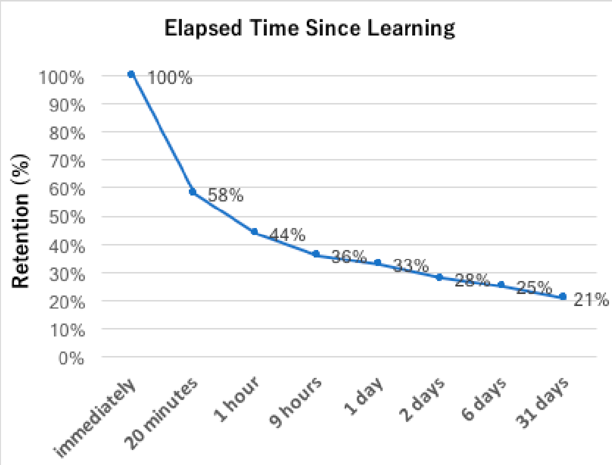


Figure 5(Ebbinghaus Forgetting Curve: Impact on Enterprise Employee Training, Ilan, 2016)

In order to realise the benefit of this, assigned project members must be able to handle all phases of the project. Schwaber and Sutherland (2016) noted that 'Development Teams are cross-functional, with all of the skills as a team necessary to create a product Increment'. The advantage of improving productivity by reduction of project term is that the cost of remembering the previous task is reduced, because it is assumed that the same person in charge carries out a series of tasks. If the person in charge is different for each role such as designer and tester, the cost of confirming the deliverables of the previous phase always occurs. That's because different staff are in charge. In addition, for large projects, multiple Scrum teams are usually required In that case, assigning team members in consideration of task assignment for each team is efficient. The advantage of productivity improvement through project shortening can also be enjoyed in Waterfall projects. However, care should be taken as to assign the multi-skilled members.

4. Acceleration of Retrospection

Retrospection is a task to look back on project activities and find improvements for the next project. In Scrum, an event called Sprint Retrospective is defined as 'a meeting facilitated by the ScrumMaster at which the team discusses the just-concluded sprint and determines what could be changed that might make the next sprint more productive' (Devendra, 2014). Then, 'The Sprint Retrospective occurs after the Sprint Review and prior to the next Sprint Planning' (Schwaber and Sutherland, 2016). When the planned "DOs" are completed, check the process and make an action for the next plan. What Sprint Retrospective is doing is about the same as continuous improvement by applying the general PDCA cycle.

Compared to Waterfall model projects, the advantage of Scrum projects is the quick application of improvement points discovered in Sprint Retrospectives. In a Waterfall project, as can be seen Figure 6, retrospectives are generally conducted when all phases of the project are completed, And the improvements obtained with the retrospective can be applied after the next project. In other words, improvements can not be applied to the project underway. Although it is possible to implement retrospective every time each phase completes, the timing to apply what to improve in doing that phase will be the next project anyway. On the other hand, in Scrum, as mentioned in Chapter 3, large projects are broken down into small Sprints and all the work of a series of projects is done in one Sprint. Improvements discovered by implementing the Sprint can be applied from the next Sprint. Therefore, it is possible to carry out improvements whilst implementing one project. In case of our Scrum project, by implementing the Sprint Retrospective and continuing improvements, the story points were greatly digested in the latter half of the planned ten sprints. As a result, shortening the period of one sprint was realized (Figure 7).

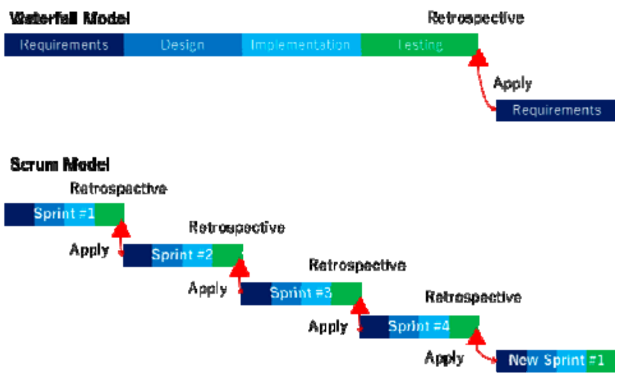


Figure 6(Timing of Retrospectives and Application in Waterfall and Scrum Project)

Sprint	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Story Point (Actual)	25	57	49	80	66	54	73	72	87	0

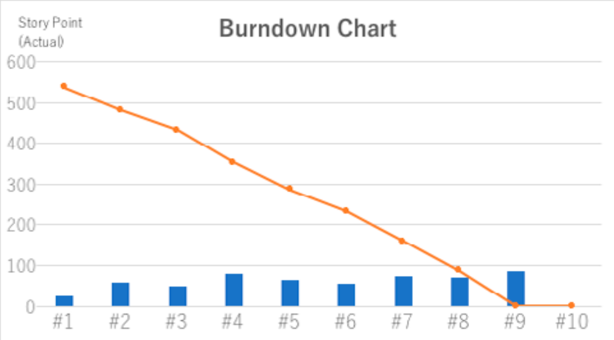


Figure 7(Burndown Chart)

In order to improve this advantage of Scrum application, it is important to implement a Sprint Retrospective for each Sprint. If retrospective is carried out after the completion of whole project, the effect will be equivalent to a Waterfall project. Also, if you implement retrospectively together after implementing several Sprints, it will be possible to bring about improvements during the project. However, in that case, it should be noted that the improvement effect obtained is reduced by lowering the quality of the improvement points obtained with the retrospective and delaying the timing of improvement application. Unlike Waterfall, why "Retrospective" is bundled up in a Sprint as an official event is because it may be considered as important and effective in continuous improvement.

5. Reduction of Communication Cost

In general, system development is performed by the team. Members belonging to the team share their roles and create deliverables as team work, for example, requirement analyst and system designer. In Scrum team, as mentioned in Chapter 3, development team members are required to be cross-functional. However, even in such cases, teamwork is essential, such as sharing divisions for each requirement and consulting with team members when running Sprint Planning. As Ohno (1988, p.23) mentioned, 'harmony among people in group, as in teamwork, is in greater demand than the art of the individual craftsman', smooth teamwork is indispensable. In order to harmonise the communication of the team, the following two factors should be considered; the size of the team and the way of communication within the team.

The more people the team has, the more communication paths will be increased (Figure 8), therefore, the burden of communication will be increased as the team becomes larger. Brooks (1985, p.25) described that 'Adding manpower to a late software project makes it later', known as "Brooks's Law". In addition, 'Participants tend to feel less accountable in crowded meetings. They doubt that any contribution they make will be rewarded, resulting in a reduction of effort' (Shellenbarger, 2016). Such "social loafing" should be avoided in a Scrum where team members participate in meetings in an equal position. On the other hand, as the number of teams decreases, the communication paths are limited, so the communication cost will be decreased. However, smaller team may encounter skill constraints during the Sprint that causes a situation where it is impossible to complete the required tasks. Therefore, whilst considering the skills required of the team and the ability of the team members, team size should be optimised with the aim of as few people as possible. 'Optimal Development Team size is small enough to remain nimble and large enough to complete significant work within a Sprint' (Schwaber and Sutherland, 2016).

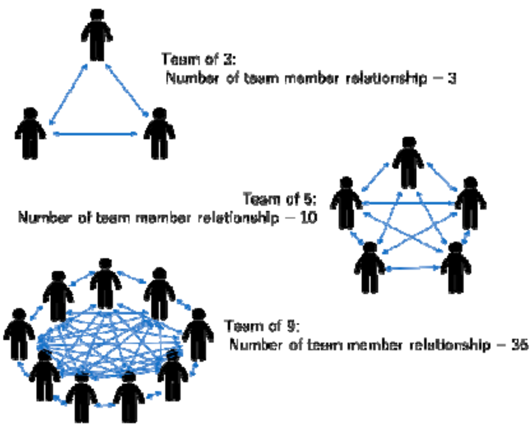


Figure 8(Relationships between team members)

In terms of team size, Schwaber and Sutherland (2016) noted that 'Having more than nine members requires too much coordination'. Sutherland (2014, p.59) mentioned that 'Once the teams grew larger than eight, they took dramatically longer to get things done' from the observations of over hundreds and hundreds of projects. Similarly, Mao *et al.* (2016) reported effects of group size on productivity that 'the performance of synthetic teams peaks around eight person-hours and then subsequently decreases'. Mankins (2014) stated "the Rules of 7" that 'every attendee over seven reduces the likelihood of making a good, quick, executable decision by 10%'. In summary, in order to maximise performance, team size should be around seven people. Also, when the team needs more than ten people, the team should be divided into two smaller teams in consideration to the low performance of larger team.

The effective communication among team members are also important in terms of reducing waste of time, because 'An organization whose people communicate effectively experiences fewer of the misunderstandings that create friction between people, waste time, and cause mistakes' (McIntosh *et al.*, 2008, p.3). Self-organised Scrum teams 'choose how best to accomplish their work, rather than being directed by others outside the team' (Schwaber and Sutherland, 2016) like Waterfall development. Therefore, in order to operate the self-organised team autonomously in Scrum, the quality of communication within a team becomes more important. Beck *et al*. (2001) described the principle behind the Agile Manifesto that 'The most efficient and effective method of conveying information to and within a development team is face-to-face conversation', and Schwaber (2007, p.137) noted that 'Collocating teams so that any team member can readily get face to face with any other team members to talk through and diagram a problem'. With a face-to-face conversation, team members can obtain rich-information from peers. 'We interpret what people say to us only partially from the words they use. We get most of the message (and all of the emotional nuance behind the words) from vocal tone, pacing, facial expressions and body language. And we rely on immediate feedback – the instantaneous responses of others – to help us gauge how well our ideas are being accepted' (Goman, 2015). Therefore, 'in communicating feelings, emotions and interpersonal attitudes, the nonverbal components of the affective messages have significantly more impact than the verbal components' (Trimboli and Walker, 1987). In order to improve communication efficiency by nonverbal communication, organising a Scrum team at the same location is better so that team members can communicate by face to face. In our project, Scrum team was organised by seven people. Although there were two inexperienced members in the team, there were no defects that brought additional burden due to communication failure.

One thing should be considered is offshore development. In terms of cost reduction and resource capability, nowadays many IT organisations have already engaged in offshore development. In this case, due to location and time difference issues, there will be physically difficulty in face-to-face communication between sites. In order not to compromise communication efficiency, it is necessary to adopt a solution that complements nonverbal communication such as video conference. Another solution suggestion is to organise Scrum teams so as not to cross cites as much as possible. For example, it may be possible to review the allocation such that a scrum team that defines requirements is placed in the same location as the customer authorized to determine requirements. Then, another Scrum team to design, implement, and test is placed in a remote cite. In case of our project, Scrum team was organised at a remote site and was in charge of external/internal design to integration test phases. System requirement design phase was implemented at the client site, and all pending issues were resolved at the client site and handed over to the remote site as Product Backlog. It could reduce the frequency of communication over distance.

6. Conclusion

This paper explained the mechanism of Scrum that will help improve productivity, and what should be aware of when applying Scrum in a software development project. First, dividing the project scope into smaller Scrum Sprints that are easy to grasp the whole picture can reduce the change requests during development due to unclearness of specification. It leads to a reduction in rework and task switching cost. To fix the requirement at the beginning of each Sprint is important to reduce these costs. In addition, it can also reduce the task switching cost. Second, the shorter duration of Scrum Sprint in comparison to Waterfall project makes it easier to remember work content in a Sprint. It is important to assign the same multi-skilled member to a series of tasks in a Sprint. Third, Sprint Retrospective can improve the way of development in a Sprint. To apply the PDCA cycle in a repetitive Scrum development at the Sprint Retrospective in each Sprint is essential. Finally, communication costs are reduced by appropriate team size and non-verbal communication among Scrum team. Forming small and member-fixed Scrum team at the same location can contribute to improve the efficiency of communication.

Lastly, but not the least, verification of the theory with the actual cases of applying Scrum methodology in system development need to be conducted and therefore should be examined in the future paper.

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3D Application for Dependability Assessment Based on Three Noisy Models for Cloud Computing

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The operation phase of cloud computing has a unique feature such as the provisioning processes, the network-based operating, and the diversity of data, because the operation phase of cloud computing changes depending on many external factors. In particular, it is very important to consider the status of fault-detection and big data in terms of reliability assessment for cloud computing, because the data storage areas for cloud computing are reconfigured via the various mobile devices. We develop a 3D application based on stochastic differential equation modeling in order to consider the interesting aspect of the software fault, cloud network, and big data. In particular, we implement as the 3D animation software of native and Web application for reliability analysis based on the proposed method. The developed 3D application is implemented by using NW.js, statistical computing R, HTML, JavaScript, CSS3, ggplot2, and plotly as the latest technologies. Then, we show performance examples of the developed 3D application to quantitatively analyze software reliability for the cloud computing. The developed 3D application will be useful for the software development managers to assess the reliability for cloud computing at anytime and anywhere, because the developed application has high portability. Moreover, we discuss the open source software project management in terms of dependability assessment for cloud computing with big data.

Keywords and phrases: 3D application, Cloud computing, Reliability, Stochastic differential equation

1. Introduction

At present, many cloud services are managed by using OSS (Open Source Software) such as OpenStack and Eucalyptus because of the unification management of data, cost reduction, quick delivery, and work saving. In particular, the big data and cloud computing are now attracting attention as the next-generation software service paradigm. The cloud software is connected by many mobile software. Then, the mobile clouds based on cloud service become known as the next-generation software service paradigm. In case of such mobile clouds, the installer software developed under the third-party developers indirectly have an effect on the reliability in area of a mobile device. In particular, OSS systems serve as key components of critical infrastructures in our society. The open source project contains special features so-called software composition by which several geographically-dispersed components are developed in all parts of the world. However, the poor handling of quality problem and customer support has limited the progress of OSS, because the development cycle of OSS has no specific testing phase to detect and remove software faults introduced in the development process. A mobile OSS known as one of OSS has been gaining a lot of attention in the embedded system area, i.e., Android and BusyBox, etc. Therefore, it is difficult for many companies to assess the reliability in mobile clouds, because a mobile OSS includes several software versions, the vulnerability issue, the opened source code, the security hole, etc. We have proposed several methods(Yamada and Tamura, 2016) of reliability assessment for OSS in the past.

Historically, many software reliability growth models (SRGM's)(Yamada, 2014, Musa et al., 1987, Kapur et al., 2011) have been applied to assess the reliability for quality management and testing progress control of software development.

On the other hand, the effective methods assisting dynamic testing management for a new distributed development paradigm as typified by the cloud computing have only a few presented(Li et al., 2011, Ullah et al., 2012, Cotroneo et al., 2013). Also, there are some interesting research papers in terms of the cloud hardware, cloud service, mobile clouds, and cloud performance evaluation(Iosup et al., 2013, Khalifa and Eltoweissy, 2013). However, most of them have focused on the case studies of cloud service and cloud data storage technologies. In particular, it is very important to consider the status of fault-detection and big data in terms of reliability assessment for cloud computing in the following standpoint:

1. The various mobile devices are connected via the network to the cloud service.

2. The big data as the results from the huge and complicated data by using the internet network cause the system-wide failures because of the complexity of data management. The cloud computing has a particular maintenance phase such as the provisioning processes.
3. The data storage areas for cloud computing are reconfigured via the various mobile devices.

From above reasons, it is important to consider the indirect influences of big data on the reliability. We have proposed several methods of software reliability assessment for cloud computing in the past(Tamura et al., 2012, Tamura, and Yamada, 2010). However, the effective methods of reliability assessment considering both the big data factor and fault one have been only a few presented, because it is very difficult to describe the indirect influence of big data and fault data as the reliability assessment measures as shown in Figure 1. Then, we have proposed a new approach to describe the indirect effect on reliability by using three kinds of Brownian motions(Tamura and Yamada, 2015).

In this paper, we focus on the method of reliability analysis for the cloud computing. Then, we discuss a method of software reliability analysis considering 3V's model(Pettey and Goasduff, 2011) in big data on cloud computing. Moreover, we develop the three-dimensional application software for reliability assessment based on our method. Then, we show numerical performance of the developed application software to evaluate the method of software reliability assessment for the big data on cloud computing.

2. Software Reliability Modeling Considering the Big Data on Cloud Computing

We have proposed three dimensional Wiener process model(Tamura and Yamada, 2015). The cumulative numbers of detected faults based on our three dimensional Wiener process model at time t are obtained as follows:

$$M(t) = R(t)\left[1 - \exp\left\{-\int_0^t b(s)ds - \sigma_1\omega_1(t) - \sigma_2\omega_2(t) - \sigma_3\omega_3(t)\right\}\right], \quad (1)$$

where $R(t)$ is the current number of faults latent in the cloud OSS, $\omega_i(t)$ i-th one-dimensional Wiener process.

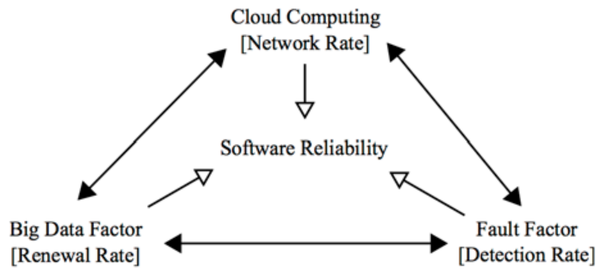

Figure 1 The relationship among big data, cloud computing, network, and reliability.

Also, we assume the software fault-detection rate per fault in case of $b(t)$ defined as:

$$b(t) \doteq \frac{\frac{dI(t)}{dt}}{a - I(t)} = \frac{b}{1 + c\cdot\exp(-bt)}, \quad (2)$$

where $I(t)$ means the mean value function for the inflection S-shaped SRGM based on a nonhomogeneous Poisson process (NHPP)(Yamada, 2014). In Eq. (2), a means the expected total number of latent faults prior to operation, and b the fault detection rate per fault. Generally, the parameter c is defined as $(1-l)/l$. We define the parameter l as the inflection factor. In our model, we assume that the parameter σ_1 considers the failure-occurrence phenomenon. Also, we assume that the parameter σ_2 depends on the network changing rate per unit time resulting from the cloud computing. Moreover, we assume that the parameter σ_3 depends on the renewal rate per unit time resulting from the big data.

3. Framework of Multi-Dimensional Application for Reliability Analysis

3.1 Specification requirement

The specification requirements of the reliability analysis tool for big data on cloud computing are shown as follows:

1. This tool should be operated by clicking the mouse button and typing on the keyboard to input the data through GUI system. In particular, the user experience design is adopted as the important element of our tool. Moreover, the three-dimensional space is used in the proposed tool in order to represent three dimensional Wiener process models.
2. Statistical computing R(The R Project for Statistical Computing) and ggplot2 library should be used to implement the program. This

tool is developed as a stand-alone of multi-platform. Also, this tool operates as Web application. Moreover, the three-dimensional space is implemented by illustrating several three-dimensional graphs.

3. The method of maximum-likelihood is used as the estimation of unknown parameters in our model.
4. This tool treats the proposed stochastic differential equation model considering the big data on cloud computing, and illustrate the cumulative number of detected faults at arbitrary time t, the mean time between software failures (MTBF), and the number of remaining faults as software reliability assessment measures.

3.2 User experience design

It is known the following items as the elements of user experience design.

- *Visual Design*
- *Information Architecture*
- *Information*
- *Structuring, Organization and Labeling*
- *Finding and Managing*
- *Interaction Design*
- *Usability*
- *Accessibility*
- *Human-Computer Interaction*

We focus on the “Visual Design” and “Interaction Design” as the user experience design. “Visual Design” and “Interaction Design” can easily implement by using CSS3 and JavaScript programming language, because CSS3 and JavaScript includes the various effect components. We develop the dynamic reliability analysis tool based on Visual Design” and “Interaction Design” by using the animation effects of CSS3 and JavaScript.

Moreover, the three-dimensional space is implemented in the developed tool by using JavaScript programming language. In particular, the plotly R library(Plotly R Library) is used in the developed tool. In order to illustrate three-dimensional graphs, the developed tool can execute the 3D rendering processing with high speed by using JavaScript. In particular, the developed application software is implemented as the stand-alone application of multi-platform by using the latest technology of NW.js. Figure 2 shows the basic concept of the developed application software.

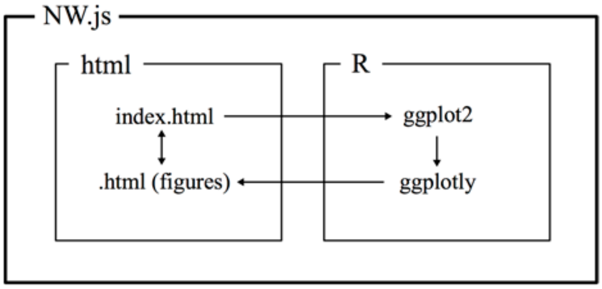

Figure 2 The basic concept of the developed application software.

Figure 3 The main screen of the developed application software.

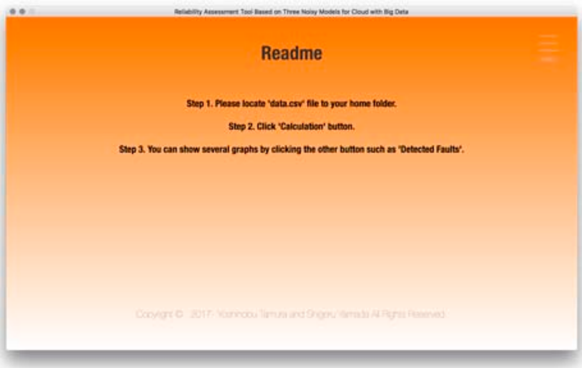

Figure 4 The readme screen of the developed application software.

4. Performance Illustrations of the Developed Application Software

The OSS is closely watched from the point of view of cost reduction and quick delivery. There are several open source projects in area of cloud computing. In particular, we focus on OpenStack(The OpenStack

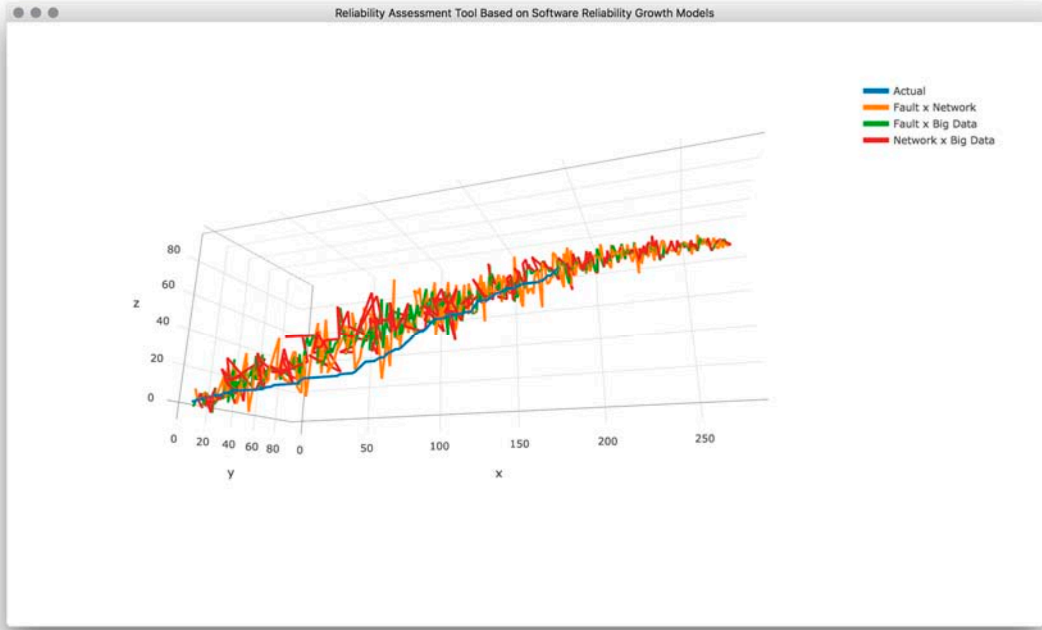

Figure 5 The sample path of the number of detected faults for all factors (Fault, Network, and Big Data).

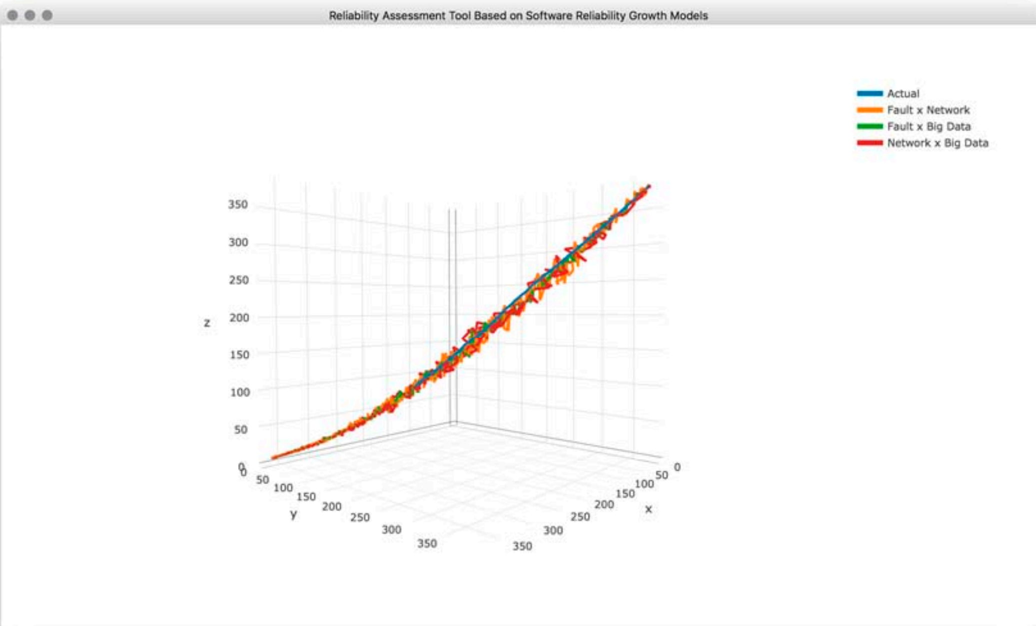

Figure 6 The sample path of the number of remaining faults for all factors (Fault, Network, and Big Data).

project) in order to evaluate the performance of our method. In this paper, we show numerical examples by using the data sets for OpenStack of cloud OSS. The data used in this paper are collected in the bug tracking system on the website of OpenStack open source project.

We show the main screen and readme screen of the developed dynamic reliability analysis tool in Figures 3 and 4. The items of several reliability assessment measures are shown as the right-side menus in Figure 1. This application software is developed considering the simple structure included

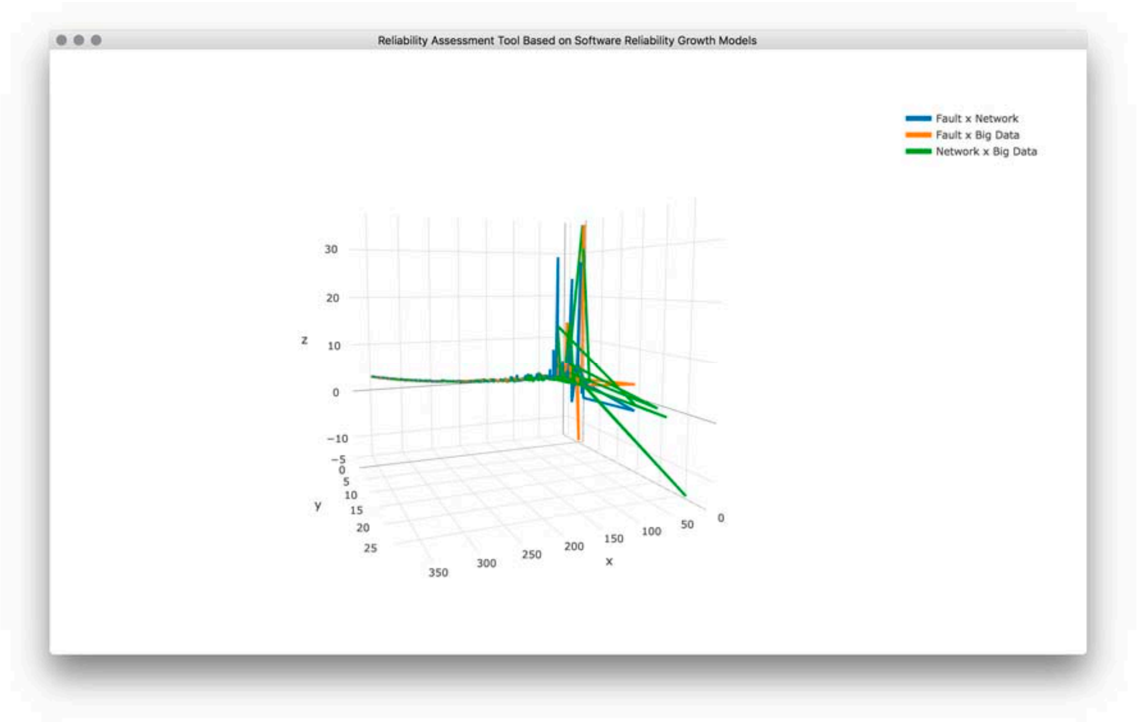

Figure 7 The estimated MTBF for all factors (Fault, Network, and Big Data).

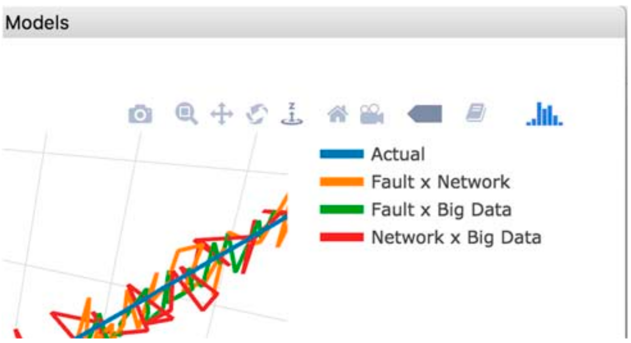

Figure 8 The menu items for the customization on the graph of developed application software.

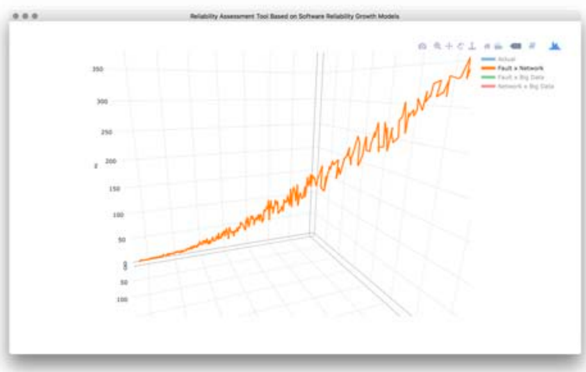

Figure 9 The extracted sample path of the number of remaining faults for the fault and network factors.

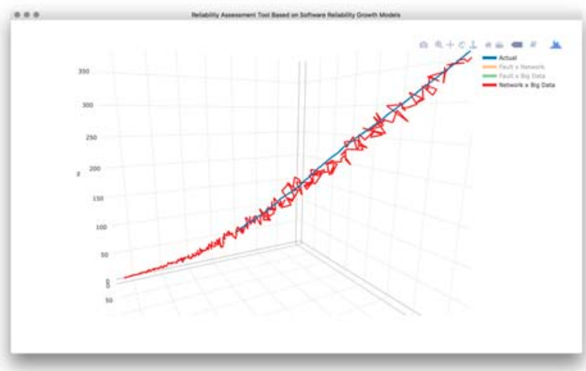

Figure 10 The extracted sample path of the number of remaining faults for the network and big data factors.

the title screen and main menu only. In particular, the software managers can easily operate by clicking. The sample path of the estimated number of detected faults for all factors such as fault, network, and big data is shown in Figure 5. Similarly, the sample path of the estimated number of remaining faults for all factors such as fault, network, and big data is shown in Figure 6. Moreover, the sample path of the estimated MTBF for all factors is shown in Figure 7. From Figures 5~7, we can confirm that the noise of network factor becomes large in the early operating phase of cloud computing. On the other hand, we can confirm that the

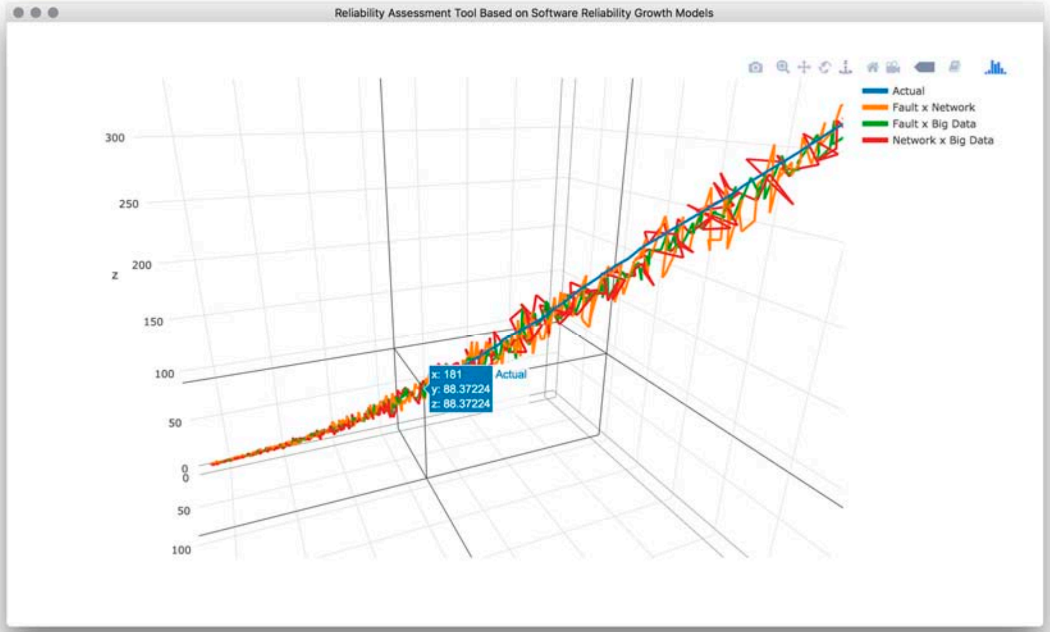

Figure 11 The zoomed sample path of the number of remaining faults for all factors (Fault, Network, and Big Data).

noise of fault factor becomes small in all operating phase of cloud computing. Also, we find that the noises of network and big data factors become large in all operating phase of cloud computing. Therefore, we can confirm that the cloud computing environment in this case keeps in stable condition in terms of the reliability.

The developed software tool is implemented by using the plotly R library. By using the plotly R library, it is possible to show 3D animation graph. In particular, the graph obtained by the plotly R library has several functions such as zoom, rotation, pan, etc. as shown in Figure 8. Figure 8 is the menu items for the customization on the graph of developed application software.

As the examples, Figure 9 shows the extracted sample path of the number of remaining faults for the fault and network factors. Also, Figure 10 shows the extracted sample path of the number of remaining faults for the network and big data factors. Moreover, the zoomed sample path of the number of remaining faults for all factors such as fault, network, and big data is shown in Figure 11.

From above mentioned results, we have found that the developed software tool can describe the characteristics of the big data on cloud computing according to the changes of the fault, the changing rate per unit time of network traffic, and the renewal rate per unit time of big data. The developed tool will be useful to assess the reliability of the characteristics of big data on cloud computing. In particular, the software development managers can use the developed software tool for cloud computing at anytime and anywhere, because the Web application has high portability. Moreover, the developed application software is useful for the software development managers to assess in various execution environment because of the multi-platform application by using the latest technology of NW.js.

5. Concluding Remarks

In this paper, we have focused on cloud computing with the big data. In particular, we have developed the reliability analysis tool in order to consider the characteristics of cloud computing under big data. Then, we have proposed the method of reliability assessment incorporating the interaction among 3V's model on big data.

Moreover, we have developed the three-dimensional mobile application based on the proposed method. Additionally, we have presented several performance illustrations of the developed mobile application and the proposed method for the actual data. Moreover, it is important for software development managers to assess the reliability for the big data on cloud computing. We have shown the estimated cumulative numbers of detected faults, the estimated number of remaining faults, and MTBF considering the big data on cloud computing. Thereby, we have found that the developed mobile application can assess integrated reliability considering the interactions among software failure, network traffic, and big data.

In case of considering the effect of external factors on entire system in the development of software reliability assessment methods for cloud computing, it is necessary to grasp the deeply-intertwined factors. In this paper, we have shown that the proposed method can grasp such deeply-intertwined factors by assuming 3V's model of big data. Also, we have analyzed actual data to show numerical performance of software reliability assessment for the cloud computing.

Acknowledgments

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Management for the Parallel System Development in Multiple Projects

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In parallel system development projects, there are some challenges such as restrictions on resources and the difficulties of coordination among related projects. Therefore, it is necessary to consider how to manage these particular challenges in addition to normal project management. This paper provides a case of parallel development project of financial system renewal. There are two financial systems that offer related financial services by different customers. These two system renewals were required to develop in parallel because the end of support for hardware of these systems had been set in the similar period. Moreover, there were some features of this project such as the system renewal policies were different between customers, and it was a replacement from other vendor. To resolve the challenges faced in this parallel system development, team organization was examined and rebuild. This paper describes the effect of team organization applied in actual projects in parallel system development.

Keywords and phrases: Parallel System Development, Team Organization

1. Introduction

Generally, enterprise information system sometimes requires to be renewed at the same time due to aging of the system and renovation of the infrastructure. In these parallel system developments, it is needed to consider not only how to manage each project but also dependencies among them. Especially, in the case of renewals of systems that have a strong dependency of business, there are some important things such as human resource placement and sharing, coordinating schedule and challenges. If management for these projects doesn't work efficiently, some problems might occur, such as reworking due to inconsistency of specification and schedule between systems, behind schedule due to unexpected situation happened.

This paper provides the case of parallel renewal project for financial systems that are interrelated. This project had many challenges caused by inefficient management. In order to address these challenges to normalize the project, focusing on the interdependence of this project, the measure of human resource replacement applied.

In this paper, it describes the effect of the improvement measure of team organization through human resource replacement.

2. Practical Challenge

2.1 Overview of Project

A certain company had provided some related financial services to several financial institutions. However, this company decided to withdraw from the business with arrival of the end of support for hardware used in these systems. Because service business cost was high and it was difficult to maintain SLA.

These systems provided service consists of two main systems that had a dependency of business. Our company took over these systems, and started the project of renewal these systems.

When transferring this service business, a certain company consulted with customers using this service, and defined policies to renew for each system as below;

-System 1: Transfer the rights of the system to the customer and renew it as customer's system
-System 2: Reserve the rights of the system and continue to provide services.

The targets of this system renewal project are as below;

-To renew aged systems
-To conduct business transfer to our company and customer within the time limit
-To reduce the cost of system renewal

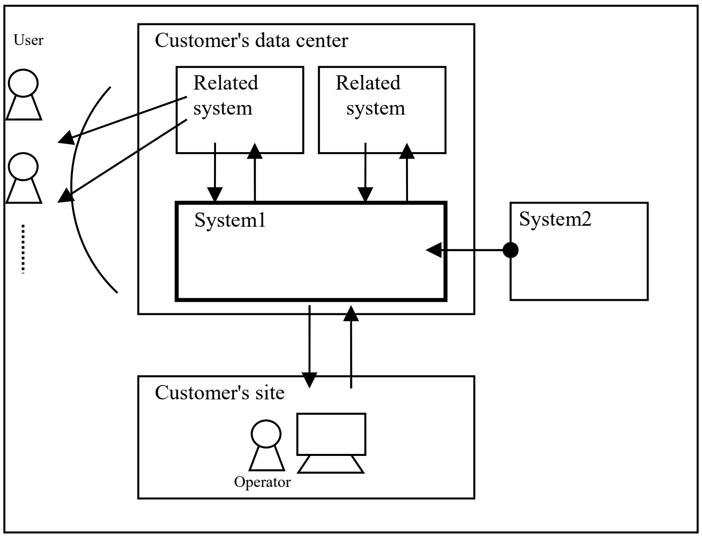
Therefore, in this renewal project, it was decided to upgrade operating system and middleware in addition to renewal of aging hardware. Besides, as for application, it was decided not to develop new function, and modified these applications to support only for working on these operating system and middleware. Moreover, there was arrangement that the development period should be able to be completed by the expiration of the maintenance term of the hardware.

It was necessary for our company to promote the system renewal project in accordance with these policies.

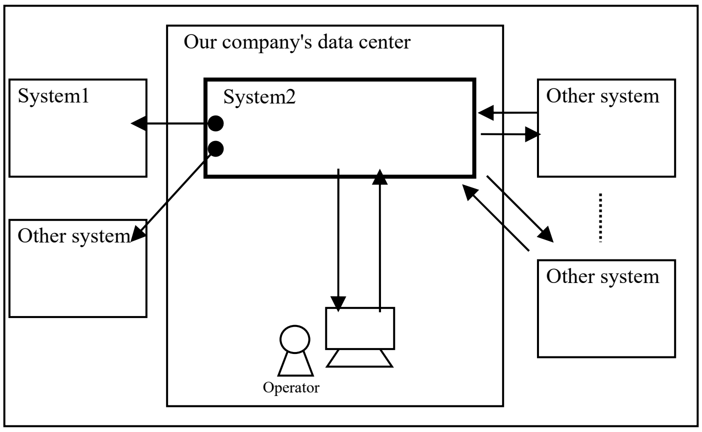
The system overview and characteristic are shown as below;

[System 1]
-System location: Customer's data center
-Operating vendor: Customer
-Supply form: Providing System integration service

[System 2]
-System location: Our company's data center
-Operating vendor: Our company
-Supply form: Providing Cloud service



Picture 1 Overview of system 1



Picture 2 Overview of system 2

Our company adjusted the development schedule after negotiating on each customers and how to proceed. As a result, each development schedule was planned according to the circumstances of each customer. Hence, it was necessary to promote projects with slightly different development schedule in parallel.

2.2 Challenge of Project Management

Based on this background, a project team was formed and started the project. To promote the project, development approaches and appropriate judgment that are optimal for individual projects are required. In terms of this project, it was necessary to consider development situation of each system and test schedule because these two systems were strongly related to each other in terms of business. Besides, integrated management and response system of the project was necessary not only for each system but also for cooperation between systems.

Therefore, at the beginning of the project, the project organization was taken as one, although development schedules were different. The following merits for having one project organization were assumed.

-Enable to reduce the time and cost required to take over since both systems were taken over from company A
-Enable sharing of experts, because each system has the same architecture
-Enable efficiency by collaborating on tasks such as tests, because each system is strongly related.
-Deter occurrence of defects due to less communication
-Minimizes mismatch of design policy and product of the project
-Suppress the costs by sharing the structure to make it smaller, and reducing the number of personnel responsible

However, as the project progressed, various problems had occurred and the schedule delayed. The author participated in the project as this stage. In order to solve the problem of the project and to recover the schedule, an investigation into what was the problem was conducted. As a result of this investigation, it turned out that the project had the following problems.

(1) Increase Communication Load

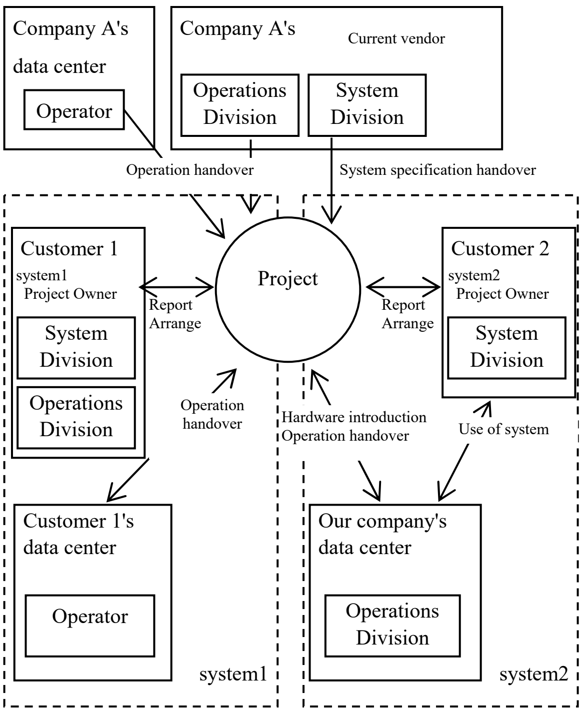
Generally, when the number of communication targets is N, the number of communication channels is represented by the formula N(N-1)/2, and the number of communication channels increases exponentially with respect to the increase in communication targets. The fact that there are many stakeholders means that there are many communication channels and the time taken to communicate is increased, so efficient promotion of projects becomes difficult.

As for this project, the number of stakeholders involved had increased compared to normal project and the project management load and management man-hour had expanded. It's because of some causes such as differences in customers, the accommodation center and the operation vendor were different for each system. Therefore, each team member had to deal with both customers and operators, and the number of mails was so large that communication load was extremely high such as not being able to handle everything.

On the management side of the project, since the report content such as the format of the document and the management index value were defined by each customer, it was necessary to respond, it was a factor of work load. Furthermore, it was necessary to carry out the report meeting separately with each customer, hence the project manager and the team leader frequently participated in the meeting, and most of the project management time was taken by communication with the customer.

This situation had led to opacity of project internal management. These things were getting into a vicious circle such as leading to deterioration of relationship with customers due to the difference between customer report contents and actual situation.

The following is overview of stakeholders and countermeasures in this project.



Picture 3 Relationship with stakeholders

(2) Increase Development Work Volume

Basically there was a policy to follow the design of the current system, hence the estimate of this project was made on the premise that documents created in the current system can be diverted. Moreover, it was assumed that the development man-hour could be reduced by diverting these documents.

However, there was not enough design documents necessary for system development, because the development process and the definition of product of project were different between current vendors and our company. Further, some changes in past system modification were not reflected in the design document, and there were no library management function for managing product of project. Therefore, as the project progresses, the following problems occurred, and development work volume tended to increase.

-Actual operation is different from design document
-There are applications, scripts and tools that do not have specifications or have different behavior from specifications
-A script that works normally exists only in the production environment
-There is some operation work which is becoming a dependent on individual skills due to lack of system operation procedure.

As a result, the project member had to acquire design content, application, script, tools and middleware setting values from these current systems on holiday or at night time. As for developing the operational procedure manual, it was necessary to go to the center according to the time of arrival of each operator and to hear whether there were operational procedures that have became dependent on individual skills.

Consequently, the amount of development work volume significantly exceeded the assumption.

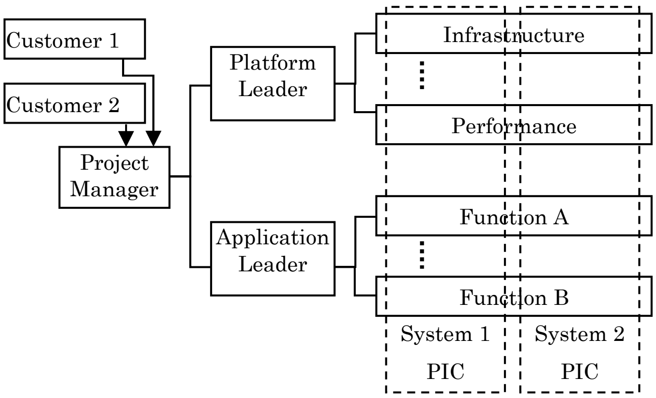
(3) Decline in Work Quality

The team organization of the project was composed a team on a design field rather than a customer unit(system unit). Hence, each team had to construct two systems at the same time.

The following is the team organization at the beginning of the project.

There was a possibility that it could be dealt with without problem if the amount of development work assumed at the beginning of the project.

However, as mentioned above, due to the fact that the communication load was very high and the



Picture 4 Team organization at the beginning of the project

amount of development work was increasing, the design work time to be carried out could not be taken sufficiently.

Even Under such circumstances, it was difficult to reset the schedule because the end of the project development schedule had been already decided. Therefore, review of the design content could not be implemented sufficiently and check out function of design mistake was lost. Moreover, the work process to be protected in each phase was ambiguous because the project phases were different for each system. As a result, the work quality in each system design work was deteriorated, and the number of occurrences of troubles and tasks had increased.

3. Consideration of Cause

The following table shows the result of examining what is the cause from the Issue of the extracted project.

As a result of examining the cause of the problem, it was decided to take measures with the assumption that the most effective measures out of measures that could be implemented to recover the project were to review the organization and optimize the workload of each member.

(1)Communication channel optimization

According to PMBOK, in communication management, after identifying stakeholders, plan a communication plan.

In this project, it was reorganized that the members who should communicate with each stakeholder and organized the information necessary for communication with the stakeholders. Through this approach, the organization which could equalize communication was considered.

Table1 Cause of Issue

No	Issue	Cause
1	Communication Load	- Necessity for the project member including PM to communicate with the two customers, system stakeholders
2	Development Work Volume	- Inadequacy of design document, design source of current system -Incorrect work estimate at the beginning of the project against the availability of the deliverables of the current system
3	Work Quality	- Necessity for the same member to design different systems at the same time -Necessity to correspond projects with different project phases simultaneously

(2)Workload optimization

According to PMBOK, after executing the activity definition and the order setting of the activities in the planning phase, schedule could be created by resource and time required estimation, and decide the arrangement of human resources and team organization. In terms of this project, since the assumed document didn't exist, then the load of creating the product was increased. Therefore, team organization was reviewed after re-conducted that the activity definition and order setting, reconfirmed the necessary resources and schedule.

4. Improvement Measure for Team Organization

The team organization at the beginning of the project was a project type organization. It meant that one project manager managed each system. The advantage of this team organization was that it could share the design policy and the level of products for each system. Additionally, compared to individual team organization for each system, it could be effectively utilized by flexibly shifting human resources.

In reviewing the team organization, the following were considered.

(1) Organization for Customer Response

In order to avoid confusion caused by differences in deliverables and methods of advancement for each customer, team organization was changed to it in charge of each system. Each member dedicated one system and one customer to adjust work volume and clarify the scope of responsibility.

Besides, each team handled only one customer, thereby reducing the number of communication channels and reducing the communication load.

(2) Organization for Project Manager

In the initial organization, the project manager managed both systems and corresponded to both customers as a counter. However, since the communication load was extremely high, sub PMs responsible for each system were arranged under the project manager for the purpose of distributing communication load. Each sub PM was delegated authority to manage each project and to deal with customers. Meanwhile, the project manager received reports from sub PMs as a manager to summarize the respective projects, and conducted the overall situation, consistency confirmation, and integrated management.

(3) Allocation for Team Member

By arranging members for each design field of each system, members could avoid having to perform work while considering multiple systems and schedules. Besides, member's ability was considered for maximize their ability by placing them on the appropriate team according to their skills.

In addition, members with the skill shortage were combined with members with high skills in order to maintain high motivation by making environment where each member could grow.

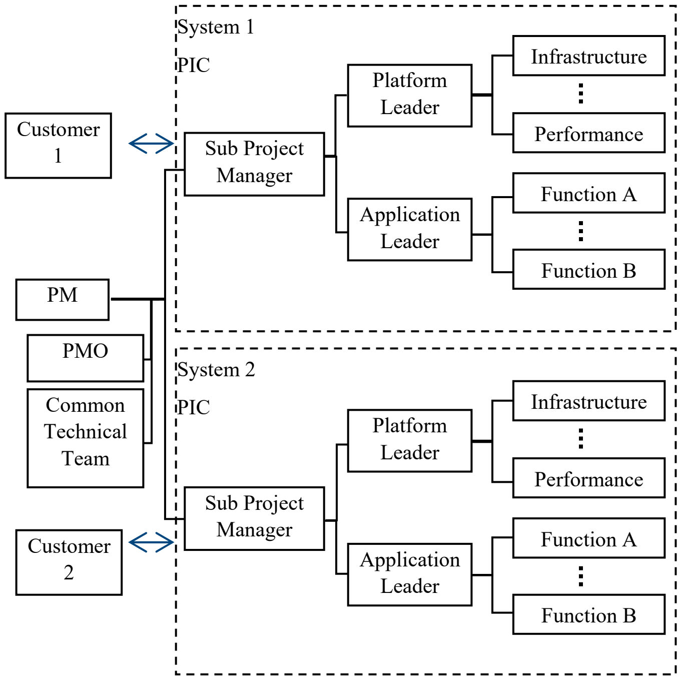
(4) Common Organization

① PMO(Project Management Office)

It was decided to divide the organization of each system, but there was concern that the division of the organization would result in variations in design policy and quality for each system. For the purpose of preventing it, PMO was placed to manage mutual systems in common. PMO organized in-house meetings of both systems on weekly progress, task reports, and confirmed the progress of the test as a test promotion for each project to follow-up of defects that occurred. As a result, PMO shared the problem occurred in one system to the other system and tried to ensure the system quality.

② Common Technical Team

Because the architectures of each system were nearly equal, particularly high members of skills with common architectural expertise would be required for either system as well as one system. Hence, a common technical team was formed to support design for both projects. Common technical team participated in the review of the design document of each system to try to ensure getting more design quality higher than a certain level as possible. Besides, common technical team members with more than a certain skill were also responsible for creating shell scripts necessary for system operation. Through this approach, it could be shared the design in mutual systems and secured quality and reduced cost.



Picture 5 Team organization after review

5. Effect

Through review of the team organization described above, it was able to normalize the projects that were in a state of confusion, and release on schedule successfully.

The following table shows effects of each measure.

In particular, the establishment of the PMO and the common technical team contributed to the improvement of the quality by sharing and incorporating the problem occurred in each system in which the schedule precedes, and it also helped to the cost reduction by standardizing the script design.

In addition, as a secondary effect, because the design policy for each system was the same, it was easy for one project member to understand the other system, so that members could be moved easily among each system. From the above, it was thought that there was expected effect in each phase of the project.

Table2 Effects of each measure

No	Measure	Effect
1	Organization for Customer Response	-The number of communication channels was optimized by dedicating one customer and system。 -Reduce the workload of each member by eliminating congestion of work and meetings
2	Organization for Project Manager	-By arranging the sub PM, PM could overlook the whole, and it was possible to promote the project under appropriate management and instructions -By making customer correspondence centered on sub PMs, communication with customers had also become smooth, improving relationships with customers and promoting projects together with customers
3	Allocation for Team Member	-By dedicating each member to one system, it was possible to concentrate on the work for schedule recovery, and the delay was eliminated -Working in an environment where each member could maximize their abilities by setting appropriate members
4	Common Organization (PMO)	-In addition to the tasks in each system, it was possible to extract common problems and reduce the occurrence of problems by taking measures in advance -With the support of the project management, it was possible to grasp the actual condition and quality situation of each project correctly, and implemented effective measures if there were any problems.
5	Common Organization (Common Technical Team)	-Appropriate support by members with high skill reduces rework, reduces defects due to design errors and mistakes -By implementing the shell script by the common technical team, it became a high-quality script, suppressing the occurrence of trouble caused by the script

6. Improvement

Although there was some effect on improving the team structure in this project, the following points remained until the completion of the project as a problem that could not be solved.

In the future, taking advantage of this experience, it is important to continue to manage appropriate projects so as not to fall into the same situation at the time of management and operation of other projects

(1)Visualize Member Skills

When considering the organization, the skills of the members were not clarified, and there were cases where it could not be placed in the proper position. As a result, there were occasional delays after arranging team organization.

(2)Cost Overrun

By dividing the structure, problems were solved in terms of system construction and customer correspondence. However, because of placing many members, overhead on the system occurred, resulting in a significant cost overrun from the original assumption. In order to prevent the occurrence of these events, it is necessary to construct an appropriate framework at the time of project start-up, and to be able to carry out the change of structure according to the occasional situation at the time of project execution timely.

7. Conclusion

In this paper, it was discussed the team organization for effective management of parallel system development.Moreover, through promoting common design and standardization in each system development project, it would be achieved that some works which are becoming a dependent on individual skills are eliminated, and mobility of personnel increases. As a result, cost optimization by appropriately allocating personnel between projects and project phases would be put into practice, therefore, it might be able to lead the project to success with customers.

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Proposal for Solution Business Model for JOC (Japan-oriented Company) Lease Company in ASEAN Nations

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In recent years, with Economic stagnation of Japan, Japanese companies' business target moved on to ASEAN nations. Japanese companies begin to invest in ASEAN business, while several Japanese companies that already have the investment in ASEAN nations. Furthermore, the increasing investment in Information Technology area can also be seen, which also lead to the increase in capital. By applying the Japanese business model with Business Know-how and Solution technology, several solution vendors that have gained market share in Japan have also aimed those business markets. However, All vendors are struggling to establish their business model in those area .Since 2012, by utilizing know-How and Lease Solution which has gained more than 30% of Japanese market share, have been expanding those ASEAN business nations. At present, established their business models for those areas with investigating the Local Japanese companies' business, Culture, Rollout Solution, Rollout Organization, Rollout policy and communication management. Key factor of success those business in those area is provided Japanese quality solution, lead rollout organization by onsite-support leader and development team organized Japanese member. In this study, success business model in JOC Lease market in ASEAN will be discussed with few projects experiences.

Keywords and Phrases: Solution Business, JOC Lease, Rollout 'Organization, Rollout Solution, Communication

1. Introduction

According to the data of 2014 in recent years, the total number of Japanese companies in the ASEAN region is 6,135 companies, which is almost the same as that of 6,276 Japanese companies in China. Looking at the number of enterprises by country within that region, in Thailand 1,956, Singapore 1,149, Indonesia 944, Malaysia 841, Vietnam 679, Philippines 479, Cambodia, Laos, and Myanmar 87.Next, the ratio of companies that started operations in relatively recent years, such as 33.1% of Vietnam, is high. Although the number is still small, the countries where Cambodia, Laos and Myanmar are expanding are also increasing (the balance of Japan's foreign direct investment as of the end of 2012, ASEAN has exceeded $ 122.27 billion and $ 93.2 billion in China).

Japanese firms' investment in ASEAN has been increasing due to additional investment by enterprises already in operation, investment in other countries in the region, investment by new enterprises, and as a target country. In this study, one of success business model in those regions which is JOC Lease market in ASEAN solution would be discussed. Start from Situation of Japanese leasing company's over-seas expansion in chapter 2, and Approach to ASEAN market and those issues described on chapter 3 and rollout achievement discussed on chapter 4. Chapter 5 presents summary of succession method of those business and next target.

2. Situation of Japanese leasing company's over-seas expansion

JOC leasing companies that are the business targets of author have rapidly advanced to ASEAN. The expansion rate has expanded approached 110% since fiscal year 2012, according to survey by the "Leasing business association" in 2015, 67 corporations in total for 67 countries have launched corporations in ASEAN region and expand their business market.

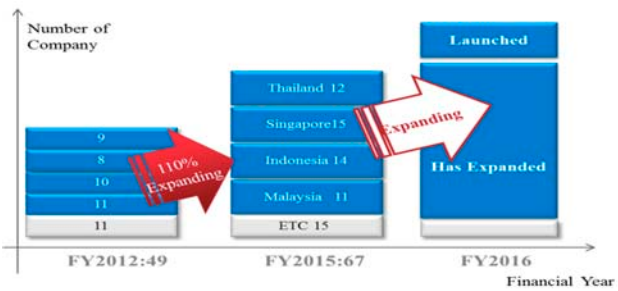


Figure 1 Expanding JOC Leasing Company in ASEAN

Furthermore, as future developments, it is planned that regional banks would enter ASEAN market and the growth strategy of major Japanese leasing company is developing the ASEAN market, which is also movement to expand business targeting those ASEAN market. Looking at the market of those Japanese leasing enterprise by region, there are four major countries. It is concentrated in Thailand, Singapore, Indonesia and Malaysia, which are relatively deeply interacted with Japan and positioned as developing countries.

2.1 Japanese leasing market and Authors Business

Leasing business package of author team boasts share No. 1 for medium-sized leasing companies in Japan. It is package for leasing companies that have been adopted by over 140 series of customers, including the achievements of construction of large scale leasing system. Promptly respond to diversifying customer needs and various system reforms and put in business as philosophy to provide optimal IT (Information Technology) solutions to realize "speed management" in Japan.

2.2 Situation of Lease package business in Japan

The following is the share analysis of Japanese leasing market and Author team, FUJITSU, market share. It covers major, semi-major, medium and small / medium scale markets and boasts 35% of Lease Market in Japan.

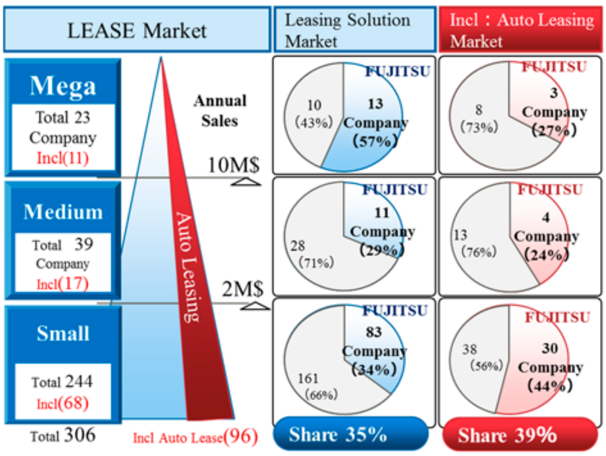


Figure 2 Market share of FUJITSU in Japan

2.3 Solution and organization of Japanese business

The Japanese leasing market is placed in harsh business environment such as the lease transaction volume decreasing year by year as the economic environment deteriorates. In large-scale leasing companies, the introduction of core business systems that realize speed management is progressing, but especially in medium-sized leasing companies, many customers are unable to introduce due to concerns about cost and operational burden. Meanwhile, facing new challenges such as business continuity including disaster measures such as earthquake disaster. Among such circumstances, Author team solution called LEASING-1, for Japanese leasing companies has been developing, targeting those market since the latter half of 1970, and the operation in the Japanese leasing market, holds resource regime that combines know-how and experience

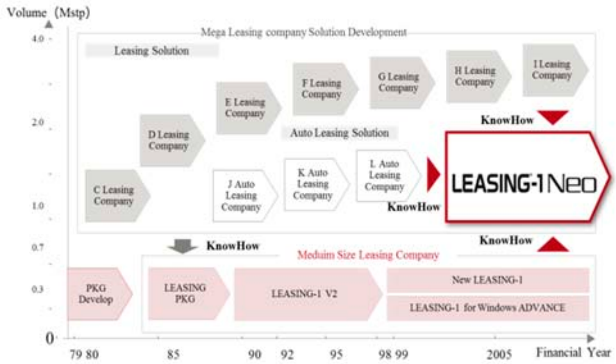


Figure 3 History of LEASING-1 Solution

3. Approach to ASEAN market and those issues

Based on the experience and know-how of the lease market in Japan, expanding to the ASEAN market is Next step. Discussed challenges, failure cases and new model related to the approach to ASEAN market.

3.1 Development of ASEAN Solution

The deployment solution must be incorporating multi-knowhow. Multi-knowhow is to combine business know-how in Japan with local business know-how, for localization. Many vendors suffering how they could develop their solution with those points .In general vendors could choose from 2 options. 1st option is solution which has achievement in Japanese business market or 2nd option is to collaborate with solution vendors that have matured in those target area. Working on both of them and learned that neither of them is successful. Naturally, the reason why the solution built in Japan could not be adapted in ASEAN is that the localization correspondence in each region dependent on language, currency, tax is incomplete. Japanese is unusual in ASEAN and is country where decimal point currency has not been applied.

Additionally, time-consuming and expensive to re-deploy with Japanese solutions for ASEAN market that could not contain those philosophies as basic solution. Taxation, localization, issue for each country is the same way. On the other hands, there are also issues that local solution vendors developed. When Japanese company targets the ASEAN market, 1st target are still Japanese companies located in those countries. The quality standards of solutions required by those companies are Japan standards. Local solution vendors could not realize solution development of "customer viewpoint" and "operator viewpoint" that is common in Japan. There is no country that hospitality is more rooted than Japan.

3.2 Systematization of rollout model

The following two approaches are considered as rollout model to the ASEAN market.

1) Building rollout team by local members
2) On-site rollout from Japanese members

1) Building rollout team by local members

Building organization by local members requires not only educating know-how and procedures for local members, but also reforming member habits, culture. It might be easy to take business model that practiced with general-purpose know-how, but it could be difficult for local members that need know-how in specific areas, in particular, niche industries in which the author is conducting business.

2) On-site rollout from Japanese members

On-site rollout supporting from Japan also increases the engineer's training monetary, and temporarily increases the cost because traveling and staying costs are charged. Moreover, because resource size not equal business scale, large-scale business could not control followed with their resource. Furthermore, success rate of the project is determined by communication ability of the rollout member from japan, and communication between the local member and customer. It is requirement definition phase and designing phase which are said to be important phase to emphasize those communications.

3.3 Maintenance Support

Supporting quality deterioration after systems go live becomes important in ASEAN business. Many local vendors are not rooted in schedule management, and many customers are dissatisfied with quality of response and response time. Furthermore, it is characteristic of JOC leasing company that vendor need report to headquarter about maintenance result.

4. Evaluation of Rollout model

Achievements of author business model would be described with few project experiences.

4.1 Provide Japanese quality solutions

The solution development is collaborated with local vendors that deployed with local requirement, and redeveloped with Japanese quality standard by Japanese development team. This is method of providing to the market. Development team redeveloped and restructured with SOR (System of Record), SOE (System of Engagement) and quality. Development team policy is accumulating expertise in the company organization in ASEAN corporate culture.

Developing SOR area: Carrying out renovation focusing on easy, single operation and user interface. Overseas solutions have fewer warnings and validation than those of Japanese, and have become mechanism for enhancing functionality. With Japanese IT culture, which is built in close to the operator, is refurbishment idea that could be accepted in those market. From the point of view of Japan fulfilling is also in line with the needs of those markets

Developing SOR area: carrying out renovations focusing on reducing operator's manual work. While ASEAN market was said to be inexpensive for operator costs, those cost raising with economic growth. Until now, there was culture that has left manual work on solutions for securing local employment, but those habits have broken out in the ASEAN market, which continues to grow with high speed. Enhancing mass operations which is billing, collection and accounting service that kept the manual work by operators taking trend of ASEAN market.

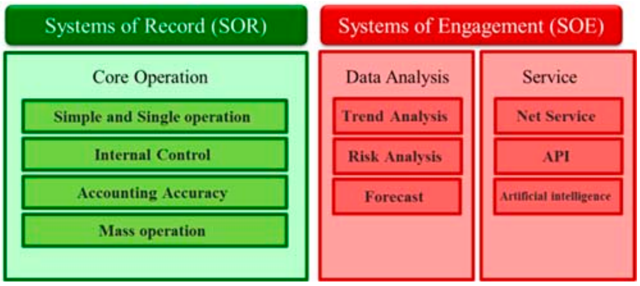


Figure 4: Solution enhancement Model

4.2 Building rollout Organization/Communication management

"Training Local member" that local members are trained Japanese project model would not succeed. It takes considerable business scale and roots of local culture that highly liquid resource environment which is said to change once every three years. As same as Japan's project, the author thought that project model carries out by development team which same as Japanese local project do could be stability and continuity. In author business that continues to doing ASEAN market business with this methodology, onsite by Japanese member for five years.

In addition, organization dividing into two groups. "Rollout team" local onsite member and "Development team" development team in Japan.

1) Rollout team

Japanese onsite members in rollout team have roles such as business consultation and bridge SE. Business consulting is not only conducts business system and consultation in terms of Japanese business view but also has an important role to lead the whole project and local members. Bridge SE is member mainly based on local customer correspondence. While discussing customer requests and local business practices, they propose solutions with utilization methods. Selection of local members is also an important factor to make the project successful. Local member needs to work specific localized business and operation. In case of customer businesses and operation could not be expected from Japanese operations, such as accounting and tax localization, local members who have that expertise could consult those operations. Local member who have business know-how of those markets and could be active globally are limited, so Development team provided Global Rollout Metrology LEASE which is a support tool and template of local members.

Solution documents, project documents, formats necessary for process meetings, development documents are in place.

2) Development Team

Development team supporting rollout team placed in Japan. Japanese quality solution and Global Rollout Metrology LEASE are controlled by development team. The main objective is to accumulate the business know-how of Japanese standards, rolling-out country business know-how and improve the efficiency of customization development that necessary for rollout. Data migration task is also said to be the most important of the projects supported by development team. Those are controlled under Japanese quality as well. The verification tool and operation explanation material for data migration, the process definition are arranged.

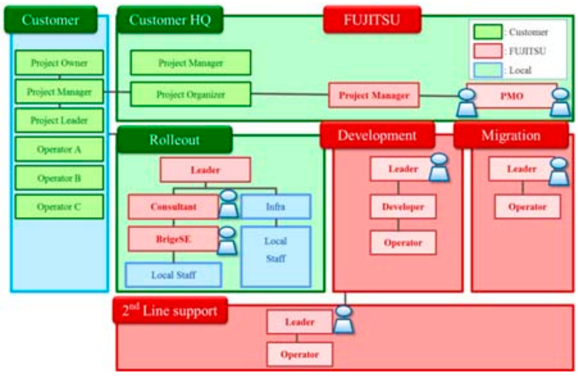


Figure 5 Rollout /Development organization

3) Communication Management

In project to be implemented in ASEAN market, vendor must be facing communication issues. Especially in projects that are "on-site" like this model, risk of communication increases.

Projects is implementing following measures to reduce the risk of communication

a) Unify the communication path

The same goes for the Japanese project. Especially when it comes to ASEAN project which attracts attention recently, not only local organization but also resources are sent from head of ASEAN region and Japanese headquarters, the number of Steering Committee increases and communication pass increases. Unifying communication paths that have been localized is important. Thinking about communication path with customer, desirable to establish one communication pass for each of headquarter and local

b) Minimize communication hierarchy

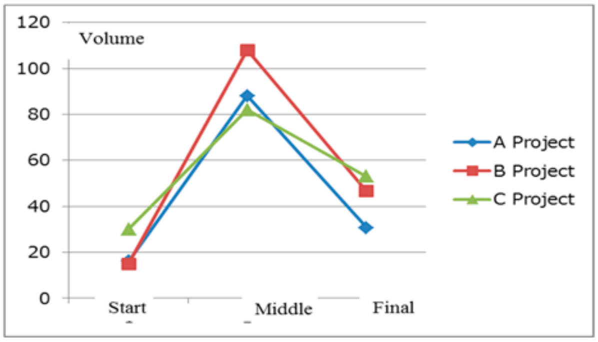
Grasping the essence of the project, suggest minimize communication hierarchy. There are cases in communication arranged with Japanese headquarters in several project. Customer's headquarters member placed between local operator and rollout team. In those project, rollout team were extremely difficult to judge planning, designing and proceeding of project because they could not understand true needs and requirements of local operator. As number of communication path hierarchies increases, the distance with local operator further. Therefore communication misalignment would increase, causing unnecessary work and cost to be increased significantly. For communication organization organizes that local operators and rollout members should be direct.

c) Check communication level based on communication threshold

Checking communication tool between local operator and rollout member is provided. From experience of projects calculation are defined. It became one of risk management. As an example, the volume of customization of requirement definition phase is cited. In the general project of Japan, as said the law of 2: 4: 3, the prediction of requirement definition start (Start) is 2, during the period during communication in the middle stage is 4, the final narrow-down based on QCD of the final result is 3. For narrowing down from middle stage to the final stage, enhancement of communication within the project is the key. Using this definition, PM could check communication satisfaction threshold value with local operator.

Explain projects that carried out by Author team. The customization volume of 3 projects in Thailand is shown below (Figure 6). In ASEAN countries' with strong self-assertiveness operators, desire claims are also strong in requirements definition phase. The customization volume up to the Start-Middle is based on those operators assertion on the system so that the communication between rollout member and local operator could be seen as volume on the graph below the figure. Noteworthy that Middle -Final process could achieve communication fulfillment with those operator. It is possible to measure communication enhancement between rollout member and local operator depending on whether could narrow down customization volume with deeply discussion and restriction by QCD. From experience it has been concluded that projects whose narrow down rate is not less than 50% could not sufficient for communication with operators.

Communication fulfillment naturally affects subsequent processes as well. Grasping communication comprehension in the requirement definition phase is very important of risk management for judging project. Authors thought that projects that could not narrow down less than 50% should extend requirements definition phase and extend project period. In fact, C Project conducted by Author team, completed requirement definition phase without approaching less than 50%, and lot of recognition difference occur with local operator.



	a.Start	b.Middle	c.Final	b/a(%)	c/b(%)
A Project	16	88	30.6	550%	35%
B Project	15	108	46.5	720%	43%
C Project	30	82	53	273%	65%

Figure 6 Communication analysis based on requirement volume

4.3 Global maintenance organization

In order to provide continues project quality, 2nd line of maintenance support organization is also built in development team. 1st Maintenance window placed on local members and 2nd maintenance window placed on Japanese development team to ensure continued project quality and report project situation to headquarter. By cooperating with maintenance work on local member, accumulate rollout know-how both local member and development team. Plus Customers who could not grasp local project such as Japan headquarters also accept those report service as maintenance contract.

5. Summary

Succession of ASEAN businesses in those areas is provided Japanese quality solution, lead rollout organization by onsite-support leader and development team to promoting solution for JOC leasing companies in the ASEAN market with improving solutions, Fostering model is takes cost for project, those model could not organized Japanese member. Remaining issue of this adapt local companies. With those models author aim resources, and enhancing rollout organization.

In FY2017 targeting development of JOC leasing market in Thailand, and after next fiscal year deepen target market and challenge new market. In addition, trying to acquire ASEAN market while developing horizontally to expand rollout expanded countries. By expanding target market, accumulating its expertise in Japanese development team, building solutions to meet localization of ASEAN countries, seeking system operability according to the customs of each country, customizing the level of further solutions.

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Introduction of Management Method Suitable for Soil Pollution Control Project

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The Soil Pollution Control Project is a new social activity that has few existed. Therefore, there is a risk that problems may arise by the different as general construction projects, so we believe that introduction of new management is necessary for the soil pollution control project. Representative contracts among various existing business forms suitable for execution of soil pollution control project. We select the form and consider important matters derived from the special nature of the soil pollution control project as a comparative item, and derive suitable management method for soil pollution control project. The six business execution forms "Design / Build Contract", "Turnkey Contract", "Construction Management Contract", "BOT Contract", "Partnering Contract" and "Value Engineering Contract" selected representatively from various business execution forms. In terms of enforcement form, the important items of the soil pollution control project, "distance/collaboration between contractor and orderers", "distance between residents and orderers", "contract procedure time" and " Ability to respond to small business "as a comparative item. CM contract was the most suitable result for soil pollution control project. The order of the evaluation result was the order of the CM agreement with the highest score, then the order of partnering contract, design / construction contract and VE clause, BOT contract, turnkey contract.

Key Words & Phrases: Soil Pollution Control Project, Construction Management, Failed Cases, Risk Matter

1. Introduction

The soil pollution control project has special characteristics, and it is a new social activity that has never existed. Therefore, only similar to how to proceed and the general construction business may cause problems, soil pollution control projects is considered necessary to introduce a new management.
From a variety of business execution form, we derive the appropriate management approach to soil pollution control projects.

2. Specificity of soil pollution control project

From the failure cases and risk management in the soil pollution control project, we summarize the special nature of the soil pollution control project

2.1 Failure cases in soil pollution control project

The following failure cases were extracted (Shimoike and Shimazaki,2011).
<Failure cases at the time of survey; 31 cases>
#Inadequate survey of materials etc, failure cases in soil survey.
#Failure cases in communication between stakeholders.
<Failure cases at the time of planning; 16 cases>
#Failure cases due to insufficient understanding of various conditions such as errors in soil survey results.
#Inadequate understanding of construction method, failure cases by communication among stakeholders.
<Failure cases at the time of construction; 38 cases>
#Failure cases in construction planning, failure cases at construction.
#Communication at construction, cases of failure after construction.
Most of the above is a failure case not found in general construction projects.

2.2 Extraction of risk in Soil Pollution Control Project

The following risk items were extracted. (Shimoike and Shimazaki,2011).
<Risk items at the survey stage; 31 items>
#Whether pollution at the project site is contaminated, its correct evaluation.
#Contract with contractor, consultation etc.
<Risk items at the planning stage; 13 items>
#Inadequate survey ~ Inadequacy of plan ~ New contamination is discovered during construction.
#Understanding of countermeasure construction method ~ selection of wrong construction method.
<Risk items at the construction stage; 54 items>
#Construction plan, vendor selection, design review.
#Description of residents, disclosure of information. (risk communication, complaints, etc.)
Most of the above are risk items not found in general construction projects.

2.3 Concept of the specialty of Soil Pollution Control Project

Next, we compare the general construction project and the soil pollution control project from the failure case in the soil pollution control project and the result of extracting the risk. (Shimoike and Shimazaki,2011).

2.3.1 Concept of General Construction Project

There are many existing cases in general construction projects, failure cases and risk matters are small. Therefore, because of the many achievements of the general construction project, standard risk matters are grasped, so it is possible to deal with the existing

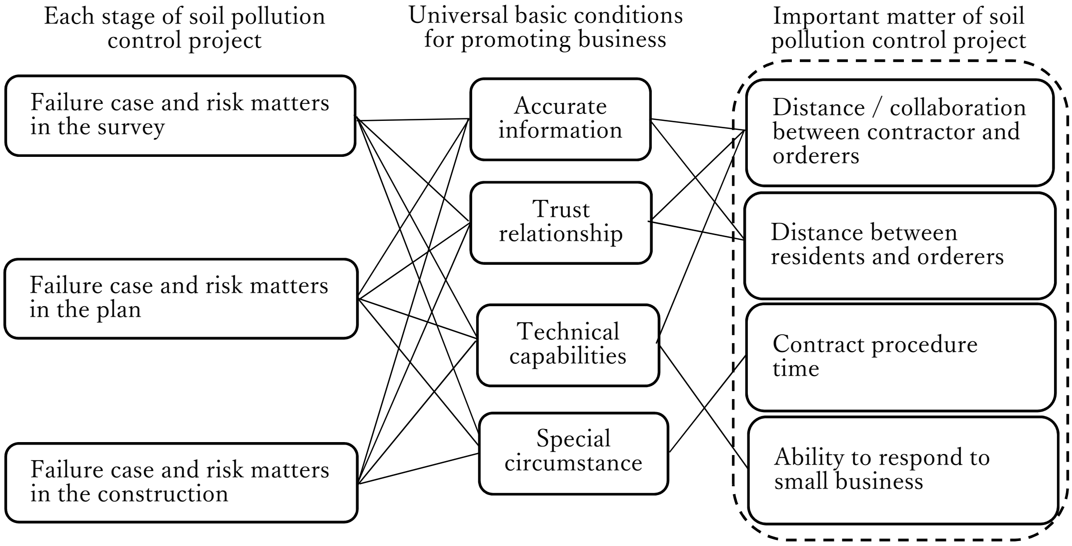

Figure 1 Relationship between failed cases/risk matters and important matters

management method. (Shimoike and Shimazaki,2011).

2.3.2 Concept of Soil Pollution Control project

There are few existing cases against soil pollution control project against general construction projects, failure cases and risk matters are large. This is because the results of soil pollution control project are small, so what kind of things will be risk items is extracted beforehand necessary. Therefore, the soil pollution control project may have problems only by the same way as the general construction project. (Shimoike and Shimazaki,2011).

2.3.3 Summary of concept of Soil Pollution Control Project

As the soil pollution control project has little experience, it is necessary to extract in advance what kind of things will be risk matters. In this study, we conducted failed cases (85 cases) in the soil pollution control project and extracted the risks (98 items) in the soil pollution control projects. Thus, in the soil pollution control project only the same way as the general construction project problems may occur in some cases. Therefore, it can be seen that a new management method is necessary for the soil pollution control project.

3. Important matters of Soil Pollution Control Project

3.1 Important matter of Soil Pollution Control Project

From the previous studies, I described a number of failure cases and a number of risks and the special nature of the soil pollution control project. Based on the results, I have derived important items of the following four soil pollution control projects. (Shimoike and Shimazaki,2011).

[Important items of Soil Pollution Control Project]

(1) Distance / collaboration between contractor and orderers
(2) Distance between residents and orderers
(3) Contract procedure time
(4) Ability to respond to small business

Next, we examine how we can derive "important matters of soil pollution control project" from "special property of soil pollution control project".

3.2 Relationship between failed cases/risk matters and important matters

The failure cases at the time of survey are considered to be related to the risk items at the survey stage, the failure cases at the planning stage to the risk matters at the planning stage, and the failure cases at the construction stage to the risk matters at the construction stage respectively.

Next, in order to connect the relationship between failure cases / risk matters and important items of the four soil pollution control projects on a line, universal basic conditions for promoting projects during the meantime," Accurate information "," Trust relationship "and" Technical capability "and" Special circumstances "as a special circumstance of the soil pollution control project, it is judged to be connected by a line as shown in Figure 1 (Shimoike and Shimazaki,2011).

3.3 Key points of important items of Soil Pollution

Control Project

As a result, it was proved that "important matter of soil pollution control project" can be derived from "special property of soil pollution control project".

In addition, the important points of the soil pollution control projects are shown below (Shimoike and Shimazaki,2011).

[Key points of important matters of Soil Pollution Control Project]

(1) Distance / collaboration between contractor and orderers

#The orderer should not give the contractor full responsibility for it.

#The orderer also needs knowledge of harmful substances.

#It is important for the orderer to grasp the situation at the site so as to inform the residents.

(2) Distance between residents and orderers

#Resident is not a word of the contractors, seeking the words of the orderer.

#In order to accurately explain to the residents, the orderer needs some expertise.

(3) Contract procedure time

#I would like to avoid contracts that involve complicated and time-consuming procedures in the form of business execution. (For example, it takes time to adjust risk sharing)

(4) Ability to respond to small business.

#There are individual business operators such as cleaning shops. For this reason, it is desirable to implement a business execution style that can accommodate small scale projects.

4. Execution form of business

Next, in order to introduce a new management method to the soil contamination countermeasure project, outline of the execution form of various business is described (Shimoike and Shimazaki,2011).

4.1 Design-Build

Based on the plans of the contractor, contract method is also contracted to undertake both design and construction. Since the design work considering the workability and the feedback to the design at the construction stage can be performed within the same organization, there is an advantage that consistent business optimization is possible. At the same time, the contractor has a consistent responsibility and must meet the trust of the orderer with a balanced capability in both design and construction. It is usual to be contracted with the total price (lamp sum) inclusive of design and construction cost, or with a cost plus fee (Kunishima and Shoji,1994).

4.2 Turn-Key

It is a contract method of contracting all the project investigation, business planning, planning, design, construction, commissioning from the contractor. Origin of the name is that the operation of the facility can be started only by the ordering person turning (turn) the key (key) handed over from the contractor at the end of the contract. It is a comprehensive contract, also called an All-in contract.

In the latter half of the 1960s, it was adopted and developed in large-scale projects such as US petrochemical plants and nuclear power plants. Because it is a risky construction, there are many cases of payment contracts with cost price fee (Kunishima and Shoji,1994).

4.3 Construction Management

When implementing a construction project planned by an orderer, the contract method of entrusting the general management to a specific organization (construction manager) is called CM (construction management).

The object managed by the Construction Manager (CMR) covers all of planning, designing, procurement, ordering, construction and delivery, but in principle it does not undertake the design itself or construction itself. As an expert in the construction project execution, the CMR plays the role of the agent (agent) of the orderer and receives the actual management fee and the fee as compensation for this service. This is the difference from the turnkey method.

This method was developed in the early 1970s in the United States, and it is a method which is currently being practiced many times, including public works. In the UK, the same form is called a management contract (MC) (Kunishima and Shoji,1994).

4.4 Build Operate Transfer

Build Operate Transfer (construction, operation, transfer) abbreviation is a business execution form. In addition to the turnkey method, it can be said that it exceeds a simple construction contract in that it consists of fund procurement at the business stage, operation for a certain period of time after construction completion, and subsequent transfer. (Kunishima and Shoji,1994).

Table 1 Comparison of Business Execution Form

Business execution form / Comparative	{1} Design-Build	{2} Turn-Key	{3} Construction Management	{4} Build Operate Transfer	{5} Partnering	{6} Value Engineering
Distance between the contractor and the orderer Collaboration	**6** 1) 2 2) 2 3) 2	**3** 1) 1 2) 1 3) 1	**13** 1) 5 2) 4 3) 4	**6** 1) 2 2) 2 3) 2	**12** 1) 4 2) 4 3) 4	**9** 1) 3 2) 3 3) 3
Distance between residentsand orderers	**4** 1) 2 2) 2	**2** 1) 1 2) 1	**8** 1) 4 2) 4	**4** 1) 2 2) 2	**8** 1) 4 2) 4	**6** 1) 3 2) 3
Time of Contract Procedure	**4** 1) 4	**4** 1) 4	**4** 1) 4	**2** 1) 2	**2** 1) 2	**2** 1) 2
Ability to respond to small business	**4** 1) 4	**4** 1) 4	**5** 1) 5	**2** 1) 2	**2** 1) 2	**1** 1) 1
Overall rating score	**18**	**13**	**30**	**14**	**24**	**18**

It was originally devised by Prime Minister Ozar of Turkey and has been widely used in debtor countries and developing countries, but recently, public works of developed countries are also adopted in the form of introduction of private vigor.

4.5 Partnering

The contractual contractor who jointly performs project management with the goal of constructing a team based on mutual trust based on mutual trust and securing the mutual benefit of the project is called partnering.

It has been used in the United States since the early 1980's, and there are many examples in private business. There are examples in military projects, but there are still few examples in public works projects.

Basically, the relationship between the two is called Partnership (= Joint) or Alliance, it is usual to sign a contract for several years, but short term or single project contracts may be possible. (Kunishima and Shoji,1994).

4.6 Value Engineering

VE is a management method devised and put into practical use in the United States and is an abbreviation for Value Engineering (value engineering). Among means for achieving one objective, the aim is to actively adopt measures that can reduce costs without degrading functions, and furthermore means to improve functions at equal cost It is a technique that also includes devising. It can be said that it is now widely used internationally. (Kunishima and Shoji,1994).

5. Reason for adopting CM method

5.1 Comparison method of business execution style

Explain the reason for adopting the CM method with a comparison table of business execution form. There are six representative business execution modes from the various business execution forms shown in the previous page ("Design / construction contract", "turnkey contract", "CM contract", "BOT contract", "partnering contract "and" VE clause contract "). Next, in regard to this typical business execution form, we compare the four important items of the soil pollution control project (Comparative items derived from 3.1, "Distance / Collaboration between Contractor and Purchaser", "Residents and Order Distance to contractors "," time of contract procedure "and" ability to respond to small scale projects "), and compared and evaluated.

Table 1 shows the business enforcement forms and comparison items to be compared.

5.2 Quantitative evaluation method

For the evaluation method, the point of important items of the soil pollution control project shown in 3.1, which is the comparison item, was taken as the evaluation item. Also, in order to carry out quantitative evaluation, it was set to 5 grades (suitable: 5, somewhat suitable: 4, ordinary: 3, less suitable: 2, unsuitable: 1) and the sum of the scores evaluated in each item. As a comprehensive evaluation point and made business execution form suitable for soil pollution control projects with the highest overall evaluation score.

[Key points of important matters of Soil Pollution Control Project]

(1) Distance / collaboration between contractor and orderers.

a) The orderer should not give the contractor full responsibility for it.

b) The orderer also needs knowledge of harmful substances.

c) It is important for the orderer to grasp the situation at the site so as to inform the residents.

(2) Distance between residents and orderers

a) Resident is not a word of the contractors, seeking the words of the orderer.

b) In order to accurately explain to the residents, the orderer needs some expertise.

(3) Contract procedure time

a) I would like to avoid contracts that involve complicated and time-consuming procedures in the form of business execution. (For example, it takes time to adjust risk sharing)

(4) Ability to respond to small business

a) There are individual business operators such as cleaning shops. For this reason, it is desirable to implement a business execution style that can accommodate small scale projects.

5.3 Reason for evaluation result

5.3.1 Distance / collaboration between contractor and orderers

1) The orderer should not give the contractor full responsibility for it(Otsu,2003).

#In the turnkey contract, according to the change in the risk sharing ratio between the orderer and the contractor, the orderer has zero risk and the contractor has all the risk. From this also it can be said that it is a contract that leaves the contractor complete. Therefore, it was evaluated as "1".

#Since efficient and rational design and construction are being implemented as merits from reference literature, it is stated that design contracts can reduce ordering work. The disadvantage, on the other hand, is a decline in consciousness of the orderer's responsibility. In other words, since it is judged that the reliance on the contractor is high, it was evaluated as "2" (Ministry of Land, Infrastructure and Transport,2009).

#BOT contract is evaluated as "2", which is determined to be strongly dependent on the contractor (Hori ,1998).

#VE contract adds VE to construction contract. The impact on contractors was judged to be minor. It is because it was evaluated as "3"(Ministry of Environment,2009).

#The partnering contract and CM contract can be judged to be suitable because collaborative work of the ordering party and the contractor is strong. Among them, the CM contract is more adopted than the partner ring contract, the position of the ordering party and the contractor is clear, the CM contract with less burden on the orderer is evaluated as "5", the partner ring contract is "4"(Yoshihara,2004).

2) The orderer also needs knowledge of harmful substances(Yoshihara,2004).

#The turnkey contract is a contract that promises to complete and deliver the project by collectively handling the whole, and it is a contract that the orderer fully gives to the contractor. Therefore, knowledge of hazardous substances etc. is considered unnecessary to the orderer. Therefore, it was evaluated as "1".

#Design-build contract will contribute to unification of responsibility because the contractor will bear the responsibility from design to construction. This indicates that the degree of dependence on the contractor is high, so there is little contact between the orderer and the contractor, and the orderer judges that it is difficult to absorb knowledge from a contractor with expert knowledge and " 2 "(Oono,2003) (Ministry of Land, Infrastructure and Transport2009).

#Because BOT contract has a high degree of reliance on contractors, there is little contact between the orderer and the contractor, and the orderer is difficult to absorb knowledge from a contractor with expert knowledge "2" (Hori ,1998).

#VE contract is a contract with VE added to ordinary construction projects, so the expert knowledge etc. of harmful substances of the orderer are considered to be normal level and evaluated as "3"(Ministry of Environment,2009).

#Regarding the CM contract and the partnering contract, orderer who have poor expertise and experts have much contact with other contracts. For this reason, the orderer considered that there are many opportunities to absorb expertise "4" (Ministry of

Land, Infrastructure and Transport,2012).

3) It is important for the orderer to grasp the situation on the site to tell the residents

#Describe from the viewpoint that it is important for the orderer to know the situations on the site.

#The turnkey contract is a contract that promises to complete and deliver the project by collectively receiving the whole. Therefore, it is considered that the orderer does not need to grasp the situation at the site. Therefore, it was evaluated as "1".

#Design-build contract Since the contractor will bear the responsibility from design to construction, it will contribute to the unification of responsibility, which indicates that the reliance on the contractor is high, So there was little contact between the orderer and the contractor, and the orderer judged it difficult to grasp the situation at the work site and rated "2"(Oono,2003).

#Because BOT Contract depends greatly on contractors and it is difficult to grasp the situation of the site, it is evaluated as "2" (Hori ,1998).

#VE contract thought that it is the same as the general construction project though there is a special nature of VE introduction, evaluated as "3"(Ministry of Environment,2009).

#The CM contract [8] and the partnering contract [7] are led by the orderer, and the on-site situation is also easy to comprehend compared with other contracts. Therefore, it was evaluated as "4" (Ministry of Land, Infrastructure and Transport,2012).

5.3.2 Distance between residents and orderers

1) Resident is not a word of the contractors, seeking the words of the orderer(Otsu,2003).

#In the turnkey contract, according to the change in the risk sharing ratio between the orderer and the contractor, the contractor has zero risk and the contractor has all the risk. Against this, it is also a contract that the contractor fully appoints. Therefore, it is considered that there is almost no point of contact between the residents and the orderer and evaluated as "1".

#Design-build contracts and BOT contracts are highly dependent on contractors, and the orderers are less likely to contact the work site. so the distance with the residents is considered to be large "2" was evaluated (Ministry of Land, Infrastructure and Transport,2009).

#The VE contract evaluated as "3" because the VE activity is special but the others are the same as the general contract method (Ministry of Environment,2009).

#As for CM contract and partnering contract, the contractor supports the orderer and collaborates, so there are many opportunities to contact with the site, and the distance between the orderer and the residents is close. Therefore, it was evaluated as "4" (Yoshihara,2004) (Ministry of Land, Infrastructure and Transport,2012).

2) In order to accurately explain to the residents, the orderer needs some expertise.

#The turnkey contract is a contract that promises to complete and deliver the project by collectively undertaking the whole operation, so the orderer is considered unnecessary expertise. Therefore, it was evaluated as "1".

#Design-build contract and BOT contract judged that it is difficult to grasp the situation of the work site because it is highly dependent on the contractor and evaluated as "2"(Ministry of Environment,2009) (Hori ,1998).

#The VE contract has the special nature of VE introduction. However, the other was the same as the general construction project, and it was evaluated as "3".

#The CM contract and the partnering agreement are led by the orderer. Site situation is easier to compare with other contracts. Therefore, it was evaluated as "4"(Yoshihara,2004) (Ministry of Land, Infrastructure and Transport,2012).

5.3.3 Contract procedure time

1) I would like to avoid contracts that involve complicated and time-consuming procedures in the form of business execution

#The turnkey contract is a contract type in which the orderer takes charge of zero risk and the contractor is responsible for all, according to the change in the risk sharing ratio between the contractor and the contractor due to the contract. Risk sharing work takes less time. Therefore, contract time is considered short contract. Therefore, it was evaluated as "4" (Ministry of Environment,2009).

#BOT contract and partnering contract evaluated as "2" because the contract procedure takes time due to risk sharing etc (Hori ,1998) (Yoshihara,2004).

#The VE contract was considered as a time-consuming contract method in the VE evaluation enactment method, etc., and evaluated as "2".

#For CM contract and Design-build contract, the CM contract has a lot of achievements, and the procedure is not complicated. And the Design-build contract has less adjustment between construction and design than the design and construction separate ordering contract, the time is reduced. Therefore, it was evaluated as "4" (Ministry of Land, Infrastructure and Transport,2012).

5.3.4 Ability to respond to small business

1) There are individual business operators such as cleaning shops. For this reason, it is desirable to implement a business execution style that can accommodate small scale projects.

#The VE contract judged that its effect was small when it introduced VE to a small-scale business operator (for example, an individual business entity of a cleaning shop contaminated with tetrachlorethylene) and evaluated it as "1" (Ministry of Environment,2009).

#BOT contract and partnering contract are complicated contract procedures for individual contractors. In addition, explanation with esoteric technical terms relating to contracts is considered to pose a threat to individual companies, It was evaluated as "2"(Yoshihara,2004) (Hori ,1998).

#The Design-build contract and the turnkey contract are agreements that promise to complete the project by handling the whole in bulk. For this reason, it is an appropriate contract method from a viewpoint that it can be fully entrusted to individual businesses with limited expertise. Therefore, it was evaluated as "4" (Ministry of Land, Infrastructure and Transport,2009).

#CM contract is considered to be able to give a sense of security to individual business operators, such as explaining the consultation from individual business operators and securing transparency of the project from the viewpoint of support of orderers, and appropriate contract method and judgment and "5" was evaluated (Ministry of Land, Infrastructure and Transport,2012).

The evaluation results are shown in Table 1.

6. Conclusion

As mentioned above, 30 points of the CM contracts are the highest score at the comprehensive evaluation point in Table 1, followed by 24point partnering contracts, 18 point design-build contracts and VE clause contracting, 14 points BOT contract, It was the turn of 13 turnkey contracts. Therefore, it is important to understand that the " design-build contract", the "turnkey contract", "CM contract", "BOT contract", "partnering contract" and "VE contract" representatively selected from various business execution forms For one type of business execution, the important items of the soil pollution control project, "Distance / collaboration between contractor and orderers", "Distance between resident and orderers", "Contract procedure time" and "Ability to respond to small business When we evaluate the ability to respond to "as a comparative item, the CM contract was the most suitable for soil pollution control projects.

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A Case on an Activity to Spread a Project Management Tool into a Corporation

- Acceleration of Innovation -

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Recently a case introducing the organizational project management is a common practice, which is an organizational activity to support projects success. And since the best practices have been published as reference books such as “Organizational functionalities for project promotion” and “Organizational Project management Maturity Model,” the environment for organizations to start the activity has been prepared. However because the activity, which is required to change the existent system, tends to evoke the inertia to oppose the change, it doesn’t take root by pushing it onto an organization unilaterally. In order to succeed in changing a system, it is important to perform the activity to develop and spread the practice suitably, NTT DATA is propelling introduction of a project management tool as a part of an activity for the organizational project management. This paper reports on an activity that spreads a project management tool into the company, when the tool was given full model change, as a case study for acceleration of innovation.

Keywords and phrases: Organizational Project Management, Project Management Tool, Spreading Activity, Marketing Theory

1. Introduction

Recently it is a common activity introducing the Organizational Project Management, hereafter OPM, as the measure to support the success of projects in many organizations. And since the best practices have been published as reference books, such as “Organizational functionalities for project promotion” by Project Management Institute(2013) or “Organizational Project management Maturity Model” by the Society of Project Management(2010), the environment for organizations to start the activity has been prepared.

Yet, this activity, which requires an organization to change from the existing system to a new one, remains difficulty because the inertia to resist the change arises in the organization. G. M. Weinberg(1997) points out that the activity supposing the diffusing model, which change diffuses spontaneously, and the hole-in-the-floor model, which people adopt ideal change instantly, fail. And Paul Hodgkins(2016) points out that the keys to introduce the OPM are the effective promoting organization and commitment from the top management. In short the change does not spread spontaneously even if it is ideal. And it requires the top management initiative and the strong spreading activity to take root. And also because there are many case studies reporting the similar lesson on the internet, the strong top down promoting activity for successful OPM is very important.

However, once the change has been introduced and taken root to some extent, the activity is apt to lose appeal rapidly because the top-down activity and the promoting team tend to be shrunken. In contrast, in order to complete the activity, continuous promotion activity to change is necessary. That is, it is increasingly important for the promoting team to drive the activity in a bottom-up manner.

Introducing a standard methodology into a company is one of examples of the OPM. And a standard methodology is often implemented to a tool to spread it into a company. Accordingly, a practice spreading the tool into a company is an example of the OPM. And this practice also requires promoting activity, besides, as time goes on, it too tends to lose appeal and the enough resource of the promoting team. However, spreading the tool tends to need much more continuous improvement than providing standards. For example, affected by environmental constraint, sometimes the tool needs large scale renewal bringing the platform change. The larger a change is, the more difficult a spreading activity is. Besides, considering the operation cost-cut, because it is necessary for an organization to keep the support versions to a minimum, the completion of the change is demanded as quickly as possible. That is, spreading the renewal tool, especially in large scale one, into a company can be called as a project.

2. Spreading a project management tool into the company

2.1 The existent project management tools

NTT DATA provides the two established in-house

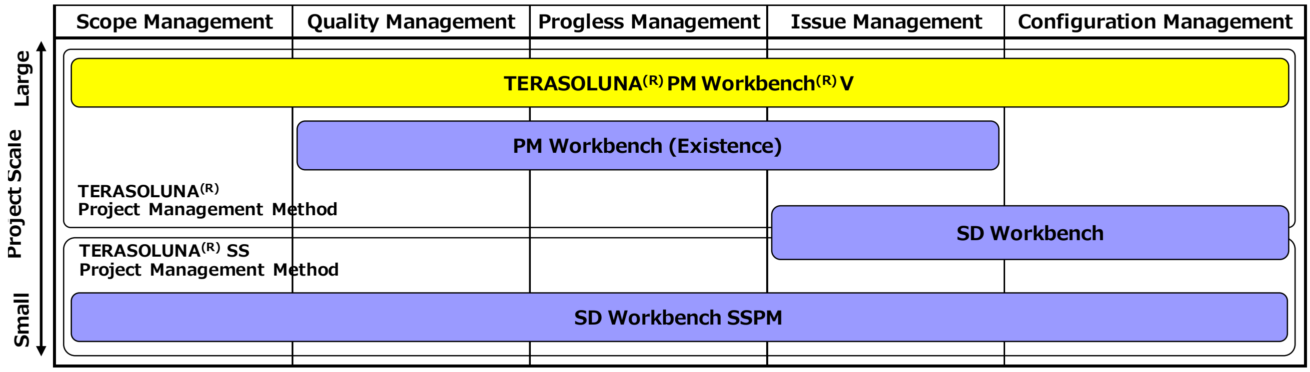


Figure 1 The project management tools and their cover areas

project management standards, TERASOLUNA(R) project management method and TERASOLUNA(R) SS project management method. Their targets are for projects, from middle to large scale and small scale, respectively. And the tools based on the methods are being spread into the company.

There are 3 existent project management tools called PM Workbench, hereafter PMWB, SD Workbench SSPM, hereafter SSPM, and SD Workbench, hereafter SDWB in NTT DATA. Their positions in a use are, respectively, from middle to large scale projects, small scale ones and mainly Software configuration management. Figure 1 shows the management tools and their covered management areas. PMWB and SSPM, whose cores are a ticket management system, both support project management covering progress, problem and issue, quality management.

Characteristic of PMWB is substantial report forms enabling various quantitative quality analyses, which realize NTT DATA style quality management. However, use of these forms requires time-consuming complex initial settings. In addition, because the setting must be done in advance of use, long lead time of introduction has been problem. And because this tool does not have a version control system in it, configuration management realizes by combining SDWB. As a result, the tool has a weakness on traceability because cooperation of the ticket management system and the version control system is weak.

Meanwhile SSPM has been developed for small projects as a derivative model of SDWB, subject to executing simple management. For example, in quality management, subject to managing only open and close of bug slips, it does not need complicate initial setting, so that it has a characteristic shortening lead time of introduction. This tool, whose origin is SDWB having the configuration management function, has an advantage being considered to implement traceability. However, it has a weakness on a report function, mainly in the quality management and progress management, the variety of reports is limited to minimal.

And then, SDWB, whose core is a version control system building a repository, is a tool mainly supporting configuration management. A selling point of this tool is customized OSS version control system for in-house use in advance. And this tool also includes a ticket management system, so that it is available for use as a communication base to manage problems in a project. Therefore, in case of a small project, which does not need severe management, or a project, whose customer specifies a project management tool, this tool is introduced alone.

The each number of projects newly introducing these three tools was as follows.

- PMWB:229 projects
- SSPM :144 projects
- SDWB:390 projects

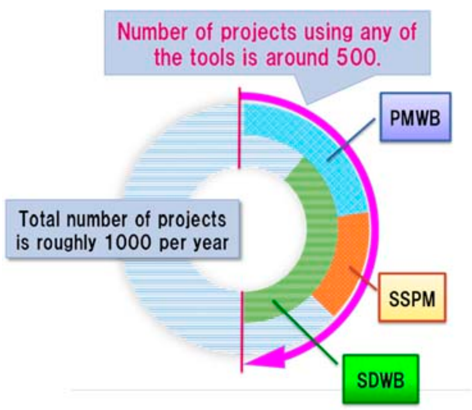


Figure 2 Spreading situation of the existent tools

Because SDWB is used with either case, independence or combination with PMWB or SSPM, as shown in Figure 2, the total number of projects that use even one of these tools is assumed to be a little over 500. Having considered the facts that there are approximately 1000 projects annually in NTT DATA and a half of them are existent function addition projects, because generally the existent project does not want to change its development environment, it can be said that the use of the tools in new projects has taken root.

2.2 The new tool

The new tool named TERASOLUNA(R) PM Workbench V (Five), hereafter PMWB-V, has been completely renovated from the ticket management system, which is its core. Now, the tool has an elegant user interface, because a commercial product provided by the Microsoft has been installed as the ticket management system. Besides, the tool has configuration management function by applying the version control system, which is also a commercial product provided by Microsoft. Because this enables not only easy cooperation with management function and resource information, but also automatic measurement of various metrics, time of information gathering has been shortened than ever before.

In addition, having improved the progress management function drastically, the tool has enabled easy to use and quick start without complicated initial setting. And also, because the tool is provided as SaaS, which keeps data in a data center and is used via a network, without building a server, it enables users to drastically shorten the lead time to start using.

Previously, although a user had to choose from 2 tools as per the project scale, the tool will be able to cover all projects by tailoring in the near future. And also the tool has covered configuration management, so that the in-house project management tool will be unified to this tool.

This new tool was released in October 2015 and the number of projects introducing the tool in FY2015 was 64. The target number of projects adopting the tool in FY2016 has been set for 250.

3. Existent spreading activities and problem

3.1 Existent spreading activities

In these several years, the tools only have had regular minor changes, so that large spreading activities have not been performed. And there is few main spreading team members experiencing the last full model change of the tools because of personnel changes. The spreading activities in these years are as follows.

- Publicity on the intranet portal site and tool's own site.
- Announcements in Seminars of other tools and services
- Persuasion for transition to existent users of the tools
- Training course to learn how to use the tools
- Persuasion for introduction to acquaintances of spreading team members

3.2 Problem of the existent spreading activities

The existent spreading activities are, if anything, to wait for existent users to approach for transition, so that goal achievement was thought to be difficult. The reasons are as follows.

- The new tool has a risk that would disrupt the development with initial failure or learning curve, so that users fear the transition to new tool.
- In order to introduce the new tool in a top-down manner, substantial results that enable the management to determine the introduction are necessary. However currently there are few results.
- There are considerable users who are satisfied with the existent tools. Especially, in small scale projects, there are a certain number of users who don't need high-functioning tool.
- There is no reason to force users to transfer from existent tool to new tool. For example, although the new tool is only provided as SaaS, there are many projects stationed in a customer site where connecting the data center via a network is prohibited for security reason, so that they are not able to use the tool. The existent tool, which enables using in such isolated areas, must be left as the solution for such projects. And, the new tool has not yet supported the English version, so that the existent tool, which supports the English version, is also the solution for the foreign group companies or the offshore development use.
- There is few existent members in the spreading team, so that now the spreading team doesn't have connection to the existent users.

For those problems, the spreading activities needed reconsideration to achieve the goal.

4. Planning the measures

In planning the measures to solve the problems shown in the last section, adopting marketing methods were thought to be effective. It means that because the new tool must be spread into the company without terminating the existing tools, which has still thrived, exploitation of a new market for the tool is inevitable.

4.1 Marketing strategy

According to Graduate School of Management, GLOBIS University(2009), in exploitation of a new market, to clarify the answer of the question, "To whom and What kind of value do you provide?" the following analysis methods are used.

(1) Segmentation
To divide a market into a number of different segments in accordance with their customer's needs.
(2) Targeting
To determine a specific segment, or customer, that your company is going to approach
(3) Positioning
To clarify a position of your company in the segment that you have determined in the above.

By performing the method of the above, the strategy of how to get users of the tool was planned.

4.2 User approach policy

In consideration for user approach policy, the theory, which Everett Rogers(2003) popularized in his book "Diffusion of Innovations," is used.

Because the theory explains how innovation spreads, it is suitable to consider the way to approach users as a reference. The theory classifies adopter into 5 categories on the basis of innovativeness, which is measured by time at which an individual adopts an innovation. The categories are as follows.

(1) Innovator
(2) Early adopter
(3) Early majority
(4) Late majority
(5) Laggards

These categories and their characteristics are used as a reference to consider trying to persuade users to introduce the tool, because the characteristics of users change in the spreading progress of the tool.

4.3 User access method

In the consideration of the user access method and its management, AIDMA, which is explained by Graduate School of Management, GLOBIS University(2009) as the psychological process of consumer to purchase a product, is used. The name of the process stands for the first letters of its items, Attention Interest Desire Memory and Action. And also this process has stages. Attention is mapped to "Cognition Stage," Interest, Desire, Memory together are mapped to "Affect Stage," and Action is mapped to "Action Stage."

(1) Cognition Stage
- Attention

(2) Affect Stage
- Interest
- Desire
- Memory

(3) Action Stage
- Action

This process is used as a reference to consider the concrete means to appeal to users to introduce the new tool.

4.4 Progress management of spreading activity

In order to grasp the progress of the spreading activities, it is important to closely observe the situation that the spreading team is approaching users. For that, as explained by Maven TM(2015), the concept of the sales pipeline management enabling overlooking of approaching situation is applied. This is used to confirm the validity of the hypothesis that plans the marketing strategy and to grasp the change of the adopter category explained above with time shift. In addition, this is used to improve the way to appeal the tool to users by looking back whether the promotion activities cause any of the user's action or not daily.

5. Details of the implementation of measures

In this section, the details of the measurers that adopt the methods and the theories explained above are described.

5.1 Segmentation of the market

The organization of NTT DATA is divided into three large segments called field, Public and Social infrastructure, Financial, and Enterprise and Solution. These segments are divided by their customers, so that the characteristics of the segments are different from each other as they inherit the characteristics from the customers.

The reason for this is thought to be related to the characteristics of systems that the customers require. Because the characteristics of systems affect the project management directly, the segments are suitable for the segmentation of the market. With carrying out the KJ-method using member's past experiences, the characteristics of the segments have been identified as follows.

(1) Public and Social infrastructure field

- Characteristics of project : large scale, high quality
- Formality of Management : very high
- Culture of organization : cautious, prudentially, systematic

(2) Financial field

- Characteristics of project : middle to large scale, high security
- Formality of Management : high
- Culture of organization : steady, consistent, explanatory

(3) Enterprise and Solution field.

- Characteristics of project : small to middle scale, quick delivery
- Formality of Management : low
- Culture of organization : challenging, daring, advanced

5.2 Targeting

The objective of the targeting is to decide an entry market, however the new tool does not have specific target, but is required to spread throughout the company, so that the targeting is carried out for considering the way to approach the users.

At first, the new tool did not have some quality management functions that the existent tool has for the advanced management. This is a disadvantage for an organization that wants a tool having high quality management formality. And because the tool is provided as SaaS, projects that are stationed at client sites and prohibited from connecting the data center by a restriction on the network access for security reason cannot use the new tool. These projects are comparatively more common in the financial field. Those problems of the tool have a risk of harmful rumors. In addition, because the new tool has been changed completely from the existent tool including the user-interface, projects open-minded to adopting new technology are desirable as target users.

However, because spreading the new tool requires the increase of the support workload, its promotion has a risk of the support resources shortage, which causes low customer satisfaction of the tool. The target users need to be projects that do not require a large support workload as much as possible. Hence it is ideal that the initial targets are small scale projects, because they do not require complex management that increases the support workload of the tool.

Having considered the conditions mentioned above, it is suitable that an initial target to approach is Enterprise and Solution field, which has relatively small scale and high flexibility projects.

5.3 Positioning

At the positioning, the method to appeal to small scale projects of Enterprise and Solution field, which was chosen in the targeting, has been considered. According to the diffusion of innovations by Rogers (2003), innovators are venturesome and eager to try new ideas. Something new is essential for them. Meanwhile, although, early adopters adopt new ideas as early as innovators, they are not too far ahead of the average individual in innovativeness. That is, they evaluate new ideas to determine their usefulness in their own situation before the implementation. And as shown in Figure3, innovators are first 2.5 % and early adopters are next 13.5 % in the left part of the normal curve.

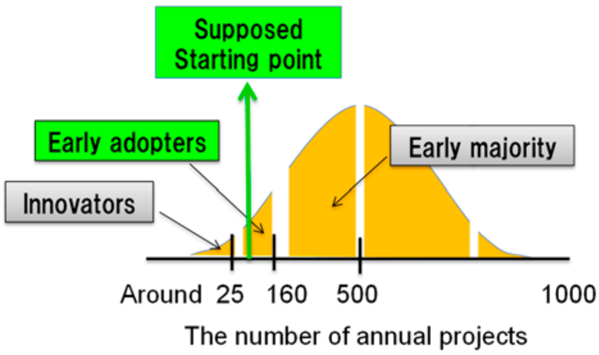


Figure 3 The breakdown of the adopter categories and the number of the annual projects

The target number of the projects introducing the tool is about 25 % against the supposed total number of projects in FY 2016. And 64 projects have introduced the tool already in FY2015, so that it is considered that introduction of the tool to innovators have already completed. Accordingly it is important to consider the approaching way to early adopters. And the project management tool that the projects of the target organization mainly introduce is SSPM. A good point of SSPM is easy to use and quick setup, the functions provided are, however, limited to basic management.

The new tool also has a characteristic of quick setup. However it has little appeal for existent tool users to change to the new tool. Accordingly, the elegant user interface is planned to appeal. In addition, the extensibility of the tool for the future is planned to appeal as an advantage, because it has the capability of quantitative quality management covering a large scale project, SSPM covers, however, only simple quality management for a minimum project. The help desk of SSPM had gotten some emails requesting to add quantitative quality management function to the tool. Therefore the appeal is expected to be worked well.

5.4 Access to users

(1) Cognition stage

First at the cognition stage, it is important to turn user's attention to the tool. And the preferable target rank is a project leader or above who has authority to decide the introduction of a project management tool, which is an infrastructure of the project. And the number of targets is the more the better. The existent communication channels to users, which expect to access from users, do not encourage broad recognition, because they are limited to access to the existent tool users.

In order to solve the problems above and access PMs of the target organization as many as possible, by negotiating to the HR department, a contact list of in-house certified PMs is provided to the tool promotion team. As shown by Shimanaka(2011) NTT DATA has the in-house certification system defining skills of specialty fields for its business similar to ITSS. The purpose of the system is to improve the business quality by providing the target of the employees to improve their skills and the standard of the positions which a person accomplishing the target is able to get. Because now the number of the certified PMs counts about 4700 in NTT DATA group, the list is suitable for a channel of tool promotion in terms of both quality and quantity.

Besides the reason why the certification system is thought to be effective for raising awareness of the tool is the maintenance of the certification. The certification holders are required to maintain their certification by taking certain amount of courses. Therefore if the seminar explaining the outline of the tool is provided as a target course to maintain the certification, this can be an incentive for certified PMs to attend the seminar and to learn the tool. Concretely the subject of the direct mail announcing holding a seminar of the tool shows that the seminar is available for maintenance of the certification.

And then, to attract PMs who open the email, it highlights the easiness of the tool, which was considered in the positioning section.

(2) Affected stage

Second at the affected stage, a condition that the target projects want to use the tool needs to be created. Hence the seminar promoting the good point of the tool, which was considered in the positioning section, has been developed and provided to the projects responding to the direct mail. Here is an explanation example in the seminar, it goes like these, "Because the tool is provided as SaaS, you can easily evaluate it by trying out it on a probationary basis at your desk, before deciding to adopt it formally." And "with a small start, you can start quickly. But once the members get used to the tool, you can adjust management formality suitably later." As the examples show, the explanation in the seminar is emphasis on its readiness and easiness and also extendibility to lower a hurdle of transition from the existence tool to the new one.

Besides the time and place of holding the seminar are on-demand so that the busy project members are able to attend it as easily as possible. In case of a request from a remote location, A video conference system is used.

And the direct mail announcing offering a seminar is not sent as a group message but as a personal message showing that it is sent for only the certificated PMs. Although this is an insignificant action, it is a consideration that lets the busy PMs attract attention and learn the value to read the mail to the last as much as possible.

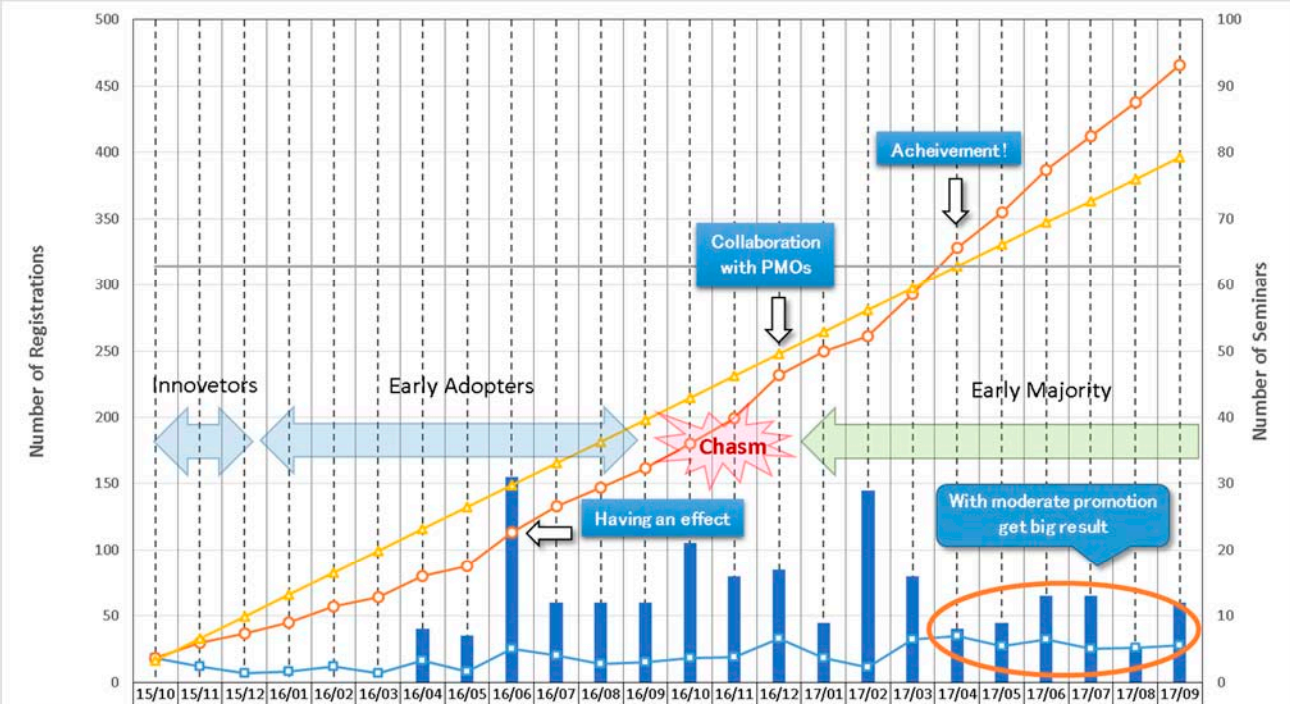
(3) Action Stage

Last at the action stage, it is necessary for projects to use the tool in practice. In this stage, there are some users who give up the introduction of the tool because of the difficulty of the application procedures. Therefor it is important to proactively support users with the paperwork and to urge user to proceed.

And interviews to learn the situations using the tool, such as how to use it actually in project management, have been conducted to improve the customer satisfaction with their feedbacks and to encourage the word of mouth by using them as cases. And these cases are shared to the employees of NTT DATA by using the knowledge sharing System.

5.5 Progress management of the spreading activity

In the spreading activity, the information sharing meetings are conducted. In the meeting key information for spreading, such as the contents of the email getting good response rate or the knowhow of the talk making attendees lead to the application, is shared in the spreading team members separately allocated the



	15/10	15/11	15/12	16/01	16/02	16/03	16/04	16/05	16/06	16/07	16/08	16/09	16/10	16/11	16/12	17/01	17/02	17/03	17/04	17/05	17/06	17/07	17/08	17/09
Seminar							8	7	31	12	12	12	21	16	17	9	29	16	8	9	13	13	5	12
Monthly	18	12	7	8	12	7	16	8	25	20	14	15	18	19	33	18	11	32	35	27	32	25	26	28
Total	18	30	37	45	57	64	80	88	113	133	147	162	180	199	232	250	261	293	328	355	387	412	438	466
Goal	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314	314
Plan	17	33	50	66	83	99	116	132	149	165	182	198	215	231	248	264	281	297	314	330	347	363	380	396

Figure 3 Time series of the number of the registrations and the seminars for the tool

organizations in charge, by visualizing the approaching situation to the organization that they access. And with analyzing the total response rate of the direct mail, the interval of sending the emails is decided and resource adjustment of the seminar instructors is ensured.

In addition, having grasped the result of response rate against the email sent to the target organization, because the response rates of other organizations have been known by analogy, the spike of the support workload which was apprehension at the beginning was estimated to be little. Hence, on trial, the same email highlighting the easiness of the tool was sent to PMs of selected organizations other than the target organization to target small scale projects. The result of the response rate was proved to be equal to that of the target organization as expected. And consequently it became clear that many organizations have a certain number of potential users. Since then the same emails were sent to all organization and the number of projects adopting the tool is increasing impartially between organizations.

6. Result and evaluation

In this section, the result of the activity spreading the tool and its evaluation are shown.

Figure 3 shows the time series of the number of the registration for the tool. As the figure shows, the registrations for the tool increased steeply soon after the release of it. The cause of this was thought to be the result that the novelty of the tool attracts people who like new things. After that the number of the registrations decreased gradually and the figure remains nearly flat until the spreading activity started, so that this phenomenon supports the theory by Rogers(2003). According to the theory, in this step, since the total number of the registrations was approximately 50, which was about 5% of annual total, almost all innovators have already introduced the new tool and the target users have changed to early adopters. Accordingly, because the spreading strategy for the tool needed to change, the activity was proved to be right.

The activity started at April 2016 and had effect soon after the start. And then, after the direct email started to be sent in earnest, as following the increase of the number of holding seminars, the number of the registrations increased more steeply than before after June 2016. Furthermore, at December 2016 the figure rises steeply. The cause of this was collaborations with the PMOs of the fields. Since the total number of registrations was close to 200, having appreciated the tool based on this result, the PMOs arranged the meeting to recommend the tool to executives of each segment. These recommendations and the result itself gave a sense of security to potential users on introduction. And also from those days, spreading team started to get some requests asking to hold seminars from projects without sending direct e-mail., so that word-of-mouth effect had begun to appear.

Later the total number of registrations increased more steeply and at last surpassed the goal at April 2017. And as the figure shows, now although the number of holding the seminars is more moderate than before, the number of the registrations is glowing steeply. This condition is so called “break through” and was the final goal of this activity. Moore(2014) points out that in order to make a high-tech product become break-through, marketers have to cross the vast chasm existing between early adopters and early majority. At December 2016, with considering the fact that the total number of the registrations was around 200, which was 20% of annual total, and also the slope of the graph became steep, it can safely say that the tool crossed the chasm. Now the target user has changed to early majority, so that the activity continues by placing importance on support and help desk from promotion.

7. Conclusion

This paper reported a case study of a project spreading the project management tool into the NTT DATA group as a part of the OPM. Although the goal of the project was very high and there were many difficulty, with the promotion activity by applying the marketing methods the goal was achieved successfully. And now at the end of July 2017 the total number of the registration is over 450 and continuously increasing in an adequate manner. The experience reported in this paper is applicable to other organization having trouble with diffusion of innovation. The authors hope that this paper helps to introduce OPM as much as possible.

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Project Management 4.0, beyond classic vs. agile

- Agile project management – a contradiction in terms or the next logical step? –

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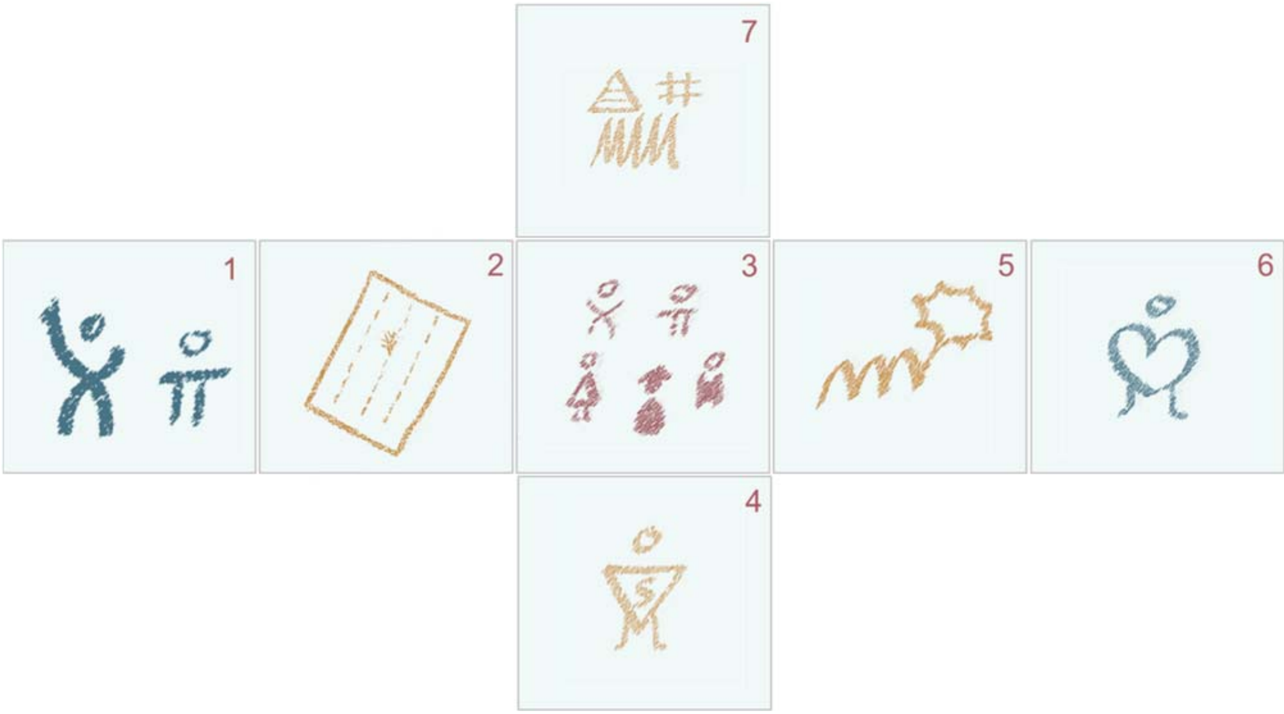
Project (in Latin, proiectum, neuter form of proiectus: thrown forwards) primarily means projecting into the future, predicting and planning for the future; and management (in Latin, manus agere: to lead by the hand) literally means to take by the hand. That means the project manager takes those involved by the hand and leads them through the projected plan. This creates security for the project participants as well as for the management. Agile (in Latin, agilis: nimble) on the other hand means to move in a nimble and flexible way in a complex environment and to keep adapting. „Inspect and adapt“ and “self-guidance” are the new buzz phrases. How is that compatible with planning and taking by the hand? Is agile project management not a contradiction in terms? Or is bringing „agility“ (whatever that means) into project management the next logical step, and perhaps even „essential to survival“, to make project management viable in times of extreme complexity and Industry 4.0? In this white paper we want to take a closer look at what actually lies behind the hype of „agilisation“ and how we can use it to transform project management.

Keywords and phrases: customer value, transformation, change management, business value, journey

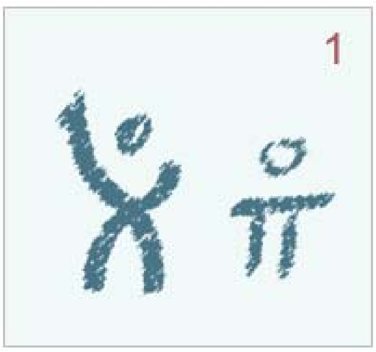
1. Background

Everyone is talking about being „agile“, organisations want to be „agile“, managers are challenging their employees to „get agile“ if other approaches aren‘t working, and human resources developers are searching everywhere for people with an „agile“ mindset... But what exactly do people mean by wanting to become „more agile“? The word „agile“ was primarily coined in software development through the „Agile Manifesto“ (2001). Software developers worked out that in their development they wanted focus more on people and to encourage collaboration within the team („We value individuals and interactions over processes and tools“) [1], wanted less bureaucracy and thus faster results („We value functional software over comprehensive documentation“) [2] and liked to work more closely and trustingly with the customer („We value customer collaboration over contract negotiation“). [3] At the same time, continuous change was perfectly natural to them („We value responding to change over following a plan“). [4] Since the agile manifesto, the word „agile“ and the associated mindset has spread quickly and has simply become a synonym for fast, non-bureaucratic and self-organised „whatever“. What has happened under the name „agile“ in software development is a counter-movement to an approach that has become too rigid and bureaucratic, usually known as „classic“. There have also been similar movements in other sectors, e.g. among Japanese car manufacturers in the 1980s. Here the production was to be oriented towards the customer in a more lean and consistent way, achieving shorter lead times and greater flexibility. We are experiencing a similar trend in Design Thinking: the benefit to the customer consistently takes priority and iterative solutions are developed in small creative teams. Two major trends are currently engaging companies more than ever before: automation and humanisation: On the one hand, the aim is to produce as many products and services as possible with the minimum possible human input - in other words „automatically“ - by means of standardised processes, IT-based workflows, automated production and scaling. On the other hand, the aim is also to make working life „more humane“, in other words make better use of human creativity and improve understanding of customer and employee needs. You just want to create things that generate real added value and surprise and enthuse customer and employees, in order to develop a good, lasting relationship between you and them. On the one hand, humans are becoming superfluous and more and more „redundant“ and on the other hand increasingly important and indispensable. Is this trend killing our livelihood and will there no longer be enough work for everyone in future, or are we freeing ourselves from decades of inhumane working conditions and elevating ourselves to our true purpose? Both can feel very right, depending on the perspective you take. Opportunity and risk are therefore very closely linked, similar to the time of the first industrial revolution. Whether you now call the whole thing „agile“ or „lean“ or whatever, it is primarily about realigning the economy more towards humans, focusing on customers and employees to optimise value creation in times of complex environments and ever-changing circumstances. What do all these „agile“ approaches have in common? What principles lie behind them? Below we consider seven principles, which may be worth using as guidance if there is a desire or an urge or even a need to be „more agile“, regardless of which method you ultimately decide on.



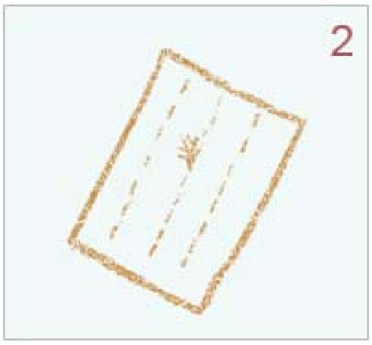
2. The seven principles for the "agilisation" of project management

2.1 Voluntary action



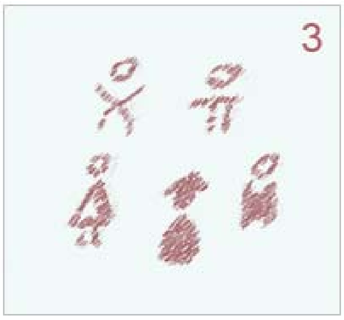
Small, self-organised teams in which various individuals work together creatively are the linchpin of value added in the company. Self-organisation works best when the individuals in the team voluntarily contribute their respective personal strengths, i.e. when they have so much „passion“ (willingness to suffer) that they work even without pressure or control. Only then can hierarchical management be largely dispensed with. For this reason, voluntary action is a fundamental principle for being able to work in an agile way. This not only requires experts from various specialist fields, but also so-called „bridging people“, who are at home in two or more different disciplines and can therefore bridge the gaps between the experts. Generally people intuitively group themselves with like-minded people, so these kinds of „bridging people“ are particularly important in times of Industry 4.0, in which interdisciplinary teams made up of representatives from Marketing, Development, IT, Production, Sales etc. have to work together more closely than ever. This is the only way to create in-depth and networked knowledge at the same time. This principle is primarily aimed at the HR department in companies, which can promote the development of experts and „bridging people“ through appropriate career models and measures such as job rotation etc.

2.2 Protected environment



To be able to work voluntarily and creatively, free space and free time must be provided accordingly by (top) management, in which the team can work in an agile way while protected from day-today business and other expectations. This way the new mindset can be created and with it a culture of trust, which is essential for a real team. For the management this means letting go of the usual efficiency mindset to a certain extent and risking time and money, without knowing what the end result will be. Like in a flowerbed where small plants can grow protected, in this safe environment a new culture can grow. „Risky is the new safe“ 5 is the motto. Where previously managers have shied away from taking risks to avoid jeopardising the familiar sense of security, these days it is almost negligent not to take any risks, as a new culture, new ideas, new business models and hence a (new) future cannot be planned, they have to be trialled and experienced. Anything that does not work is abandoned, everything that proves successful is developed further, a bit like natural selection and evolution. To ensure such „risky“ experiments do not jeopardise the whole company or the core business, they should also be carried out in a protected environment and only gradually rolled out to the rest of the company after a test phase. So a certain amount of „passion“ (willingness to suffer) is also required on the part of the company, whereby the (top) management invests money - which could be paid out in the short term as bonuses, for example - in building a new culture to ensure long-term survival.

2.3 Real team



An interdisciplinary team is made up of diverse experts and so-called „bridging people“. What „diverse“ means depends on each task. The more creative, unconventional and complex the task is, the more diverse the team members should be. Many companies have now come to recognise this and are increasingly creating cross-hierarchical, interdisciplinary and international teams, and peppering them with lateral thinkers, artists and employees from completely different specialisms. Of course, this results in greatly increased demands on team development. Forming a real team from the different participants, one that adopts Collective Ownership, takes time and requires a considerable degree of openness and also courage from those involved. This is rewarded with many new perspectives and usually a major leap in personal development for those involved, and creative new products or services for the company. In addition, the team should also be allowed to work truly creatively. Visual and tactile elements in a dedicated space, where the team also physically sits together, are just as important as free, unplanned time for „experimenting“ and networking. Anyone who has previously only worked in „pseudo project teams“, which are little more than a group of work package managers who only see each other at regular meetings or occasionally at a joint dinner, may be amazed by what it means to be part of a real team. Through ongoing reflection, the team continues to develop along the entire project duration.

2.4 Supportive management

The middle management also plays a somewhat different role in the complex environment than most have previously been used to. There is little room for self-publicists, world saviours or superheroes. Instead people are needed here who watch the team with a smile and help it to organise itself in order to master ITS task. It is not servant leadership, as the management should neither be a servant (receiving orders from the team) nor a leader (primarily the team is guided by customer needs), but act in partnership with the team as equals. The management has its own active and responsible task: to specifically facilitate the self-organisation of the team and provide the best possible support for it to be successful. This requires a mature personality and skills that have generally not been the focus of previous management seminars. It will probably be as hard for the managers to embrace this role as it will be for the team to organise itself, as both are mutually dependent. The beauty of it is that both will grow considerably in this endeavour, and it actively counteracts a culture of nagging as well as individual ego trips. As a consequence, un-even distribution of work in the company is reduced and thus the gulf between under-challenging and over-burdening. The new key tasks of the manager will be to act as moderator or facilitator, to consistently protect the team from external influences and to create the conditions required for creativity and trust.

2.5 Iterate to wow

„Iterate to wow" is possibly the principle which is most difficult to understand for people who have not worked in an agile environment or with Design Thinking before. The assumption is that in complex environments and when we want to create products and services that impress (and thereby surprise) the customer, the requirements cannot be clearly defined or the customers themselves do not know what they want or need. It does not help to spend even more time clarifying the task; it is better to simply get started and create a prototype that can be experienced. This prototype and the customer's associated experiences can be used to gradually, iteratively get closer to the desired solution. We make as many iterations as it takes to not only satisfy the customer, but to really enthuse them (Wow effect). The iterative approach is also not as sensitive to the changes that occur in complex environments that easily undermine long-term planning. The better we know the customer or the better our assumptions about the complex system are, the fewer iterations we will need and the faster we can achieve results. So we need somebody in the team who acts as the interface with the customer or the user groups. Traditionally this would be marketing and sales or project sponsor. In Scrum he is called the Product Owner; most importantly, he is empathetic towards users and their history and is able to recognise the needs behind the wishes, thereby composing requirements or assumptions for the team.

2.6 Customer benefits

This is about providing the customer with a true benefit. Our goal is of course long-term customer retention and these days this is no longer so easy in an affluent society. Many customers can order anything they want at the touch of a button or purchase it from the competition. To have someone who knows you better than you know yourself and can surprise you with products or services you did not even know that you needed before creates trust and, consequently, loyalty. It is less about the perfect product and more about finding the perfect match between the product or service and the individual needs. And ascertaining needs is not trivial. To do this we need a lot of data about our customer (Big Data), or a lot of time to understand their history and to look beneath the superficially formulated wishes. Therefore, the customer is also no longer the king who simply formulates his requirements and is then served, but he is an equal partner, whose needs the team attempts to satisfy using its abilities. The better the communication and the more trusting the collaboration, the better the match.

2.7 Interdisciplinary coordination

Often „agile“ work starts in a protected environment, shielded from the rest of the organisation. However, only a few projects can be fully implemented when isolated from the rest. It is almost always necessary to coordinate with other teams or collaborate with the rest of the organisation and the specialist departments. In doing so, different cultures often collide. However, overcoming these „cultural differences“ without converting the „dissenters“ requires „bridging people“ and space for real encounters. Regular consultation and mutual tuning between individuals, teams and throughout the company is necessary; both should start at an early stage and be more intensive the more varied the cultures are. This requires honesty, interest, consideration and humility from both parties. This area of conflict can perhaps be compared with the often tense relationship between Engineering and Purchasing in the classic environment, which can also be improved by good, early consultation and a collaborative, iterative approach.

3. Implementation

Every individual in a company can contribute to bringing the 7 principles to life - at all times.

HR

- In many companies, as well as the traditional specialist careers, it is also important to encourage the training of "bridging people" – e.g. by means of increased use of job rotation.
- In order to be independent of individuals as a company and to make everyone replaceable at any time, many of our current practices in the company specifically promote egalitarianism and prevent individuality. In an agile environment however, individuality is increasingly important; not only to have as many different perspectives as possible, in order to develop creative solutions, but also to promote a culture of trust. Real trust only develops if these people are not worried that they will be replaced.
- Promote new approaches to learning, based on independent responsibility, train to learn, and increase the reflective faculties of employees
- Promote individual strengths and personal development

Top management

- Permit experiments, allow committed employees to surprise us
- Learn to let go, without having to be in control
- Gradually build up trust and then give increasing amounts of freedom
- Enable flexible working hours and working from home, in order to develop employee autonomy

Middle management

- Learn moderation, mediation and facilitation
- Learn to create space
- Allow the team to present team results itself
- Learn to delegate tasks with the appropriate responsibility
- Engage in personal development

Employees

- Take responsibility
- Recognise and consistently develop your strengths, go your own way, do not do what everyone is doing

- Have the courage to show your vulnerabilities and express your needs
- Learn to take risks and step out of your comfort zone, learn to think in an entrepreneurial way in the interests of the company
- Show an interest in other perspectives, where appropriate carry out
- job rotation
- Network across departments within the company
- Engage in personal development

Sales
- Spend more "quality time" with clients, learn to listen to them and read between the lines
- Develop emotional intelligence and empathy in order to identify needs
- Learn Story Mapping instead of recording requirements

Specific aspects in project management that can be made agile by actively applying the principles

Contract clarification
- Use of Story Mapping, prototyping or Design Thinking in the contract clarification, to reveal hidden needs
- Closer contact with the end user (if necessary via the PO)

Management of risks
- No bureaucratic filling in of tools and lists, rather identification of risks in discussions, taking into account gut feelings and intuition
- Careful trialling and gradual exploration of the risky areas, in order to learn about them and not suppress them

Planning
- No long, detailed planning period, instead greater transparency about the activities over the coming weeks; just a rough plan of milestones for any long-running projects
- Iterative approach in the team rather than central planning
- Plan early experiments to gain insights

Interdisciplinary approach
- Development and use of "bridging people", in order to enable constructive teamwork
- Increased use of non-specialists or people from complementary disciplines, in order to find new approaches

Dealing with changes
- Regular involvement of clients with continuous feedback and an iterative approach enables changes to be recognised at an early stage and planned for.
- This prevents complex change management.

Lessons learned

- As well as receiving feedback on the product or result, the team also regularly records improvements in the team process.
- As a result, the team consolidates to form a real team more quickly

4. Outlook

For most companies, the application of the above principles and the associated self-organisation of the teams and supportive management is linked with a big change in mindset and therefore cannot happen overnight. So making the PM agile should take place with a special process model, which enables every organisation to define the appropriate degree of agility for them and gradually implement the change, without asking too much of the organisation in the process. Entirely according to the principles, this should also be an iterative process, different PM approaches should be individually combined and client feedback should be continuously considered. Of course, all of this takes place in a protected environment, in order to sufficiently test the new culture and the agile process, before rolling it out on a large scale. One thing we should never forget: It is not about classic or agile, instead it is about enhancing the existing project management with enough "agility" to meet current and future requirements, no more and no less. The methods that are ultimately applied, be it Design Thinking, Scrum, Lean, Kanban or something else entirely, should be left open for now, because a specific approach usually develops during the introduction phase which suits the company better than each method alone.

Proposal of Improvement about Education for Younger Aged PM Used by Communication Model

- Improvement parts of Communication which are Analyzed by Survey to College Students -

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In Project Management, it is needless to say that communication with stake holders is very important. However, at an actual field site, between the users and the developers of computer systems, misunderstanding about the system specification has been continuously caused. This tendency is remarkable among the young member of project managers. Although until now 'Communication code model' of 'Shannon & Weaver', 'Inferential model' of 'Sperber & Wilson' have been prevailed model, with the development of the internet and SNS, the way of communications has been changed. Therefore, it is necessary to make new model to solve the problem. I conducted a survey of college student how they use SNS. In this article, I make improvement over 'Information Communication model', and propose the means of 'Project Management' education for the young group

Keywords and Phrases: communication model , education , student , specification defect

1. Introduction

In Project Management, it is needless to say that communication with stake holders is very important. However, at an actual field site, between the users and the developers of systems, misunderstanding toward the specification has been continuously caused. This tendency is remarkable among young member of project managers.

Lots of projects which ware seemed to go as planned in an early stage turned out to have some misunderstandings toward the system specification in the last stage of user tests. In consequence, additional work for out-of-specification is occurred.

In many cases, these works are treated as bugs arised by the lack of consideration for operation method and they work for free.

This tendency is remarkable among young members who have comparatively poor experiences of project management.

I assume that this reason comes from lacks of accurate understanding of communication between the users and the developers of systems on design stage. In a project, it is important to consider user's background, and their requirement, priority concern. As a result of consideration, both developers and users can work toward the same goal. Although the young group, there is a lack of consideration on communication partner's requirement. Therefore trouble points are revealed by a survey of the young group's SNS utilization. The reason of SNS, it is the most popular communication device for them. The purpose of analysis, a survey of college students was conducted. The purpose of this article is to clarify the important part of communication education for younger aged group by analyzing the result of the survey.

2. Issues and methods of resolution

Recently, internet environments have been enhanced, and SNS have been in widespread use. As a result, communication styles have been changed. I speculate that those changes have triggered the communication trouble among young generations. Although until now 'Communication code model' of 'Shannon & Weaver', 'Inferential model' of 'Sperber & Wilson' have been prevailing models, with the development of the internet and SNS, the way of communication has been changed As a result, when young people start working after graduation, some issues are arisen in building systems due to the immaturity of information sending technique.

On that premise, I write this article. Based on prevailing 'Communication Model', I investigate the insufficiency of current communication style, and look into defecting points on communication education for young people, then propose the way of improving or strengthening them.

In consideration, a research was made by following steps. First, a survey to students about "the way of utilizing internet communication" was provided. Second the characteristic of the result was examined. In the end, the problem was pointed out and analyzed.

3. Limit of existing Communication Model

'Communication code model' of 'Shannon & Weaver' give an account of following theory. In the process that 'Transmitter' sends 'Signal' to 'Receiver', 'Noise Source' which exists between the two hinders signal transmission. Accurate communication requires minimizing effect to Noise Source. If that could be done, signal sent by transmitter would be communicated to receiver accurately. (See Figure 1) According to this theory 'character or data' which is hardly affected by noise has 'accurate information', so receiver can get 'accurate information'. And it means that receiver can construct accurate information which is completely same to transmitter's 'accurate information'. (Amari,S.(2011). Takaoka,E.(2012) expounded 'Communication code model' in their books.) In fact this model premise that accurately encoded information surely guarantee the quality of communication. If this theory is correct, when people use encoded character or graphics data as e-mail or SNS, misunderstanding would never be occurred.

However, 'Sperber & Wilson' noticed that 'Communication code model' of 'Shannon & Weaver' is not accurate, so they proposed 'Inferential model' as new communication model.(See Figure 2) (Otsu,S (2014) expounded 'Inferential model' in his article.) They guessed that it would be impossible to communicate transmitter's intention accurately by using just voice signal which was composed by literal meaning of"character" 'Sperber & Wilson' defined their theory as following; Communicator provides evidence of intention which they want to communicate by depending on context (preliminary knowledge). Audience receives this evidence and refers to context (preliminary knowledge), then infer communicator's intention. To put it briefly, it becomes following theory that audience cannot infer accurately as truth without referring communicator's context composed by aggregation which is not able to couch. For communicator, it is same. (Pointed out in a paper by Tsuda,S.(1998). Kokubu,T.(2017))

This theory is analogous to 'Phenomenology' of 'Husserl', a famous philosopher. He advocated, we can understand other people beyond the scope of 'Lebenwelt' which are experienced by themselves. This theory has a commonality, about possibility of understanding other people by only their context.

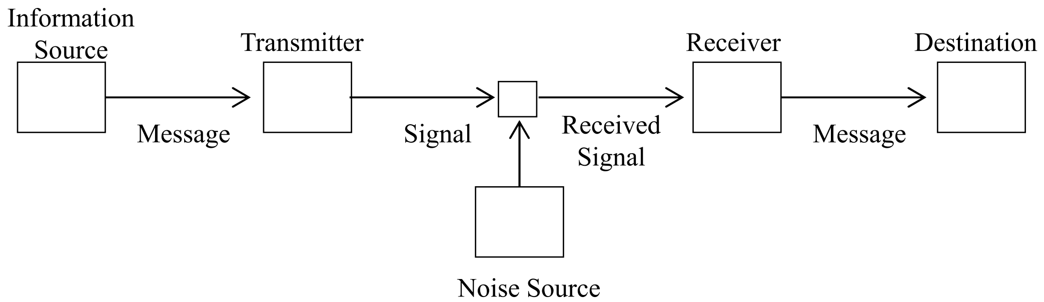

Figure 1 Schematic diagram of a general communication system (Shannon)

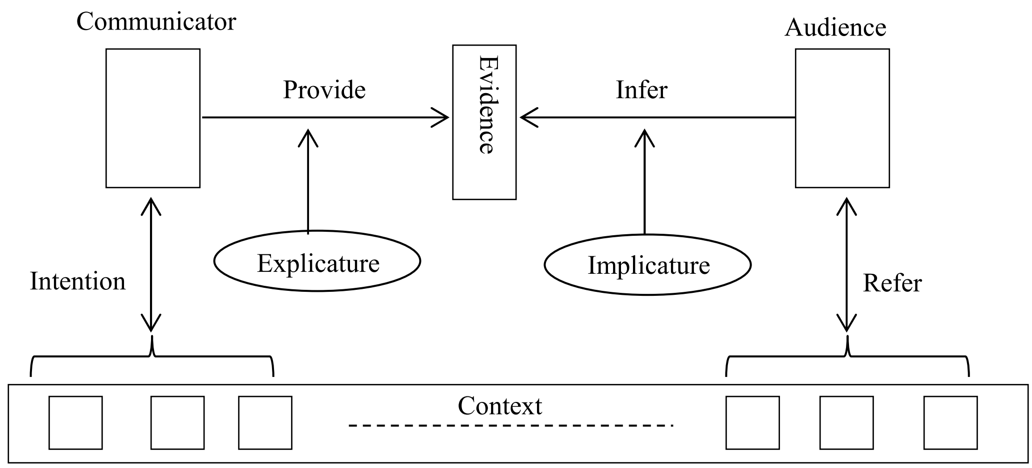

Figure 2 Sperber & Wilson's 'Inferential Model' drawn up by writer

However, inferential model could be dicey if diversity is strongly required, inferential model brought radical theory that 'information communication is possible to depend on their context between different persons'. In this article, this dicey was analyzed with attention.

In those two models; Code Model and Inferential Model, I conduct analysis based on 'Inferential Model'.

4. Premise of issue resolution

The following premise is considered; when the actual project is run, the range of inference required for that scene is confined. Specifically, the following objects related to the purpose of the project are included; system support facility, development schedule, target cost, and so on. They are categorized as context and sharable by stake holders. And defining the contents of context enables the information transmitted accurately. It follows that both communicator and audience can receive the information correctly and then misunderstandings toward the specification are reduced.

5. Results of survey

5.1 Content of implementation survey

As mentioned in Chapter1, at an actual project, there have been many misunderstandings toward the specification brought by lack of communication. For investigation of the causes, a survey of college students was conducted - they are young age group - how they use SNS. By utilizing the result of this survey, I reveal the tendency of information acquisition with the use of SNS and e-mail communication, and attempt to abstract the problem, which is insufficiency of the communication.

A survey of students from 3 schools was conducted; department of engineering at a university, school of business at a university, and institute of technology. The survey was anonymous style.

The contents of this survey are shown below.

- Questionnaires are composed of 14 listings. There are 4 categories.
- From Q 1 to Q 6 ; base questionnaire, about possession of smartphone, purpose of use
- Q 7; Questionnaire about method of credibility check for reference information
- From Q 8 to Q 10 ; questionnaire about presence or absence and frequency of communication failure
- From Q 11 to Q 13 ; questionnaire about strategy of how to cope with the communication failure

The detailed contents of this survey are shown below.

- Q 1 Utilization purpose of smartphone
- Q 2 Using kinds of SNS
- Q 3 Quantity of community
- Q 4 Kinds of community
- Q 5 Utilization purpose of SNS
- Q 6 Kinds of retrieved data by SNS
- Q 7 Method of credibility check for reference information
- Q 8 Presence or absence of communication failure
- Q 9 Frequency of communication failure
- Q 10 Frequency of communication failure
- Q 11 The way to cope with communication trouble
- Q 12 The way to cope with communication trouble
- Q 13 The way to cope with communication trouble
- Q 14 Gender

5.2 Results of survey

The number of respondent counts 316 respondents. Although there is unanswered questionnaire partly, valid response counts for 314, so response rate reach 99.4%.

Results of response are detailed below.

1) According to the investigation which was aimed at confirming the accuracy of information gained on SNS, the frequency of checking where the information comes from showed; "every time" 3.8%, became less than half of the total even summed up "sometimes". (See Table 1)
2) The rate of students who have received fake news accounts for over 90%, however even after getting fake news, most students would not check where the original data sources come from. This means that the experience of getting fake news have little effect on the behavior that students conduct credibility check of post on SNS. (See Table 2)
3) The rate of students with experience in getting unpleasant post on SNS massage shows 57.1%. The rate of students with experience inundated their SNS post with comment accounts for 18.5%. (See Table 3 and Table 4)
4) After encountering troubles on SNS, nearly 60% students "block" or "ignore" the post. This phenomenon implicates that most students leave

troubles unsettled. On the other hand, students who have no trouble experience plan to communicate directly at the trouble situation. (See Table 3 and Table 4)

5) The frequency of checking the original data source on SNS has not changed even after students encountered troubles. That is to say, the experience in encountering troubles does not effect on the behavior of credibility check of post. (See Table 5 and Table 6)

6) For the response to the survey, there was no significant difference among three schools.

Table 1 Credibility check of post

credibility check of post	Each time		Sometimes		Only infrequently		Nothing		Sum total	
	12	3.8%	140	44.3%	131	41.5%	33	10.4%	316	100%

Table 2 Credibility check of post after getting fake news

Getting fake news			credibility check of post							
			Each time		Sometimes		Only infrequently		Nothing	
Nothing	19	6.1%	1	5.3%	7	36.8%	11	57.9%	0	0.0%
Only infrequently	103	32.8%	5	4.9%	40	38.8%	47	45.6%	11	10.7%
Sometimes	146	46.5%	5	3.4%	73	50.0%	56	38.4%	12	8.2%
Frequently	46	14.6%	1	2.2%	20	43.5%	16	34.8%	9	19.6%
Sum total	314	100%	12	3.8%	140	44.6%	130	41.4%	32	10.2%

Table 3 Trouble solution after unpleasant post by friends

Unpleasant post by friends			Trouble solution							
			Direct dialogue		Reply on web pages		Block or ignore		Other	
Nothing	135	42.9%	43	31.9%	29	21.5%	54	40.0%	7	5.2%
Only infrequently	115	36.5%	37	32.2%	29	25.2%	44	38.3%	5	4.3%
Sometimes	54	17.1%	13	24.1%	10	18.5%	30	55.6%	1	1.9%
Frequently	11	3.5%	0	0.0%	2	18.2%	9	81.8%	0	0.0%
Sum total	315	100%	93	29.5%	70	22.2%	137	43.5%	13	4.1%

Table 4 Trouble solution after inundated your web pages with comment

Inundated your web pages with comment			Trouble solution							
			Direct dialogue		Reply on web pages		Block or ignore		Other	
Nothing	256	81.5%	82	32.0%	55	21.5%	107	41.8%	10	3.9%
Only infrequently	46	14.6%	8	17.4%	15	32.6%	13	28.3%	10	21.7%
Sometimes	8	2.5%	3	37.5%	0	0.0%	4	50.0%	1	12.5%
Frequently	4	1.3%	0	0.0%	0	0.0%	3	75.0%	1	25.0%
Sum total	314	100%	93	29.6%	70	22.3%	127	40.4%	22	7.0%

Table 5 Credibility check of post after unpleasant post by friends

Unpleasant post by friends			credibility check of post							
			Each time		Sometimes		Only infrequently		Nothing	
Nothing	135	42.9%	3	2.2%	57	42.2%	60	44.4%	15	11.1%
Only infrequently	115	36.5%	5	4.3%	50	43.5%	49	42.6%	11	9.6%
Sometimes	54	17.1%	3	5.6%	26	48.1%	20	37.0%	5	9.3%
Frequently	11	3.5%	1	9.1%	7	63.6%	1	9.1%	2	18.2%
Sum total	315	100%	12	3.8%	140	44.4%	130	41.3%	33	10.5%

Table 6 Credibility check of post after inundated your web pages with comment

Inundated your web pages with comment			credibility check of post							
			Each time		Sometimes		Only infrequently		Nothing	
Nothing	256	81.5%	11	4.3%	107	41.8%	110	43.0%	28	10.9%
Only infrequently	46	14.6%	1	2.2%	26	56.5%	17	37.0%	2	4.3%
Sometimes	8	2.5%	0	0.0%	5	62.5%	2	25.0%	1	12.5%
Frequently	4	1.3%	0	0.0%	2	50.0%	0	0.0%	2	50.0%
Sum total	314	100%	12	3.8%	140	44.6%	129	41.1%	33	10.5%

6. Characteristics of student's Communication and analysis

6.1 Characteristics of immediate phenomenon

The result of survey in Chapter 6 defined that immediate phenomenon which details below had been shown when students targeted for this survey communicate each other.

1) The rate of conducting credibility check on SNS is rather few. (Q 7)
2) There are comparatively many students who have received fake news. (Q 8)
3) While SNS communication, some students had trouble with friends. (Q 9 and Q 10)
4) There is tendency to leave troubles without making action. (Q 11)
5) There is not a big change of communication style, even though having experienced trouble.

6.2 Cause analysis of inconsistent communications

As the basis for these aforementioned immediate phenomena, It is cited below some instances of cause which bring inconsistent communications to student.

a) Audience does not recognize action for obtaining credible data as important. As a result, misunderstanding is occurred during communication.
b) Audience does not recognize accurate inference for communicator's implicature which can not be couched in language, as important action. As a result, during communication, misunderstanding is occurred.
c) Communicator does not recognize audience's clear explicature which is communicated to audience, as important action. As a result, during communication, misunderstanding is occurred.
d) Insufficient recognition of the importance to cope with the situation as defined from a) to c) above prevents problem-solving on communication.
e) As an extension of cause which I defined in d) above, students who encountered trouble do not improve accuracy of information transmission to avoid trouble, but they have tendency to escape from trouble by being deterrent to information transmission.

7. Trouble point of inconsistent communications

7.1 Identify the point of problem

In this chapter, I defined the root cause of the problem in the inconsistent communications which I mentioned in Capter6 referring 'Inferential model' which is defined at figure 2.

Immediate phenomenon of communication misunderstanding is occurred in two processes. One is in the process of 'communicator's providing process', other is in the process of 'infer process' in which audience understand data provided by communicator. Furthermore, there are two causes occurred in these processes.

First of all, the communicators have an obligation to deliver their 'explicature' definitely considering the context of the audience's premise. Communicator's evidence which is shown (in this case) as character used in e-mail or SNS, is required consideration to

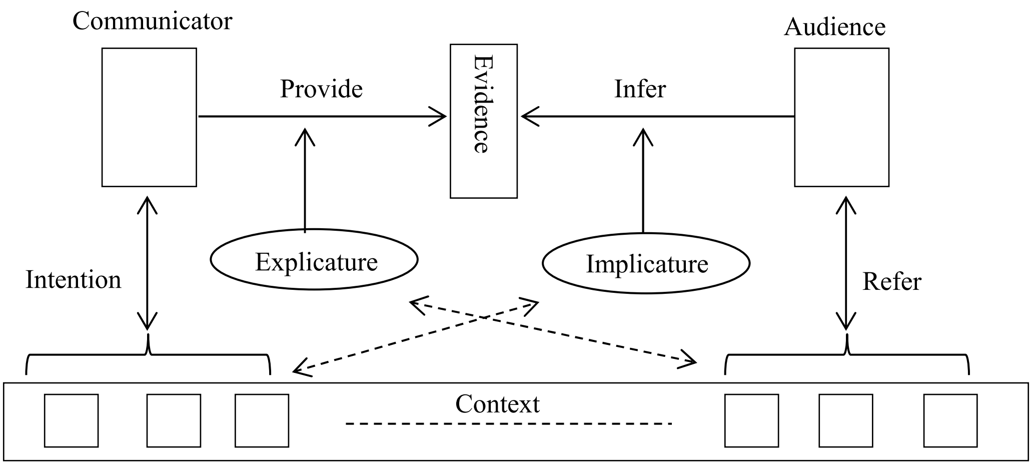

Figure 3 Sperber & Wilson's 'Inferential Model' covered by writer

audience's context. However, I guess that the short sense for consideration is the most effective cause.

On the other hand, in inferring provided data, the audiences are required to infer accurately the communicator's 'implicature' with consideration to context which is communicator's premise. In this case, the audiences have an obligation to consider the context of the communicators in inferring the 'implicature' of the communicators. Then, if audience made a judgmental decision that only evidence used in receiving data can't infer the communicator's 'implicature', audience had to require to clear evidence with question for communicator. However, I guess that the short sense for consideration is the most another effective cause.

Figure 3 indicate the two cause which I described. The first cause is indicated by arrow which is from 'explicature' to context closed to audience. The secondly cause is indicated by arrow which is from 'implicature' to context closed to communicator. I guess that varying conditions of two arrows indicate data accuracy while inference.

7.2 Verifying trouble point

Preceding theory is only an assumption. However the result of survey to students indicates high using rate of 'LINE', (Note 1) 'Twitter' (Note 2), 'You Tube' (Note 3). A feature of these SNS application is that it has difficulty in making communication with accuracy. The cause is that quantity of characters per entry is so small that quantity of data is permitted. Then,the result of survey similarly indicates that they have little behavior of validating to relative data. The result of survey is enough to make a decision that both communicator and audience are insufficient recognition of necessity to consider context each other. It follows from that the theories suggested in first section of this Chapter.

Additionally, the results of past analogous investigations are sufficient to certify preceding my theory. (Pointed out in a paper by Ikemura,S.(2014), Kato,C.(unknown), Karino,M.(2014), Yamaguchi,S(2015))

8. Applying method to Project Management

In the preceding chapter, I indicated the cause and part which prevented young member's communication. In this chapter, I apply my theory into the actual project management.

As long as organizing a project, a restricted range of context shared by stake holders is possible. Unlike general communication of daily life, restricting a range of context shared with stake holders is possible in preceding a project. Examples of context in system building are given as follows.

- Implemented function
- Required business operation
- Restriction and premise related to business Operation
- Cost and schedule which should be observed

These contexts are entries to plan document, what is called "Project management plans", composed in staring up a project. Then, those contents are step wisely refined from 'Requirement Definition Document' to 'Basic Design Document' as it gets to upper side. These documents become deliverables of which should be arrived at the agreement between stake holders.

Most problems occurred in recent project are due to misunderstanding of specification. The reason derives from lack of information sharing for the context. Especially, this tendency is prominently shown among young aged project managers (PM), that is because they are insufficient to recognize the context sharing as important matter. As for senior PM, they recognize the importance of the context; however, as the knowledge was brought from past accidental failures, there are possibilities that they do not understand the importance of context logically. That is to say, senior PM has risks of same failure as young aged PM when they are tasked with inexperienced project management.

9. Management education for younger aged PM

9.1 Required skill

From the preceding sections, with the spread of the internet and SNS, the specific communication skill required especially for young member can be clarified.

The training skill needed for young members are listed below.

1) Awareness of importance for shared context owned by both communicator and audience.
2) Acquisition of accurate data, and arrangement of acquired data.
3) Providing skills of accurate data.
4) Inferring skills of accurate data.

And common basic technique in all cases above is 'documentation technique' for sharing context.Students cooperated this survey will become a member of society and participate in a project after graduation. Based on the result of this survey, earlier introduction of project management education including new communication methods, seems to be required for developing their ability.

9.2 Problem of existed education contents

However, General communication education is composed of following program. To begin with, 'it is dialogue technique' tailoring their communication style to others. Next, 'data providing technique', communicating their intention accurately. Finally, 'mental technique' controlling their emotion. The current problem of communication education derives from this curriculum composition.

To acquire smooth and accurate communication skill, the following education is additionally required.

1) Context sharing technique with themselves and others.
2) Accessing accurate data technique.
3) Interactive communication technique of data providing and inferring.
4) Documentation technique of shared context.

With the theory described in this article, I consider the specific contents of PM education.

10. Conclusion

I described my theory as following order. First, I marshaled and drew a comparison between 'Communication code model' of 'Shannon & Weaver', and 'Inferential model' of 'Sperber & Wilson' prevailed model until now, then conducted analysis based on 'Inferential Model'

Secondly, through the survey to students, I attempted to investigate the status of utilization in SNS communication applications. The result revealed that two problems below are more common among younger member's communication.

1) In providing data, communicator tends to give insufficient consideration to audience's context.
2) In inferring the provided data, audience tends to give insufficient consideration to communicator's context.

Thirdly, the result of survey, the influence to actual project site and the reason given by these problems become clear, and thereby, the solutions are elucidated; which is improving the skill of context sharing and context documentation.

These skills have been recognized as unvalued in general communication education. In this article, I marshaled logically the importance of improving these skills which has been overlooked until now. As future challenge, I consider specific education curriculum and the ideal style which was not developed this time.

Note

Note 1) "LINE" is the trademark or a registered trademark of LINE Co, Ltd. or the affiliates.
Note 2) "Twitter" is the trademark or a registered trademark of "Twitter.Inc." or the affiliates. The position of "Twitter.Inc" is that "Twitter" is not a kinds of SNS. Although in this article, I categorize it as SNS, for the purpose of convenience.
Note 3) (c) 2015 Google Inc. All rights reserved. YouTube. "YouTube" is the trademark of Google Inc.

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Application Example of SCRUM Development Method in the Integration of Intra-company Business Systems

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Company mergers arising out of social changes and the reorganization of business divisions often result in the consolidation of intra-company business systems operated by information system departments. When intra-company information systems are integrated, it is likely that development and remodeling of the application programs will occur. In addition, these developments often have a fixed time limit and promptness is essential. In this study, SCRUM, which is one of the agile development methods, was applied to integrate internal business systems. Development processes, problems in implementation, and examples of countermeasures are discussed. We also describe the role of the SCRUM master.

Keywords and Phrases：SCRUM, Software Development, SCRUM Master, Project Manager

1. Introduction

An agile development approach called "scrum methodology" was adopted in a project for the integration of intra-company business systems. In this article, the development flow for scrum methodology will be described with a focus on actual cases of progress management and quality control. Then, the differences between SCRUM masters and project managers in conventional water-fall system development (hereinafter "project manager(s)") will be explored, followed by a discussion of the issues and challenges faced by scrum members in the project and their responses.

Scrum development requires seemingly-contradictory practices to be carried out simultaneously. including quick decision-making on development processes and consensus building among stakeholders such as users. Communication and a scrum master's leadership techniques are said to be important in solving these issues(Naito, 2015). To this end, approaches that encourage the participation of all persons associated with the system should be the most effective, yet it is difficult in practice to have all stakeholders including users involved in development. The reporting in this article is considered to be significant as only a small number of specific cases of scrum practice have been reported.

A scrum consists of three parties: a product owner, a scrum master and a development team. A product owner takes responsibility for a product to be developed and determines the prioritization of items in the product backlog under their ultimate responsibility. A scrum master promotes rules and modes of agile development processes collectively called a "scrum" and contributes to the progress and increased productivity of the development team. A development team in a scrum must be cross-functional and tasks must be closed within the team(Hammarberg et al., 2016)(Lacey, 2016)(Nishimura, 2016).

Focusing primarily on user values, a scrum framework was used in this development with architectures that included user stories, test-driven development and refactoring.

As mentioned above, communication and leadership are often referred to as key factors in scrum development. In this paper, however, processes at the start of scrum development and activities in progress management and quality control implemented in a period called "sprint" will be discussed. Integration testing based on single test coverages and individual test items is still essential for scrum development and processes for progress checks in the overall flow are also required. In this scrum development, a sprint burndown chart and a release burndown chart were used.

Generally, a scrum master should play the roles of an integrator, a communicator, a team leader, a decision maker and an inspiring person, and in this article differences from roles of a project manager will be summarized.

Although scrum development is said to eliminate the conventional issues in water-fall development of the inability of users to check functions until the completion of the development and the inability to flexibly modify specifications, several challenges were revealed through actual implementation despite certain benefits.

2. Project Overview

The target project is a project to integrate ordering management systems that had been separated for each business department. The project period was from April 2016 to October 2016 and the scheduled date of start of operation was November 8, 2016. As the systems were internal business systems, stakeholders were limited to persons within the company, and the product owner, the scrum master and the development team were, respectively, a person in charge of planning in a business department to be integrated, an internal system development group member, and 6 internal and cooperative persons.

3. SCRUM Development

3.1 Inception Deck

The purpose was to discuss matters to be clarified when implementing the project, and to deepen the common understanding of all persons involved in development regarding project objectives, individual roles, schedules, and relevant procedures, which is equivalent to requirement definition in water-fall development.

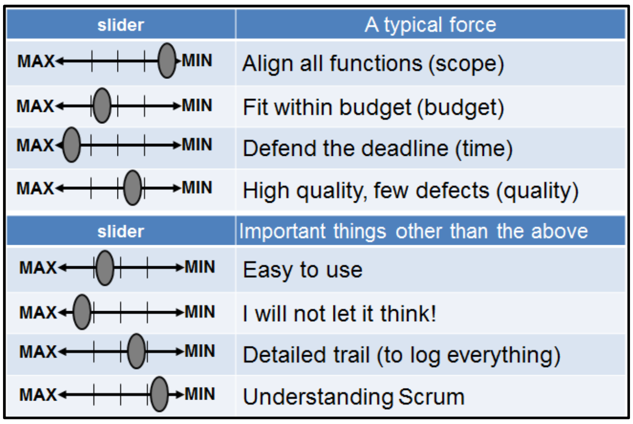

Figure 1 Trade-off slider

Participants were the product owner, the scrum master, the development team and users. They discussed possible concerns and questions about actual tasks and, rather than merely proposing ideas, they took the opportunity to determine the project's direction with the purpose of eliminating questions and concerns and sharing the same objectives among the stakeholders. To make important matters known to the stakeholders, summary information was written on tags and placed on a dedicated whiteboard. If there was any change in the situation, the tags on the whiteboard were updated at the time of the sprint review meeting.

Importantly, 10 questions in the inception deck were used to identify all issues and priorities. A product backlog was developed based on the inception deck. Item prioritization in the product backlog should be determined so as to maximize user values, that is, user interests, but it was eventually determined by the product owner according to priority criteria in the trade-off slider (Figure 1).

3.2 Sprint Planning Meeting

A characteristic of agile development is the definition of sprint periods as short as 1 to 4 weeks during which a series of processes are performed including requirement analysis, design, implementation and testing in order to build satisfactory software. For this project, the sprint unit was originally set as 1 week. A sprint planning meeting is to be held at the start of the sprint period for the following 3 tasks:

- To determine requirements to be addressed in the sprint period
- To identify tasks
- To estimate time required for each task

In most cases, these tasks are performed by a project manager, but here they are performed by all scrum members. For this project, a plenary project committee was convened for the estimation task, and any disagreement on estimated time were discussed to reach an agreement. Through this process, a common awareness was built and reinforced among the stakeholders.

3.3 Sprint Review Meeting

A sprint review meeting was held at the end of the sprint period for the following 8 tasks. For this project, a whole week was defined as a sprint period and therefore the meeting was held in the afternoon on Friday.

(1) Confirmation of sprint goals
(2) Confirmation of committed stories
(3) Confirmation of completed stories
(4) Confirmation of uncompleted stories
(5) Important decisions during the sprint period

(6) Confirmation of project metrics (code coverage, etc.)
(7) Demonstration of completed product
(8) Reflection toward the next sprint period and review of priorities

Items to be implemented were confirmed and shared by performing tasks (1) through (6). In water-fall development, deliverables are not normally presented to customers in a short period of time, but feedback was obtained from users by conducting a demonstration of the completed software in task (7). Feedback on the demonstration was included in reflection (retrospective) and priority review in task (8), and good practices and challenges were discussed in the reflection, resulting in an opportunity to improve tasks for the next sprint period. Consequently, the 1-week sprint period was extended to 2 weeks and the development members attained a deepened understanding of the scrum methodology. Thus, the sprint period may be modified during the course of development.

3.4 Daily Scrum

Daily scrum meetings are generally called morning assemblies and aim to promptly share important information within the sprint team, in which the following matters are to be discussed in 15 minutes.

- Progress and status of tasks performed on previous day
- Tasks to be performed on current day
- Concerns and events

The 15-minute period is important and absolute. By setting up an exact time period, participants become careful about making reporting as concise as possible in order not to use up time for their own reporting.

4. Quality Control and Progress Management in Scrum

4.1 Test Plan and Quality Control

In both the scrum and water-fall methodology, a test plan should be created in advance once the project architecture is determined. Some say no test plan is needed for the scrum methodology. However, development of individual test standards (whitebox test and blackbox test) and integration test standards is essential. Thus, the need for testing is not eliminated only by automation of test execution methods and the use of sprint periods instead of testing processes in agile development, e.g. scrum development. It is certainly desirable to accumulate quality data as such data is beneficial for subsequent development. An integration test item table should be created as necessary for each function to be developed within each sprint period. The number of test items and bugs differs among sprint periods, so it is difficult to find absolute criteria. Accordingly, each sprint period was evaluated by comparing the actual performances of each function, and the total score in all sprint periods was aggregated as a rating of the entire project.

4.2 Velocity and Progress Management

The term "velocity" refers to a relative team performance index indicating the number of points earned by the team against the product backlog, i.e. user values. Note that this index is an input intended for forecasting the next sprint period and for process improvement. The number of points actually earned in a sprint period is checked against the number of points estimated in advance, and the reasons for any deviation are to be addressed in order to improve performance and/or estimation. If the number of actually-earned points are 4 or 6, it should be analyzed against the estimated number of points earned by the team, for example "6."

In the initial phase of the project, deviation from estimation was chaotic but the situation was steadily improved by the scrum methodology. As the scheme of "one person for one sprint in one week" was impractical due to, for example, difficulties in compensating for staff leave, it was found that the "one story, one person" scheme should be avoided and stories of higher priority should be handled by the entire team by appropriately distributing tasks. In fact, assigning tasks from each story to one person resulted in stories of a higher priority going incomplete, while stories of lower priority were completed.

For reporting, a burndown chart was used. The burndown chart shows changes in the estimated total time remaining for all tasks in a chart format, in which the vertical axis represents remaining time (one point = 2 man-day) and the horizontal axis the number of elapsed sprint days. The degree of deviation from the ideal line (estimated remaining points set at the start) indicates the team's project quality, conformity to stories to be handled within the sprint period, and presence or absence of feedback within the team. The smaller the deviation is, the closer the team is to the ideal status.

For this project, 2 types of burndown chart were used: a sprint burndown chart (Figure 2) and a release burndown chart (Figure 3).

A sprint burndown chart shows remaining work hours per day during the sprint period and is filled with individuals' estimated work hours as well as task distribution for scheduling the next sprint period. Naturally, the progress of individual members varies as some may spend more time than scheduled and others may finish their work earlier, but the cumulative results of all members will provide an overall picture of the remaining work hours for the entire team rather than individual members, which helps predict the team's future progress.

A release burndown chart indicates the remaining number of points per sprint period against the overall schedule. The more product backlog items pointed out in the sprint review meeting, the higher the number of remaining points. Color-coding of product backlogs with higher priority and those with lower priority is desirable. Points for backlogs added during the sprint period may also be color-coded for a visual representation of changes in order to draw the attention of team members in daily scrum meetings. However, the progress of the entire project is to be managed by the velocity index and the burndown charts do not indicate possible function delays.

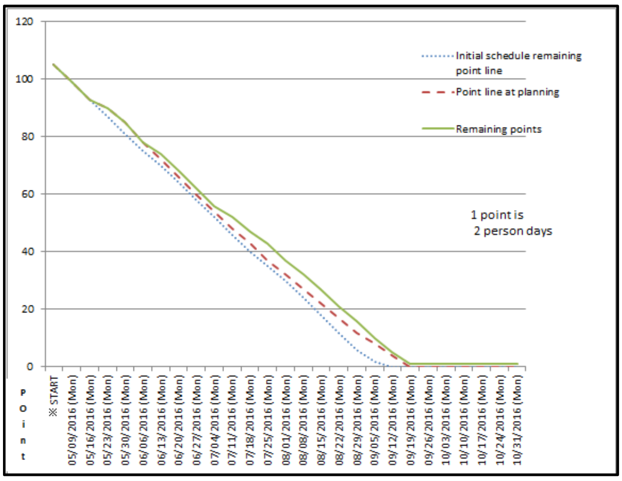

Figure 2 Sprint burndown chart

Figure 2 and Figure 3 show ideal burndown charts in which points decrease exactly as planned in the daily schedule. Note that not all scrum development projects would exhibit such ideal lines.

In the next section, actual progress management practices in the project will be discussed and Figure 2 and Figure 3 will be compared respectively with

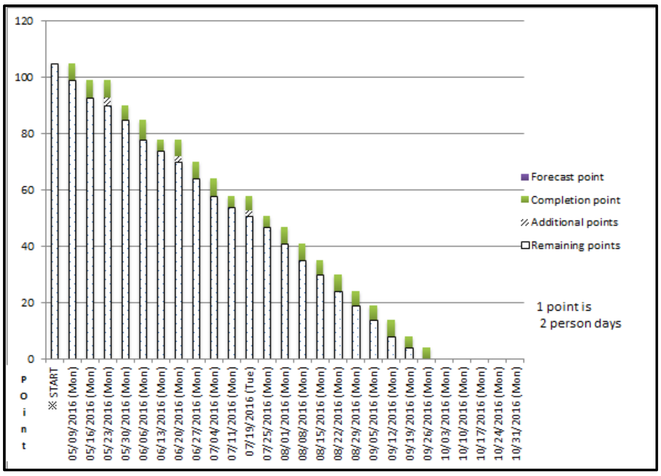

Figure 3 Release burndown chart

Figure 4 & 5 and Figure 6 & 7 to show how signs of deviation could be recognized based on differences from ideal burndown charts and the responses to be taken when deviation reaches a peak.

4.3 Sprint Burndown Chart

The vertical axis represents remaining work volume (hours) in man-day. For this chart, one point accounts for 2 man-days and 105 points (210 man-days) were estimated as the total work volume at the beginning. The ideal line was drawn throughout the period starting on May 9, 2016 and ending on September 12, 2016. Each time a task was added, corresponding points were also added and reflected in the planned point line (dashed line). An actual decrease of points was reflected in the remaining point line (solid line). As clearly indicated in the chart in Figure 4, deviation started to increase around June 20, the seventh sprint period, but points added in the period were not significant and no impact on the sprint schedule was projected. While inclination in the chart once approached the ideal line, the number of added points came to its peak on July 18, the eleventh sprint period, as shown in Figure 5. This was due to a request for an addition of a CSV output function, which required the addition of necessary items on the table as well as the simple addition of output items, resulting in a significant alteration of the product.

Typical reasons for a sign of deviation in a sprint burndown chart include: an attempt to implement excessive number of stories; a high degree of uncertainty arising after project commencement; a large number of bugs due to poor code quality; additional burdens arising from technical burdens. As changes are acceptable in the scrum methodology, a

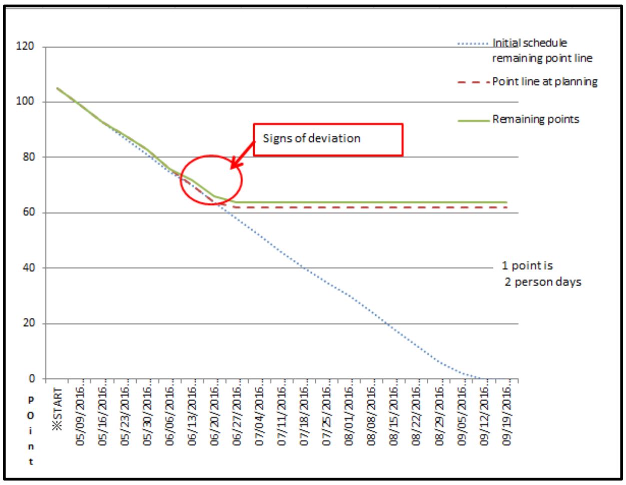

Figure 4 Sign of deviation (Sprint Burndown Chart)

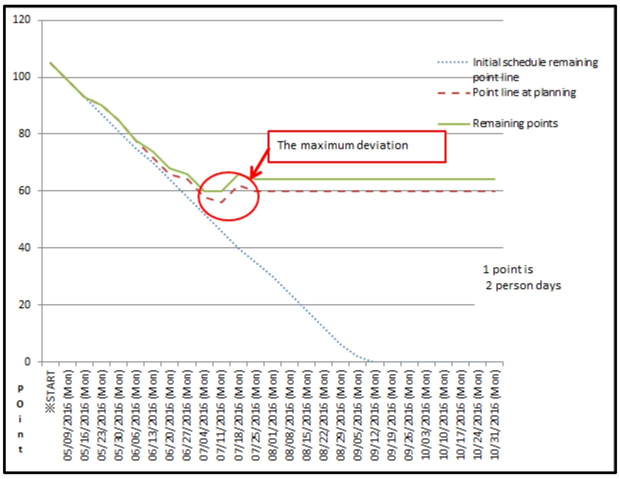

Figure 5 Maximum deviation (Sprint Burndown Chart)

significant margin for allowance should be included in initial planning and an initial plan should be filled only to about 60-70% of the full capacity. However, the relevant planning department should be made aware and should agree that the schedule is developed with an allowance in mind under the assumption that changes will arise during development. Also, there should be a review of product backlog priorities and re-arrangement of backlogs for subsequent sprint periods.

4.4 Release Burndown Chart

In a release burndown chart, the horizontal axis represents sprint dates while the vertical axis represents the number of points (as in the spring burndown chart), i.e. the number of remaining points (shaded) out of the total work volume estimated at the start of the sprint period. The initial number of points equals the total work volume. Works completed during the sprint period are represented by completed points (filled). Added points (downward slopes) represent works not originally included in the total work volume of the sprint period and result in a change of the project scope. These indications help development team members understand the work volume to be processed until the product release.

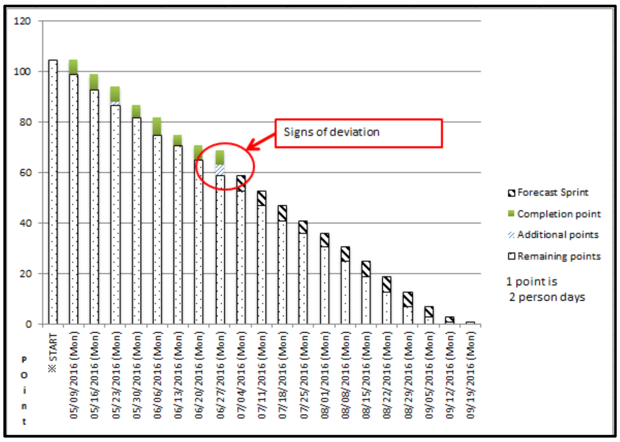

Figure 6 Sign of deviation (Release Burndown Chart)

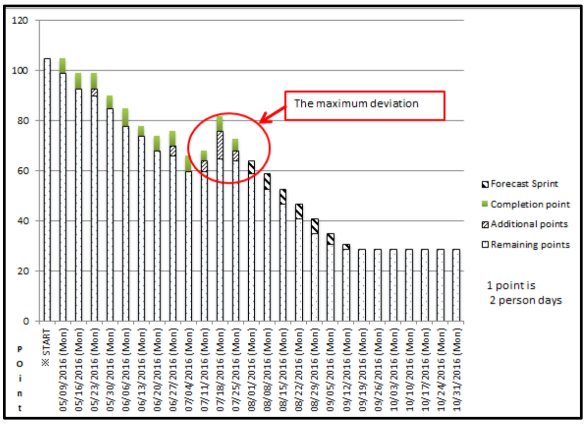

Figure 7 Maximum deviation (Release Burndown Chart)

The slope of remaining points in the release burndown chart represents the team's speed in processing backlog works; a steep slope may represent a large work volume in the sprint period while a gradual slope may be a sign of poor division of work. Also, the change in remaining points indicates the effect on the overall progress of the team due to a decrease, addition or deletion of work volume between sprint periods, which further allows for a projection of the number of sprint periods required for completion.

When a sign of deviation is observed in the release burndown chart (Figure 6), the height of the remaining point bar (shaded) inclusive of completed points (filled) and added points (downward slopes) should be higher than that of the remaining point bar in the previous sprint period. When the deviation is locally extreme, the bar height should be apparently higher than that of the previous sprint period as seen in Figure 7. If such a situation arises due to items added during the sprint review, reflection and product backlog review should be performed.

The focus is on responding to changes rather than conforming to the initial plan, so the scrum methodology should involve updating product backlogs and assigning tasks to be performed in sprint periods.

5. Scrum Master and Project Manager

The primary role of a project manager is to ensure conformity to the wire list and budget, whereas a scrum master in scrum development should take supportive leadership with a focus on the achievement of project objectives and improvement of development team conditions. Thus, scrum masters are expected to encourage scrum members toward positive direction rather than engaging in management tasks such as instructions and task assignment, leading to organizational development of the team. Unlike conventional project managers, in fact, the scrum master assumed supportive roles in this project.

The responsibilities of a project manager include risk management, and a project manager should receive reports on project progress and quality, whereas a scrum master should work to help their development team find and respond to any problem. In other words, the scrum methodology can activate and develop a development team but it is dependent on a scrum master whether the approach will take full advantage of the team's potential.

For either a project manager or a scrum master in scrum development, it is essential to take central roles in a project, provide members with follow-ups and to be motivated to lead the project to success.

6. Conclusions

In this article, scrum development practices have been explored through a case study of a project for integration of internal business systems, and the necessity of project management practices in both scrum and water-fall development approaches has been shown. The benefits, challenges and countermeasures when implementing scrum development in this project are described below.

(1) Benefits
- Members of the development team were on an equal level, allowing for active proposals and the implementation of improvement ideas.
- Information sharing in daily scrum meetings clarified individual roles for each day and allowed for a common understanding of overall improvement among all the members.
- Challenges clarified and shared in daily scrum meetings were responded to and addressed effectively.
- The sprint review allowed for reflection on tasks performed, providing frequent chances for future improvement

(2) Issues and challenges
- Frequent reworking on specifications was needed, although this is a common issue of scrum development because of the absence of an overall design and the impact of other functional development.
- The scrum master remained involved in the conventional controlling management style and was unable to fully commit to the supportive management style, resulting in insufficient support for proactive development of team members.

A project manager in scrum development is regarded as a scrum master. A scrum manager is expected not only to exercise the same management as a conventional project manager but also to help team members find their challenges and issues and ensure effective collaboration within their team. While priority is often given to conformity to specifications and schedules in water-fall development, mutual care and communication are valued the most in scrum development, which is expected to consolidate the team further and deliver outcomes of corresponding quality. As mentioned earlier, leadership is not an essential element of scrum development, but the scrum master's leadership in scrum development may take the form of follow-ups with other members based on individual strengths regardless of position within the organization, thereby moving the team forward to better outcomes.

Further, this project dealt with internal systems and the product owner and the scrum master and the development team were able to work together closely. However, when dealing with systems for which an external customer takes the role of product owner, a scrum system involving such a customer must be established, and practices involving customers need to be explored in the future.

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Project Managers: professionals or managers?

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It is almost a common knowledge that most IS (information systems) projects fail. The current study goal is to examine the relationships between the project manager's professional capabilities vs. managerial capabilities and the IS project success. A correlative research method, based on a questionnaire, was used to survey professionals in the IS industry in Israel. The survey was distributed via the Internet to a variety of IS units in public and private organizations. 90 completed questionnaires received and used as the research data for analysis. Both project managers and other project stakeholders, agree that there is a significant correlation between managerial competencies and project success and both groups agree that there is a low-level positive insignificant correlation between professional competencies and project success. An in-depth analysis of the results show that project managers ranked "critical analysis & judgment" with the highest scores, while other stakeholders ranked "conscientiousness" with the highest scores. Additional inquiries identify the correlations between managerial vs. professional competencies and project's attributes, such as complexity and technological level.

Keywords and phrases: Leadership, Project Managers, Information Systems

1. Introduction

Information systems (IS) projects serve strategic and operational objectives in any business organizations and are the core of today's emerging businesses. Thus, every organization performs at least several IS projects, whether implemented in-house or outsourced to professional firms. But, although the project management profession had been developed, and methodologies, best practice and procedures were defined and applied, the rate of unsuccessful IS projects is still very high and estimated at the level of about 70 percent (Cecez-Kecmanovic et al., 2014; standish group, 2009; Flyvbjerg and Budzier, 2011). Assessing a project success is usually based on delivering a working system on time, on budget, and to specifications, but understanding the role of projects in an organizational strategy requires a broader assessment perspective (Shenhar and Dvir, 2007). The reasons for projects failure, however, are not related to technological incompetence but derive from unsuccessful interactions and managerial flaws. During the last decades, as the position of IS in organizations had changed, the role of the IS professional have changed as well, from a technical specialist to an internal consultant to all functional areas of the organization (Doherty et al., 2012). This study examines the relationships between the project manager's professional capabilities vs. managerial capabilities and IS project success (the terms competencies and capabilities are used interchangeably in this paper).

2. Theoretical Background

2.1 Professional capabilities

Literature review of the skill sets required for IS professionals reveals that technical knowledge is a core competence (Todd et al., 1995; Gallivan et al., 2004; Peppard et al., 2007). But, different portfolio of professional capabilities fits different level of IS managers (Wilcox, 2003). This study follows previous study by Wu et al., (2007) which investigated the perceived importance of critical professional activities and skills/knowledge required by three levels of IS managers. They used the Activity Competency Model that was earlier (Wu et al., 2004) proposed based on the job characteristic theory by Hackman and Oldham (1980). This model offers three levels of IS managers with regard to managerial activities and skills: (1) top management level – Information Chief Officers and Information Technology Officers; (2) middle management level – System Managers and Project

Managers; and (3) supervisory management level – Project Management Officers and Supervisors. A list of 14 critical IS professional skills/knowledge of IS managers was presented with relation to each one of the three management levels, as the following table shows.

Table 1 Critical IS professional skills/knowledge of IS managers by management levels (Based on Wu et al., 2007).

Critical IS professional skills/knowledge	Top Managers	Middle Managers	Supervisors
Systems analysis and design (Understanding of the system development and modification process, evaluating and choosing a system development methodology)	✓	✓	
System life-cycle management (manage systems development life phases from requirements analysis to evaluation and deployment)	✓	✓	
Database management (concepts, principles, issues and techniques for managing corporate data resources)	✓	✓	✓
Distributed systems (manage and support distributed computing technologies and employ these technologies to improve the processes)	✓		
Business domain knowledge (understand and participate in the others' key processes and respect each other's contribution and challenges)	✓	✓	✓
Programming language (algorithm development, programming, computer concepts, design and application of data and file structures)	✓	✓	
Telecommunications and network (technical knowledge for data, voice, image, and video communications and computer networks)	✓	✓	✓
Operating systems (skills and knowledge of how systems software efficiently allocate hardware resources to applications)	✓	✓	✓
System integration (develop an integrated technical architecture to serve organizational needs)	✓	✓	✓
Project management (manage projects within an organizational context, including project's processes and knowledge areas)	✓	✓	✓
Information technology management (deploy information technologies effectively and profitably for meeting strategic business objectives)	✓		
Analysis and judgment (choose an appropriate response based on the perceived factors in a given situation)	✓	✓	✓
Communication and coordination (coordinate IT activities in ways that support other functional managers, suppliers, and customers)	✓		
Team working (achieve team goals and secures cooperation and progresses toward user and organizational goals)	✓		

Information systems professionals work in a dynamic environment that necessitates a continuous process of capabilities improvement. The enhancement of knowledge, competences, skills and know-hows enables better productiveness and effectiveness. Therefore, organizations should promote individual professional development, which covers a wide range of learning situations, including: private study and reading, attending conferences and seminars, preparing papers and presentations, committee work, collaborative work with colleagues, conversation and discussions with others, courses and distance learning, researching the solution to problems, and working with others outside the organization (Wilcox, 2003). Information systems managers are required to update and improve their professional capabilities to be able to manage the critical IS resources. However, since these capabilities can be acquired and learned, the improvement is an ongoing process.

2.2 Managerial capabilities

From a managerial perspective, many studies indicate that a successful project manager uses effective leadership style and management methods (Thite, 2000; Müller and Turner, 2010; Keil, et al., 2013). Turner and Müller (2005) review the development of leadership theories throughout the centuries with reference to six schools: the trait schools, the behavioral or style school, the contingency school, the visionary or charismatic school, the emotional intelligence school, and the competency school. The competency school, developed during the 1990's, refers to the leader's competencies which include knowledge, skills and personal characteristics. It is a later theory that embraces all the earlier schools, as it includes personal qualities as well as intelligence, behavior and managerial skills, and in addition it suggests that different combination of competencies is appropriate in different circumstances.

Dulewicz and Higgs (2004) identified three leadership styles: Engaging leadership, Involving leadership, and Goal oriented leadership, each one is appropriate for a different level of business transition or change (from the highest to the lowest, respectively). They also developed a list of fifteen leadership competencies, grouped into three dimensions: Intellectual (IQ), including critical analysis and judgment, vision and imagination, and strategic perspective; Managerial (MQ), including resource management, engaging communication, empowering, developing the team, and achieving objectives by making decisions; and Emotional (EQ), including self-awareness, emotional resilience, motivation, sensitivity, influence, intuitiveness, and conscientiousness. The list of 15 managerial capabilities was presented with relation to each one of the three leadership styles, as the following table shows.

Table 2 Leadership competencies by leadership styles (Based on Dulewicz and Higgs, 2003).

Group	Competency	Goal oriented	Involving	Engaging
Intellectual	Critical Analysis & Judgment	High	Medium	Medium
	Vision & Imagination	High	High	Medium
	Strategic Perspective	High	Medium	Medium
Managerial	Engaging Communication	Medium	Medium	High
	Managing Resources	High	Medium	Low
	Empowering	Low	Medium	High
	Developing	Medium	Medium	High
	Achieving	High	Medium	Medium
Emotional	Self-awareness	Medium	High	High
	Emotional Resilience	High	High	High
	Motivation	High	High	High
	Interpersonal Sensitivity	Medium	Medium	High
	Influencing	Medium	High	High
	Intuitiveness	Medium	Medium	High
	Conscientiousness	High	High	High

The modern technological environment is characterized by its dynamic nature and the ongoing demand for adaptation in order to remain competitive. The role of the modern technological managers is complex and requires learning, development and improvement. Management and leadership are not the same but they are used as alternatives to achieve the business objectives while considering different perspectives (Harvey, 1996; O'Neill, 2011). Information systems project managers are expected to act as leaders and managers to accomplish successful projects, based on the project's attributes.

2.3 Project's attributes

It is an acknowledged understanding that there are no two projects alike, and each project is unique (e.g., PMI, 2013; Meredith and Mantel, 2016). Müller and Turner (2010) examined leadership competencies of successful project managers in different types of projects. They found that different types of leadership competency profiles are accounted for successful projects of different types, i.e., from different industry, of different complexity and importance, and using different contract type. The current study is focused on IS projects and examines the professional and managerial capabilities of successful project managers within this industry. Based on Shenhar and Dvir (2007) the projects are analyzed on four dimensions: (1) Novelty, represents level of the project's product newness to the market, the customers and the potential users; (2) Technology, represents the technological uncertainty of the project; (3) Complexity, represents the level of the project's hierarchical complexity; and (4) Pace, represents the urgency and criticality of meeting a project's schedule. The degrees in each one of the four dimensions are presented in the following table.

Table 3 Project types analyzed by four dimensions (Based on Shenhar and Dvir, 2007).

Dimension				
Novelty	Derivative	Platform	Breakthrough	
	Extending or improving existing products or services	Developing and producing new generations of existing product lines	Introducing a new-to-the-world product or concept.	
Technology	Low-Tech	Medium-Tech	High-Tech	Super High-Tech
	Uses only existing, well-established and matured technologies	Mostly existing technologies; limited new technology or a new feature	Uses many new, recently developed, exiting technologies	Key project technologies do not exist at the time of project initiation
Complexity	Assembly	System	Array	
	Deals with a single component or device or with a complete assembly	Deals with a collection of subsystems or entire platforms with multiple functions.	Deals with dispersed collection of systems that function together to achieve a common goal.	
Pace	Regular	Fast-Competitive	Time-Critical	Blitz
	Delays are not critical.	Time to market is important for the business	Time is crucial for success by exploiting a window of opportunity	Crisis project performed to provide immediate solution

IS projects are usually complex and innovative tasks that use medium to high tech technologies to produce a new product or service. However, the measurement of project success had been developed during the years from the known triangle that refers to the evaluation of meeting budget, schedule, and performance requirements (PMI, 2013), to include customer satisfaction (Turner and Müller, 2005), and further to the achievement of current and future project and business strategic objectives (Cooke-Davies, 2002).Assessment of IS project success should also take into account the users requirements and requests and the achievements at each phase of the product life cycle (Wateridge, 1998; Jugdev and Müller, 2005).

2.4 The research question

Literature review indicates that there is a relationship between the project manager's personality, which is included in its managerial capabilities, and the project characteristics for success (Dvir et al., 2006; LeBlanc, 2008). Complex, innovative, and strategic projects require emotional flexibility and communication skills, which are usually characterize the transformational leadership style (Bass, 1990; Turner and Müller, 2005). Other studies show that professional capabilities in IS projects are required for medium and high level managers (Wilcox, 2003; Wu et al., 2007). The mix of attributes, skills and experiences of successful project managers was examined by El-Sabaa (2001) with the aim to evaluate how project managers and functional managers differ and to enhance the selection and performance of effective project managers. Human skills were found to be the most essential for successful IS project managers (85.9%), followed by conceptual and organizational skills (78.9%), and finally technical skills (52.5%).

The current study follows previous studies in this field and examines the relationship between the IS project manager's professional capabilities, managerial capabilities, and the project success. It aims to evaluate the balance of professional and managerial project managers' capabilities in different types of successful IS projects.

3. Methodology

The research method of this study is based on a questionnaire, which was used to survey professionals in the IS industry in Israel. The research population included IS project managers, senior managers, and project team members, who were asked to refer in their answers to a specific project manager and to a particular IS project that was recently completed or it is in its final phase. The survey was distributed via the Internet to an array of IS units in public and private organizations with a request to distribute it in the organization. The respondents were informed that the survey is anonymously.

3.1 The questionnaire

The research questionnaire, which was developed based on literature review, was translated to Hebrew. It is composed of an introduction and three parts. *Part A: Project Manager's Capabilities* includes an evaluation of the project manager's managerial capabilities, using 15 items (intellectual, managerial, and emotional capabilities) assessed on a Likert scale of 1-5 and 2 questions regarding the project manager's seniority and management education. It also includes an evaluation of the project manager's professional capabilities, using 10 items assessed on a Likert scale of 1-5 and 2 questions regarding the project manager's professional experience and information systems education. *Part B: Project Success Measures* includes a subjective evaluation of the project success on several dimensions, using 10 items on a Likert scale of 1-5. *Part C: Project Characteristics* includes information on the project type, the project scope, budget and schedule, the project team and the performing organization.

The questionnaire was validated by five evaluators: two academic professors and three professional experts from different firms, to confirm the relevance and the clarity of the questions. A pilot study was conducted by presenting the questionnaire to six IS professionals, including project managers, senior managers and team members. Each one of those professionals was interviewed by the researchers with the aim to correct any mistakes and to make sure that the answers will reflect the respondents' evaluation on the subject. Following the interviews, the introduction to the questionnaire was expanded and several explanations were added next to the questions in order to eliminate any ambiguousness.

Cronbach's alpha reliability tests confirmed internal consistency in each part of the questionnaire, as the following table shows.

Table 4 Cronbach's alpha reliability results

	N of Items	Cronbach's Alpha
Part A1: Project Manager's Capabilities	15	0.905
Part A2: Project manager's professional capabilities	10	0.874
Part B: Project Success Measures	10	0.882
Overall Questionnaire	35	0.914

3.2 The Research data

IS project managers, senior managers, and project team members in the IS industry in Israel were approached by email with a link to an Internet survey created by Google Docs. The recipients were asked to complete the questionnaire while no personal information was required to sustain anonymity, but most of the questions were obligatory.

90 completed questionnaires were received and used for analysis. The respondents were: 43 (47.8%) Project Managers, 28 (31.1%) Project Team Members, and 19 (21.1%) Senior Managers. Among the project managers, 77% have more than 4 years of IS project experience, 79% have formal academic education in management and 81% have academic education in information systems .

The distribution of project type, as classified by the respondents, is presented in the following chart.

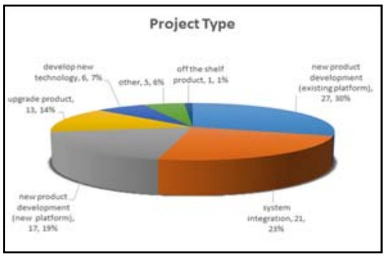

Figure 1 Research project type distribution

These projects are performed by public (61%) and private (39%) organizations in the IS industry in Israel.

4. Research Findings

To examine the perceived project manager's capabilities and project success, we analyzed the data with regard to two different groups: project managers (43 respondents) and other stakeholders (47 respondents, including team members and senior managers). The following table presents the average values (on a scale of 1, lowest, to 5, highest) of the perceived managerial capabilities by each group.

Table 5 Perceived project manager's managerial capabilities

		Project Managers evaluation		Other stakeholders evaluation	
		Avg.	Std.	Avg.	Std.
Intellectual	Critical Analysis & Judgment	4.39	0.728	4.30	0.623
	Vision & Imagination	4.00	0.724	4.17	0.940
	Strategic Perspective	4.13	0.861	4.15	1.024
Managerial	Engaging Communication	4.00	0.617	3.89	0.914
	Managing Resources	3.95	0.722	3.89	1.026
	Empowering	3.95	0.899	4.02	1.011
	Developing	3.95	0.722	4.11	1.005
	Achieving	4.26	0.658	4.28	0.682
Emotional	Self-awareness	4.07	0.910	4.15	0.834
	Emotional Resilience	3.88	0.823	3.79	0.921
	Motivation	4.35	0.720	4.30	0.832
	Interpersonal Sensitivity	4.02	0.740	4.06	0.942
	Influencing	3.88	0.625	4.19	0.798
	Intuitiveness	4.02	0.831	4.23	0.840
	Conscientiousness	4.21	0.773	4.40	0.790

Both project managers and other stakeholders perceive the *emotional resilience competency* of an IS project manager, expressed by the ability to balance between personal and professional needs and by consistent performance in stress situations, as the lowest capability. The project managers gave the same low score to *influencing*, which is manifested by the ability to persuade others to change by listening, understating their position and justify the reason for change. However, there is a disagreement with regard to the highest evaluated managerial competency. Project managers perceive the intellectual capability of *critical analysis and judgment* as their highest competence, while others perceive the emotional capability of *conscientiousness* as the highest competence of IS project managers. Those subjective evaluations might imply to the importance that each group grants to each capability, due to the understanding of the organizational roles and responsibilities.

The next table presents the average values (on a scale of 1, lowest, to 5, highest) of the perceived project managers' professional capabilities by each group.

Table 6 Perceived project manager's professional capabilities

	Project Managers evaluation		Other stakeholders evaluation	
	Avg.	Std.	Avg.	Std.
Systems analysis and design	4.28	1.141	4.04	0.859
System life-cycle management	4.02	1.035	3.83	0.940
Database management	3.86	1.038	3.74	0.988
Business domain knowledge	3.81	1.118	4.17	0.789
Programming language	3.12	1.013	3.30	1.031
Telecommunications and network	2.49	0.985	3.30	1.059
Operating systems	2.84	1.038	3.49	0.997
System integration	3.02	1.025	3.53	1.015
Project management	4.07	0.737	3.74	0.943
Analysis and judgment	4.09	1.091	3.87	0.797

Project managers perceive their knowledge and skills of systems analysis and design, i.e., understanding the development processes involved in managing information systems, as the highest professional capability, while team members and senior managers perceive the project manager's business domain knowledge as the highest competency. Both groups agree that the professional skill of telecommunications and network, i.e., the technical knowledge related to data, voice, image, and video communications as well as computer networks, should be rated with the lowest score.

The relationship between the IS project manager's managerial and professional capabilities and the project success was examined by a Pearson correlation using the average values for each one of the three composite variables. The evaluations produced the following results:

Project Managers Evaluation		Average Managerial Capabilities	Average Professional Capabilities
Project Success	Pearson Correlation	.461	.122
	Sig. (2-tailed)	.002	.435
	N	43	43

Other Stakeholders Evaluation		Average Managerial Capabilities	Average Professional Capabilities
Project Success	Pearson Correlation	.536	.197
	Sig. (2-tailed)	.000	.184
	N	47	47

Figure 2 Correlation between managerial & professional capabilities and project success

The above records indicate a positive significant relationship between managerial capabilities and project success (R=0.461, Sig<0.05 by project managers; R=0.536, Sig<0.05 by senior managers and team members). A positive insignificant relationship was found between professional capabilities and project success. An additional examination of the relationship between the components (intellectual, managerial, and emotional) of the managerial capabilities composite variable and project success, as assessed by the project managers reveals that they all have medium to strong positive significant correlation, as presented in the following chart.

Project Managers Evaluation		Average Intellectual Capabilities (IQ)	Average Managerial Capabilities (MQ)	Average Emotional Capabilities (EQ)
Project Success	Pearson Correlation	**.401**	**.422**	**.351**
	Sig. (2-tailed)	**.008**	**.005**	**.021**
	N	43	43	43

Figure 3 Correlation between managerial capabilities and project success

Project success and the project manager's managerial and professional capabilities were analyzed for different types of IS projects as characterized by level of novelty, technology, complexity, and pace (Shenhar and Dvir, 2007). For different levels of project novelty and pace no significant results were found. In projects of low complexity, managerial and professional capabilities were significantly related to project success (R=0.841, Sig<0.05; R=0.718, Sig<0.05 respectively), and in projects of high complexity level only the managerial capabilities were found to be significantly related to project success (R=0.683, Sig<0.01). These findings indicate that in low complexity projects, usually performed in small teams while developing a product in-house, the project manager has to be an IS professional and an effective manager. When working in more complex projects, usually performed with many subcontractors to develop a product with resources in-house and outsourced, the project manager's professional knowledge is less important than the managerial proficiency. However, in high-technology level projects it was found that managerial capabilities have a significant positive relationship to project success (R=0.700, Sig<0.05), while professional capabilities do not support this type of relationship to project success. Although this finding might seem surprising at first, it can be explained by the understanding that almost all IS projects are categorized as high-tech projects, thus project managers and team members must have professional know-hows required for the product development and those capabilities are perceived as pre-requisites for managers in this environment. To conclude, the difference between successful and unsuccessful projects remains within the field of managerial capabilities.

5. Conclusions

The current study focused on IS projects and used an Internet survey to assess the perceived relationships between managerial capabilities vs. professional capabilities and project success in the IS industry in Israel. The results indicate that managerial capabilities, composed of intellectual, managerial and emotional competencies, characterize successful project managers, while professional and technical skills have only marginal relation to project success. These findings are in line with previous research that reported on a positive relationship between project manager's managerial capabilities and project success (Cooke-Davies, 2002; Turner and Müller, 2005). However, within the components of the managerial capabilities we found the managerial competencies to be the most influential, followed by the intellectual competencies and lastly the emotional competencies, while Turner and Müller (2005) suggested a different order of importance, starting with the emotional competencies, continuing with the intellectual competencies and lastly the managerial competencies. The differences might derive from the focus on leadership rather than project success or due to the research population which originated from a variety of industries rather than the IS industry. An additional interesting insight derived from the current study is the self-evaluation of project managers to the high importance of intellectual competencies, compared to the evaluation of other project stakeholders to the high importance of emotional competencies. Project managers perceive their abilities to analyze and make rational decisions as the strongest competency, while their subordinates and managers think otherwise. This might imply to the different perception that managers have about themselves, or as they would like to think about themselves, comparing to the way others perceive them.

The relationship between the IS project manager's professional capabilities and project success was found positive but not significant, although Wu et al., (2007) argue that managers should have the professional knowledge and skills to efficiently manage the activities. A possible explanation for this difference might be that a basic or even moderate level of professionalism is a pre-requisite for IS project managers. Most of the IS project managers started as programmers, system analysts, or another professional role, and during the years were promoted through the hierarchical ladder in the organization. At a certain stage of the career path, when they become project managers, who are responsible for the overall delivery of the product or service, the relationship between additional professional knowledge and skills and project success is reduced up to the point it becomes negligible.

To summarize, in the IS industry, successful project managers are expected to be equipped with managerial understandings, experience and abilities. The technological professional knowledge, which is probably required for team members at their earlier stages in the industry, becomes less important for IS project managers. Of course, we can assume that those managers have the professional knowledge but it has less impact on the probability to manage a successful project in comparison to the importance of effective management practices and capabilities.

The current study is based on an analysis of subjective evaluations of project managers and other stakeholders in the IS industry in Israel. Future studies can improve the research by using larger sample that will represent professionals and managers from other cultures, countries, and professions within the IS industry. In addition, it will be intriguing to identify the specific set of managerial capabilities that contributes to the role of successful IS project managers in order to develop a roadmap for training .

In this study we looked into the challenging rate of IS projects failure, focusing on the project manager's skills, knowledge, and capabilities. A successful IS project manager is usually an experienced technical expert, but much more important for the project success is his/her leadership style and management abilities. These abilities can be taught, acquired and improved throughout the years. The practical implications of the results are that for a successful IS project, and especially complicated high-tech project, the firm should assign a project manager who has acquired the managerial competencies. It is recommended for IS firms to train their employees not only for professional tasks but also to develop their management and leadership skills.

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A Case Study for Young PM to Become the Versatilist on a Small-Scale ICT Development System

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One of the most talented people in the IT industry is "Versatailist". Versatailist is a person who has multiple specialized fields and can perform multiple roles according to business needs at that time. One of the success factors of small and medium-sized projects is that PM, which is Versataailist, is assigned. Small new project is carried out in last year with my leadership. The aim of this study was case studies for Versataailist creation and how it can be attempted in different projects. Because of the above, effects such as appeal to clients, quality up and accurate appeal to stakeholders were recognized. It also contributed greatly to the success of the project. This study is written A case study for young PM to become the Versatilist on a small-scale ICT system development project.

Keywords and phrases: Versataailist, Multiple Roles, Generalist, Specialist, Small Project

1. Introduction

In the current ICT system development, environmental development in Cloud is becoming common. The way to continue to receive changes in the short term requiring release in Mobile, development with Agile type is essential. Therefore, the role of PM now corresponds not only to the PM management skill but also various new technologies, and it must be able to cope with the client's requirements. Among them, the person called "Versataailist" has been drawing attention. "Versatilist" is made-up word and a term that expresses the role required of future IT professionals announced in the report published in by Gartner(2005) and Morello(2005). It is a person who possesses many specialized fields and can play multiple roles according to the business needs at that time and is a person who creates business value by integrating knowledge and context based on a lot of experience. In many cases, Versataailist is needed especially for small and midsize projects. One of the main reasons is resources. Large projects can have multiple teams and many people. At that time, the role required for PM is Generalist. As a result, project members have Specialist in each field. Meanwhile, there are not many Specialist in each field for small and medium projects. Because project members are limited in number.

Therefore, to make small and medium-sized projects successful, the PM needs to be Versataailist beyond the framework of Generalist.

I carried out team leader task of large scale project for 5 years. This was a major aspect of generalist. And last year, for the first time I carried out the PM work of a small project of a new project. While doing business I tried to grow myself and project members into Versataailists. This paper describes what was useful for Versataailist creation and what was not so in this attempt as a case study and examined how it can be developed in different projects.

2. Issue

This chapter describes the definition of Versatilist and why a small-scale project requires a Versatilist. Also, the issue in this case study will be refined.

2.1 Versatilist definition

First, the definition of the Versatilist is implemented. As standardization of processes and clouds on the global scale progresses, the addition of value by the knowledge intensive service is also becoming mainstream for the roles of IT organizations. The work of the IT organization ranges from planning to design, development, operation, project management, and so on, and a wide range of abilities such as strategy building, negotiation, coordination and risk correspondence are required as well as technology. Day after day, there is a demand for brush-up of knowledge on new technologies and management concepts, and many processes can’t be standardized at present. Under these circumstances, the characteristics that are required for future IT human resources in the global are discussed as "Specialist" and at the same time human resources having a sophistication as "Generalist": It is the necessity of "Versatailist". This content has been reported by Koohang(2010) and Narisawa(2009).

Versatilist is a person who skillfully performs various roles at the same time based on experience, has a perspective from many fields, and has deep relationships with people and communities through business. The idea that such human resources are accelerating innovation in organizations and becoming a source of competitiveness is spreading. The contents and relationships of the above three types of human resources can be defined by the following contents and figure 1.

[Specialist]

- Deep Skill
- Narrow Scope
- Not known to other areas

[Generalist]

- Wide Scope
- Shallow Skill
- Sometimes it is not trusted deeply
- Be known to other areas

[Versatilist]

- Deep Skill
- Wide Scope
- Many experiences
- Deep and wide relationship
- Be known to other areas

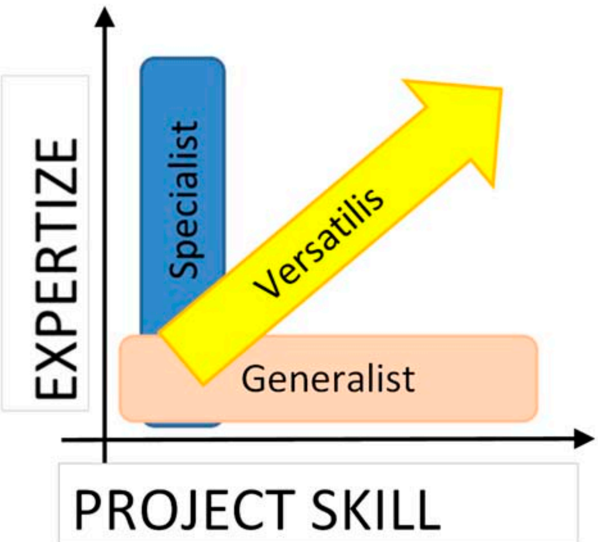

Figure 1 Versatilist Image

2.2 Cases where Versatilist is required

Versatilist is necessity an indispensable person in the current IT industry, but it is a more valuable person in small / medium scale projects. It is because it is difficult to prepare specialists in each field because it is necessary for small / medium scale projects to carry out all projects with limited personnel. The small / medium-sized project is temporarily defined as a project with an FTE of less than 20 persons for a period of about one year, based on experience values.

In the past, the project that the author participated was a large-scale project as FTE exceeded 60 people in 5 years. Small scale projects were involved from the new initialization phase. The author 's skill area was PM and generalist at the time of assigning the project. When launching a new project (scratch development), it is natural to use lessons and knowledge such as previous projects, but it is difficult to apply it package-wise. This is because the project size, type, solution, client characteristics and so on are different. For example, for agile development such as Saas, it can’t be applied in the resource structure of Waterfall type project. Also, as clients' budgets are severe, This project can’t use a large budget. In consideration of the system in this new project, I organized the several skill areas of the members, it was difficult to cover all of them, and some problems or risks were seen. Therefore, by becoming a Versatilist for each member including me, it is possible to extend the skill area, and it will be able to lead the project to success with high quality and high efficiency.

Because projects are greatly affected by targeted products, stakeholders, and project types, the above solution to the problem is a personal solution. However, the situation of such a project is generally an important issue, and this case study is a hint for one solution.

The detailed information on the project that will carry out this case study is as follows.

Project period: 14 months

FTE: 7 or more

2.3 Case Study’s issue

In the case study of this paper, when the author starts a new project, the following issues are listed. You need to clarify the problem and find a solution by Versatilist.

Table 1 Skill set status of main project members (before project starts)

Member	Skill						
	WAS	JAVA	Excel	F/W	PM	Help Desk	Training
A	-	**	*	-	**	*	*
B	*	*	*	-	**	-	-
C	**	**	*	*	-	-	-
D	*	*	-	-	-	-	-
E	*	*	-	-	*	-	*
F	-	-	*	-	-	-	-
G	-	-	*	-	-	-	-

** : Expert * : Foundation - : No Skill

These issues are closely related to the project management itself as well as the purpose of Versatilistization. Therefore, the resolution of this issue is also very important for the success of the project.

2.3.1 Resource's issue

To achieve the project, completion of various deliverables and execution of work are necessary. For example, it is considered that the following Skill is necessary in this project, but it is not easy to formulate a system that satisfies all of them with high quality.

The following list is the skill defined as necessary in the project. Table 1 matrixed the status of skill acquisition at the time of project start for each member.

<Need Skill>

- WAS
- JAVA
- Excel VBA
- Application development Framework (F/W)
- Project Management
- Skill for Helpdesk
- Preparation of the training plan

WebSphere Application Server (WAS) is an application server software for supporting Web system construction and operation

2.3.2 Quality's issue

This project is a new solution, there are few projects that can be referred to and there are few members with business knowledge in the members, so there was concern about proper understanding of client's requirements. Also, as it is a scratch development project and all the team collaborate for the first time, maximum care and care is required about the quality of the product to be created.

2.3.3 Stakeholder management's issue

In this project, there was a high possibility that the IT level was various for stakeholders such as clients, sponsors, end-user, and the speed of decision making was also slow. In addition, it was necessary to understand clients' work, IT level, other corporate culture, etc., because it was specified as a promised matter to train the system to clients and end-user.

3. Approach to Versatilistization

In the new project, to achieve Versatilist while conducting actual work, a total of 5 items were implemented in the project team on the efforts for resources, quality, and stakeholder.

Section 3.1 described the two items that were done on resources. Specifically, it is a specialist's assignment of minimization and large-scale project knowledge sharing. In Section 3.2 described two items that were done on quality. Specifically, it is PoC and quality assessment. Finally, it is about Stakeholder management in the project.

Proof of Concept (PoC) is a realization of a certain method or idea to demonstrate its feasibility, or a demonstration in principle with the aim of verifying that some concept or theory has practical potential. Proof of Concept is usually small and may or may not be complete.

3.1 Approach to resource issue

The following two points were devised and implemented as a solution to the resource issue in the project.

3.1.1 specialist's assignment of minimization

A proposal was made to find experts with skills necessary for the project from personnel not participating in the project and to implement technical support within a limited working time of about several hours a month. Multiple specialists were negotiated and some assignments became possible. While the specialist Labor was available, the following items were implemented.

- Holding study sessions for relevant skills
- Answer and manage questions generated in project work Using groupware for middleware
- Following feedback by in-house training

Team members decided to implement the above items during the assignment of specialists. This aims at achieving compatibility between tasks and Versatilistization, which carries out project work while approaching skills of specialists. The skill area of the specialist who performs the minimum assignment was as follows.

- Excel VBA
- Application development Framework
- Skill for Helpdesk
- Preparation of the training plan

In addition, it is assumed that the condition of the specialist who performs the minimum assignment here has experience of development in the Asset division, or has practical experience of the skill area in actual project solution. This merit is because you do not need Over Skill in the project and you only should secure Skill as much as you need for project work.

3.1.2 Knowledge sharing

This effort is to create documents on various knowledge and develop them to team members. These were done using the experience of large-scale projects. These are the matters that the authors themselves carried out. In addition, these made each team member do the same.

<Knowledge example>

- F/W procedure manual
- WAS release manual
- Test review check sheet
- Manual for helpdesk
  - Helpdesk operation manual
  - FAQ
  - Flow of communication with others team

3.2 Quality's issue

The following two points were devised and implemented as a solution to the quality issue in the project.

3.2.1 PoC

With the permission of the client, as a solution for this project, the development team created a PoC and conducted a client review. This is aimed at using PoC for reviewing requirement with clients, thereby eliminating mistakes in recognition with clients and realizing quality improvement as a result. In addition, through the creation of PoC, it is also intended to extend the technical skills and problem-solving skills of the members.

3.2.2 Quality Assessment

To implement quantitative quality management in the process, quality assessment was carried out. In some cases, the quality assessment is conducted only in the test phase, but this time, From the initial phase of the project, quality assessment will be implemented. Quality assessment was aimed at creating deliverables based on objective quality indicators by sharing with each member from the beginning to the end of the project and managing the quality based on this.

Although it is difficult to compare quality with other projects in the new project, the quality assessment process can be established based on past project knowledge, internal quality indicators, and information-technology Promotion Agency (IPA,2014) public data.

3.3 Stakeholder management

Because various stakeholders exist in this project, it is necessary to identify stakeholders and individual stakeholder management plans. For example, end users are located all over Japan, and the knowledge level of IT varies greatly depending on users. Even if the knowledge level of IT is different, it was necessary to consider the following plan to understand the specification properly.

- Creation of system manual
- Briefing session for end users
- Preparation of training material and

By dealing with stakeholders with knowledge level of different IT, conversion to Versatilist is done, and knowledge is deepened as a Generalist.

Table 2 Skill set status of main project members (project finished)

Member	Skill						
	WAS	JAVA	Excel	F/W	PM	Help Desk	Training
A	**	**	**	**	**	**	**
B	*	*	**	*	**	**	**
C	**	**	**	**	-	-	-
D	*	*	*	*	*	*	*
E	*	*	*	-	*	*	**
F	-	-	*	-	-	*	*
G	-	-	*	-	-	*	*

** : Expert * : Foundation - : No Skill

4. Verification

In Chapter 4, the verified result is described about what solution proposal was made in Chapter 3. Verification is carried out in terms of Versatilistization and whether it contributes to the success of the project in specific.

Table 2 also shows the members' skill set at the end of the project. The content of the skill was set by setting a hearing on the members' self-assessment, the PM, the supervising PM, and the project owner. Because of the verification, the following skills improved compared with the project start time.

- Excel VBA
  3 people Expert
  2 people Foundation
- Application development Framework
  2 people Expert
  2 people Foundation
- Skill for Helpdesk
  2 people Expert
  4 people Foundation
- Preparation of the training plan
  2 people Expert
  2 people Foundation

4.1 Resource

Below, describe verification results on two proposals on resource issue. It was effective for the following three skills in specific.

- Excel VBA
- Application development Framework
- Skill for Helpdesk

4.1.1 specialist's assignment of minimization

Results of verifying that Skill transfer plan was implemented from specialists, Skill transfer was able to be carried out efficiently without enlarging specialist labor. Especially for the following three areas defined in Chapter 3, the importance as a project was high, which is considered to have contributed greatly to the success of the project.

- Excel VBA
- Application development Framework
- Skill for Helpdesk

As a specialist's cost, it is about 16h x 3 months (2 people) per month, but if you assign a specialist as a main member of the project, it costs 120h to 160h a month and costs several months.

A cost reduction corresponding to that was achieved, and the member's Versatilist was advanced.

4.1.2 Knowledge sharing

Regarding the sharing of knowledge formulated in Chapter 3, it was verified that efficient skill acquisition and work quality improvement were achieved by advancing the project while utilizing knowledge.

It was effective for the following three skills. About the manual of the helpdesk, Many of these were available for project deliverables, and the quality of the deliverables and shortening of several man-days cost was achieved

- WAS
- Application development Framework
- Manual for helpdesk

4.2 Quality

Below, describe verification results on two proposals on quality issue. It was effective for the following three skills in specific.

- Excel VBA
- Application development Framework

Apart from skills, this measure was verified to have earned the trust of customers and contributed to the success of the quality of the project.

4.2.1 PoC

Requirement definition and design were implemented efficiently by proceeding with cycles such as creating a PoC, explaining to clients, specifying specifications and improving PoC. Through the project, schedule delay due to the cause of the requirement missing hardly occurred, and even in the quality control implemented in 4.2.2, the product quality exceeding the reference value was able to be achieved.

As a result, it was verified that five members improved the following skills.

- Excel VBA
- Application development Framework

Also, clients have asked for PoC in different projects. It means that the value of PoC was evaluated as excellent for the client.

4.2.2 Quality assessment

By conducting quality evaluation, it was usefully used as a report to clients, as well as quality control within the project team. Concerning the deliverables, it was confirmed that there was no quality problem and contributed to the project, but many team members who have already done it was not to expand the big skill area.

4.3 Stakeholder management

In this project, the system briefing session was held for all welfare section of all prefectures in Japan to promote the use of end users and make correct use. It was implemented in 7 places in Japan, 32 times in total, about 4000 people in total, about 90% attended, and it was possible to complete without major problems in operation. In addition to the briefing session, the following were also conducted

- Creation of operation manual
- Create help on the system
- Create Demonstration movie
- Opening a help desk (email, telephone)

Through the above trial, over 97% of over 20000 organizations use for over 2 months, and more than 84% of data applications on the system are completed. For this result, the project was evaluated well as a result beyond expectation with clients and sponsors. In addition, by implementing the above work, team members were able to acquire various skills that are not just system development.

- Skill for Helpdesk
- Preparation of training plan
- Other skill
  (Briefing management, Logistic skill)

5. Conclusion

As one of the conclusions, the team member's Versatilistization attempt tried and the project itself was very successful. The client's evaluation was high as this project got more compliments from client executives. Also, it was highly appreciated within the company, and received the company's award.

The implementation of Versatilist led to project success and productivity improvement of the project. There are three things that have been highly effective in making Versatilists in specific.

a). To be assigned specialists minimum
b). PoC
c). Work done to improve user's system knowledge

Regarding a), it is considered that this was a significant trial in terms of reducing expenses as project personnel management and contributing to the success of the project. Also, depending on the solution content of the project, a) was a very good prototype for the team members because it is possible to efficiently acquire skills directly connected to system development.

About b), the customer was highly appreciated. These were able to make requirements definition and basic design very efficient. In addition, since it is necessary to improve development skills to prepare in advance, the skill of team members is inevitably improved, and even when requesting work to a cooperating company etc. in the development and testing process is based on development experience, it was able to be a high-quality product. The disadvantage is that the man-hours required for creation are large. Therefore, it is necessary to secure some degree of skill holders even a small number, and to incorporate them into the schedule plan beforehand.

About c), improvement of utilization which is the client's goal was accomplished, and it was very pleasing from the client. In addition, skills that can't be obtained by simple system development were acquired, and the efficiency of communication with stakeholders also improved greatly. It is thought that providing an expression method and information that make the contents of the system easy to understand for various stakeholders can be used in any project.

In large-scale projects, it may be a bit difficult to try such things as above. The larger the scale, the more vertical the organization is organized by section and so on, the specialists in each field will be assigned under the leader who is generalist. With such a structure, flexible movement becomes difficult.

As a postscript, there are many opportunities to convert small projects into Versatilist, but there is a big difference in characteristics between people who can become Versatilist and those who are not. That is motivation. A person without motivation can't become Versatilist. Because resources can't afford, you should combine various tasks and learning themselves. Therefore, people who wait for instruction think that it is impossible to combine the success of the project with Versatilist. Indeed, one of the members had such a tendency, and skills were not able to be acquired until the end.

6. Next Deployment

Generally, waterfall type projects and agile type projects differ in various elements. But there are areas that can be applied to Cloud, Agile, etc. Therefore, there is a possibility that it can be developed. The reason for doing this is to make project members Versatilist realize speedy response with less resources. Therefore, it can deal with Agile system.

In addition, since data access became easier by Cloud, various opportunities such as software, middleware, language etc. expanded, and data sharing seems to have Versatilist mass production environment.

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Cases of Visualization of Project Situation and Realization of Instant Information Sharing in Large Scale Projects

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It is indispensable to grasp precise situation of each development team instantly in order to manage development projects properly. There are, however, several challenges that make it difficult to achieve the above in large scale and iterative development projects due to the number of project member, complexity of organizations and frequency of resource replacement. Following are three major challenges. First, the scope of roles and responsibilities of each organization and team get obscure. Second, the information are not precisely passed over between each organization and team in time. Finally, the operational rules are not thoroughly followed by each team. We, over fifteen years of experiences of engagements to large scale (over a thousand project members) and iterative development projects, will introduce several cases of methodologies to resolve these challenges with the view point of roles and responsibilities, sharing information and operation.

Keywords and phrases: Large Scale Projects, Responsibilities, Sharing Information, Operation

1. Introduction

It is apparent that many of the current social infrastructure systems are introducing Information Technology, and many of them is continuing to extend their functions since initial operation. Also, many of them are required to respond flexibly for changes in the needs of service users. Therefore some systems would be complicated functional structure and some projects such as large scale project are required to repeat parallel development of multiple teams.

The more people involved in the project such as large scale project, the more complicated communication processes become. Also trifling problems in the project may be an issue for whole project. Then it is very difficult to take measures for issue. One of the keys to success is how well communication goes. Therefore it is indispensable to grasp precise situation of each development team instantly (Software Engineering Center Information-Technology Promotion Agency, 2008) in order to manage large scale projects properly and to detect problems at an early stage. Also it has often been discussed how to do it. Many project management methodologies are presently defined, but its practice is not easy (Japan Users Association of Information Systems, 2014). Some development projects are causing problems without being able to grasp precise situation of each development team instantly.

In this paper, we introduce using the quality management, our measures and results that we had implemented for some challenges as cases of large scale project management.

2. Project Summary

We have been managing a development project of mission critical system with more than thousand project members for over fifteen years. This system is always used by 60 million users, it is non-stop 24 hours a day, 365 days a year, high quality, high level service-level agreements (SLAs) is required. We add an additional schedule based on Waterfall type development method, development period is based on 4 annual version. The feature of development is that one version consists of multiple services, and one service consists of multiple functions. Even trifling problems will affect subsequent versions in addition to the current version.

We have adopted a concept architecture similar to Microservices (Fowler and Lewis, 2014) at the initial development of the system and have continued development for fifteen years. We believe that our concept of project management can be utilized for development projects currently applying Microservices as well.

3. Challenges of Project Management in Large Scale Projects

It is indispensable to grasp precise situation of each development team instantly in order to manage large scale projects properly and to detect problems at an early stage. In order to do, project members and team leaders have to be able to report result of their task clearly and immediately. In addition, team leaders and project manager have to be able to grasp their report of precise the situation instantly. But there are several challenges as shown in Table 1 and Figure 1 that make it difficult to do in large scale and iterative development projects due to the number of project member, complexity of organizations and frequency of resource replacement.

We will introduce actual cases of these challenges that occurred in the project on following sections.

Table 1 Challenges of Project Management

No	Challenges
1	Since the responsibility range of project manager is wide and there is much information, it takes time for all judgment to finish. - Challenges of roles and responsibilities
2	Information are not precisely passed over between each organization and team in time. - Challenges of sharing information.
3	Operational rules are not thoroughly followed by each team. - Challenges to maintain operational Rules.

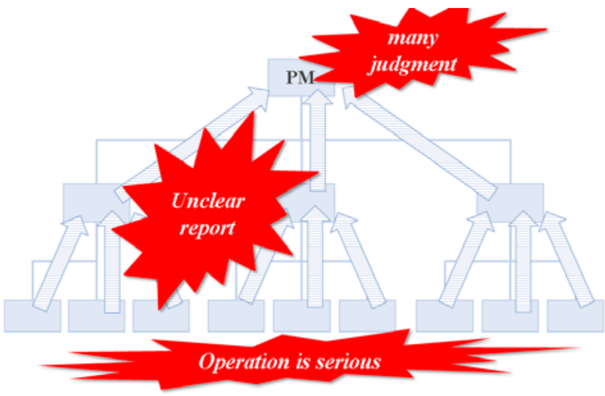

Figure 1 Challenges of Project Management

3.1 Challenges of Roles and Responsibilities

When it becomes a long development project a project environment gradually changes and issues that are not initially expected may occur. Especially for systems with social responsibility, once the problem has occurred in the product, project manager will have to make final judgements on measures. Therefore the responsibility range of project manager is spread and there is much information, it takes time for all judgment to finish. Such issues were dealt with in the Cross-Sectional Meeting that were implemented only by administrators such as project manager and team leaders. But we were not able to have sufficient time to discuss issues within that meeting time due to the expansion of the organization and increasing the number of agenda items. As a result, following cases as shown in Figure 2 occurred.

CASE-1a, the first action for problems was delayed since the project manager or team leaders had dealt with multiple teams problems in regular Cross-Sectional Meeting.

CASE-1b, the project manager and team leaders were late for dealing with the management tasks and key issues since they were busy dealing with trifling details.

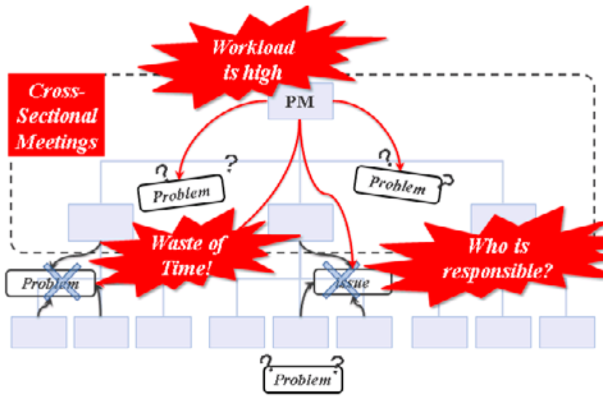

Figure 2 Cases of roles and responsibilities

In case of the Quality Management, each team leader used their quantitative analysis method and their qualitative analysis method to analyze quality. However the confirmation methodology was different in each team leader. Therefore project manager had to check all of quality detail.

3.2 Challenges of Sharing Information

It took time for reports to reach the project manager since they reported to their supervisors after project members researched and analyzed information for each organization and created team report. In addition, although they unified the report input formats and styles to unify the report description level, many members on report line added their own consideration to their reports, which resulted in following cases shown in Figure 3.

CASE-2a, it was hard for the project manager to notice that there was a divergence between the factual situation and the content of the report.

CASE-2b, it was a short time to take measures when the project manager noticed problems.

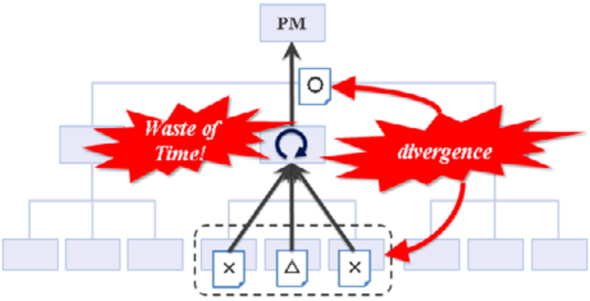

Figure 3 Cases of sharing information

In case of the Quality Management, each team leader did report judgement on the result of quantitative analysis and qualitative analysis. However since the judgement criteria differed for each leader in charge, there was a case where even if a problem had occurred, it was not escalated.

3.3 Challenges to Maintain Operational Rules

The project repeatedly have added members by expanding the system and have released members at the end of the service. Some of project member would had been not to follow the operational rules. It had been insufficient just to distribute the implementation guideline for all project member in order for them to keep with the operational rules. As a result, following cases shown in Figure 4 occurred.

CASE-3a, there were some problems that should have been already solved had recurred in some projects.

CASE-3b, we were not able to predict the time until project members keep the rules.

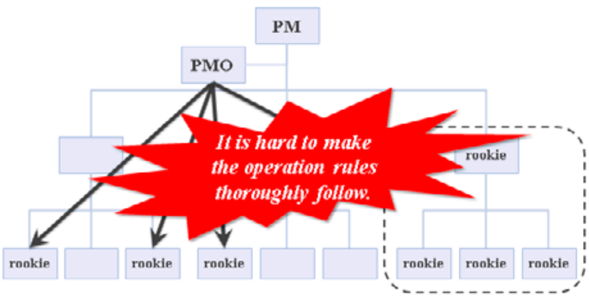

Figure 4 Cases to maintain operational rules

In case of the Quality Management, quality control sector provided large number of kind and detailed operational rules. In addition, quality control staff checked that operation was worked. However, due to large number of rules and frequency of resource replacement, we needed much time to make all of project member follow.

4. Case Study on Challenges of Project Management in Large Scale Projects

We will introduce our measures to resolve these cases using examples of the Quality Management on following sections. They can also be applied to the Time Management and Cost Management.

4.1 Measures for Challenges of Roles and Responsibilities

We have organized a common team that have similar responsibility as Project Management Office (PMO) to handle issues that cannot be solved by a team. Project members are gathered from the team that had original issue. A part of project manager authority have delegated to each team at that time. The PMO have set the Middle Layer Meeting regularly to monitor the status of issues that effects multiple teams and prevent from issues to be neglected.

4.1.1 Case Study of the Quality Management is shown in Figure 6

First, the PMO standardized report forms incorporating multifaceted quantitative analysis viewpoint by consolidating project knowledge such as quality judgment standards that the project manager and quality management teams were implementing. The points considered when preparing analysis viewpoints to be standardized are shown in Figure 5.

That is three steps approach. The first step is to find where the problem is. Next step is to understand why the problem happened. Final step is how to fix it. Among them, those were targeted that can be automatically determined by quantitative analysis. As a result, we targeted to find where the problem is.

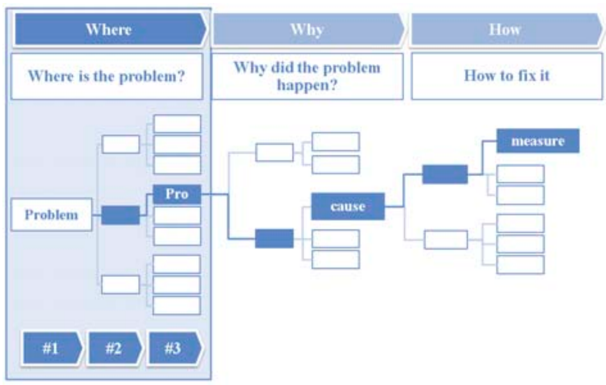

Figure 5 Analysis viewpoints

In addition, the PMO defined the conditions for the project leader to judge of a warning report to project manager. In the summary view of the project quality situation, we created it possible to confirm the quality of each team. Next, we created a quality indicator analysis for each development step, and made visible warnings for items beyond the indicators.

Second, each team have controlled the quality and if necessary, have taken necessary measures at the responsibility of the team leader.

Finally, we have set the Middle Layer Meeting regularly in order to be monitored the status of quality problems. Also the purpose of the meeting was defined so that the same agenda will not be confirmed at the Cross-Section Meeting and the Middle Layer Meeting.

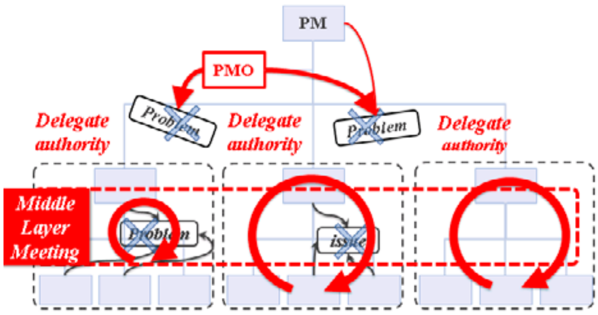

Figure 6 Measures for Challenges of Roles and Responsibilities

4.2 Measures for Challenges of Sharing Information

We have transferred the roles of gathering metadata and creating statistical data gathered for each team to the PMO. Then the PMO have constructed a mechanism to automatically, immediately collect the metadata entered by project members, and output the result. The PMO changed to above process so that everyone can judge with the same information source.

4.2.1 Case Study of the Quality Management is shown in Figure 7

First, we have gathered the bug reports from project members using bug management system, developed for this project. It automatically calculates the data weekly and output quantitative analysis result as a report form.

Second, we have created a report that added quantitative analysis result plus qualitative evaluation viewpoint of development team leader when we released information to all stakeholders including development team, project manager and customer. When we provide information to the development team, we report analysis information specialized for the team. When we provide to the project manager, we report summary of quality reports for each development team. The contents of the reports are changed according to the organization hierarchy.

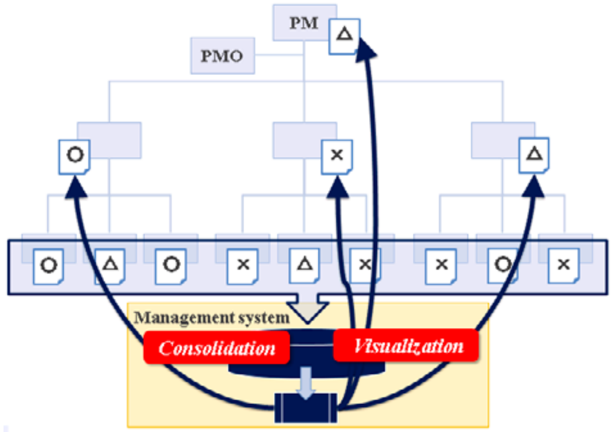

Figure 7 Measures for Challenges of Sharing Information

4.3 Measures for Challenges to Maintain Operational Rules

When the PMO constructed a mechanism of Sharing Information described above, we simplified the input column assistance and input process and cut down the place where people make mistakes. Also abolishing many rules, we have created new simple rules of project members in order to thoroughly understand the expecting basic behavior.

We have switched from passive response by distribution of implementation guidelines to regular interactive training by an e-learning. Also, information was shared from project members to all stakeholders, with the details of their responsibly.

4.3.1 Case Study of the Quality Management is shown in Figure 8

First, the Quality Information input by project members have provided to all stakeholders. Project manager and customers pointed out their comments and they are shared to project members through organizational hierarchy. As a result, the knowledge of viewpoints accumulated and the organizational culture to self-check have been established.

Second, we have prepared training materials which summarize the quality control training for new members. The lessons of actual problems were shred to them through e-learning.

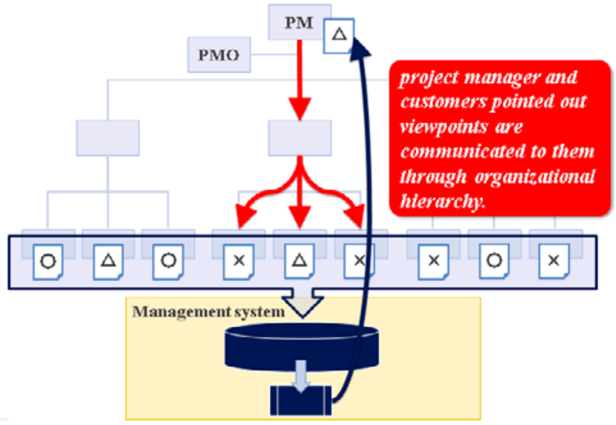

Figure 8 Measures for Challenges to Maintain Operational Rules

5. Evaluation of Each Measures

The following describes how the challenges in Chapter 3 have been changed by the measures in Chapter 4.

5.1 Evaluation of Measures for Challenges of Roles and Responsibilities

For CASE-1a, as a result of management of the PMO and Middle Layer Meeting that monitor the status of problems across multiple teams, response delay was reduced or leak to apply countermeasures was reduced as well. There have created the culture to share the issues across multiple teams through the PMO.

For CASE-1b, as a result of delegating authority of the project manager to each team and defining objective of several meetings and defining conditions of judgements, some issues which used to be solved the high layer were solved by the middle layer. As a result, the workload of the project manager was reduced.

5.2 Evaluation of Measures for Challenges of Sharing Information

For CASE-2a and CASE-2b, as a result of sharing information regularly to all stakeholders, it automatically calculates metadata to input by project members which include quantitative evaluation from many sides. Project manager can understand the detail of the situation instantly. In addition, the level of the detail of information entered by project members fit to expectation that the number to confirm the writings reduced. Because the information entered by project members have shared to all the stakeholders, the project manager and customers can make their comments and the comments are shared to project members through organizational hierarchy. As a result, the knowledge of stakeholders are accumulated. And, even without being pointed out by the PMO, the atmosphere to self-check be-forehand came out.

5.3 Evaluation of Measures for Challenges to Maintain Operational Rules

For CASE-3a and CASE-3b, as a result of training regularly by e-learning to project members and rookie, operational rules have been thoroughly followed. In addition to the above e-learning, the tasks were directly assigned to the project manager, so each development team leader is forced to control project members in order to make a correct report. As a result, within the project, the project rules became their mutual agreement and during routine daily tasks, special discussion to establish new rules became unnecessary.

6. Conclusion

6.1 Summary

In Chapter 1, 2 and 3, we discussed the importance of management in large scale projects and specific challenges. In Chapter 4, based on the actual project management experience, we introduced a solution to the problem mentioned in Chapter 3 as a cases study. In Chapter 5, as a result, we described how the problem of Chapter 3 was solved.

6.2 Conclusion

There were several challenges that make it difficult to grasp the precise situation of each development team instantly to detect problems at an early stage in large scale and iterative development projects due to the number of project member, complexity of organizations and frequency of resource replacement. First, the scope of roles and responsibilities of each organization and team were not precisely defined. Second, the information are not precisely passed over between each team in time. Finally, the operational rules are not understood by each team.

The following measures are effective against these challenges. First, redefining the responsibilities of each development team, delegating authority to development members and organizations, organizing a common team to solve multiple team issues. Second, gather situations of the project status and manage it centrally and develop a mechanism to report to the right people in appropriate content in proper time. Finally, create operation rules and atmosphere to share the basic understanding of the project rule. It became possible to grasp problem detection early in daily monitoring by implementing countermeasures to the problems explained so far.

Acknowledgement

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Application of Enterprise Agile Development to an Insurance Company

- Approach and Issues on the Enterprise Model -

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Fujitsu Limited

Although agile development has been incorporated actively in small and medium companies, there are still few Japanese large companies adopting it. Agile, which is practiced with books and in small and medium companies, tends to be difficult to be fit in rules, development environment and organizational culture specific to large companies. This is why agile development has not been actively adopted in large companies while they are interested in it. This article introduces a case of adopting the optimized enterprise agile to a customer. In the concept of the enterprise agile for large companies, the optimized enterprise agile is defined as a type of agile development in organizations where require their own culture and controls at a higher level. This is also a know-how which can be applicable in companies requiring high-level governance. I hope that it will be used as a development methodology for large companies to respond flexibly to fast-changing and diversifying needs.

Keywords and phrases: Agile, Enterprise Agile

1. Introduction

1.1 Agile Development, Whose Environment Has Started to Develop

In recent years, a development method called agile development has highly been publicized. This method has existed as a concept for more than ten years and been adopted by small-scale projects. (See Figure 1.)

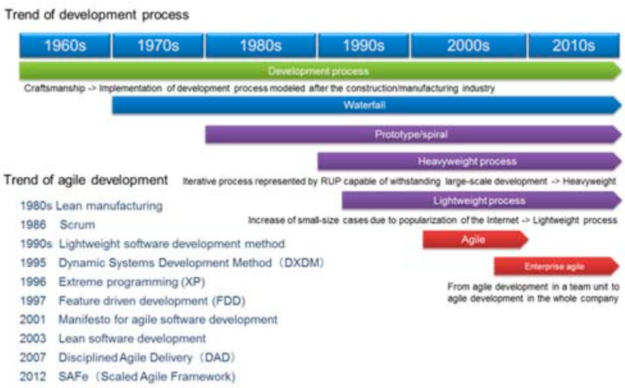


Figure 1 Trend of System Development Process

In fast-changing markets or circumstances where it is difficult to meet needs, agile development has been focused again.

There were some inquiries regarding this from even Fujitsu's customers. This wave, which was generated in the manufacturing industry, has now come to system development in the financial industry. There are two points many customers expect from agile development:

(1) Earlier release

(2) Development cost reduction

In the dawn of agile development, environments of automatic build, automatic deployment and automatic test were created through trial and error. Today, the development and spread of open-source software has made it easier to build these environments. These automatizations are a great advantage for agile development, which iterates designing, programming and testing. In small and medium companies where can introduce environments easily, the hurdle against efforts to agile development has become quite low. This is the reason why agile development has drawn attention again.

1.2 Increase of Its Implementation in Large Company (Enterprise) Field

Whereas agile development has drawn attention on the one hand, large companies have not implemented it for a long time. They have not taken it into even consideration.

There are two reasons for this. One is, large companies have so few developers with the experience of agile development that it is difficult for them to conceive benefits for their projects. The other is that large companies have no reason to implement any development other than proven waterfall development.

The customers have a strong feeling that it is more certain to take requirement changes in proven waterfall development than to take a risk of employing a new scheme like agile development.

The idea of agile development contains the sense of speed which prioritizes movement and the simplicity of rules. However, if agile development is used in a mission-critical system development, such sense of speed and simplicity would inspire anxiety of neglecting design documentation or any other documentation.

1.3 Approach to Optimized Enterprise Agile Development

I once was in charge of a project, in which the customer had a problem of releasing an insurance product in an early stage. Despite attempts at focusing on agile development, they still had the same kind of concern and had the feeling of resistance toward applying the agile method as it is.

I therefore extracted elements which customers value in a system development. While keeping it as it is, I tried to define customer-specific "optimized enterprise agile," in which the advantages of agile are combined to the conventional waterfall development as much as possible.

The following chapters define what agile is, describe issues when implementing it to a mission-critical system development as is, and introduce the "optimized enterprise agile" I developed. Keeping the issues for agile applications in mind, I will describe any necessary solutions.

2. Definition of Agile Development and Issues of Applying it to Enterprise Area

2.1 What is Agile Development?

This is a development method of "making necessities as many as possible without unreasonableness and waste." This development is performed in the following processes:

(1) Create a small but elect joint development team consisting of customer members and engineers. (According to the size of a developed product, multiple teams may be established at the same time.)
(2) Divide the entire development scope into a number of short scopes, which are supposed to be completed in about two weeks. (Iteration)
(3) Decide which scope to start in the development by considering the priority of the business processes.
(4) Within the two-week period, decide, implement, test, correct and release the requirements of this scope.
(5) Examine the scope of released functions and remaining business processes, and decide a prioritized scope to start in the development next.
(6) Repeat the processes from (2) to (5).

This brings the following four main benefits:

(1) Efficiency: You can start the development from a high-priority and important function where the business process has been established.
(2) Optimization: Customers can try actually-working screens and functions, making it possible for them to be aware of any wrong specifications or requirement leaks earlier.
(3) Quality improvement: If an error occurs between a requirement and an actual product, the analysis for this occurrence improves the way of customers and engineers to send and check information.
(4) Deletion of wastes: If a business process is changed during the development, you can use the changed content to implement work that has not been started. If it has already been implemented, the scope of impact by such change is limited.

2.2 Separation between Agile Development and Waterfall Development

Agile development is a development method of releasing priority functions first when it is adopted in a case whose requirement specifications are unclear. This method enables you to enjoy cost merits in future by avoiding rework or production of unnecessary functions.

Waterfall development is a method capable of system development in a minimum procedure if requirement specifications are clear (or if there is no rework). Table 2 shows the result of comparison between waterfall development and agile development.

Agile development is more likely to be used in system developments in which it is difficult to define requirement specifications, for example when the users are general consumers. Waterfall development is more likely to be used in system developments, such as an in-company system or infrastructure function, in which any major change is not expected in requirement specifications.

Table 2 Waterfall Development and Agile Development

	Agile Development	Waterfall Development
Product	In most cases, original requirement specifications are not fully met. This concept is to change accordingly-required priorities and aim for the best at the time of release.	Produced to fully meet original requirement specifications. This concept is on the assumption that no changes are basically made in midstream.
Team	All members, involving even customers, think and act as one team to give a maximum value to developed products.	It is divided by roles: customer, requirement specification creator, detail specification creator, programmer, and tester.
Test	In a short iteration development, tests should be repeated again and again, as automatic as possible.	When an implementation is done, a test is conducted for each process, such as unit test, join test and system test.
Utility Phase	It is perfect when requirement specifications are unknown or expected to be changed frequently, or when requirement can be evoked by implementing it to the market.	It is perfect for developments in which requirement specifications are not frequently changed and it is unnecessary to hasten the implementation to the market.

2.3 Applying Agile Development to Enterprise Area

To extract issues in applying agile development to enterprise area, I supported its implementation to a customer of which I was in charge.

As a starter, I used three small-size projects in the customer in order to support the trial of agile development.

The following is the result of the latest trial project I implemented. The contents of this support are as follows:

(1) Education of agile development
The target people were the product owner who presented requirements (customer), scrum master who promoted the project (customer), system engineers in charge of the development, and programmers.

(2) Supporting next action and solving issues
I conducted a regular daily meeting with the scrum master and presented issues as well as actions to be provided next.

(3) Introducing a tool
I demonstrated how to use "Practice," a tool for agile development. I also introduced other tools whose functions are not restricted by software. Some of these tools use tag.

2.4 Result of Applying Agile Development to Enterprise Area

The result of the trial showed certain effects of shortening the development period and reducing the cost.

Meanwhile, the stability evaluation clarified complaints from some of the project members, revealing a difficulty in agile development.

Figures 3 to 5 are the questionnaire results from the project members. These questionnaires were carried out at the retrospective.

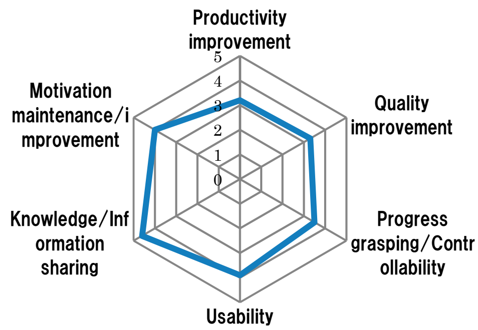


Figure 3 Questionnaire Result: Effect-Based Evaluation

In these graphs above, the scores of "Productivity improvement," "Pair work" and "No workload variation" are relatively lower than other quadrants.

Regarding the productivity improvement, they had an opinion of the lack of a sense of speed if they finished a programming or test early. This is because they were interrupted by preparing reviews, creating deliverables and completing procedure documents due to the lack of environment for automatic build or automatic deployment.

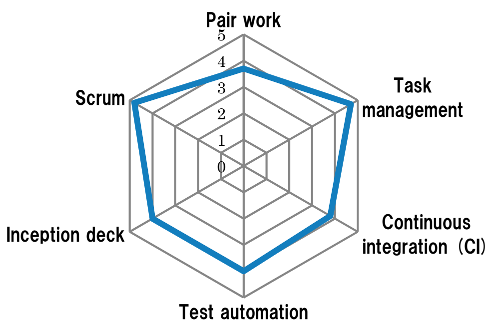


Figure 4 Questionnaire Result: Measure-Based Evaluation

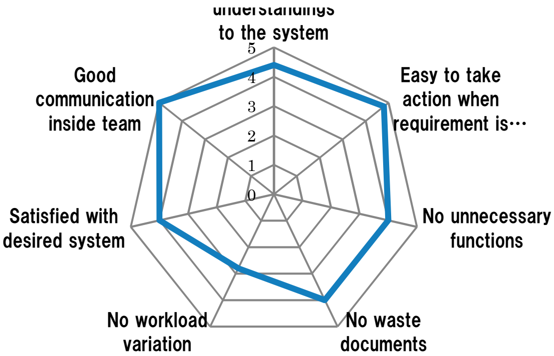


Figure 5 Questionnaire Result: Individual-Based Evaluation

They had the strongest feeling of resistance for pair work: They gave an opinion that skilled people could not feel its effect. The lower score of the workload variation also reflects the low evaluation of pair work.

With respect to quality improvement, a manager (reviewee), who is usually not in the field, expressed the opinion that they had concern about whether halfway-added requirements were tested from a higher perspective.

2.5 Issues Derived From Application Result

From the results described above, I derived the following five issues:

(1) Compliance with company regulations
The development standard defines the timing of reviews and the criteria of process completion, and in agile development, a formal design document is created in the last stage. Therefore, the rules of company regulations differ from those of agile development.

(2) Release timing
Release to the production environment occurs on every one iteration, but customers' development environment has no system for release to the production environment every other week/month. This also makes it difficult to make its adjustment.

(3) Contract
Agile development is basically conducted based on mandate contract, but in the standard contract system of customers, it is difficult to conclude development projects based on quasi-mandate contract.

(4) Selection of deciders for requirements
To absorb specification changes, it is general to set a customer (a staff member or advisor of the user department or branch office in this case) as the product owner (PO) and promote close communication with him/her. (PO is a person in charge of requirement development, priority decision and acceptance test implementation.) In this case, however, it was difficult to make such communication because the physical distance to this customer was too far.

(5) Development environment
We generally use a task management tool or CI environment (automatic (regular) build environment) but did not have such environment (as of 2015). In addition, the whole market generally has few use results or know-hows for such tools in an adopted .Net framework.

3. Redefinition as Optimized Enterprise Agile

3.1 Changes of Rules and Environment Unwanted

From the result of the trial project, we understood that internal rules or development environments were forced to be changed if we applied general agile as it was.

We considered some ideas of rule change or development environment, but making changes in accordance with relatively new agile development was not acceptable to the risk management department of the customer.

3.2 Setting Achievement Level

We broke down agile development into multiple components. For each of the components, we defined the achievement level and clarified the positioning of the customer. (See Table 6.)

We set a policy of moving closer to the ideal situation by solving the issues of each component step-by-step and building up achievements.

3.3 Definition of Optimized Enterprise Agile

I had concern that confusion, negative reaction or rejection would occur among customers if the word of "agile development" was continuously used. For this reason, I defined this word as "optimized enterprise agile" for term unification in the customer's company. This definition implies that the customer's own rule has been applied to it and that it is also applicable to the enterprise area.

Table 6 Agile Development Achievement Level (Excerpt)

	Level				
	1	2	3	4	5
Education	Schematic education	Agile education	Agile implementation education	Scrum practical exercise	Product owner education
Developer	2	5	8	10 or more	Multiple teams
Scrum master	Follow-up by expert (dense)	Follow-up by expert (sparse)	Development leader only	Development leader only	Case leader only (multiple businesses)
Product owner	Inside development team	Requirement checker inside department	Requirement checker inside information system	Department in charge and system department	Department in charge
CI environment	No implementation	Preliminary tool	CI environment in server	CI environment using IT environment	Interaction with resource management. Continuous deployment.
Test	Developer	Automatic unit test	Automatic join test	Automatic scenario test	Screen/Form test
Backlog management	None	Hand-Writing	EXCEL	Redmine	Redmine interacted with server
Communication	Mainly e-mail	Mainly e-mail	Mainly e-mail	Mainly thread	Using chats

3.4 Selecting Either Waterfall Development or Optimized Enterprise Agile

To break away from only one choice of waterfall development, we set an item of selecting either agile development or waterfall development on the project management table where the customer filled before a project started. (See Figure 7.)

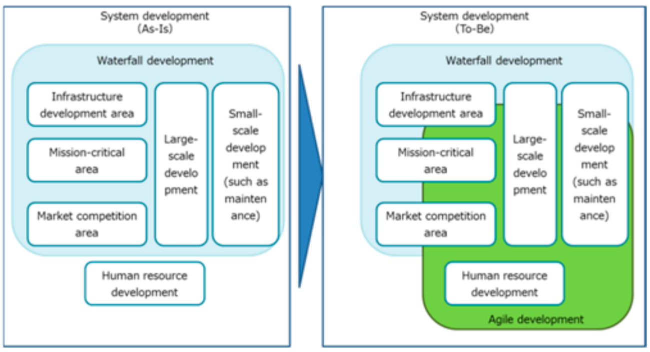


Figure 7 Breaking Away From Only One Choice of Waterfall Development (Excerpt)

We previously created the "Agile development operation check" on an assumption that not all developments were suitable for agile development and some project managers might have a trouble of such decision. (See Table 8.)

On the check list, we provided adaptive degrees to agile development. To prevent a useless cost increase, we also applied agile development to cases for which waterfall development is suitable.

Table 8 Agile Development Operation Check

	Large Classification	Middle Classification	Appropriate	1	2	3	4	5	Inappropriate
1	Characteristics of project	Decision degree of requirement	Low<-						-> High
2		Importance of earlier launch	High<-						-> Low
3		Feedback frequency	More <-						-> Less
4		Interaction with other systems	Less <-						-> More
5		Retention of developers with experience of agile development	Possible <-						-> Impossible
6		Frequency of requirement changes	More <-						-> Less
7	Organization	Involvement with business department	Dense <-						-> Sparse
8	Development team/environment	Organization conducting development	Single <-						->Multiple
9		Development location	Intensive <-						-> Dispersive

3.5 Creating Model Diagram and Defining Whole Image

All issues relating to education, rule and environment were managed by only the issue list, making it difficult to let the customer know what was necessary for agile development and what the customer lacked for it.

We created a model diagram to grasp the whole image and illustrate the components of agile development. (See Figure 9.)

We also set an achievement level in each item, in order for quantification of the level to be achieved as an organization as well as agile development. In the form of "The goal of this period is to raise one level of the education rules," we became able to share a roadmap with the customer.

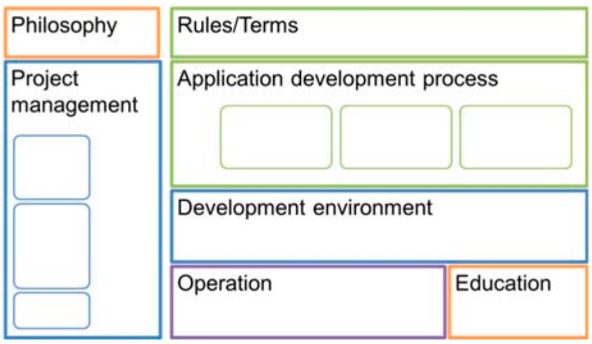


Figure 9 Systematized Model Diagram Looking at Whole Image

3.6 Integration with Waterfall Development

For customers mainly using waterfall development, review processes and process completion conditions are set based on waterfall development. If you

create the standard of agile development separately from waterfall development, it takes too much cost and time, making it difficult to persuade relevant people (especially the risk management department).
To solve the concerns of quality, we decided to carry out a scenario test and its review secured in waterfall development, while basing waterfall development and incorporating the idea of iteration in agile development. (See Figure 10.)

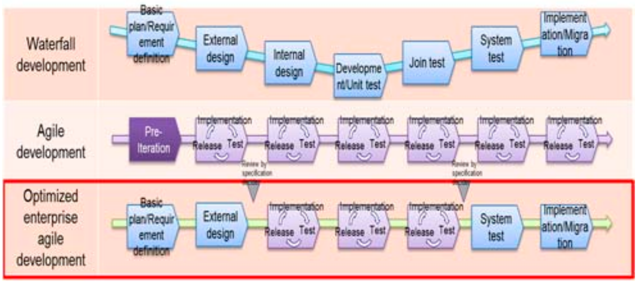


Figure 10 Optimized Enterprise Agile Incorporating the Idea of Waterfall Development

In the following three points, I especially considered the rules of the organization and applied the agile development method within the existing rules.

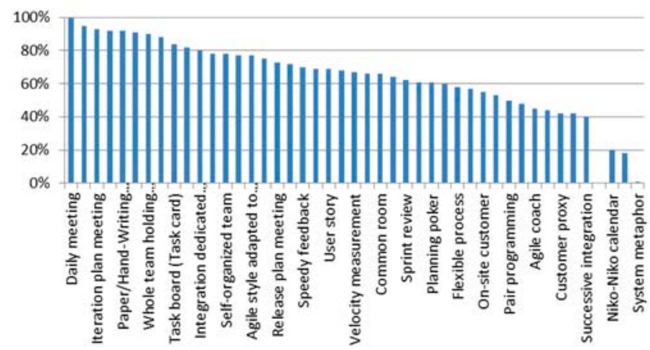
(1) Narrowing the review timing
- In waterfall development, a specification decider is supposed to review a process when it is completed. I narrowed the timing of the specification decider's review to after external design and before integration test.
- I decided to remove external design and integration test from repeating iterations. This is because multiple reviews by a specification decider will be necessary if you incorporate it into an iteration.

(2) Emphasizing the external design process and the system test process (scenario test)
I decided to create minimal external design without including it into iteration. There are two reasons for this. One is that audits require the whereabouts of design documents in a large-scale project. The other reason is that the same development company is not always in charge of external design and internal design, so that I emphasized the design as a means of communication.
After internal design, it is emphasized that a prioritized function is first developed by repeating it with iteration and a new requirement can be discovered by showing it to a specification decider (product owner).
For the scenario test, I did not change the project rule securing quality by making a specification decider review its result. In agile development, I left a similar scheme of implementing the scenario test and making a specification decider review it.

(3) Performing release up to verification environment, not production environment
It is difficult to take a risk of placing something unreliable in quality to the production environment at the time of its implementation. I consequently decided to make the release done up to the verification environment and provide distribution to the production environment according to an existing process.
Since this process is associated with the release speed to the market, it should be reconsidered if it is proven that quality can be kept in agile development as well.

3.7 Sorting Useful Practices

Agile development has so many tools called "Practice" to streamline development and facilitate communication. (See Figure 11.)



* In totaling the number of applications, I counted a complete application as 1 and a partial application as 0.5.
* Among the 26 cases in Japan, there were no cases of utilizing system metaphor. In *Guide: Manual for Practice*, I examined some cases in other countries.

Figure 11 Application Rates of General Practices

For optimized enterprise agile, I defined required tools and optional tools.

For required practices, I selected those which generically have high usage frequency and many actual performances and quantitatively show unique effects as agile.

(1) Example of main required practices
1) Product backlog (List of requirements (stories) in the order of priority)
2) Planning poker (Improvement of estimation accuracy in which all team members use points to estimate stories)
3) Continuous integration (CI environment: Automatic build and test execution environment such as TFS and Jenkins)
4) Automatic test (Effective to automatic tests run in CI environment, efficiency of tests, and investigation of impact scope)
5) Daily meeting (15-minute morning meeting, evening meeting, information sharing in team, and task management)
6) Iteration review (At the end of iteration, a product owner and a department in charge review a working program.)
7) Retrospective (Reviewing good points and bad points at the end of iteration and improving them at the next iteration)

(2) Example of selectable practices
1) Pair programming (programming by a pair of two persons, which becomes effective when agile matures)
2) Test-Driven development (Performing programming by creating automatic test code first)
3) Niko-Niko calendar (Posting faces, which show the feelings of team members, on a calendar)

4. Agile Development inside Enterprise

Although the enterprise field had the feeling of resistance toward agile development, optimized enterprise agile succeeded in lowering the hurdle toward agile development by adopting the agile method to organizational culture in an attractive way.
This method enabled us to clarify segregation between waterfall development and agile development and create a base that made it possible to select the most appropriate development method to a project. This development method is organized as shown in Table 12.

Table 12 Development Method Suitable for Organizations and Projects

	Waterfall Development	Agile Development	Optimized Enterprise Agile Development
Suitable project	Projects in which few requirement specifications are changed. For example, the users are all internal ones and the requirement is migration of an existing function.	Projects whose earlier implementation to the market is required, because the requirement specification of such users, including general consumers, is unknown.	Projects whose earlier implementation to the market is required, because the requirement specification of such users, including general consumers, is unknown.
Suitable organization	Organizations which are difficult to make a change for environments, rules and procedures.	Organizations which are difficult to make a change for environments, rules and procedures. Size: Small and medium Business type: Easy to withdraw from the market	Organizations which are difficult to make a change for environments, rules and procedures. Size: Enterprise Business type: Mission-critical

5. Issues of Optimized Enterprise Agile Development

(1) Re-examination of system policy
Security standard, quality standard and any other standards have been defined based on waterfall development and a standard for performing agile development has not been defined clearly. A more flexible development becomes possible by defining a system policy and a standard that satisfies the policy in agile development.

(2) Preparation for automated environment
In agile development based on iterated tests, environments of automatic build, automatic test and automatic deployment are a great advantage for speed-up of developments and releases.
If you computerize development environments and office procedures such as a review approval workflow and automate any work that can be automated, you can speed up releases and eliminate human errors.

(3) Arrangement of contract system
It is essentially difficult to conduct agile development, which changes the form of deliverables in midstream based on the service contract predefining deliverables. It is necessary to make a

contract quasi-mandate based on the trust relationship or to define an agile-specific contract type which has been agreed by both sides.

Another issue is whether multiple companies can agree on agile development as well as its contract if they have participated in one system development. Considerable negotiation ability is required for a project manager or a scrum master who handles this issue.

6. Consistent with other systems

Optimized Enterprise Agile Development in this case put a system test on after the end of the all the iteration. However, what if the project proceeded by agile development could receive the integration module only after the end of other project's development. The agile project's schedule won't precede the system test because the integration module from other system is not developed. It means the product owner's wants can be found in the latest process, because he/she can check the specification only after integration with other system.

In this case, agile development includes system test in iteration. And human resource should be saved at the former iteration and be taken a long span of one iteration. When it comes to integration with other systems, put human resources and develop rapidly and release to product owner. It causes increase opportunities for product owner to check its specification and increase chance to develop new product owners' wants.

It is no difference between waterfall development and agile development in the point of sharing resources into risky process to reduce risks, even though irregular agile development is adopted.

Originally, the project that is strongly regulated by other system, schedule and law, is not suit to agile development, like this project.

7. Conclusion

It is challenging to apply agile development, which is often written in books, to an enterprise system. In addition, many conditions such as the CI environment must be prepared for agile development; there are some reasons for hesitating its implementation.

First and foremost, a company needs to have risk preference of challenging a new development method and appoint a staff member with discretion and driving force as a responsible person of agile development. Otherwise, their development would abort in the face of pressure from a resistance force or end after only one trial.

In the financial field, it is very rare that the above conditions are met. In order to promote the implementation of agile development, you must not provoke anxiety by making a change at once. It is a shortcut for the implementation that builds results and achievements one by one and increases your supporters.

There is no doubt that agile development produces an effect on the fast-changing market whose needs cannot be read.

In order to accept the flexibility of a development method, it is important to clearly state the essential meanings of the architects and rules of your system and make the means for the protection of this essence flexibly selectable.

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Probabilistic Risk Assessment for Project Plan and Project Manager

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Following the adoption of probabilistic risk assessment (PRA), which has traditionally been applied to the risk assessment of physical systems like nuclear power plants, chemical plants, railroad facilities, and so on, to information security, this study attempts to apply PRA to project management (PM). Probabilistic Risk Assessment (PRA) is a strong tool for assessing the safety risks of physical system such as nuclear power plant, chemical plant, railway facilities, etc. The study of PRA was made public in 1975 with the codename WASH-1400 as one of the studies on the safety of the nuclear reactors in the United States. When an accident type has been identified as, for example, an explosion, there exist various steps, scenarios, and a series of events before the occurrence of the accident. In order to quantify the risk of the accident, in the first place, it is necessary as well as important to enumerate the scenarios and quantify the scenarios. In the field of information security and project management, the same can be applied. This paper discusses the quantitative risk assessment by PRA, especially focusing on the case in which cost planning of a project collapse. Also, what should be done as PM, and how to prevent the collapse of the project plan beforehand will be discussed.

Key Words and Phrases: PRA, Risk Assessment, Project Plan Collapse, Scenario Management

1. Introduction

Probabilistic Risk Assessment (PRA) is a strong tool for assessing the safety risks of physical system such as nuclear power plant, chemical plant, railway facilities, etc. The study of PRA was made public in 1975 with the codename WASH-1400 as one of the studies on the safety of the nuclear reactors in the United States. When an accident type has been identified as, for example, an explosion, there exist various steps, scenarios, and a series of events before the occurrence of the accident. In order to quantify the risk of the accident, in the first place, it is necessary as well as important to enumerate the scenarios and quantify the scenarios. In the field of information security and project management, the same can be applied.

According to Satoh, N. et al. (2010), the area of information security and project management is similar to the physical system in this respect. To be concrete, based on the scenario, the quantification of the project plan collapse of cost plan, quality plan, and staff plan is discussed.

PRA is composed of event trees and failure trees. While failure trees are employed to analyze the causes of functional failure, event trees are the key tool for enumerating the accident scenarios. The event tree is a kind of decisive tree that starts from the initiating event and finally reaches success or failure. The accident scenario of each individual initiating event is enumerated with the event trees that start from the initiating event.

2. Scenario management

As the preliminary step for the application of PRA, this section illustrates the course of a project plan collapse, enumerating the courses of the plan collapse of cost plan, staff plan, quality plan, and delivery plan.

2.1 Cost plan collapse

The course of the cost plan collapse is as follows:

1) The in-house design document was handed to the client, who orally accepted the design. However, no documented inspection acceptance was obtained from the client.
2) Bugs in the generated file were detected by the system test.
3) In order to correct the bugs, modification program had to be generated. As a result, incremental man-hour is required.
4) The negotiation with the client broke down due to the additional fee, the delayed delivery, and the additional staff.
5) The budget was not secured enough.

Consequently, the cost plan collapsed.

2.2 Staff plan collapse

The course of the staff plan collapse is as follows:

1) Since the number of system engineers who are familiar with the work was few, the project plan depended on the partner company staff.
2) Due to the flaw of the project, delivery to the client had often been delayed. However, the delivery deadline of the deliverables was at the beginning of April. On the other hand, the man-hour of the

system engineers from the partner company was overflowing due to trouble resolution and Q&A correspondence. Moreover, due to the flaw of the project, new tasks were accumulating, which led to the lack of Key Men who are able to design with good knowledge of specifications. As a result, it was impossible to implement the project with the staff plan. Thus, the staff plan collapsed.

2.3 Quality plan collapse

The course of the quality plan collapse is as follows:

1) The implementation test was done, but it did not encompass all the real jobs, i.e., it was done by sampling the weekly, monthly, and annual jobs on the ordinary online.
2) The test was coding by using the Inspect Instructions of PC Cobol. Four to five hours after the real online started working, the middleware caused Abend. Abend Dump was obtained, and Dump was analyzed to identify the cause. Then, it turned out that the cause of Abend was the Instruction Inspect of PC Cobol, thus the patch was made. In this case, if the implementation test encompassed all the real jobs, this Abend could be evaded. Then, recovery measure was taken by re-coding with PC Cobol without using Inspect. Finally, operation check and operation test were conducted. As a result, medical accounting jobs recovered, but it took long to recover, and the work stopped. Thus, the original quality was not obtained, and the quality plan resulted in collapse.

2.4 Delivery plan collapse

The course of the delivery plan collapse is as follows:

1) The in-house design document was handed to the client, who orally accepted the design. However, no documented inspection acceptance was obtained from the client.
2) Bugs in the generated file were detected by the system test.
3) In order to correct the bugs, modification program had to be generated. As a result, incremental man-hour is required.
4) The negotiation with the client for increment of staff broke down.
5) Despite the necessity of incremental man-hour, it was not possible to increase staff members. As a result 0f the work done by current staff members, the delivery due was not observed. Thus, the delivery plan collapsed.

2.5 Correspondence as PM

I participated as a rescue PM in the project of the failure of the personnel plan in 2.2 above. I will examine how we should have responded. The project was in a state of conflict without a clear project plan. In the beginning of April delivery of deliverables. Since it was inevitable, we will create a WBS that targets this and assess the risk. Determine countermeasures for the detected risk. Risks / troubles that occurred during project progression other than the risk detected in the planning phase As well as considering not to affect the progress of the project. In this paper we consider the application of PRA as a method of risk assessment.

3. Application of PRA to project management

When the type of the accident such as the explosion accident is identified, various process, a scenario, a series of phenomena exist before the accident occurs.
At First enumerate such scenarios and must quantify each scenario to quantify a risk.
It is necessary as well as important to enumerate the scenarios and quantify the scenarios. In the field of project management, the same can be applied.
In applying PRA to project management (PM), firstly, it is necessary to define the accident and clarify the initiating event for the occurrence of the accident. Here, the initiating event is the factor that triggers the accident. Then, the accident scenario is enumerated with event trees. Finally, event probability of each scenario is calculated.

3.1. The merits of the application of PRA to PM

The conceivable merits of the application of PRA to PM are as follows:

1) Accident scenarios can be enumerated with event trees.
2) The risk can be assessed by both the combination of the event probability of the scenario and the degree of influence.
3) The risks can be assessed for each scenario.

3.2. Problems of uncertainty

In the previous section, the scenarios of collapse of cost plan, quality plan, staff plan, and delivery plan were enumerated. Also, the scenarios with high event probability to fail were able to be extracted. However, these event probabilities of the main collapse are only qualitatively presumed, i.e., they have uncertainty. Therefore, this paper attempts to examine the uncertainty of the accident scenarios of the collapse of cost plan, quality plan, staff plan, and delivery plan.

4. An example of the application of PRA to PM

In this paper, PRA is regarded as an approach to risk management, a knowledge area of PMBOK, and the focus hereafter is on cost plan collapse. In this case, from the event trees, 10 scenarios can be identified as is shown in Fig. 1. In discussing the application of PRA to PM, the case that enough cost could not be obtained and thereby the cost plan collapsed is taken as an example. The merit of the application of PRA is that it enables to draw up the scenarios that lead to the accident. The definition of the accident is "the collapse of the cost plan," and that of the initiating event is "what causes the collapse of the cost plan."

4.1 Scenarios of the cost plan collapse

The course of the cost plan collapse is stated in 2.1, 1) to 5).

In discussing the application of PRA, let us take the case that enough cost could not be obtained and thereby the cost plan collapsed. By illustrating the course of cost plan collapse with event trees, 10 scenarios can be identified from the event trees in Fig. 1. The probability that the in-house design is delivered to the client, and the documented inspection acceptance is obtained from the client is supposed 0.05 (P1). The probability that the bugs in the generated file are not detected is supposed 0.12 (P2, P7). The probability that no correction program, incremental man-hour, or incremental cost is necessary is supposed 0.1 (P3, P8). The probability that the negotiation with the client concerning incremental fee, extending delivery due, and incremental staff does not break down is supposed 0.1 (P5, P10). Finally, the probability that the contingency budget is not secured is supposed 0.05 (P6, P11).

Scenario 1

The in-house design was delivered to the client, who agreed with it, but the inspection acceptance document was not received from the client. In the system test, bugs of the generated file were detected. Increment of correction program, incremental man-hour, and incremental cost were necessary to complete the project. However, the negotiation with the client with regard to incremental fee, extending delivery due, and incremental staff broke down. The contingency budget is not secured.

Scenario 2

The in-house design was delivered to the client, who agreed with it, but the inspection acceptance document was not received from the client. In the system test, bugs of the generated file were detected. Increment of correction program, incremental man-hour, and incremental cost were necessary to complete the project. The negotiation with the client with regard to incremental fee, extending delivery due, and incremental staff broke down. However, the contingency budget is secured.

Scenario 3

The in-house design was delivered to the client, who agreed with it, but the inspection acceptance document was not received from the client. In the system test, bugs of the generated file were detected. Increment of correction program, incremental man-hour, and incremental cost were necessary to complete the project. However, the negotiation with the client with regard to incremental fee, extending delivery due, and incremental staff did not break down.

Scenario 4

The in-house design was delivered to the client, who agreed with it, but the inspection acceptance document was not received from the client. In the system test, bugs of the generated file were detected. However, increment of correction program, incremental man-hour, and incremental cost were not necessary to complete the project.

Scenario 5

The in-house design was delivered to the client, who agreed with it, but the inspection acceptance document was not received from the client. In the system test, bugs of the generated file were not detected.

Scenario 6

The in-house design was delivered to the client, who agreed with it, and the inspection acceptance document was received from the client. In the system test, bugs of the generated file were detected. Increment of correction program, incremental man-hour, and incremental cost were necessary to complete the project. The negotiation with the client with regard to incremental fee, extending delivery due, and incremental staff broke down. Moreover, the contingency budget is not secured.

Scenario 7

The in-house design was delivered to the client, who agreed with it, and the inspection acceptance document was received from the client. In the system test, bugs of the generated file were detected. Increment of correction program, incremental man-hour, and incremental cost were necessary to complete the project. The negotiation with the client with regard to incremental fee, extending delivery due, and incremental staff broke down. However, the contingency budget is secured.

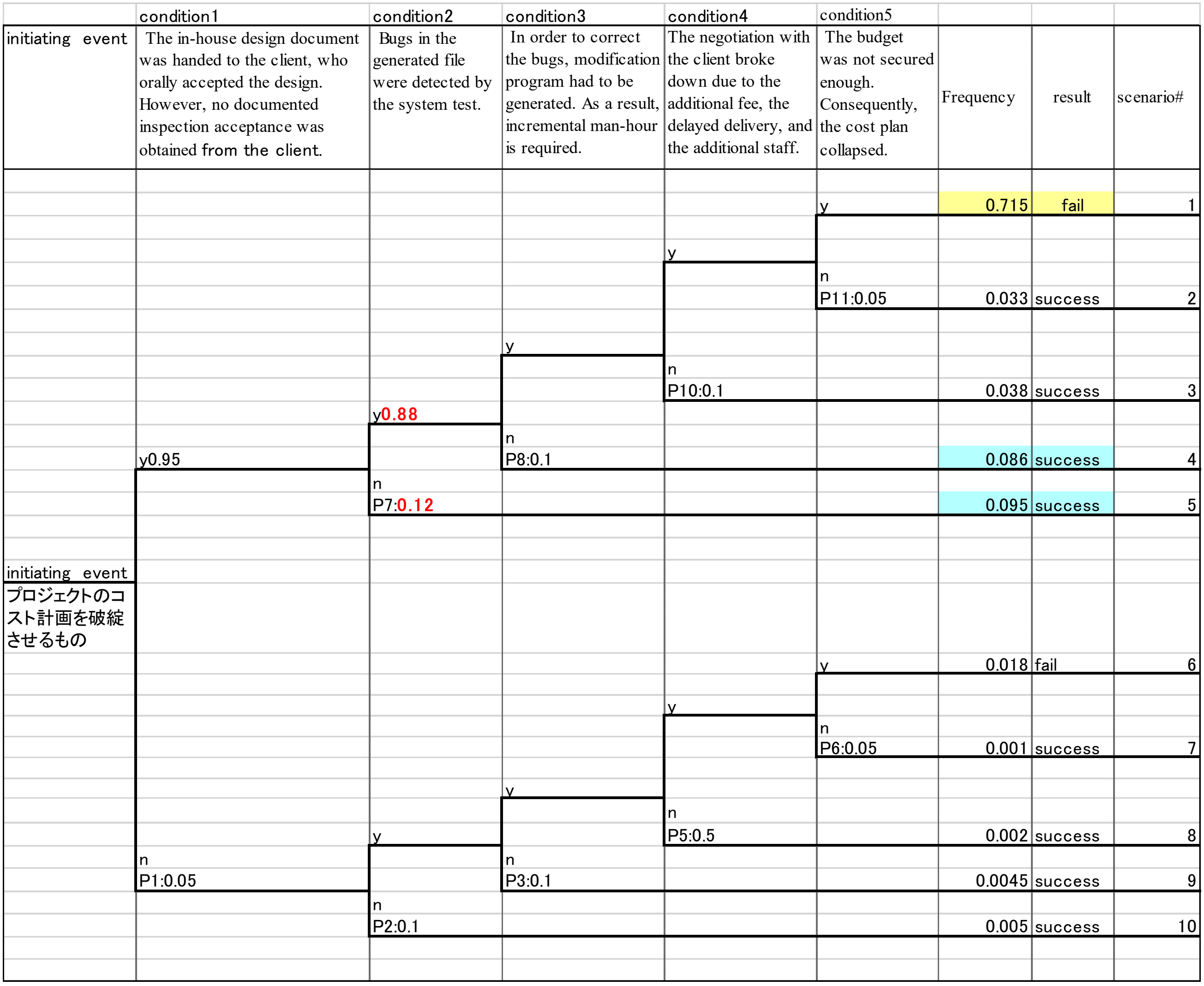

Fig 1 Event Tree Cost plan collapse

Scenario 8

The in-house design was delivered to the client, who agreed with it, and the inspection acceptance document was received from the client. In the system test, bugs of the generated file were detected. Increment of correction program, incremental man-hour, and incremental cost were necessary to complete the project. However, the negotiation with the client with regard to incremental fee, extending delivery due, and incremental staff did not break down.

Scenario 9

The in-house design was delivered to the client, who agreed with it, and the inspection acceptance document was received from the client. In the system test, bugs of the generated file were detected. However, increment of correction program, incremental man-hour, and incremental cost were not necessary.

Scenario 10

The in-house design was delivered to the client, who agreed with it, and the inspection acceptance document was received from the client. In the system test, no bugs of the generated file were detected.

Now, focusing on Scenario 1, whose appearance probability would be the highest due to the fail, let us generate normal random numbers of the appearance probabilities of plan collapse condition 1, 3, 4, and 5 in Section 2.1 of this paper, on the condition that the probabilities take normal distribution. As for condition 1, normal random number is generated with 0.95 averages and 0.01 SD. As for condition 3, 4, 5, normal random numbers are generated with averages of 0.9, 0.9, and 0.85 and with SD of 0.02, 0.02, and o.1 respectively. As for condition 2, adopting the detection model based on detection model focusing on human motion state and arousal level, detection rate of 0.88 under the static condition is applied.

The occurrence probability of Scenario 1 is given by the equation (I) blow.

(Scenario 1 occurrence probability) = (condition 1 occurrence probability) * (condition 2 occurrence probability) * (condition 3 occurrence probability) * (condition 4 occurrence probability) * (condition 5 occurrence probability)   (1)

In order to obtain the occurrence probability of Scenario 1, the simulation to generate normal random numbers was repeated 1,000 times.

As a result, the probability distribution histogram illustrated in Fig. 2 was obtained, while the qualitative estimate value of the occurrence probability of Scenario 1 is 0.575. The histogram in Fig. 2 shows that the occurrence probability falls in the interval between 0.563 and 0.623 with high frequency. Therefore, it can be considered that the qualitative estimate value of the occurrence probability of Scenario 1 is within the valid interval. As for the probability that this occurrence probability is below 0.573, the result of the calculation of cumulative of this histogram from 0 to 0.573 is 0.443. This means that the occurrence probability that the qualitative estimate value is below 0.575 is around 0.443.

Next, in the simulation that the occurrence probability of condition 1 is 0.8 and the occurrence probabilities of condition 2, 3, 4, and 5 are the same as those in Fig. 2, probability distribution histogram illustrated in Fig. 3 was obtained. Although the qualitative estimate value is 0.485, the results of the simulation fall in the interval between 0.444 and 0.484 with high frequency. Thus, it can be considered that the qualitative estimate value tend to be rather over estimate.

4.2 The detection model

As for the detection model, a detection model (Matsuoka. K. et al., 2001) focusing on human exercise status and arousal level has been created and improved. As a result, around 88% detection rate has been obtained for static state, while around 50% detection rate for simple kinetic state. In this paper, the 0.88 detection rate for static state is applied to the detection of the bugs in the file generated for the system test.

4.3 Application to cost plan making

The resulted figures of this simulation can be used in the calculation of contingency reserve.

In coping with the penalty article in the contract on a success-fee basis, it is possible to calculate the contingency reserve by using the resulted figures of this simulation. Contingency reserve is given by the equation below:

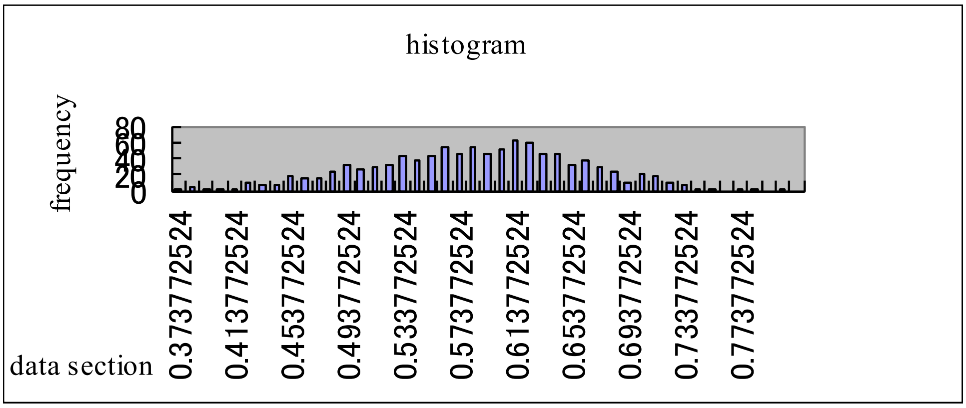

Fig 2 occurrence probabilities distribution of scenario1(case1)

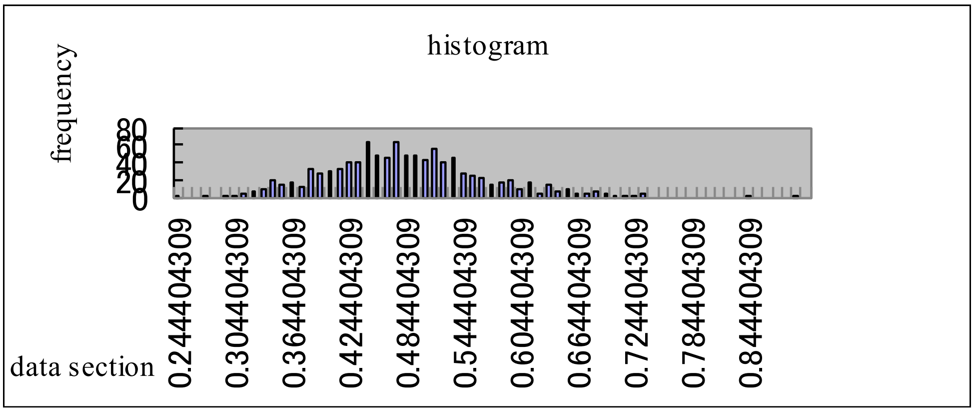

Fig 3 occurrence probabilities distribution of scenario1(case2)

(Contingency reserve) = (cost for the threat risk) * (occurrence probability of the risk) (2)

When the contingency budget for the occurrence of Scenario 1 is 5 million yen, in the case 1 in Fig 2, the contingency reserve is indicated as follows:

5,000,000 * 0.563<=contingency reserve<= 5,000,000 * 0.623 (3)

2,815,000<=contingency reserve<=3,115,000

That is to say, the contingency reserve would be between ¥2,815,000 and ¥3,115,000. With the qualitative estimate value 0.575, contingency reserve is calculated only uniquely as 5,000,000 X 0.575 = 2,875,000 (yen). However, with the use of the simulation, the contingency reserve can be obtained more specifically, i.e., between ¥2,815,000 and ¥3,115,000.

5. Conclusion

As a result of this study, by employing event trees, the scenario with high occurrence probabilities of main failure in the case of cost plan collapse was able to be extracted. By generating normal random numbers against cost plan collapse conditions 1, 3, 4, and 5 (Section 2.1) of this scenario, and by applying the detection rate under the static condition in detection model focusing on human motion state and arousal level (0.88) to condition 2, histograms of probability distribution were obtained. Furthermore, the occurrence probability of the scenario, which had been qualitatively and uniquely estimated, was able to be analyzed and assessed multilaterally because the frequency of occurrence probability of each condition was obtained by the simulation. In addition, calculation of contingency reserve was able to be available.

On the other hand, project management is the field where experience is respected, and thus computer support is difficult. By accumulating the achievement experience of the veteran PM, the tendency of each industry application can be grasped, which could be a strong support to future PM work. Therefore, it is our future subject to promote improvement in the efficiency and quality of project management work.

Acknowledgement

I would like to express my deep appreciation to the various suggestions from the project members and other people concerned, without which this study could not have been completed.

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A Study on Restructuring Uncontrolled Project as a Project Manager

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Recently, due to the drastic technological innovation, and the demand of efficient and mature development, implementation of project management for system development and maintenance project has been becoming very complicated and difficult. At the same time, the project management skills and experience of not only system vendors but also clients have improved. Therefore, the absolute advantage of the vendor has been lost, and vendors have been under constant and severe pressure from the clients during the project delivery. There is a project that the members of it left the project due to the health condition etc. and the situation of the project suddenly deteriorated because the members left the project two, project manager and project leader. As the results, the project fell into the poor management. To recover the uncontrolled project situation, a rescue project manager was quickly requested to be appointed. Based on my experience as a rescue project manager, this paper gives ideas on essence of the project recovery methods using the 7 Keys Report. Of course, it is no need to say that the fundamentals of project management, such that how to understand the situation, how to plan the solution methods, how to implement and control the situation, and how to complete the project were kept.

Keywords and Phrases: Project Recovery, Stakeholder Management, Communication Management, Visualization, Global Delivery

1. Introduction

I have led several projects as a project manager for over ten years. From my experience, to implement project management of system development and maintenance is becoming extremely complicated and difficult due to the dramatic technological innovation, more efficient development and mature development Methods.

At the same time, not only system vendors' but also clients' project management skills and experience have improved, so, the absolute advantage of the vendors has been lost, and many vendors have been constantly under severe pressure from the clients during the project delivery. Therefore, expectation from customers to the projects is high and high level task implementation is required. Under these circumstances, the event of the leave of project members from ongoing one is no longer a low risk. Such projects are required to be recovered quickly.

In this paper, I will report the counter measures I took as a rescue project manager against the uncontrolled project that the managing level members had left the project suddenly.

2. Project Profile

The system and project outlined in this paper are as follows.

2.1 System Outline

The outline of the system covered in this paper is as follows:

- CRM system for Employees
- Daily use of this system Thousands of employees
- A simple information reference only for the initial construction of the system concept
- Web-based online system and data transmission and reception batch
- Expansion of the sequential function by the system users, by request

In addition, the project details we implemented are as follows. (See Figure 1)

- # of projects per contract unit: 20
- # of production release per year: 6
- # of the additional function requests: Frequent

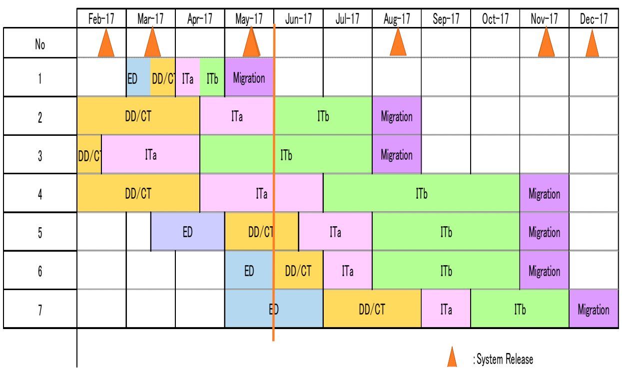

Figure 1 Master Schedules of this system

And there is a department that controls the function improvement under this system. It is the system for about 15 years under the regular operation, and function expansion and modification are repeatedly implemented every year at the frequency as described above. So, the system configuration has become complicated more and more.

2.2 Project Status

The outline of the project covered in this paper is as follows: (See Figure 2)

- Application enhancement project
- 120 MM for 11 months from External Design to Migration for production area. It was ranked as medium-scale project from the viewpoint of this system referring to the related project in the past
- No repairing or expansion of the HW and SW
- Available reference materials design documents and practical programs

Cost benefit is expected by the cooperation with the off-site resources development of the online features. Also, the overall workload was shared half and half between on-site members and offsite resource members. Therefore, a competent Bridge-SE who connects the both sides was an important key factor for the success of this project. (See Figure 3)

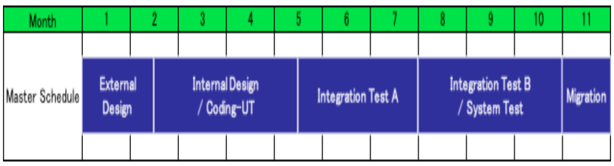

Figure 2 Master Schedule of This Project

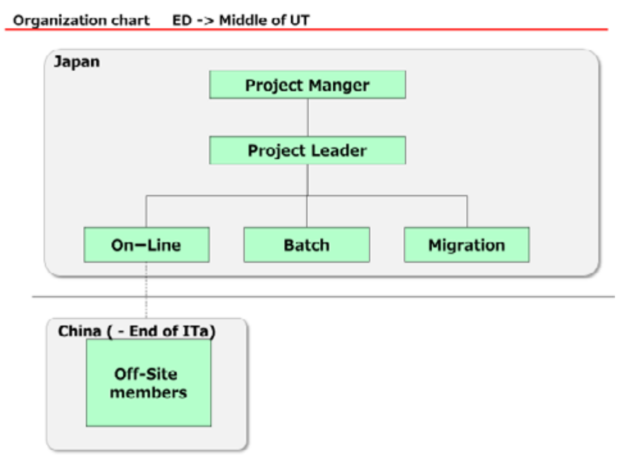

Figure 3 Organization chart
(ED -> Middle of UT)

The project was progressing as planned, but a major problem occurred during UT implementation. In this phase, the project manager and project leader left the project one after another. (I do not know the direct cause for it, but it seemed to be a leave due to some mental problems from both working reason and private reason). Under the situation like this the progress of a simple work had been kept going, but the progress of the main and core project had been extremely unclear for about 2 months. (See Figure 4,5)

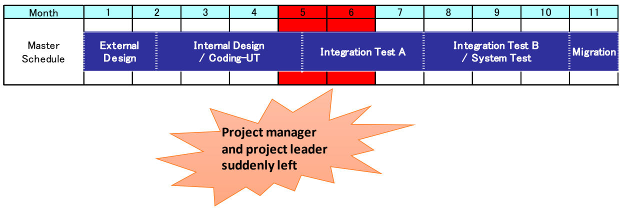

Figure 4 PM and PL suddenly left

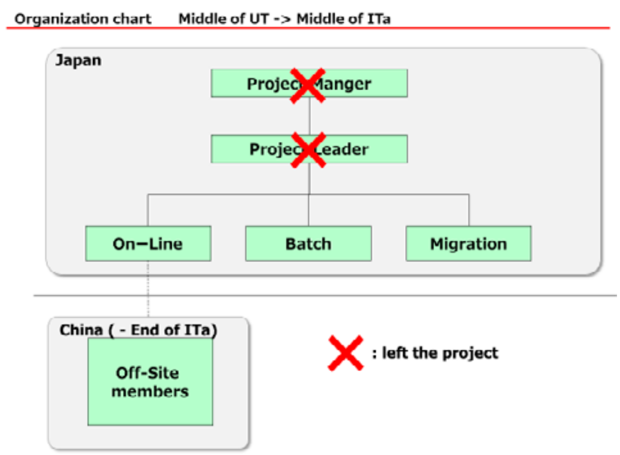

Figure 5 Organization chart
(Middle of UT-> Middle of ITa)

I took over the project as the rescue Project Manager in this situation without knowing the reason why I was appointed as the rescue Project Manager. It seemed as follows.

- Since I had overseen the project management on this system for over 5 years before. It was easy to make me join the project of this system.
- Since the members of the past projects had been working as the customer side. It was relatively easy for an experienced person to construct relations with customers.
- Since the functions of the output of the previous projects I was in charge had been stable. Change of project manager was

relatively easy from the view point of experience, qualification and responsibility. However, it was a very difficult situation for me. Because I had to take over both roles of rescue project manager and rescue project leader "alone". (See Figure 6,7)

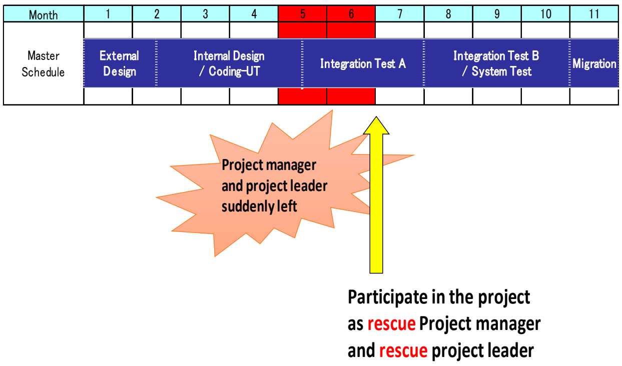

Figure 6 rescue Project Manager and Project Leader

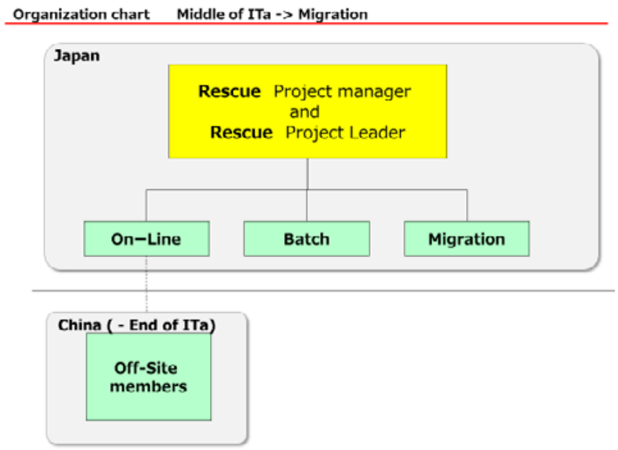

Figure 7 Organization chart
(Middle of ITa -> Migration)

In the next chapter, I will introduce to the restructuring procedure of the uncontrolled project maintenance.

3. Restructuring of the Project

As I mentioned in the previous chapter, I had to take over the crisis situation that project manager and project leader had left the project, but I was appointed without knowing the status of the project at all. Therefore, first of all, I and project members, arranged a hearing of each stakeholder to grasp the current situation.

Based on the results of the interview, I set goals for the project restructuring, made the action plans for it, then implemented them in order.

3.1 Understanding of the Current Project Situation

In order to know the current situation, it is important to gather various opinions from various stakeholders. Therefore, we identified stakeholders related to this project, and conducted a hearing of stakeholders.

The stakeholders that I could have a hearing are as follows:

· Our customers;

This includes the Customer's project manager and its team members. Customers are not directly involved in the system construction itself, but are engaged as members of the project development sharing their views or opinions for the system which are essential to develop the suitable system for them.

· Project members;

As Japan side, On-Line team members, Batch team leader and its members, Migration team leader, its members.

As China side, Off-Site team leader, sub-leaders and Sales representative.

Based on the findings through the hearing, we evaluated the current status of the project using the 7 keys framework. (See Figure 8)

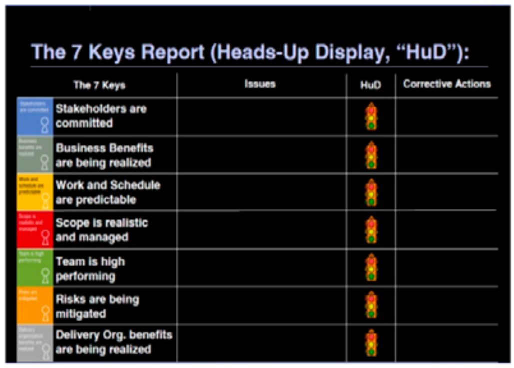

Figure 8 7keys Report template

The details of each 7 Key are as follows:

- Stakeholders are committed

  The goal of the client and the project (the completion of this project itself), ROI were shared.

  Result: Green

- Business(Client) Benefits are realized

  Because it was assumed that work efficiency of the employees who use the system was ~~is~~ expected to be improved by this project, we concluded that the benefit of the customer could be realized.

Result: Green

- Work and Schedule are predictable

  Management of the project schedule change due to the sudden leave of project manager and project leader was insufficient. Immediate improvement was necessary

  Result: Red

- Team is high performing

  As stated in the progress management situation above 2.2, there was no problem on the communication with Batch team and Migration team through the traditional communication path established. However, there was a serious communication problem with the Online team. Because we were developing the system in the onsite and Off-shore site separately in this project, it was difficult to communicate with each other. Specifically, the communication path between the clients and the project members was unclear and the decision making could not be carried out sufficiently. As a result, we were able to carry out the only simple ITa test case planned in cooperation with the Japanese team and the Chinese team, but ITa test case which needs to solve the problem was not implemented

  Result: Red

- Scope is realistic and managed

  We found that there was no need to change the current contract at the moment. However, we thought that it would depend on the possible pending issues at the time of that project manager and project leader had left. So, we decided to check the situation considering the possibility of necessary scope expansion.

  Result: Yellow

- Risks are mitigated

  For the event of a risk occurrence, a mechanism for managing client QA, tasks etc. was established. Due to the sudden leave of project manager and project leader, the period to be resolved the problems was extended. Improvement was expected by my participation in the project.

  Result: Yellow

- Delivery Organization Benefits are realized

  We judged that there was no problem because the profit originally planned by ~~as~~ the project was realized.

  Result: Green

Based on these evaluations, I recognized that the following two points were the most important issues to be solved for this project and that urgent solution was necessary.

- Team is high performing
- Work and Schedule are predictable

From the next section, I will apply the results of our analysis on the crisis of the project to the basics of project management and practical problem solving with the following procedure.

3.2 Project Restructuring Target Setting

It is impossible to handle all problems at once because of the impact to the project, but it was judged that incremental improvement was possible considering the phase of the project. So, I set two recovery periods based on the project master schedule. As for Phase 1, Phase 2 was set as follows. (See Figure 9,10)

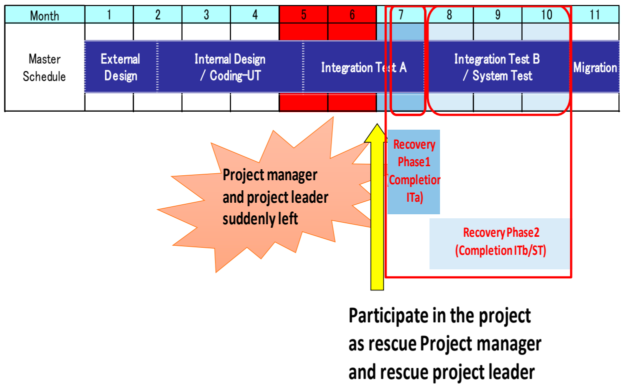

Figure 9 Recovery Schedule

	Recovery Phase1 (End of ITa)	Recovery Phase2 (End of ITb/ST)
Team is high performing	**Reestablish communication path** between Off-Shore team and On-Site team	**Reestablish communication path** between vender project team and customer
Work and Schedule are predictable	**work visualization** daily report from Off-Shore team	**work visualization** daily report from all members include customers

Figure 10 Recovery target

Recovery Phase 1: End of ITa

a) Reestablishment of the communication path (between Off-Site team and On-Site team)

b) work visualization (daily report from Off-Site team)

Recovery Phase 2: End of ITb / ST

a) Reestablishment of the communication path

(between vender project team and customer)

b) work visualization (daily report from all members include customers)

3.3 Project Restructuring Plan

The plan for recovery phase 1 and recovery phase 2 targets are described below.

Recovery Phase 1:

a) Reestablishment of the communication path:

In order to establish close communication with Off-site, we held "Progress Meeting" and decided the followings.

Participants also defined the participation of Off-shore leaders and Project Manager in Japan as mandatory to clarify the communication path between Off-shore leaders and onsite leaders. It is a rule to report the progress from the Off-shore team in Japanese. Because it is difficult to judge if you really understand that you answer with Yes or No, but if you ask the Off-shore team's speech, you understand the degree of understanding from the other side.

b) Practice of work visualization

With the current management system, we cannot grasp / share the progress situation of the Off-shore team. Therefore, for the practice-purpose of the work visualization, we made a report format.

Recovery Phase 2:

a) Reestablishment of the communication path

When considering the importance and circumstances of this project, I think that it is necessary to strengthen the structure of the project. Therefore, I explained to the customer the necessity of the involvement of the department manager who is the program manager including this system and the "experienced two advanced SEs" who have a relation with me from the past. They would contribute to not only the skill enhancement but also the reconstruction of the communication path.

b) Practice of work visualization

The ITb / ST phase is a client-oriented work, but under this severe circumstance, "Visualization" of work was necessary in order to complete the planned work surely. We also explained to the customers about the importance of visualization adopted in Recovery Phase 1, and they agreed with the adoption of the "Visualization" also into ITb / ST.

4. Project Restructuring Implementation and Result

In this chapter, I report on the results of the project recovery.

Recovery Phase1:

- We held the progress meetings on a daily basis, including holidays during the last two weeks until the ITa was completed (See Figure 11,12)
- As a result, all of the ITa cases are completed.
- Faults and QA were all resolved in the ITa phase.

However, we found some weak points in quality. Therefore, we decided to confirm the quality of the ITb / ST collaborating with customers ~~as~~ based on the result of ITa (or like we did for the ITa).

Figure 11 Communication sheet

Figure 12 Communication sheet

Recovery Phase2

- The whole day progress meetings were held during 60 days on a daily basis.
- All ITb/ST cases were completed
- Faults and QA ware all resolved in the ITb /ST phase.

As a result of these recovery works, we could provide with successfully services in this project. I confirmed that restructuring of uncontrolled project was possible following these tools such as the "7 Keys Report" focusing on the result like the "Communication Management" or "Visualization".

5. Conclusions

In this paper, I explained about the restructuring of the system based on my experience of the recovery of the project that members of it had left suddenly. Recovery of the projects in trouble cannot be implemented all so easily at once.

Therefore, in order to solve the problem, it is necessary to identify what kind of situation is now, what are the problems or the barriers, and to find on how to resolve such problems or barriers in order. The cause of this time problem was a sudden leave of the members from ongoing project. Then

· Communication Management
· Visualization

these 2 words were very important elements for the quick recovery of the uncontrolled project we faced. We confirmed that the project was successfully recovered and completed using these countermeasures. However, this time case I experienced reminded me of the importance of the risk management at all stages of the project, such that.

From now on, I will be keen more and more to the confirmation and reinforcement for the risk management.

By reading the signs before falling into this trouble situation and taking appropriate measures, I would like to contribute to the increase of the numbers of the new projects, even one, responding to the clients' requests.

Acknowledgements

I appreciate to the members and other stakeholders of the project under my management. They worked hard and spent a lot of time for the successful achievement of the project and the customer's business expansion. So, I would like to express my sincere appreciation for their efforts. Also, writing this paper, I received many advices from many authorities across the organization of IBM Japan. I really appreciated it for that.

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Would "Few Software Designer and Many Programmer Project" Fail?

Computer Simulation on the Effect of Ratio between Software Designer and Programmer

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Software development project has its own characteristic problems, such as difficulty in communication, knowledge transfer, scheduling and so on. A report shows that designer ratio between software designer and programmer has an effect on software development project. It shows some projects, which failed on managing cost or delivery, had small ratio of software designer. The purpose of this paper is to reproduce the effect of designer ratio through computer simulation. We propose a software development model based on ORGMEM Model, and simulate how designer ratio affects on the performance of software development project. The result shows that communication cost would decrease when designer ratio increase. In the aspect of efficiency, the best designer ratio depends on the project size. It can be presumed from our model that higher designer ratio would be better when the communication cost is heavy.

Keywords and Phrases : Software Development, Agent Based Simulation, ORGMEM Model, Ratio between Software Designer and Programmer

1. Introduction

Offshore software development project became popular, such as software designing in Japan and developing in India or China. Software development project has its own characteristic problems, such as difficulty in communication, knowledge transfer, scheduling and so on. Such problems appear especially in offshore software development project. Goto (2017) shows survey that the failed off shore projects tend to have smaller ratio of software designers.

We try to reproduce the effect of designer ratio through computer simulation. First of all, we propose a software development model based on ORGMEM Model, and data design to reproduce the effect of designer ratio.

Second, we define four variables; designer ratio between software designer and programmer, task difficulty, project size and weight of knowledge exploration. Finally we execute simulation through the model and the four variables.

2. Theoretical Background

Ren et al. (2006) researched in software development through computer simulation. In this research, they proposed ORGMEM Model, and measured the effect of transactive memory. Transactive memory means the knowledge of "Who knows what", which Wegner (1987) advocated.

Sakuma et al. (2010) is another research using ORGMEM Model. The authors divided people into six types, and simulated which type of member is effective in a certain kind of project.

We add our original design to ORGMEM, and set value of relation matrices, cost of knowledge exploration, to reproduce the importance of software designers.

3. Model Description

3.1 ORGMEM Model

3.1.1 Three Key Elements and Six Relations

Ren et al. (2006) advocated ORGMEM Model, which had three key elements and six relations among these elements to represent software development project.

Three key elements are as below.

- People(P)
- Resource(R)
- Task(T)

Six relations are as below.

- Precedence of Tasks(T x T)
- Capability Linking People to Resources(P x R)
- Assignment of Tasks to People(P x T)
- Networks among People(P x P)
- Resource Needs of Tasks(R x T)
- Substitute of Resources(R x R)

Figure 1 shows Three People project. Six relationship in the figure are represented by following matrix. ds(Authors touch up Ren et al. (2006)).

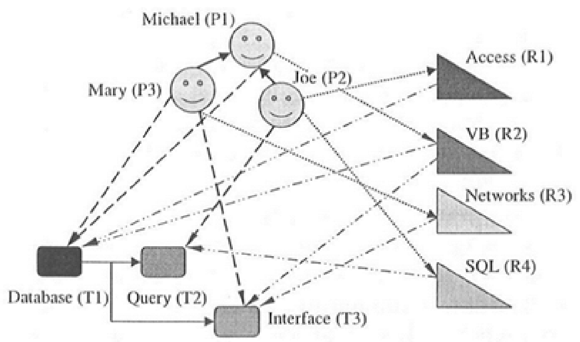

Figure 1 3 People Project (From Ren et al. (2006))

Figure 2 shows a relation between people and resources. A concrete situation is as below.

- P1(Micheal) knows R2(VB)
- P2(Joe) knows R1(Access) and R4(SQL)
- P3(Mary) knows R3(Networks)

	R1	R2	R3	R4
P1	0	1	0	0
P2	1	0	0	1
P3	0	0	1	0

Figure 2 P x R

Figure 3 shows a relation between people and tasks. A concrete situation is as below.

- P1(Micheal) is assigned to T1(Database)
- P2(Joe) is assigned to T2(Query)
- P3(Mary) is assigned to T1(Database) and T3(Interface)

	T1	T2	T3
P1	1	0	0
P2	0	1	0
P3	1	0	1

Figure 3 P x T

Figure 4 means that no other resources can substitute.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0	0	0
R3	0	0	0	0
R4	0	0	0	0

Figure 4 R x R

Figure 5 shows a relation between resources and tasks. A concrete situation is as below.

- T1(Database) needs R1(Access)
- T1(Database) and T3(Interface) needs R2(VB)
- T3(Interface) needs R3(Networks)
- T2(Query) needs R4(SQL)

	T1	T2	T3
R1	1	0	0
R2	1	0	1
R3	0	0	1
R4	0	1	0

Figure 5 R x T

Figure 6 shows a relation between Tasks. A concrete situation is that T1(Database) is ahead of T2(Query) and T3(Interface).

We explain P x P in the last of next section.

	T1	T2	T3
T1	0	1	1
T2	0	0	0
T3	0	0	0

Figure 6 T x T

3.1.2 Definition of Transactive Memory

P x R in 3.1.1 doesn't show what every member knows. In ORGMEM, every member has transactive memory, and they process tasks with their own transactive memory. In other word, every member has a matrix P x R, and the matrix is called transactive memory. Transactive memory has three value: 1,0,-1. These meanings are as below.

1 : The agent knows there is connection between two agents.

-1 : The agent knows there is NO connection between two agents.

0 : The agent doesn't know about the connection.

For example, P3 has P x R as below.

	R1	R2	R3	R4
P1	-1	1	0	0
P2	1	-1	0	0
P3	-1	-1	1	-1

Figure 7 P3 has P x R

Compared to P x R in 3.1.1, "0" is replaced by "-1" in row P3, because P3 knows P3's own knowledge precisely. P3 knows P1 and P2 know or don't know about R1 and R2. Therefore P3 knows P3 should ask P1 or P2 when P3 needs R1 or R2. From P3's point of view, P3 doesn't know P1 and P2 know or don't know about R3 and R4. When P3 needs R3, P3 process the task by itself. But when P3 needs R4, P3 doesn't know who P3 should ask. In this way, the knowledge "who knows what" has effect on project efficiency.

Here we explain P x P in ORGMEM Model.

	P1	P2	P3
P1	0	0	0
P2	1	0	0
P3	1	0	0

Figure 8 P x P

Figure 8 shows a relation between people. A concrete situation is as below.

- P2(Joe) knows P1(Micheal)
- P3(Mary) knows P1(Micheal)

In our model, agents explore through knowledge, which is "who talks to whom". For example, when P2 (Joe) are assigned to task, which he cannot process the task by only his knowledge or his transactive memory, P2 (Joe) explore others' knowledge or transactive memory. In such a case, he explore P2 (Joe)'s knowledge or transactive memory at first.

3.1.3 Definition of Task

A task is an N bit binary string. Each bit represents resources, which are required when it is processed. Therefore N would be the number of resources. For example, task "1 0 0 1 1" corresponds to resources as below.

R1	R2	R3	R4	R5
1	0	0	1	1

This binary string shows a situation as below.

- This task needs resources R1, R4 and R5
- This task doesn't need resources R2 and R3

By definition of ORGMEM, a task which has more "0" is easier. On the other hand, a task which has more "1" is more difficult. A task whose bit are all "0" doesn't need any resources, therefore people can process the task by only their own knowledge. A task whose bit are all "1" needs all resources, therefore people have to access all resources. We define the difficulty of project by changing designer ratio of "1".

4. Data Design and Simulation Flow

We describe data design and simulation flow in this chapter. We have to design three key elements, six relations and every people's transactive memory in ORGMEM model. We design these values based on empirical fact. We have to note that our data design and simulation result don't represent real project exactly.

4.1 Project Size

One of the features of software development project is project size. We identify software development project three types; small size, middle size and large size. We define small size project has around 10 people, middle size project has around 50 people, and large size project has around 100 people.

We define three types of people in project; project leader, software designer and programmer. There are some other roles in real project, such as project manager, quality manager, librarian and so on. But we focus on designer ratio between software designer and programmer. Therefore we define minimum role other than software designer and programmer.

We suppose that small size project has eleven people; one project leader, 1 to 5 software designers and 5 to 9 programmers. We change designer ratio between software designer and programmer from 10% to 50% by 10%. Realistically there are more programmers than software designers in software development project. Therefore we set 50% as maximum ratio. It is impossible that no software designer in software development project. Therefore we set 10% as minimum ratio.

We specify people, resource and task as below.

People
L1: Project Leader
D1-D5: Software Designer
P1-P5: Programmer

Resource
R1: Project Management
R2: Requirement Definition
R3: Overview Design
R4: Detailed Design
R5: Programing

Task
T1: Project Management
T2: Requirement Definition
T3: Overview Design
T4: Detailed Design
T5: Programing

Matrix P x P defines the communication route in project. Figure 9 shows P x P in 2 software designers case. We specifically suppose a project as below.

- Project leader knows software designer, but doesn't know programmers

- Software designer knows project leader
- Software designer knows each other
- Programmers knows only themselves

We design programmers don't know software designers. It looks like unnaturally. But "programmer knows software designer" means that programmer can access all knowledge through software designers' transactive memory in our model. We suppose a project whose members don't have close relationship. Therefore we designed P x P as Figure 9.

We set values of Matrix in more programmers' case under the same concept.

	L1	D1	D2	P1	P2	P3	P4	P5	P6	P7	P8
L1	1	1	1	0	0	0	0	0	0	0	0
D1	1	1	1	0	0	0	0	0	0	0	0
D2	1	1	1	0	0	0	0	0	0	0	0
P1	0	0	0	1	0	0	0	0	0	0	0
P2	0	0	0	0	1	0	0	0	0	0	0
P3	0	0	0	0	0	1	0	0	0	0	0
P4	0	0	0	0	0	0	1	0	0	0	0
P5	0	0	0	0	0	0	0	1	0	0	0
P6	0	0	0	0	0	0	0	0	1	0	0
P7	0	0	0	0	0	0	0	0	0	1	0
P8	0	0	0	0	0	0	0	0	0	0	1

Figure 9 P x P (2 Software Designers Case)

Figure 10 shows P x R in 2 software designers' case. We specifically suppose a project as below.

- Project leader knows project management and requirement definition
- Software designer knows overview design and detailed design
- Programmer knows ONLY programing

	R1	R2	R3	R4	R5
L1	1	1	0	0	0
D1-D2	0	0	1	1	0
P1-P8	0	0	0	0	1

Figure 10 P x R in 2 Software Designers Case

Matrix P x T defines task assignment in project. Figure 11 shows P x T in 2 Software Designers Case. By using this matrix, the following situation is represented.

- Project leader does project management and requirement definition
- Software designer does overview design and detailed design
- Programmer does detailed design and programing

We set values of Matrix in more programmers' case under the same concept.

	T1	T2	T3	T4	T5
L1	1	1	0	0	0
D1	0	0	1	1	0
D2	0	0	1	1	0
P1-P8	0	0	0	1	1

Figure 11 P x T in 2 Software Designers Case

We define middle size project has fifty-one people; one project leader, 1 to 25 software designers and 25 to 49 programmers. We set values of other Matrix in middle size project under the same concept.

We define large size project has hundred-one people; one project leader, 1 to 50 software designers and 50 to 99 programmers. We set values of Matrix in large size project under the same concept.

4.2 Representation of Transactive Memory

Transactive memory plays an important role in our model. Every project member has their own P x R, which represents transactive memory. Figure 12 shows project leader's transactive memory in small size project in 2 software designers' case. By using this matrix, the following situation is represented.

- Project leader knows what software designers know and what they don't know precisely.
- Project leader doesn't know what programmers know.

	R1	R2	R3	R4	R5
L1	1	1	-1	-1	-1
D1-D2	-1	-1	1	1	-1
P1-P8	0	0	0	0	0

Figure 12 Project Leader's P x R

Figure 13 shows software designers' transactive memory in small size project in 2 programmers' case. By using this matrix, the following situation is represented.

- Software designers know what project leader knows.
- Software designers don't know each other's knowledge
- Software designers don't know what programmers know.

	R1	R2	R3	R4	R5
L1	1	1	0	0	0
D1	0	0	0	0	0
D2	-1	-1	1	1	-1
P1-P8	0	0	0	0	0

Figure 13 Software Designers' P x R

Figure 14 shows programmers' transactive memory in small size project in 2 software designers' case. We specifically suppose a programmers' transactive memory that programmers know only their own knowledge

We set values of Matrix in other programmers' ratio project under the same concept.

	R1	R2	R3	R4	R5
L1	0	0	0	0	0
D1-D2	0	0	0	0	0
P1-P7	0	0	0	0	0
P8	-1	-1	-1	-1	1

Figure 14 Programmers' P x R

4.3 Simulation Flow Chart

In real software development project, project manager considers ordinality of tasks, assign tasks to project members, and schedule project. We can reproduce such project manager's task on ORGMEM Model, but we designed very simple simulation model in this paper. We don't consider ordinality of tasks in our model. Ordinality of tasks is defined in T x T, but it isn't considered in simulation. On top of that, we don't assign tasks dynamically. Tasks are assigned to people in charge who is defined in P x T beforehand. The simulation doesn't include dynamic task assignment with consideration of schedule.

Ren et al. (2006) advocated ORGMEM Model, but the authors didn't describe simulation flow chart. Given this preceding study, we design our original simulation flow chart. We design simulation as sequential processing. People read tasks which are assigned to people, and process tasks in a sequential order. When all people accomplish all tasks, the simulation ends. Task assignment is defined in P x T beforehand. The values of Matrix are defined that a task has only one people in charge.

4.4 Algorithm of Knowledge Exploration

Ren et al. (2006) advocated ORGMEM Model, but the authors didn't describe algorithm of knowledge exploration. Sakuma et al. (2010) defined six types of knowledge exploration algorithm; "minimum effort" type, "risk aversion" type, "ask others" type, "acquire on my own" type, "broad retrieval" type and random type. From six types, we employed "minimum effort" type and slightly modified it. We define "orthodox" algorithm. "Orthodox" means that agents explore in order from their own knowledge to others' they don't know. We defined algorithm of knowledge exploration as below.

(1) First, the agents assigned to a task tries to process it by their own knowledge. Referring their own knowledge costs μ_1 steps.
(2) IF they could not process a task by their own knowledge, they try to fine who has the knowledge. (= They use their own transactive memory). Referring their own transactive memory costs μ_2 steps.
(3) If they don't know who has the knowledge, they ask "Who has the knowledge?" to whom they know. (=They use others' transactive memory whom they know). Referring others' transactive memory whom they know costs μ_3 steps per agent.
(4) If nobody knows, they ask the same question others whom they don't know directly. (=They use others' transactive memory whom they don't know). Referring others' transactive memory whom they don't know costs μ_4 steps per agent.

Appendix 1 shows the flowchart of resource explore and communication cost.

4.5 Definition of Efficiency

We define the total number of steps as communication cost, and we define amount of programmers' task as programmer cost. Therefore total cost would be summation of programmer cost and communication cost. Let ratio between programmer cost and total cost be efficiency. Definitional equation is as below.

$$Efficiency = \frac{\text{Programmer Cost}}{\text{Programmer Cost} + \text{Communication Cost}}$$

5. Variables of Simulation

We experiment without changing task or resources. We change some ratio or project size. Our model has four variables.

First is designer ratio between software designer and programmer. As we discussed in 4.3, we change designer ratio from 10% to 50% by 10%.

Second is difficulty of tasks. As we discussed in 3.1.3, we defined the difficulty of project by changing ratio of "1". We change ratio from 0% to 100% by 10%.

Third is project size. As we discussed in the beginning of 4. , we simulate in small size, middle size and large size project.

Last is communication weight pattern. Table 1 shows the way of explore and communication cost. It is obvious that $\mu_1 < \mu_2 < \mu_3 < \mu_4$. But designer ratio between μ_1 and μ_4 is different in each project. In a team whose members are easy to communicate each other, $\mu 3$ and $\mu 4$ are not so big compared to $\mu 1$ or $\mu 2$. In a team whose members are difficult to communicate, $\mu 3$ and $\mu 4$ are much bigger than $\mu 1$ or $\mu 2$.

We define value from μ_1 to μ_4 in Table 2. Pattern 2 has values which increases arithmetically from μ_1 to μ_4. Pattern 3 has values which increases geometrically from μ_1 to μ_4. Pattern 4 has values which increases exponentially from μ_3 to μ_4. We define pattern 1 as all value is 1 from μ_1 to μ_4 to compare to other pattern.

Table 1 The Way of Explore and Communication Cost

The Way of Explore	Communication Cost
Process tasks by their own knowledge	μ_1
Process tasks by their own transactive memory	μ_2
Process tasks by using others' transactive memory whom they know	μ_3
Process tasks by using others' transactive memory whom they don't know	μ_4

Table 2 Communication Weight Pattern

	μ_1	μ_2	μ_3	μ_4
Pattern 1	1	1	1	1
Pattern 2	1	2	3	4
Pattern 3	1	2	4	8
Pattern 4	1	2	10	100

6. Model Result

6.1 Communication Cost

Figure 15 shows that the relation between designer ratio and communication cost in small size, middle size and large size project (μ_1=1, μ_2=2, μ_3=3, μ_4=4). Graph tendency is the same in any size project. As we described 4.5., we define the total number of steps as communication cost. Figure 15 also shows that the more software designers, the less communication cost.

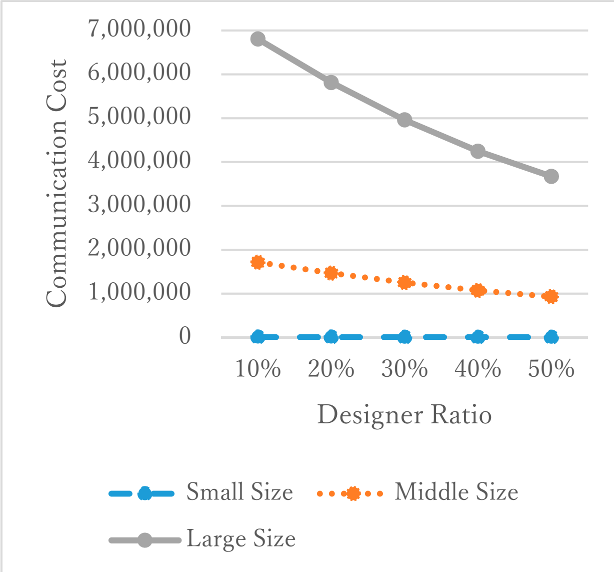

Figure 15 Relation between Designer Ratio and Communication Cost
(Task Difficulty = 50%, μ_1=1, μ_2=2, μ_3=3, μ_4=4)

Why does designer ratio have an effect on communication cost? Figure 14 shows that programmers know only R5. When programmers are required R1 to R4, they have to explore resources they need in the project member. Figure 14 also shows that they know only themselves. In such case, they have to ask to all other members till they explore all resources they need. The more software designers a project has, the more probability programmers have to explore resources they need. Therefore programmers explore R1 to R4 effectively when designer ratio is large.

On the other hand, software designers know R3 and R4 according to Figure 13. Figure 13 also shows that software designers know the project leader knows R1 and R2. In that case, software designers explore resources only when R5 is required. For that reason, the less programmers a project has, the more probability software designers have to explore resources they need, because they need to explore only in fewer programmers. In this case, software designers explore effectively when designer ratio is large.

Figure 16 shows how much effect of designer ratio was on software designer and programmer. Both software designer and programmer became more effective in larger ratio. The ratio has more effect on programmers. The reason is that programmers have to explore larger range of project members, when they are required resources they don't know. On the other hand, software designers explore resources only R5 is required. Therefore software designers explore resources only in programmers. In other words, software designers have to explore small range of project members. For this reason, the effect of designer ratio is smaller than programmers.

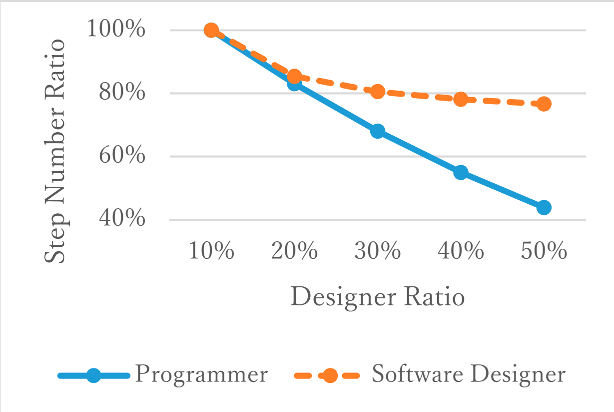

Figure 16 The Effect of Designer Ratio on Software Designer and Programmer

6.2 Efficiency

Figure 15 shows that communication cost and designer ratio graph is downward convex in any size project. Communication cost of large size project and middle size project is much larger than that of small size project, then small size project graph looks like flat. Actually the small size project graph is downward convex.

Table 3 shows that programmer cost decrease linearly when designer ratio increase. Therefore efficiency graph must be upward convex.

We describe efficiency difference when communication weight pattern and project size change.

Table 3 Programmer Cost in Small Size Project

Designer Ratio	Programmer Cost
10%	9,000
20%	8,000
30%	7,000
40%	6,000
50%	5,000

6.2.1 Communication Weight Pattern

Figure 17 shows that the relation between designer ratio and efficiency in some communication weight pattern in middle size project of task difficulty is 10%. As Figure 17 indicates, efficiency is the most around designer ratio 20% when communication weight pattern is (μ_1=1, μ_2=1, μ_3=1, μ_4=1). The more heavy communication weight is, the more designer ratio is the most efficiency. When communication weight pattern is (μ_1=1, μ_2=2, μ_3=4, μ_4=8), efficiency is the most around designer ratio 40%. The tendency is the same in small size project and large size project.

The result indicates that designer ratio should be larger when communication weight is heavy. Offshore software development project would have heavy communication cost, because they have to communicate through different culture, language, law and so on. Therefore it can be presumed from our model that larger designer ratio would be needed for offshore project compared to nearshore or onsite project.

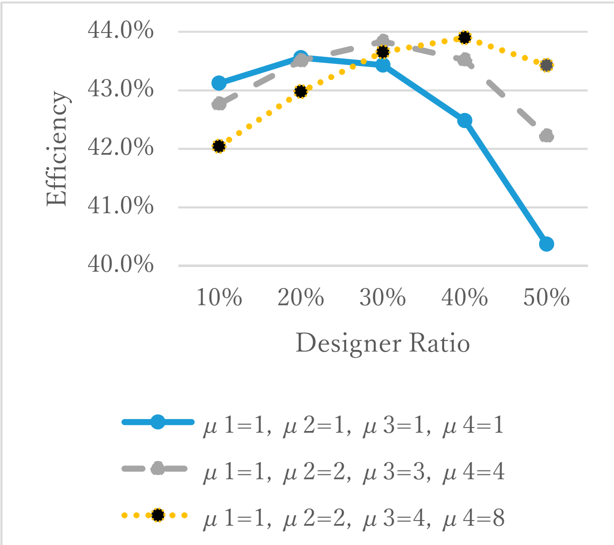

Figure 17 Relation between Designer Ratio and Efficiency in Some Communication Weight Patterns

6.2.2 Project Size

Figure 18 shows that the relation between designer ratio and efficiency in task difficulty is 10% (μ_1=1, μ_2=1, μ_3=1, μ_4=1). Figure 18 also shows that middle size project and large size project have similar curve, but efficiency peak ratio is larger in small size project. The tendency is the same in any communication weight pattern and task difficulty. Therefore it can be presumed from our model that larger designer ratio would be needed for small size project compared to middle size or large size project.

Model result depends on data design and algorithm of knowledge exploration. These result based on data design and algorithm of knowledge exploration we described in this paper.

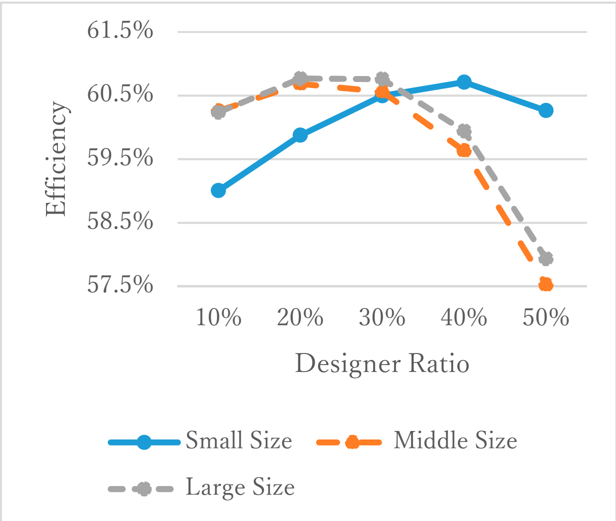

Figure 18 Difference between Project Sizes (μ_1=1, μ_2=1, μ_3=1, μ_4=1)

7. Conclusion

We proposed a model which represents software development project based on ORGMEM model. We simulated with changing designer ratio between software designer and programmer, task difficulty, project sizes and communication weight pattern.

The result shows that communication cost would decrease when designer ratio increase. In the aspect of efficiency, the best designer ratio depends on the project size. It can be presumed from our model that heavy communication weight project would be effective when they have larger designer ratio than ordinary project. It also can be presumed from our model that small size project would be effective when they have larger designer ratio than middle size or large size project.

We think we have some future works. We data designed simply in our model. We would like to approximate real project in the future. We didn't consider ordinality of tasks in our model. We didn't assign tasks dynamically neither. We would like to make model of ordinality of tasks and dynamic task assign as future works.

Acknowledgement

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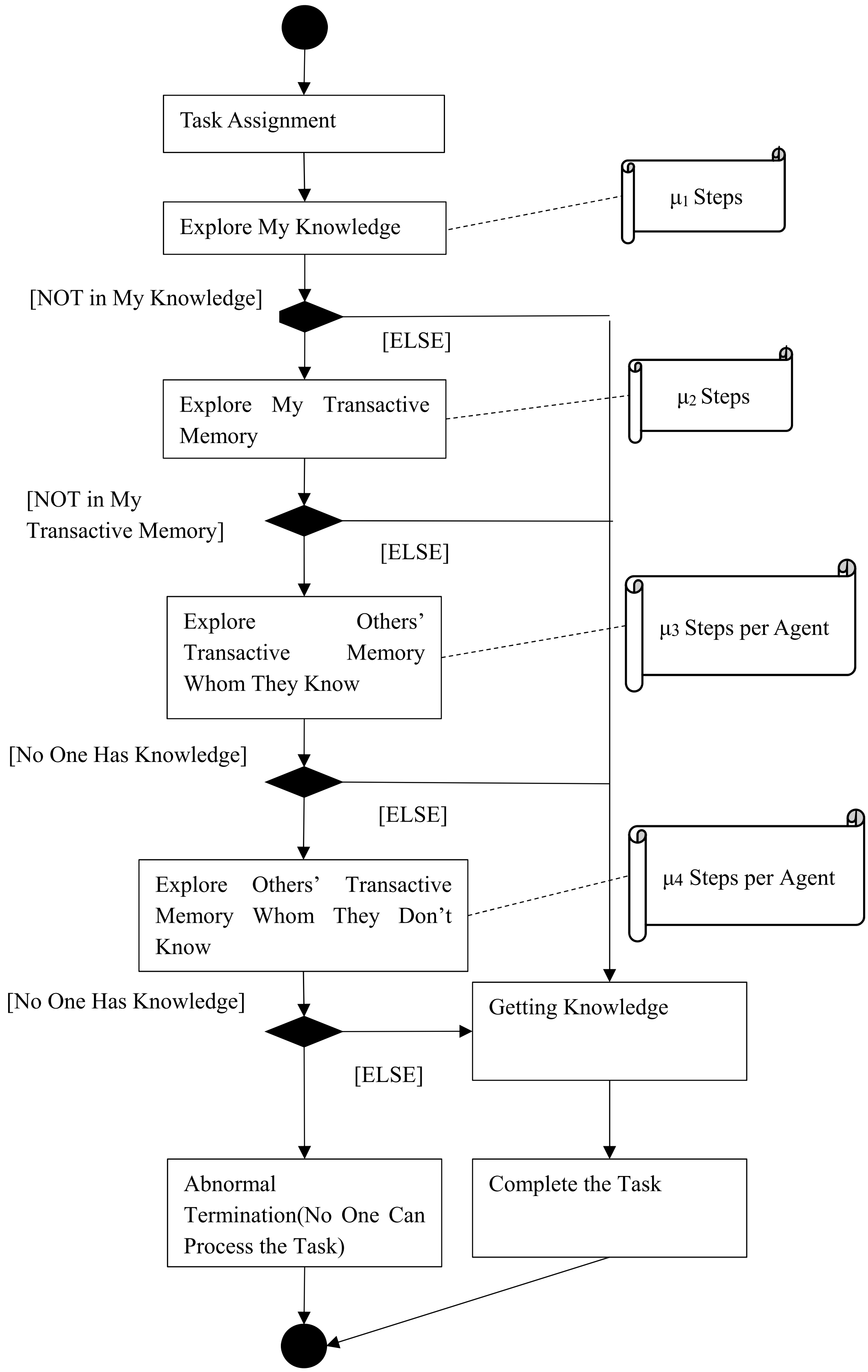
Appendix 1 Algorithm of Explore



Public Private Partnership Projects Failure Syndrome: The Paradox of Critical Success Factors (CSF) – The Case of South Africa

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Public -private partnerships (PPPs) as new project funding models were, and still are intended to respond to societal problems previously held as intractable. In all countries, the originality of PPP raises new questions of governance. These are: the problem of sharing economic, social, and political responsibility among various segments of society in the development of the country; and the adoption of new institutional forms to enhance the efficiency of government action. These issues are raised in both developed and developing countries, but with more acuteness in the latter. The ability of governments to provide adequate infrastructure through the treasury in future is likely to become a tall order. There are strong indications to suggest that strategic alliances between government and private sector will be extensively a new normal. Hence success should be considered as a constant. The paper concludes that South Africa doesn't compare very well with UK and Hong Kong but does compare very well with Australia in terms of CSFs for PPP implementation. The paper then recommends that the South African government should use CSFs for PPPs to inform/shape policy development and generate corresponding effective strategies for successfully delivering future PPP projects.

Keywords & Phrases: Critical Success Factors, Public-Private Partnerships, Funding the Gap, Budget Deficit, Funding Mechanisms

1. Introduction

African governments are faced with service delivery challenges and inadequate infrastructure, mainly due to lack of investments or insufficient funds, poor planning, poor project selection, insufficient or ineffective delivery and the deteriorated infrastructure that needs maintenance and/or replacing (Ahmed, 2014; Farlam, 2005; World Bank, 2014). The other challenge faced by governments is whether the infrastructure development offers value for money to taxpayers, as well as whether to finance the infrastructure development through the private sector or through the public sector. A variety of expedients have been tried in an attempt to provide new physical and social infrastructure without incurring new debt (Quiggin, 2004). Traditional procurement methods and funding of public infrastructure within SADC have resulted in projects being delivered late and over budget, with little regard for long-term costs or value for money (Rwelamila, 2009). Hence, governments are looking for public infrastructure funding alternatives that can overcome these funding gap challenges.

This infrastructure funding gap keeps growing in Africa due to a mismatch between demand (increased due to population growth and urbanisation) and supply (which has decreased due to lack of proper maintenance). Africa's total annual infrastructure expenditure needs is approximately US$93 billion, and governments are currently spending only US$45 billion, leaving a funding gap of roughly US$48 billion per year (Agence Française de Développement and World Bank, 2010). According to the Organisation for Economic Co-operation and Development (OECD) (2013), projects covered in the SADC Regional Infrastructure Development Master Plan (RIDMP) have estimated capital requirements of US$500 billion, with approximately US$100 billion of this amount expected to come from the private sector if the Plan is to be successfully rolled out over 2014 – 2027. This reinforces the point that there is a huge infrastructure funding gap in Africa.

It can be seen from above that public investment alone will not suffice to fund these infrastructure projects due to governments' budget deficit. The dilemma necessitates the requirement for private sector funding to supplement government's funding.

2. Research Problem Statement

According to Zhang (2005), there are various complex factors that can contribute to PPP project success and a number of these factors combine to determine the success or failure of a PPP project. What makes PPPs distinct from a traditional infrastructure development funding mechanism is the complexity of contractual relationships between PPP participants and the long concession periods (Kwak, Chih and Ibbs, 2009).

Despite a number of prior studies and research that have been carried out on CSFs for PPP projects, studies on CSFs for PPP project implementation in South Africa remain scarce. There is no study concerning CSFs for PPP project implementation which has been conducted in South Africa. Moreover, the unique characteristics of PPP to a particular country require a study on CSFs specifically for PPPs in South Africa. Hence, this paper fills the gap by investigating the CSFs for implementation of PPP in South Africa.

Given these challenges in PPPs, it is important to conduct research work to investigate, identify and analyze these various factors that are critical to the success of PPPs projects, particularly in the context of South Africa. The identification of the CSFs for these objectives will enable efficient allocation of limited resources. These CSFs help in the development of effective PPP policies and enable efficient allocation of limited resources.

3. Research Questions (RQs)

This paper focuses on the critical success factors (CSFs) for PPPs:

RQ 1: What are the critical success factors (CSFs) for PPPs as perceived by the clients, project managers, contractors and transaction advisers in South Africa?

RQ 2: What are the differences concerning CSFs between the public sector (clients) and the private sector (project managers, contractors and transaction advisers)?

RQ 3: How does South Africa compare with UK, Australia and Hong Kong in terms of critical success factors CSFs for PPP implementation? These countries have been chosen on the basis that there were similar studies done in those countries and there are research results from prior studies.

4. Hypotheses

In line with the research questions and objectives above, the following hypotheses were formulated and tested:

Hypothesis 1

$H1_1$**:** There are specific critical success factors (CSFs) for PPPs as perceived by clients, project managers, contractors and transaction advisers in South Africa?

$H1_0$: There are no specific critical success factors (CSFs) for PPPs as perceived by clients, project managers, contractors and transaction advisers in South Africa?

Hypothesis 2

$H2_1$: There are no specific differences concerning CSFs between the public sector (clients) and the private sector (project managers, contractors and transaction advisers)**.**

$H2_0$: There are specific differences concerning CSFs between the public sector (clients) and the private sector (project managers, contractors and transaction advisers)**.**

Hypothesis 3

$H3_1$: South Africa compares very well with UK, Australia and Hong Kong in terms of critical success factors CSFs for PPP implementation.

$H3_0$: South Africa doesn't compares very well with UK, Australia and Hong Kong in terms of critical success factors CSFs for PPP implementation.

5. Theory and Practice of Public-Private Partnerships (PPPs) & Critical Success Factors (CSFs)

5.1 What is a Public-Private Partnership (PPP)?

The National Treasury PPP Manual: South African Regulations for PPPs (2004) defines a PPP as:

> *".....a contract between a public sector institution and a private party, in which the private party assumes substantial financial, technical and operational risk in the design, financing, building and operation of a project."*

The private sector receives payment for performing the institutional function and this compensation is commensurate with the levels of risk, quality and timeliness of the service provision.

5.2 Types of PPPs

When it comes to PPPs, there are various PPP types used. Hodge and Greve (2009) argue that variations of PPPs come about due the fact that there are different risk profiles and risk allocation for each PPP. According to World Bank (2014), PPP contracts tend to bundle together multiple phases and these phases typically include the following:

- Design - engineering work done to produce design specifications
- Build - construct assets and install equipment or rehabilitate/extend existing assets
- Finance - to finance the necessary capital expenditure for the assets.
- Maintain - maintaining an asset over the life of the contract.
- Operate - the technical operation of an asset and/or providing support services.
- Own - own the asset.

The bundled phases include Build Operate Transfer (BOT), Build Own Operate Transfer (BOOT), Design Build Finance Operate (DBFO), Build Own Operate (BOO), Design Build Operate (DBO), Build Transfer Operate (BTO), Design Build Operate Maintain (DBOM), Operate and Maintain (O&M), Design and Build (DB), Design Build Operate and Finance (DBOF) and several other various types (Eaton and Akbiyikli, 2005). The types of PPP contracts are shown in Figure 1.

PPP projects involving new assets are called Greenfield projects (e.g. building a new Power Station, new hospital or new school) while PPP projects involving upgrading and rehabilitating existing assets are called Brownfield projects.

Public project ⟷ Private project

← Public-Private Partnership →

Contract Type	Public-sector procurement	Franchise (Afterimage)	Design-Build-Finance-Operate (DBFO)	Built-Transfer-Operate (BTO)	Built-Operate-Transfer (BOT)	Build-Own-Operate (BOO)
Construction	Public sector	Public sector	Private sector	Private sector	Private sector	Private sector
Operation	Public sector	Private sector	Private sector	Private sector	Private sector	Private sector
Ownership	Public sector	Public sector	Public sector	Private sector during construction, then public sector	Private sector during Contract, then public sector	Private sector
Who pays?	Public sector	Users	Public sector or users	Public sector or users	Public sector or users	Private-sector off taker public sector, or users
Who is paid?	N/a	Private sector	Private sector	Private sector	Private sector	Private sector

Figure 1 Types of PPP contracts
Source: Yescombe (2007)

There are also different PPP payment mechanisms. According to the World Bank (2014), the private party provides a service to users and generates revenue by charging users for that service (i.e. the user pays. e.g. toll fees), or the government is the sole source of revenue for the private party (i.e. the government pays. e.g. availability payments) or a combination of the two and in all cases that payment is contingent on performance.

5.3 Funding mechanisms of PPPs

According to the Public-Private Partnership in Infrastructure Resource Center (PPPIRC) (2016), there are three main financing mechanisms available for PPP projects and these are:

i. Project Finance – this is the most efficient and most common forms of financing for PPP projects and is typically used for new build or refurbishment contracts. It is quiet risky and lenders generally require that the SPV conducts a detailed due diligence on the bankability/viability of the project.

ii. Government Funding – the public sector may invite the private sector to bring efficiency and expertise while they, as government, funds some or all of the capital investment in the project.

iii. Corporate Finance (Balance Sheet Financing) - the SPV finances some of the capital investment for the project and fund the rest through corporate financing based on the balance sheet of the SPV (rather than the project itself). A key benefit is that the cost of funding is lower and less complicated than project finance.

5.4 Structure of PPPs

According to Yescombe (2007), the private sector consortium partners forms a special purpose company called a Special Purpose Vehicle (SPV) in order to In order to make a clear separation in terms of the long-term liabilities of a PPP contract and all the PPP transactions/payments are routed through that SPV. The SPV clearly defines the roles, responsibilities, liabilities and shareholding of each partner. The typical PPP structure is shown in Figure 2.

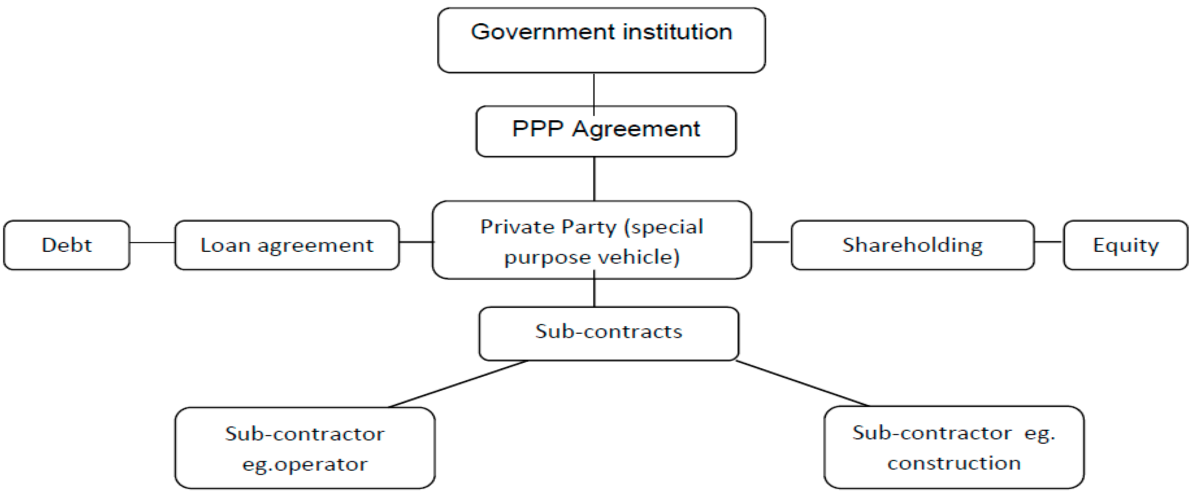

Figure 2 Typical PPP Structure
Source: National Treasury PPP Manual (2004); Helmy (2012)

5.5 Critical success factors (CSFs) for Public-Private Partnerships (PPPs)

According to Merna and Smith (1996), PPPs do not automatically lead to successful infrastructure projects as they involve various kinds of risks that emerge at different stages in the project life cycle. These PPPs are not mere infrastructure project development vehicles for governments to transfer all the risks to the private sector and thus shedding of all their responsibilities. Rather, PPPs require appropriate risk allocation, appropriate risk management and the PPP project should be well structured, otherwise, resources could be wasted and depleted. PPP project procurement should create a favourable environment where governmental support and private sector inputs are balanced in a win–win arrangement.

According to Rockart (1982); Kwak, Chih and Ibbs (2009); Boynton and Zmud (1984), Critical Success Factors (CSFs) as the key areas of activity that need to be focused on to ensure competitive performance, as well the core aspects where things must go right for the business to flourish, with a key focus of identifying the key areas essential to management success. Rowlinson (1999) asserts that CSFs are significantly important to help organizations to identify key factors that firms should focus on in order to have successful projects.

Prior studies, research and literature assessed the CSFs for PPP projects and have come up with various findings as summarized in chronological order below:

Tiong (1996) has identified six CSFs: (1) entrepreneurship and leadership; (2) right project identification; (3) strength of the consortium; (4) technical solution advantage; (5) financial package differentiation; and (6) differentiation in guarantees.

Tiong and Alum (1997) identified distinctive elements of the CSFs being: (1) technical solution advantage, (2) financial package differentiation, and (3) differentiation in guarantees.

Gupta and Narasimham (1998) provide additional CSFs being: (1) ability to provide a suitable transfer package, (2) built-in flexibility for future growth and changes, (3) supportive and understanding community, and (4) short construction period.

Jefferies, Gameson and Rowlinson (2002) and Jefferies (2006) identified and examined 15 success factors relevant to the project and the most significant CSFs include: (1) compatibility/complimentary skills among the key parties, (2) technical innovation in overcoming project complexity and (3) efficient approval processes. Other CSFs identified include (4) environmental impact, (5) developed legal/economic framework, (6) political stability, (7) selecting the right project, (8) existing strategic alliances, (9) good resource management, (10) trust, (11) community support, (12) feasibility study, (13) transfer of technology, (14) financial capability, and (15) consortium structure.

Jamali (2004) investigated the CSFs for PPP implementation in the telecommunication industry in Lebanon and the findings indicate that the basic foundational underpinnings of successful PPPs are: (1) trust, (2) openness and (3) fairness.

Zhang (2005) identified 47 CSFs for PPP projects, the five main CSFs being: (1) favourable investment environment, (2) economic viability, (3) reliable concessionaire consortium with strong technical strength, (4) sound financial package, and (5) appropriate risk allocation via reliable contractual arrangements.

Li *et al.* (2005) examined the relative importance of 18 potential CSFs for PPPs in the UK. The study concludes that the three CSFs are: (1) a strong and good private consortium, (2) appropriate risk allocation and (3) available financial market.

Chan *et al.* (2010) asserts that the CSFs for PPPs can be categorized into seven groups: (1) equitable allocation of risks, (2) strong private sector, (3) judicious government control, (4) transparent and efficient procurement process, (5) project economic viability, (6) adequate legal framework and stable political environment, and (7) available financial market. These identified CSFs provide an insight into key areas that are critical to PPP success.

Zhao *et al.* (2010) investigated the factors contributing to the success of thermal and wind power. These authors identified that the CSFs include: (1) the necessity for the project, (2) the expected debt paying ability of the project, (3) the financial capacity of the contractor, (4) level of project financing management of the project company, (5) level of business operation, (6) qualification of the contractor, (7) competency of personnel of the project company, (8) expected profitability of the project and (9) legal environment.

Abdul Aziz (2010) identified 15 success factors for PPP housing projects being: (1) action against errant developer, (2) robust and clear agreement, (3) reputable developer, (4) constant communication, (5) developers profit sharing accountability, (6) developers social accountability, (7) house buyers demand, (8) negotiation skills, (9) adequate negotiation staff, (10) realistic projection, (11) competition, (12) ample time to evaluate proposal, (13) political influence, (14) consistent monitoring, and (15) compatibility between partners.

Meng, Zhao and Shen (2011) investigated CSFs for urban water supply projects in China and identified that the CSFs include (1) project profitability, (2) asset quality, (3) fair risk allocation, (4) competitive tendering, (5) internal coordination within government, (6) employment of professional advisers, (7) corporate governance, and (8) governmental supervision.

Ng, Wong and Wong (2012) investigated CSFs of PPP at feasibility stage in Hong Kong and identified that the CSFs include (1) technical support and innovation, (2) stable and favourable economic environment, (3) sound financial package, (4) favourable social environment, (5) supportive political and legal framework, and (7) supportive project team and management actions.

Hwang, Zhao and Gay (2013) investigated PPP projects in Singapore and identified that the CSFs were (1) well-organized public agency, (2) appropriate risk allocation and sharing, (3) strong private consortium, (4) transparency in procurement process, (5) clear defined responsibilities and roles, (6) clarification of contract documents, (7) favourable legal framework, and (8) shared authority between public and private sector.

Despite a number of prior studies and research that have been carried out on CSFs for PPP projects, studies on CSFs for PPP project implementation in South Africa remain scarce. There is no study concerning CSFs for PPPs which has been conducted in South Africa. Moreover, the unique characteristics of PPP to a particular country require a study on CSFs specifically for PPPs in South Africa. Hence, this paper fills the gap by investigating the CSFs for implementation of PPP in South Africa.

6. Research Methodology, Instrument, Results and Synthesis and Analysis of Results

This paper takes a quantitative approach in line with deductive reasoning which starts with a theory, develops and tests a hypothesis in order to confirm or disconfirm the theory. According to Williams (2007), quantitative research creates meaning through objectivity uncovered in the collected data. Research strategies that are consistent with quantitative research strategies include experiments and surveys while qualitative research strategies employ action research, ethnography and archival research (Leedy and Ormrod, 2014). In line with its quantitative approach, this research paper employs the structured survey research strategy, which an extremely versatile, effective, efficient and economical way of gathering data (Blumberg, Cooper and Schindler, 2008). According to Crowther and Lancaster (2009), a structured survey research strategy makes use of a quantitative depiction of characteristics of a population by focusing on a representative sample of that population.

Therefore, the paper uses a quantitative approach and employs a structured survey research strategy, using a questionnaire to collect and solicit data about the respondents' (PPP practitioners') opinions on the relative significance of the CSFs for PPP implementation in South Africa. The questionnaire was self-administered via email and GoogleForms (web-based surveys). LinkedIn, a business and professional social networking site, is used as a database for collecting contacts of PPP practitioners in South Africa. The population in this paper comprises of South African PPP practitioners in both private and public sectors. Public PPP practitioners includes those from national government, local government and state owned enterprises while private sector PPP practitioners include financiers, designers, consultants, transaction advisers, contractors, operators, suppliers and sub-contractors. A sample of 86 respondents is drawn from both the private and public sector organisations in the PPP industry in South Africa using simple random sampling.

6.1 Data analysis methods

According to Saunders, Lewis and Thornhill (2009), data analysis involves the computation of specific measures and the searching for patterns and relationships that exist in the data gathered during the survey as well as to generate meaning from the raw data collected. This analysis helps to reduce a large number of items on the questionnaire to a smaller number which makes it easier to discover hidden patterns and relationships in the collected data. In line with the quantitative nature of this paper, descriptive and inferential data analysis is used to analyse the data collected. The Statistical Package for Social Sciences (SPSS) software and Microsoft Excel are used to analyse the collected data.

6.2 Research response rate

The population in this paper comprises of South African PPP practitioners in both private and public sector organisations (clients, project managers, contractors and transaction advisers). The population of PPP Practitioners in South Africa is estimated to be 110. A sample of 86 respondents is drawn from the population using simple random sampling. Eighty six (86) self-administered questionnaires are distributed to prospective respondents via email. A total of twenty five (25) responses were received. This resulted in a response rate of 29.1%. This is quite a high response rate, considering that the average response rate for e-surveys is around 15% (Kent and Lee, 1999). The high response rate could be attributed to the fact that the researcher made follow-ups and reminded respondents to complete the questionnaires. Sheehan and Hoy (1999) established that the use of reminders in a survey can increase the response rate by up to 25%.

6.3 Research results, synthesis and analysis of results

According to Razali and Wah (2011), normality test is used as a way of detecting departures from normality due to either skewness or kurtosis, or both. The Shapiro-Wilk test indicates that the research data is not normally distributed, meaning it is an uneven or a non-normal distribution. Having established that the distribution is uneven, non-parametric tests are used in the analysis of data. The reliability test is carried out to assess the extent to which the research instrument is a consistent measure of a concept. Cronbach's Alpha is used to test the reliability or internal consistency of the measuring instrument. The Cronbach's Alpha is found to be 0.724 which is above the 0.7 threshold for reliability.

(a) Success factors

The frequency of each Likert scale rating (1 to 5) for the success factor (frequency), the Likert scale rating given to a success factor by respondent (rating) and the total number of responses (N) are obtained from the analysis of the various groupings of success. These three (frequency, rating and N) obtained from the research results are then used to calculate what is known as Mean Scores for the eighteen (18) success factors.

The Mean Score method is used to establish the relative importance of success factors using the five-point Likert scale (1 = Least Important and 5 = Most Important).

Microsoft Excel is used to calculate Mean Scores for each of the eighteen (18) success factors and then rank the factors using the calculated mean scores, thus giving the relative importance of the success factors.

The Mean Score is calculated using the following formula:

$$\text{Mean Score} = \frac{\sum(\text{freq x Rating})}{\text{n}}$$

Where freq = frequency of each Likert scale rating (1 to 5) for the success factor;

Rating = Likert scale rating given to a success factor by respondent;

n = total number of responses

Table 1 shows the Mean Scores and the Rankings (relative importance) of each of the eighteen (18) success factors based on the overall respondents, as well as based on the sectors (i.e. public and private sectors). The public sector is the Client.

The results indicate that all eighteen (18) factors are perceived very important by respondents as seen in the mean scores ranging from 3.44 to 4.60 in Table 1.

Table 1 Critical Success Factor Mean Score Rankings

Item	factor description	Factor	Overall Mean Score	Overall Rank	Public Sector Mean Score	Public Sector Rank	Private Sector Mean Score	Private Sector Rank
1	Transparent procurement process	D2	4,60	1	4,56	1	4,60	4
2	Thorough and realistic assessment of the cost and benefits	C4	4,60	1	4,44	2	4,67	2
3	Commitment and responsibility of public and private sectors	C2	4,52	3	4,33	5	4,73	1
4	Appropriate risk allocation and risk sharing	B4	4,48	4	4,11	8	4,67	2
5	Political support	E1	4,40	5	4,44	2	4,33	8
6	Project technical feasibility	C3	4,36	6	4,22	7	4,40	7
7	Strong and good private consortium	E3	4,32	7	3,89	12	4,53	5
8	Favourable legal framework	B2	4,28	8	3,89	12	4,47	6
9	Well-organized and committed public agency	D3	4,16	9	4,44	2	4,07	12
10	Government Guarantee	F1	4,16	9	4,11	8	4,20	9
11	Competitive procurement process	D1	4,16	9	4,00	11	4,20	9
12	Sustainable procurement and operation	D4	4,12	12	4,33	5	4,07	12
13	Shared authority between public and private sectors	C1	3,92	13	3,89	12	4,07	12
14	Social support	E2	3,92	13	3,67	16	4,00	15
15	Available financial market	B5	3,92	13	3,56	17	4,20	9
16	Sound economic policy	B1	3,88	16	4,11	8	3,73	16
17	Stable macroeconomic condition	B3	3,72	17	3,78	15	3,73	16
18	Multi-Benefit Objectives	F2	3,64	18	3,44	18	3,73	16

Table 2 Success Factor Mean Scores & Rankings, including South Africa

		South Africa			Hong Kong			Australia			United Kingdom		
Code	Success Factors	n	Mean Score	Rank	n	Mean Score	Rank	n	Mean Score	Rank	n	Mean Score	Rank
C4	Thorough and realistic assessment of the cost and benefits	25	4,60	1	34	3,65	13	11	4,00	15	61	3,95	5
D2	Transparent procurement process	25	4,60	1	33	3,67	11	11	4,09	14	61	3,60	10
C2	Commitment and responsibility of public and private sectors	25	4,52	3	34	3,97	2	11	4,91	1	61	3,98	4
B4	Appropriate risk allocation and risk sharing	25	4,48	4	34	3,85	5	11	4,64	2	61	4,05	2
E1	Political support	25	4,40	5	34	3,44	17	11	3,36	17	61	2,81	18
C3	Project technical feasibility	25	4,36	6	34	3,56	15	11	4,63	5	61	3,79	6
E3	Strong and good private consortium	25	4,32	7	34	3,62	14	10	2,40	18	61	3,16	16
B2	Favourable legal framework	25	4,28	8	34	4,06	1	11	4,27	7	61	3,63	9
D1	Competitive procurement process	25	4,16	9	34	3,68	9	11	4,27	9	61	3,37	12
D3	Well-organized and committed public agency	25	4,16	9	34	3,65	12	11	4,27	8	61	3,74	7
F1	Government Guarantee	25	4,16	9	34	3,68	10	11	4,45	4	61	3,72	8
D4	Sustainable procurement and operation	25	4,12	12	34	3,76	6	11	4,27	6	61	3,56	11
B5	Available financial market	25	3,92	13	34	3,71	8	11	4,18	11	61	4,04	3
C1	Shared authority between public and private sectors	25	3,92	13	34	3,41	18	10	3,70	16	61	2,98	17
E2	Social support	25	3,92	13	34	3,91	3	11	4,64	3	61	4,11	1
B1	Sound economic policy	25	3,88	16	34	3,74	7	11	4,09	13	61	3,19	13
B3	Stable macroeconomic condition	25	3,72	17	34	3,85	4	11	4,18	12	61	3,19	15
F2	Multi-Benefit Objectives	25	3,64	18	34	3,5	16	10	4,20	10	61	3,19	14

(b) Comparison of PPP success factors between countries

Table 2 above shows the mean scores, rankings and number of respondents (n) for success factors from the four countries. The Table containing data from Hong Kong, Australia and the United Kingdom was adopted from Cheung, Chan, and Kajewski (2012) for comparison purposes with data obtained from South African respondents during this research paper (shown in Table 2).

(c) Answering Research Questions

Research Question 1

Table 1 shows that there is a unique list of success factor for South Africa. Hypothesis 1 is tested using the Kruskal-Wallis H test and the test results are highly significant ($p<0.05$) and therefore the Null hypothesis (H_10) that there are no specific critical success factors (CSFs) for PPPs as perceived by clients, project managers, contractors and transaction advisers in South Africa is rejected. It is therefore concluded that there are specific critical success factors (CSFs) for PPPs as perceived by clients, project managers, contractors and transaction advisers in South Africa.

Research Question 2:

Table 1 also shows the rankings of success factors by public and private sector PPP practitioners. Hypothesis 2 is tested using the Mann-Whitney U test and the test results are not significant ($p>0.05$) and therefore the Null hypothesis (H_20) that there are no

specific differences concerning CSFs between the public sector (clients) and the private sector (project managers, contractors and transaction advisers) is accepted. It is therefore concluded that there are no specific differences concerning CSFs between the public sector (clients) and the private sector (project managers, contractors and transaction advisers).
Research Question 3:

Table 2 shows the rankings of success factors by South Africa, UK, Australia and Hong Kong. Hypothesis 3 is tested using the Kruskal-Wallis H test and the test results are highly significant ($p<0.05$) and therefore the Null hypothesis (H_30) that South Africa compares very well with UK, Australia and Hong Kong in terms of critical success factors CSFs for PPP implementation is rejected. However, the Kruskal-Wallis H test tells you that you have an overall difference between your groups, but it does not tell you which specific groups differed. Further testing in the form of Kruskal-Wallis Post Hoc tests are done to confirm which specific groups differ. This reveals that South Africa doesn't compare very well with Hong Kong and UK, compares very well with Australia in terms of critical success factors CSFs for PPP implementation. It is therefore concluded that South Africa doesn't compare very well with UK and Hong Kong but does compare very well with Australia in terms of critical success factors CSFs for PPP implementation.

7. Conclusions and Recommendations

7.1 Conclusions

This paper examines the critical success factors for PPP implementation in South Africa.

Critical success factors for PPP implementation in South Africa:
The research results show that the top five success factors (or critical success factors) for PPPs in South Africa, in descending order of importance are:
i) Transparent procurement process (D2);
ii) Thorough and realistic assessment of the cost and benefits (C4);
iii) Commitment and responsibility of public and private sectors (C2);
iv) Appropriate risk allocation and risk sharing (B4); and
v) Political support (E1).
It is concluded that there are specific critical success factors (CSFs) for PPPs as perceived by clients, project managers, contractors and transaction advisers in South Africa.

Comparing CSFs for Public and Private sectors in South Africa:
'Commitment and responsibility of public and private sectors' (C2), 'Thorough and realistic assessment of the cost and benefits' (C4) and 'Transparent procurement process' (D2) are however ranked highly by both public and private sectors. These can be seen appearing on the top six lists of both private and public sectors. This is no surprise as they are the overall top three success factors in South Africa.

It is concluded that there are no specific differences concerning CSFs between the public sector (clients) and the private sector (project managers, contractors and transaction advisers).

Comparing CSFs for South Africa with UK, Australia and Hong Kong:
Commitment and responsibility of public and private sectors (C2) and appropriate risk allocation and risk sharing (B4) are in the top five of all four countries. This emphasizes the fact that PPP projects are long-term project and both parties (public and private sector) should stay committed for the duration of the partnership for it to be successful. This also illustrates the point that Risk allocation and sharing is a key factor in PPP procurement.

All the other factors are ranked differently in the four countries which interestingly are on different continents. This shows that the four countries are unique and different politically, economically and legislatively (i.e. they have different PPP policies and regulations). Hence, they implement PPP projects differently as they have different PPP policies and regulations.

It is concluded that South Africa doesn't compare very well with UK and Hong Kong but does compare very well with Australia in terms of critical success factors CSFs for PPP implementation.

7.2 Recommendations

The following recommendations are made to the government of South Africa:
Critical success factors for South Africa:
It is recommended that the government of South Africa use the list of CSFs for PPPs identified in this paper in informing and shaping policy development. They should use this paper of the CSFs for PPPs to better understand the success factors and to generate corresponding effective strategies for successfully delivering future PPP projects. Thus, it will help in the development of effective PPP policies.

It is further recommended that the identified CSFs for PPPs should be given utmost consideration by both the public and private sector parties. This will ensure successful PPP implementation and goes a long way to better serve South African tax payers who are the ultimate clients/end-users.

It is further recommended that PPP practitioners in South Africa use the CSFs identified by this paper to focus their attention on the few critical success factors and optimise the use of resources on real issues. They should prioritise addressing these few critical success factors and increase their chances of successfully implementing PPP projects. Thus, it will help enable efficient allocation of limited resources.

Sharing lessons learned Critical success factors for South Africa:

Most of the success factors are ranked differently in the four countries. This shows that the four countries are unique and different politically, economically and legislatively (i.e. they have different PPP policies and regulations). Hence, they implement PPP projects differently as they have different PPP policies and regulations. However, these countries can still learn from each other in terms of CSFs for PPP implementation.

It is recommended that countries should share lessons learned. However, each country will need to customise the lessons from other countries to their own unique environment. They can even participate in each other's project for a set timeframe in order to witness the various systems, policies and regulations of their peers in action so that they can bring back practical experience from the other countries.

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Case Study for Managing Stakeholders in Large Scale System Integration

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To keep QCD of a project, a project manager needs to quickly understand the situation and then take the most effective measures. In order to succeed in the QCD keeping process, relationship building with customers, group members and related organizations is required. I have introduced some marketing techniques and analyzed customers characteristics, market characteristics and customer behaviors so that I can build relationships efficiently, especially with customers. This presentation shows the process and mindset to satisfy key elements of project management such as scope control (which leads to QCD directly), development schedule, and cost negotiation with stakeholders including relationship building techniques, based on my experience.

Keywords and phrases: Stakeholder Management, Customer (Client) Characteristics Analysis, Marketing Method, QCD

1. Introduction

When an IT services provider manages a system integration project, there is a tendency to focus on risks involved with developing an IT system. For example, failure to adjust the scope of the project or a discrepancy in understanding the development schedule and sense of cost is, in general, treated as a risk item related to IT system development, and the ways to remedy these situations are established as part of various IT system development methodologies. This is based on a principle of forcing the scope of the project, schedule, and cost to fit the original plan. However, there are probably many cases in which this rigid way of managing a project creates an adverse effect. This is why I am now starting to change the focus slightly, and managing the projects by gaining accurate understanding of the market needs (users' needs) and looking at the users' trends, with the allowable limits taken into consideration. What I am starting to learn is the significance of communication with the stakeholders, mainly the users.

With regards to the trends in project management, the section related to stakeholder management was moved to the extension of the 10th knowledge area in the *PMBOK® Guide – Fifth Edition* (the latest edition is the Sixth Edition, published in September 2017), which was published in December 2012. In the Fourth Edition, this stakeholder management section was included in the knowledge area for communication management. One reason for the change is our current perception that "the important factors for a successful project are planning and managing the stakeholders' needs and properly engaging the stakeholders in the decision-making and other processes." To meet the stakeholders' needs and expectations, we need to interact with them continuously and address existing issues. Therefore, the project manager, who must actively work with the stakeholders, is expected to have the interpersonal skills to establish good relationships with the stakeholders. (Yamamoto, 2016)

On the other hand, with the current general perception that we should embrace diversity, an increasing number of people with different values are participating in our projects. Discipline alone based on a uniform way of thinking is not effective in driving these projects forward. For this reason, it is becoming increasingly important to lay the foundation for decision-making processes with stakeholder management in mind.

There are also various types of projects. For instance, if a project is related to the country's laws and regulations, this project will be heavily influenced by political agendas and the government's intentions and policies. With this type of project, it is essential to identify not just the hierarchies in the organizations (internal stakeholders), with the project managers for the client and IT services provider at the top, but also other stakeholders that may be involved indirectly (external stakeholders), and figure out the effective ways to deal with these stakeholders. This means, we need to lay the foundation for decision-making processes with the internal and external stakeholder management in mind.

Based on the factors above, this study first describes what I considered when I created the stakeholder management plans and acted accordingly in actual projects. Next, the study describes the summary of what I observed when the plans were executed. The last part in this paper describes the lessons we learned from these projects.

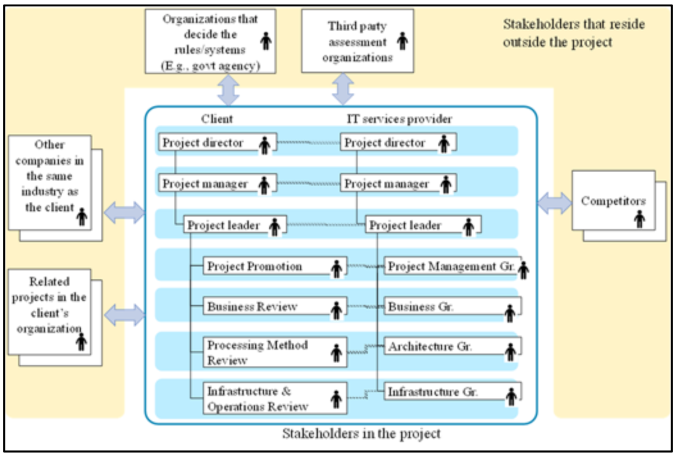

Figure 1 Internal and external stakeholders in a project

2. Overview of stakeholder management in PMBOK

According to PMBOK, we should manage the stakeholders while following the four processes below.

1) Identify stakeholders (Initiating Process Group)

Identify the stakeholders, analyze their interests and interdependencies, and document the results.

2) Plan stakeholder management (Planning Process Group)

Develop a management strategy for effective engagement by the stakeholders throughout the entire project.

3) Manage stakeholder engagement (Executing Process Group)

Communicate with the stakeholders throughout the entire project, and encourage appropriate engagement in the project.

4) Control stakeholder engagement (Monitoring & Controlling Process Group)

Monitor the overall relationship with the stakeholders, and adjust the strategies and plans accordingly for their appropriate engagement in the project.

The next section describes the actions I took with these four processes in mind.

3. Identifying stakeholders

3.1 Identify

As described in the previous section (1.Introduction) and Figure 1, there are internal and external stakeholders, and they have the following characteristics.

Table 1 Comparison of internal and external stakeholders

	Internal stakeholders	External stakeholders
Characteristics	Direct engagement Visible Generally similar psychologically	Indirect engagement Not visible Generally dissimilar psychologically
Examples	- Client representatives participating in the project - Company to which the IT services provider outsource - Company that provides the product used in the project	- Competitors - Other companies in the industry - Related projects - Third-party assessment organizations - Organizations that decide the rules and systems

The process of identifying the internal stakeholders and profiling them is relatively easy, but the way in which the external stakeholders can be identified is a difficult task. Some might gather information from various sources and pick out probable information from among disparate and inconsistent information, just for the purpose of identifying the external stakeholders. Once the stakeholders are identified, they still need to be tracked constantly, to confirm that they are true stakeholders. As the project progresses, we often find out later that the true stakeholder was in a different place. So again, we need to constantly monitor whether the identified stakeholders are true stakeholders through the entire project, and make corrections when necessary as we carry out the project.

3.2 Identify the internal stakeholders

The typical example of an internal stakeholder is the client. For example, the final judgment on QCD (quality, cost, delivery) is left to the client. In a project with good QCD, the quality, cost, and delivery schedule meet the client's expectations.

It is important to understand what the client is thinking, expecting, and prioritizing, share each other's thoughts, and figure out the end goal. To do so, we must cultivate trust with the client and be highly motivated to make the project succeed.

Cultivating trust with the client requires analyzing and understanding the client's characteristics. Aside from that, we need to also analyze and understand the client's interests with relevant parties and their interdependencies. See the figure 2 for details.

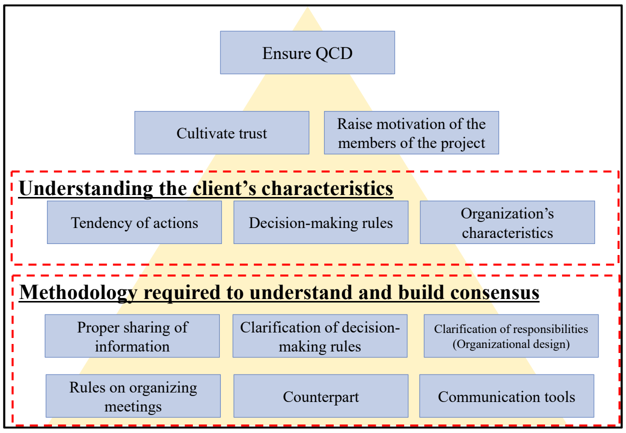

Figure 2 Ensuring QCD

The three factors (i.e., tendency of client's actions, decision-making rules, and characteristics of the organization and its leadership) in the figure 2 are important in ensuring QCD. The next section (3.2.x) reviews and analyzes each of these factors.

3.2.1 Tendency of client's actions

This is an analysis on the factors that drive the decision-making process, and these can be categorized into mainly three types.

1) Triggers that lead to actions

The client's actions are often influenced and triggered by market, competitive, legal (system), cost competitiveness, and other factors. The tendency of the client's actions reflects how the client prioritizes and acts for each of these factors (external threats).

2) Alternative and complementary relationships

The decisions are made by understanding the alternative and complementary factors. For example, the business specifications, system configuration, schedule, operation load, cost, and other factors are all related to each other. Thus, we should make decisions by assessing all the factors.

3) Individual and total optimization

The final decision in a decision-making process may vary depending on the perspective of the individual. If you are in a position to find an optimal solution for a limited scope, you should use that perspective to make the decision, but if the discussion is about the future vision or whole picture, you should use the perspective of considering the total optimization to find the solution.

3.2.2 Decision-making rules

It is important to identify who makes the decisions and how these decisions are made. This can be divided broadly into corporate rules/systems and stakeholders.

1) Corporate rules/systems

Rules and timings regarding approval processes and securing, execution, and modification of budgets.

2) Stakeholders

Decision makers and people that have large influences on others' opinions.

3.2.3 Characteristics of the organization and its leadership

It is also important to identify the characteristics of the client's organization and its leadership. You need to mainly identify the following two aspects:

1) Communication characteristics

It is important to understand how the stakeholders prefer to communicate. Some consider it important to honor the top-down approach, while others prefer the flat and open approach.

2) Organization's characteristics

Does the target organization have a compartmentalized (bureaucratic) structure with each division having clear authorities and responsibilities, or a flat (network-type) structure that allows open communication between different divisions?

This is not an either/or matter. Some organizations may have a structure where the characteristics vary between each layer. For example, the workers may have horizontal connections with the workers in other divisions, but the decision-making layer in the organization may be compartmentalized.

3.3 Identify the characteristics of external stakeholders

We need to also try to identify the characteristics of external stakeholders. This is about identifying the characteristics of external stakeholders, such as those described in Table 1, and use this information to create a plan that will be described in the subsequent section (4.Planning stakeholder management). The following are the main questions that should be asked in this step.

1) Are the stakeholders for or against the target project?

For example, a competitor may see our company undertaking the target project as negative. If this is the case, we may need to act and change the situation.

2) What are the current situations of the stakeholders?

For example, if one of the external stakeholders is another company in the same industry as the client, and their business is on an upward trend, the client might take an interest in the method used by this company, which is different from our method. This could potentially become a threat to our company.

3) Who are the stakeholders connected to?

Based on the backgrounds and interests of the external stakeholders, see what types of connections these stakeholders may have. Does someone involved in the project also have connections with the stakeholders? If so, do they have a good relationship?

4) What influences do the stakeholders have?

For example, a third-party assessment organization that has a large influence in the industry may exert its power on the target project.

4. Planning stakeholder management

4.1 Policy

In general, a management strategy should be formulated based on the policy below, after identifying the internal and external stakeholders and analyzing their characteristics.

> Let the project members achieve their full potential, by effectively managing the engagement of external stakeholders, and creating a sense of unity among the internal stakeholders.

For example, in an American football game, the offensive guards block the opponents to create a passing lane between the quarterback and wide receivers. The activities implemented against the external stakeholders are similar to the blocking schemes employed by the guards. If successful, the quarterback and the rest of the team can achieve their full potential and gain positive yardage on each down.

I will first summarize the plans for effectively managing the external stakeholders in section 4.2, and then explain the plans for allowing internal stakeholders to realize their full potential in these situations in section 4.3.

4.2 Plans for external stakeholder management

In a typical situation, external stakeholders do not participate in a project, and their involvement is usually indirect. Thus, a normal communication rule does not apply. In other words, we need another activity plan, aside from the communication rules defined for the project plan.

The following are the main factors to be considered when formulating an activity plan.

1) Select a counterpart who will approach the external stakeholder

Take the position/status of the target stakeholder into consideration when selecting the counterpart.

2) Timing of the approach

Take the status of the project into consideration when deciding when to approach the stakeholder.

3) Hypothesis

The counterpart will be approaching the stakeholder without knowing how he/she might respond. Therefore, we usually hypothesize how the situation might unfold and confirm the hypothesis before taking action. The hypothesis may turn out to be incorrect, but if this is the case, we should just create another hypothesis.

This cycle of planning and executing the plans on external stakeholders (external activity) may in some cases have a positive effect on the internal activity. On the other hand, we might hear about the internal activity from the outside. In short, it is important to understand that the internal and external activities are interconnected.

4.3 Plans for internal stakeholder management

For the internal stakeholders, it is important to create a sense of unity. The following aspects should be taken into consideration when formulating a plan.

4.3.1 Creating a sense of unity (Raising motivation in the project)

What is essential when building a good relationship with the client is that the project members are highly motivated.

High morale closes the distances with the client and heightens the sense of unity, and also produces a combined effect, such as raising the morale of everyone involved in the project.

To this end, a communication plan should be formulated with the following factors in mind.

1) Raising awareness on working towards the same direction/goal as one
   - Share and empathize the impending issues
   - Set goals for everyone
   - Foster a sense of belonging

- Create a common enemy

2) Creating an environment where everyone is willing to take the initiative
   - Motivation of others
   - Define and name each role
3) Do not take an all or nothing approach but instead provide multiple options
   - Coordinate with the alternative and complementary relationships in mind

4.3.2 Establishing communication rules

Communication rules should be established based on the items described in the previous section 4.3.1.

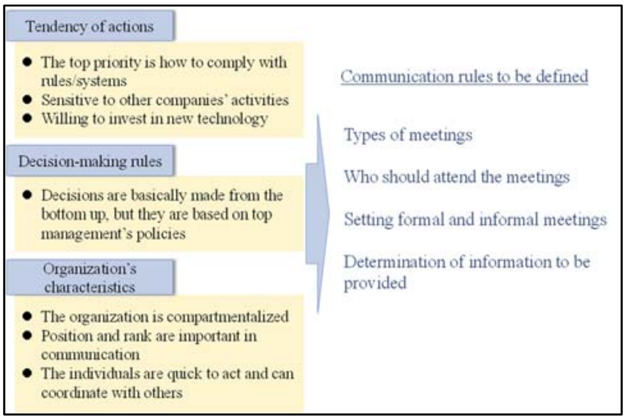

Figure 3 Example of client characteristics and communication rules that consider these characteristics

I established the rules based on the characteristics described in the figure 3. They are:

1) Select a counterpart based on the client's authority/position

Clarify who the target client is and then clarify the role of the counterpart who will interact with this client.

2) Determine the decision-making hierarchies for both the supplier and purchaser

Each layer in the decision-making hierarchy should be linked to a layer in the other decision-making hierarchy.

Each layer reports to the upper layer in this hierarchy.

3) Arrange regular meetings for each layer

Foster a sense of belonging to the project by having the members meet regularly.

Encourage the members to hold informal meetings beforehand by establishing a rule to hold formal meetings. Reinforce horizontal connections.

4) Hold networking events that transcend different layers

Create an opportunity where the project members can meet in person and build relationships (mutual recognition). This is not just about drinking parties. There needs to be clear distinctions between formal and informal events. Examples of formal events include technical presentations and project kickoff meetings.

5) Create an organization that links different segments horizontally and engage the leaders in each segment

This is a hybrid organization that has the characteristics of both the network-type and bureaucratic-type structure. It has an advantage of endorsing the current procedures being used and letting the members move more freely.

6) Research and share information on external factors (rules/systems and competitors' activities)

Share information on technology trends and trends in the client's industry.

Review where our company stands on these trends. The members will be reassured through information exchange. The presence of the project will also be felt.

5. Managing and controlling stakeholder engagement

In some cases, the position or perspective of the client may change due to what is happening in the world. An unexpected change may occur in other cases. Therefore, we need to regularly check where the internal and external stakeholders stand, and share the information with other project members.

For example, you should mainly check the following factors:

- Change in psychological connections
- Determination of whether he/she is a true stakeholder
- Emergence of a new stakeholder
- The (negative) effect of the project negotiation expanding to outside the project

In addition, client satisfaction should be measured regularly, using a particular benchmark. This allows you to see how the relationship of trust with the client has changed over time, and use this information to examine what should be done in the project.

6. Conclusions

The projects introduced as examples for this study had a high degree of difficulty, regardless of whether they involved a new client, new business area, or new method. I was, however, able to meet the deadlines for these projects, and their systems are running smoothly.

The direct impacts of employing stakeholder management were:

- Faster decision making
- Reduction in costs for preparation and review processes
- Reduction in coordination costs

However, the most significant achievement was probably the satisfaction of the client and employee.

I used the marketing techniques in our interactions with the clients, but I was also able to achieve the same achievements in our interactions with outsourced companies, using the same techniques.

If we get too concerned with the success of the project at hand and continue to make strong arguments, the relationship of trust may gradually erode. This may have a negative effect on our future business. Once the relationship is compromised, we will have to spend a significant amount of time to fix it. In other cases, the situation may change drastically with the change in management or mid-level executives. Unfortunately, the tide can turn in an instant. Your own position may fluctuate when other relevant projects succeed or fail.

I was reminded of the importance of carrying out the project management processes while remembering that there are various projects that are interconnected in terms of time and space and that I need to build a long-term relationship of trust.

Acknowledgments

I would like to express my heartfelt gratitude to those that provided support for this study in sorting out the examples and lessons learned.

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A novel framework of the video advertising business and its function

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The development of Information and Communication Technology (ICT) produces a variety of services. The lifecycle of those services are varied, short or long, depending on the popularity, price, usability, and so on. As a result, a provider wants to design and provide long-term services to maintain steady management. Hence, it is important that the key factors in designing essential services be clarified from the IT service management point of view. Our previous research points out that key factors are deeply related to extract customers' requirements. We apply the IT service management methodology such as who are stakeholders, constraints of the conventional companies and so on, in order to find key factors and designing new services in web advertising field. Web advertising is an effective way for enterprises, but people tend to be reluctant to see such content when viewing news sites or watching video, recently. Consequently, there is a possibility that conventional web advertising will become obsolete. Thus, this study firstly proposes a new web advertising method as a new business based on IT service management. Moreover, the required functions are clarified for this new business.

Keywords and phrases: Web advertising, Business model, Human behavior analysis, Matching algorithm, IT service management

1. Introduction

Broadband access services can be rapidly deployed by asymmetric digital subscriber line (ADSL) penetration. Moreover, fiber-to-the-home (FTTH), available in Japan since 2002, is an ultra-high-speed broadband access infrastructure.

Mobile gadgets, such as smartphones and tablet PCs, have high usability and performance, and can provide easy access to required information at any time and place.

These broadband access environments have enabled the wide use of not only information browsing, such as news sites and blogs, but also consumer-generated media (CGM), such as YouTube, Facebook, etc. These multimedia services have dramatically changed the modern lifestyle, and have made it possible for individuals to obtain and share information with ease. In particular, CGM is commonly used for various purposes such as hobbies, entertainment, music/movie promotions, etc.

Although these multimedia services are very useful, their content always includes advertisements. These advertisements sometimes result in decreased browsing speed. The reason these services include advertisements arises from the portal site's business model, which aims to earn large amounts of ad revenue. It is widely known that attaching advertisements to all content is highly effective. However, in some situations, people feel inconvenienced or frustrated, especially by low browsing and streaming processing speeds. This critical issue forces users to skip advertisements by any means, and worsens the image of enterprises. Like this situation, the lifecycle of these services are short or long, depending on the popularity, usability, comfort ability, and so on. As a result, a provider wants to design and provide long-term services to maintain steady management, while an enterprise makes advertisement efficiently. Therefore, it is crucial to establish a new advertising method that users will not block and will view widely.

This study proposes a new video advertising method that is expected to reduce user stress and enable effective advertising for enterprises as a new type of service based on the IT service management methodology. The basic idea behind the proposed method is not attaching advertisements to the main content, but rather having video advertisers create advertisement content, which they will then post on CGM sites. Moreover, in case of an increase in such video advertisers, a function is constructed.

The remainder of the paper is organized as follows: Section 2 describes the related literature. Section 3 explains a framework and focusing point of IT service management. Section 4 analyses user requirements and trends. Section 5 proposes a new framework/business model in the field of web advertising. Section 6 proposes the functions required for implementing the new business model. Section 7 presents the conclusion.

2. Related works

To properly manage the development of new ICT-related services, the modeling of customer and service relationships is essential. This can help to predict the direction of user requirements and allow for quicker reactions to technological and environmental changes. This area of study aims to systematize service design methods using a scientific approach. This method includes a view model and a scope model, in addition to a flow model as a sub-model (Naito, 2009). A service-modeling method (i.e., a service-design software tool) has been previously developed for specific services, such as restaurants and travel agencies, and has been assessed. For the acquisition of information regarding customer requirements for new services in the near future, new necessary functions focusing on billing management have been extracted (Iwashita and Tanimoto, 2016) based on the soft systems methodology (Checkland and Scholes, 1990). Moreover, extracting customers' major requirements is a key step in service design. In Iwashita (2017), the author discusses how the key factors for the design of new ICT-based services can be identified.

Regarding online advertisement distribution, several patents have been registered, such as the advertisement distribution mechanism that considers customers' preferences, the agent system that distributes web advertisements made by enterprises for consumers, the direct digital content trade system between sellers and buyers in real estate, etc. Such conventional business platforms' aims are mainly the efficiency of advertisement distribution and brokerage of the completed/finished products. The negotiation between enterprises and producers is necessary to build an image and to fully understand each other regarding future product/service development. However, no previous studies focus on the brokerage of future products under the enterprise and producer requirements.

3. Service strategy and design in IT service management

Information Technology Infrastructure Library (ITIL) is a famous framework for collecting way of thinking and methodology of IT service management. ITIL Ver. 3.0 by itSMF (http://www.itsmf.co.uk) includes five stages in service lifecycle management, namely service strategy, service design, service transition, service operation and continual service improvement. As for service strategy, its aim is for achieving effective and efficient service management. More precisely, understanding surrounding circumstances and deciding the project goal to achieve service provision are a first step. Then, clarifying the needs and trends of the target market, and deciding countermeasures to achieve the goal are a second step. As for service design, its aim is for providing concrete IT service to users. More precisely, it includes business process, service, customers' requirement, supplier etc. as service construction elements. We point out research steps based on these methodologies as follows.

- Trend of the target market
- Customer requirements
- Related players as stakeholders
- Conventional framework and extracting the current constraints

We take these steps to web advertising field from the next section.

4. Customer requirements for web advertising

Nearly all users are accustomed to viewing web advertising on websites and even CGM. This section examine users' current attitudes toward web advertising.

4.1 Web advertising business model

End users can search for any information free-of-charge using portal sites, and it is a common service today. The revenue of search portals, such as Google and Yahoo, mostly comprises advertising and posting fees from enterprises. For an enterprise, the more products' names/goods are diffused to the consumers, the larger the income expected from the purchase of their goods/products by consumers, as shown in the upper part of Fig. 1. In particular, most of Google's revenue (more than 90%) is obtained from advertising every year, as shown in the lower part of Fig. 1. Thus, the business model of search portals has been successful recently.

4.2 Customer attitudes toward web advertising

In this subsection, the trend of customers' attitudes toward web advertising is investigated. In (MyVoice, 2017), the questionnaire results show the users' attitudes toward web advertising in 2016, as shown in Fig. 2. The major attitudes are "feel stressed by the appearance of ads" and "feel stressed by the frequency of ads." Including "reluctant to view ads while using sites," these negative attitudes are dominant toward nearly 80% of web advertising today. Therefore, if no counter measures are taken, the damage caused by conventional web advertising will increase for enterprises.

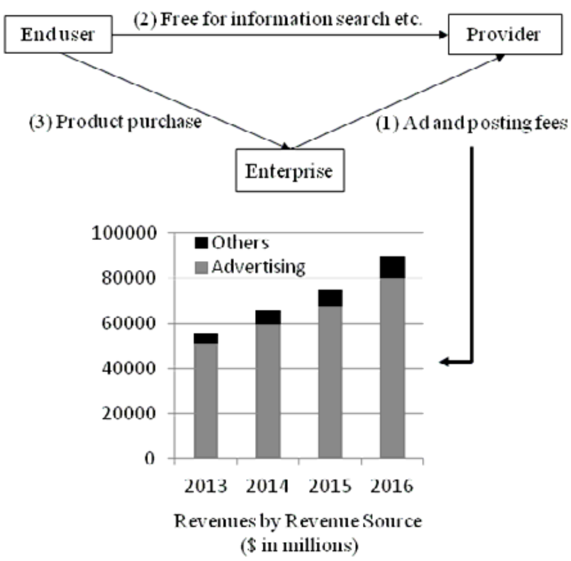

Figure 1 Business model for providers based on ad revenue

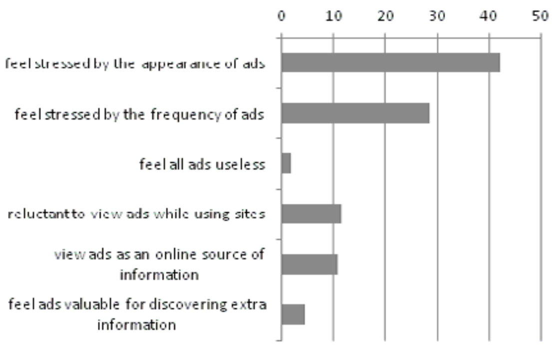

Figure 2 Customer attitudes toward online advertisements

Many users feel uncomfortable when viewing advertisements, and some users block web advertising when they read news, blogs, surf the Internet, etc. Several browser applications are available for blocking web advertising as shown in Table 1. These applications block not only spyware, malware, and advertisements, but also SNS buttons, comment cells, and customized fonts, which are seldom used. The selling point of these applications is enhanced browsing speed with optimized blocking rules and reduced data traffic.

Table 1 Browser applications for blocking web advertising

Ad-blocking applications	Summary
1Blocker	- customized selection of content to be blocked - free for one group to be blocked (free for two or more groups to be blocked) - block target: advertisements, tracking, SNS button, customized fonts, comment cell, adult sites
Adblock First	- light-weight content blocking in optimizing blocking rule - block target: advertisements
Adblocker for Safari Browser	- average page loading speed doubles - block target: advertisement
Adblock plus	- iOS extended version application of the well-known application in PC browsers - block target: advertisements, tracking
Clearly	- maximum page loading speed is four times faster - doubles battery life - data traffic is reduced to half - block target: advertisements, tracking, spyware, malware

4.3 Customer lifestyle characteristics

We also investigated what devices customers use for web browsing. Fig. 3 presents the percentages of the devices used to access CGM (MyVoice, 2017). While more than 50% of users utilize notebook PCs, followed by desktop PCs, the use of smartphones is relatively high at about 30%. Since smartphones are connected to the Internet wirelessly, the data transmission speed is poor compared with fiber optic. Thus, smartphone users try to access website quickly anyway.

Nowadays, many users block web advertisements. Fig. 4 shows the reasons why consumers use advertisement-blocking applications (MyVoice, 2017). A major reason is that they feel that most website and application advertising is useless. For website advertisements, more than 80% of users block ads because they consider them worthless. Moreover, nearly 30% use ad-blockers to improve browsing speed. Therefore, some browser advertisement-blocking applications are viewed as necessary by these users.

Today, many users watch free online videos via sites such as YouTube. The frequency of free video viewing by users, based on the results of (MyVoice, 2017), is shown in Fig. 5. The percentage of users that view free videos at least once a week is about 40%. Nowadays, video advertisements are included at the beginning of the content as instream advertisements. Therefore, the same situation (people feel inconvenienced by the video advertisements and want to block them) will occur for video ads in the future. This situation can be detrimental for enterprises because it reduces the impact of web advertising. From this viewpoint, a countermeasure is necessary as their advertising strategy.

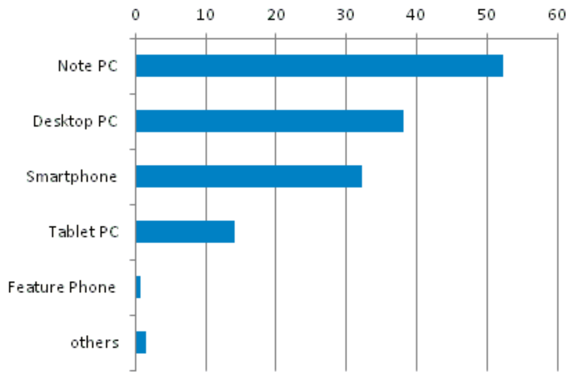

Figure 3 CGM use

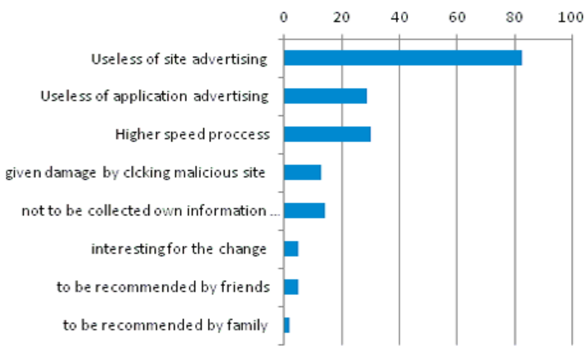

Figure 4 Reasons for using advertisement blockers

5. Framework of the new business model for advertising

The systematic establishment of a new business model is under way. Research regarding the development of new service functions is currently limited. Therefore, a previous study (Iwashita, 2017) focuses on finding the key factors influencing ICT-related new service design. To construct a new business model, the relevant players are classified, the problems of the conventional model are identified, and a counter-measure is evaluated.

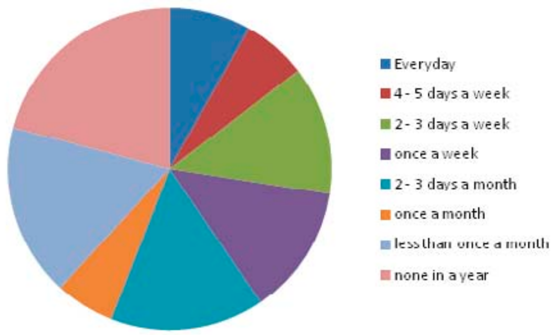

Figure 5 Frequency of customers viewing free videos

5.1 Classification of players

Various players, such as application service providers (ASPs), network service providers (NSPs), and Internet service providers (ISPs), are involved in the provision of info-communication services. First, we classify players based on the variety of their services. To systematize player classification for future new services and technologies, the three players concerned with info-communication services are classified as end users, providers, and content developers, as shown in Table 2.

Table 2 Classification of players in ICT

First category	Second category
End user: uses ICT services	Individual users (IU)
	Business users (BU)
Provider: provides a large amount of collected information to end users	Data Service Provider (DSP): provides sharing data for end users
	Application Service Provider (ASP): provides common applications
	Platform Service Provider (PSP): provides common platform
	Hardware Service Provider (HSP): provides common hardware
	Network Service Provider (NSP): provides transmission network
Content developer: creates and owns information/contents	Data holder, software holder

An end user is defined as a consumer using info-communication services at the "first category" level, and includes individual and business users at the "second category" level. Individual users' characteristics include age, gender, revenue, etc., while business users characteristics include user size, number of employees, etc. A provider provides collected information to the end users, and can be classified into five categories: DSP, ASP, PSP, HSP, and NSP. These categories belong to the "second category" level. Information service providers (ISP), management service providers (MSP), communication service providers (CSP), streaming service providers (SSP), contents integrators (CI), security service providers (SecSP), and point-service providers (PoSP) are examples of PSPs. A "content developer," who creates and owns information or content, is defined as a data holder, or software or application holder at the "second category" level.

5.2 Conventional web advertising framework

The conventional framework of web advertising is shown in Fig. 6. An enterprise produces and posts advertisement content on a content provider (procedure (1)). The content provider provides such content by slipping it into news as a banner, video as an instream advertisement, etc., for the public. Thus, consumers can easily see such content when they read the news or watch online videos (procedure (2)). Some consumers are inspired by the advertisement and purchase the products of the enterprise (procedure (3)).

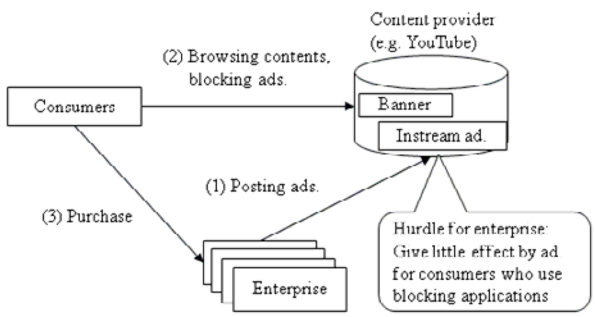

Figure 6 Conventional web advertising framework for enterprises

Since consumers are typically reluctant to view online advertisements, they install ad-blocking applications as described in the previous section. Consequently, enterprises have little impact on consumers through content provider services, which is a hurdle for enterprises.

5.3 Proposed web advertising business model

To resolve the problems of the conventional framework, we propose a new web advertising business model in this section. Since consumers mostly watch videos on content providers such as YouTube as described in the previous section, it is highly effective to advertise using video content. Moreover, this kind of video content is not included with other videos as commercials, but rather the video content is a posted as an individual work. The enterprise asks a video advertiser, for example, a YouTuber, to make and post an individual video. The number of views is a popular topic of conversation, and there are some people (e.g., YouTubers), who become the focus of attention nowadays. Thus, such video advertisers have a large influence over consumers and are expected to be effective for enterprises.

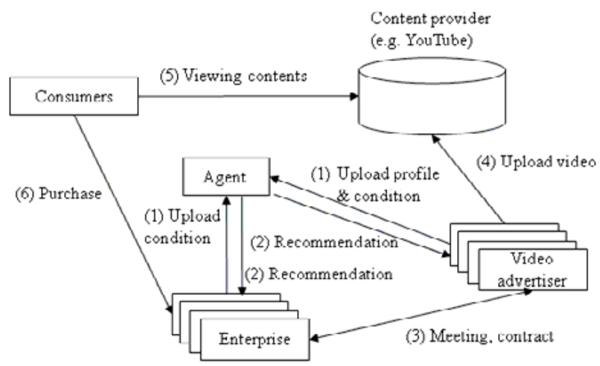

Figure 7 Video advertising model

The new framework is presented in Fig. 7. To achieve high quality and efficiency in producing video content, the agent matches the requirements of both the enterprise and the video advertiser. The agent collects information from both the enterprise and video advertiser in advance (procedure (1)) and then recommends each to the other under the condition of high matching ratio (procedure (2)). Subsequently, the enterprise and the video advertiser meet and sign a contract (procedure (3)). Finally, the video advertiser uploads the video content to the server of a content provider (procedure (4)). Consumers will watch the video content produced by a famous YouTuber (procedure (5)), and will want to purchase the advertised products (procedure (6)). In this way, consumers reduce their stresses with high browsing speed. Moreover, they can watch video content with comfort whenever they want. Multi-channel networks (MCN) have become famous for supporting individual video advertisers and are part of the scope of this framework. Maker Studios are famous in this field worldwide, while UUUM Co., Ltd. (https://www.uuum.jp/) is a Japanese forerunner in this field and works as a bridge between enterprises and YouTubers. However, focusing on this video advertising method, it is not enough for enterprises and video advertisers to be prepared, but an additional matching function must be included in the framework.

6. Matching algorithm for realization

Since MCN supports creating contents and promoting it for video advertiser, its role is very similar to that of entertainment agency for supporting artists. MCN also chooses its members by audition like entertainment agency. The number of entertainment agencies is about 500 in Japan. Since YouTubers have become widely popular today, the number of video advertisers will likely increase in the near future. As for MCN, that number is less than 10 now. However, the number of MCN type of companies will increase according to the increase of the number of video advertisers. This is because it is easy to establish MCN for individual, which is a similar point for entertainment agency. Consequently, it will become difficult for enterprises to select suitable video advertisers among the large number of MCNs and video advertisers. Therefore, the mechanism in which an agent matches an enterprise and a video advertiser adequately is required. The basic concept of matching algorithm is shown in Fig. 8.

The requirements of both enterprises and video advertisers are necessary for matching as inputs. The requirements of an enterprise comprises numerical data, such as content length, amount paid to the video advertiser, when the content will be posted, that is, release time, and textual data such as target product, content keywords, selling point, etc. On the other hand, the video advertiser's inputs also comprise numerical data such as confidence producing time, earnings, desired production time, and textual data such as confidence in the product, keywords of work produced in the past, own sales point, etc.

The matching algorithm works in the calculation part of the system. The degree of matching is calculated by the corresponding matching numerical/textual input data between an enterprise and a video advertiser. Therefore, many degrees are calculated from several viewpoints. Finally, the total matching degree is calculated by multiplying each degree with the weight of its input in advance by an enterprise.

The output includes the matching result, that is, who is the suitable video advertiser for an enterprise. Moreover, it is necessary to provide the matching algorithm with feedback, wherein an enterprise updates each weight.

Since this paper proposes the new framework according to the methodology of IT service management, we need the methodology of project management (PMBOK) and apply lifecycle processes such as initiating, planning, executing, monitoring & controlling, and closing processes to construct this new framework as a service successfully.

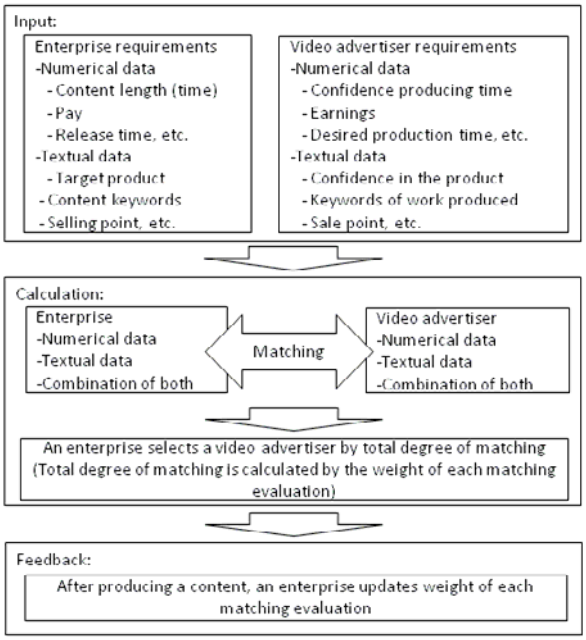

Figure 8 Matching algorithm

7. Conclusions

Web advertising tends ineffective for attracting consumers today. If this situation continues, enterprises will have to find new way of advertisement. This study proposes a new type of advertising, that is, a video advertising method in which a video advertiser posts content as an individual work, as a new advertising model according to service strategy and design in IT service management. Further, as the number of video advertisers increases, it is necessary to develop an efficient matching mechanism between enterprises and video advertisers for producing interesting content. Therefore, a matching algorithm is proposed as a necessary function to handle the increase of number of video advertisers.

The details of the matching algorithm, that is, how to calculate the matching degree according to numerical and textual data, and its development based on the methodology of project management requires further study.

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Managing Environmental Public Policy Projects and Integration of Risk Management as a New Paradigm – The Case of South Africa

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Policy development within the environmental sector across the world has improved significantly over the past two decades, highlighting the level of effort applied to conserve and manage environmental assets in a sustainable manner. This effort has been duplicated in South Africa, with high accolades bestowed for policy developed for water, environment and biodiversity management. What has emerged from recent studies is that policy development follows the same principles of project management, of which risk management and risk management expertise play a vital role. This paper reports the findings of a study which examined whether government environmental public policy makers in South Africa integrates risk management into project planning during their policy development process; it reports on the extent at which risk management is integrated during the policy development process; and makes recommendations on how policy and decision makers can improve the integration of risk management into their environmental policy development processes.

Keywords & Phrases: Public Environmental Policy Projects, Risk Management, South Africa

1. Introduction

Over the past two decades, the environmental sector's policies and policy development processes have improved significantly across the world, highlighting the level of effort applied to conserve and manage environmental assets in a sustainable manner. This effort has been duplicated in South Africa, with high accolades bestowed for policies developed for water, environment and biodiversity management (du Plooy and Nel, 2012; McAuslan, 2002; Sowman *et al.*, 2014).

What has emerged from recent studies is that policy development follows the same principles of project management (Shiferaw and Klakegg, 2012; Stephens, 2013; Subramanian and Urpelainen, 2014), of which risk management and risk management (RM) expertise play a vital role (Bertien and van der Ploeg, 2012; Zwikael and Ahn, 2011).

At an international level, especially when focusing on international treaties, policy development involves the participation of stakeholders from different sectors and countries to provide input and support to the policy development process. This implies that coordinated effort and resources are required to formulate the concepts, to draft the initial policy transcripts and to bring together different players from these participating countries and sectors to agree and endorse these policies (Subramanian and Urpelainen, 2014). These policy development efforts carry risk as each participating member has his or her own agenda and risk management (RM) becomes a fundamental issue.

Furthermore, risk has been defined in many ways, often incorporating industry specific terminology (Pidgeon and Butler, 2009). These definitions generally sound similar and have the same implications, but it is acknowledged that they also have very direct and significant implications for different industry specific needs. Risk management on the other hand is an important element of project management and is considered a core area in any project; hence the introduction of new tools to manage these risks.

Despite all this myriad of RM tools and products being developed, there are still some concerns being raised on their effectiveness within the project environment field (Benta, Podean and Mircean, 2011; Zwikael and Ahn, 2011). Even more disturbing is that some risk managers still struggle to use these tools and products because of lack of or limited training and knowledge in applying these tools. This further exposes the challenges that exist with regard to RM expertise.

In South Africa, the same principles of policy development applied at an international scale have been adopted at a local level. The policy development process in South Africa is often burdened with unintentional delays due to extended stakeholder consultation; delayed parliamentary approvals; and limited or lack of RM integrated into project management of these processes. These delays pose several risks that undermine the country's efforts to conserve and manage environmental assets.

These limitations undoubtedly affect policy development as RM is not clearly defined and outlined. There is relatively limited or non-existent information published in South African literature (and internationally) related to integration of RM into the environmental sector's policy development processes. It is anticipated that this research study will address this knowledge gap.

2. Integrating Risk Management into Policy Development – Theory and Practice

Risk is regarded as a possibility or chance of loss, exposure to misfortune, hazard or danger (Pidgeon and Butler, 2009; Van Der Pligt, 1996). It is also defined as an uncertainty that poses great challenge for most projects (Hillson, 2010). Risk is generally a condition that occurs when uncertainties emerge (Project Management Institute, 2013) and can occur in many different forms, such as known or unknown, quantitative or qualitative, and even real or imaginary (Shaw, Abrams and Marteau, 1999).

The study reported in this paper adopted the following definition: “Risk is an uncertainty that poses great challenges, whether known or unknown, quantitative or qualitative, and even real or imaginary to most projects”.

For lack of space and brevity extensive review of project risk management literature is not presented here but could be found elsewhere (for example: Pidgeon and Butler, 2009; Van Der Pligt, 1996; Hillson, 2010; Project Management Institute, 2013; Shaw, Abrams and Marteau, 1999; Thamhain, 2013; and She, Lu and Ma, 2012).

A rigorous literature trawl was conducted to evaluate whether there were any international or locally published articles on integration of risk management into policy development. This trawl yielded no published peer reviewed articles.

2.1 A brief global and local perspective

Several research studies have been undertaken on risk management and/or in policy development at a global and local level. Few of these studies are presented below. It is important to note that these studies cover a myriad of elements on risk management and/in policy making/development, but that they have not specifically addressed risk management integration into policy processes.

Rothstein and Downer (2012) compiled a report for the Department for Environment, Food and Rural Affairs (DEFRA) in the United Kingdom. DEFRA had recognised the need for a better understanding of the many forms that risk takes in policy-making, in order to improve policy decision-making, implementation and ultimately outcomes across the DEFRA departments.

Another study by Deere-Birkbeck (2009) elaborated that the use of risk assessment, management and communication practices in policy development is very important. This study confirmed that ‘risk’ should be interpreted as a knowledge practice for informing decision-making (especially at policy level) and an instrument for addressing risk related key issues

Macfarlane (2012) also mentioned that when governments develop new policies and implement programs to deliver on those policies, there was much to consider in terms of achieving good governance.

Research done in South Africa regarding risk management and policy development largely confirmed results done internationally and in most cases served to test theories adopted globally. Unfortunately, a trawl of South African peer reviewed published articles did not yield the desired material for integration of risk management into policy development.

2.2 Integrating risk management into environmental policy

Good environmental management is everyone's responsibility, including the risk manager (Dvir, Sadeh and Malach-Pines, 2006). Meeting the demand of a risk-free environment requires managers to use every resource available to them. For them, the key to dealing with risk exposures is the ability to successfully identify, analyse and manage those exposures (Teets *et al*., 1994). Environmental performance, environmental risk and risk management are of contemporary interest, but to date there is limited evidence on their relationships (Dobler, Lajili and Zeghal, 2014).

The environmental sector encompasses an array of stakeholders from different science disciplines, hence the study by Schaefer and Bielak (2006) which highlights that:

> *“To ensure science better informs the decision-making process, researchers and policy/ program managers need to understand and respect each other’s way of working, culture and operational timelines”.*

However, this research by Schaefer and Bielak (2006) stated that there is little practical guidance on how this should be done and even less documented experience with specific mechanisms that better link these two groups (i.e. researchers and policy managers).

A study by Thamhain (2013) claimed that managers often argue that no single manager or group within an organisation has the knowledge and insight for assessing multi-variable risks and their cascading effects. This study also cited that managers realize that, while analytical methods provide a critically important toolset for risk management, it also takes the collective thinking and collaboration of all stakeholders to identify and integrate risks management issues into any process.

Another equally vital challenge to integration of risk into any process was the lack of a “post-project review” step (Hillson, 2010). This was linked to the wider malaise of failure to identify lessons to be learned at the end of each process, denying organisations the chance to learn from its experience and improve performance on future projects (Hillson, 2010).

Hillson (2010) also mentioned that there are many risk-related lessons to be learned in each project or policy process, and the inclusion of a formal “Post-project Risk Review” would help to capture these, either as part of a more generic project meeting or as a separate event. Such lessons may include identifying which threats and opportunities arise frequently on typical processes, finding which risk responses work and which do not, and understanding the level of effort typically required to manage risk effectively.

Both studies by Thamhain (2013) and Hillson (2010) served to outline the need for collaboration of all stakeholders to identify and integrate risks management issues into any process and for setting up post-project reviews to identify and share lessons learned to improve performance.

Other research projects which have been carried out across the world include Holmes and Savgård' work (2009); Thamhain (2013); Hillson (2010) and Holmes and Savgård (2009).

It is fundamentally clear from this review that not much research has been compiled or published regarding the integration of risk management into policy making process.

3. The Problem

There are strong indications to suggest that extensive delays in current legislative updates and policy development processes caused by extended stakeholder consultation; delayed parliamentary approvals; limited or lack of risk management integrated into management of these processes. These delays pose several risks that can undermine the countries efforts to conserve and manage environmental assets in a sustainable manner.

One key issue that emerges is that these delays have a potential for creating protracted court cases where opportunistic stakeholders can take advantage of the legislative gaps and unlawfully undertake activities that go against conservation and environmental management.

Currently, there is limited information available on risk management integration into policy development within the environmental sector.

3.1 Research questions

The research reported in this paper attempted to answer the following questions (RQs):

RQ 1: Is the South African environmental sector integrating risk management into project planning during their policy development process?

RQ 2: To what extent is risk management integrated into project planning during policy development in the South African environmental sector?

RQ 3: How can the South African policy and decision makers improve the integration of risk management into their environmental policy development processes?

3.2 Research propositions

In addition to the research questions the following propositions (Props) were proved or disproved:

Prop 1: The South African environmental sector integrates risk management into project planning during the policy development process

Prop 2: Risk management is integrated into environmental policy development processes in South Africa

Prop 3: There are tools and potential recommendations to be made for policy and decision makers to improve the integration of risk management into environmental policy development processes.

4. Research Methodology

An exploratory and qualitative research approach was adopted for this study. This approach is regarded as more useful to answer the what, how and why certain phenomena occur/not occur as sought by the purpose, objectives and research questions of this study. Another reason for choosing a qualitative approach was that it provides an array of interpretative techniques which seek to describe, decode and translate the meaning, not frequency of certain occurring phenomena.

The research found the case study approach to be more suitable for learning more about risk management integration into the policy development process. Yin (2014) defined case study research as:

> *"….an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence is used".*

Case studies are theory testing, theory building (intended to develop a theory) and practice oriented. The main purpose of case studies is to contribute knowledge by identifying and describing not yet known variables (Yin, 2014).

The case study approach provided a platform for doing an in-depth evaluation of issues related to the research over a 20 year period, from 1994 to 2014. The other methods i.e. ethnography, phenomenography and grounded theory (Leedy and Ormrod, 2010) were found to be unsuitable for addressing the three research questions posed by the study.

Thirty five (35) potential respondents were identified and invited to participate in this study and only twenty (20) consented to the invite and completed the online questionnaire. Out of the twenty respondents who completed the questionnaire, only ten (10) were willing and available to be interviewed face to face or via telephone to provide more insight and clarity to the responses they provided in their answered questionnaires. The method for selecting participants and the sample size is explained elsewhere (Manaka and Rwelamila 2015).

Data collected from questionnaires was presented in tabular and graphic format while data collected from semi structured interviews was presented through graphics, a narrative or cognitive maps. Research findings from all data collected from questionnaires and interviews were then triangulated back to literature review for comparisons and indicated below. Summaries of these findings are presented under Section 5 with limited illustrations due to lack of space and brevity. Suffice to say that all illustration used in presenting results are found elsewhere (Manaka and Rwelamila 2015).

5. Research Results, Synthesis and Analysis

5.1 Context

It is important to emphasise upfront that focus on this study was placed on extracting expert opinions to establish information that was previously unknown. In order to achieve this, several data analysis techniques were used. These techniques included:

a) Content analysis: This technique was used to examine responses obtained from the questionnaires and interviews to see what themes emerge and how these themes relate to theory for comparisons.
b) Narrative analysis which looked at personal experiences and tacit knowledge provided by experts. This information was coded and the process of content analysis was followed (see Figure 1).
c)
d) Logical analysis which is an outline of generalized causation and logical reasoning process. Responses were displayed as flow charts and diagrams as well as written descriptions (Figure 1).
e) Quasi-statistical analysis: This technique was used to count the number of times a particular aspect is mentioned in the interviews or questionnaire as an estimate of frequency.
f) Closed ended questions that had a choice of "Yes" or "No", the responses were tallied and pie charts produced to illustrate the differences between the answers.
g) Closed ended questions that required respondents to choose from a list provided in the questionnaire (i.e. ranking and ratings using Likert scale, etc.), the results were tallied and descriptive statistics used to produce graphs, figures and tables.

Open ended questions that required expert opinions, common words or phrases were grouped into themes and the frequencies of these themes were tallied in order to determine which themes were dominant.

Figure 1 Process followed for content data analysis

- Information obtained from interviews and questionnaires were coded and categorised such that they will not be traced back to the participants for maintaining their confidentiality and privacy in line with ethical conduct of this study.
- Common words or phrases were summarised into concepts to develop cognitive maps. Cognitive mapping is a causal mapping technique where the words or phrases are presented as concepts which are then grouped into themes (Decision Explorer, 2014). This form of mapping provides an alternative means of gathering and structuring data. The themes are generally used to provide in-depth information and for comparisons.
- The themes that emerged from cognitive maps were discussed in a form of narratives; or,
- The frequencies of words and phrases were tallied in order to determine which emerging themes were dominant. The results were then presented as tables and figures.

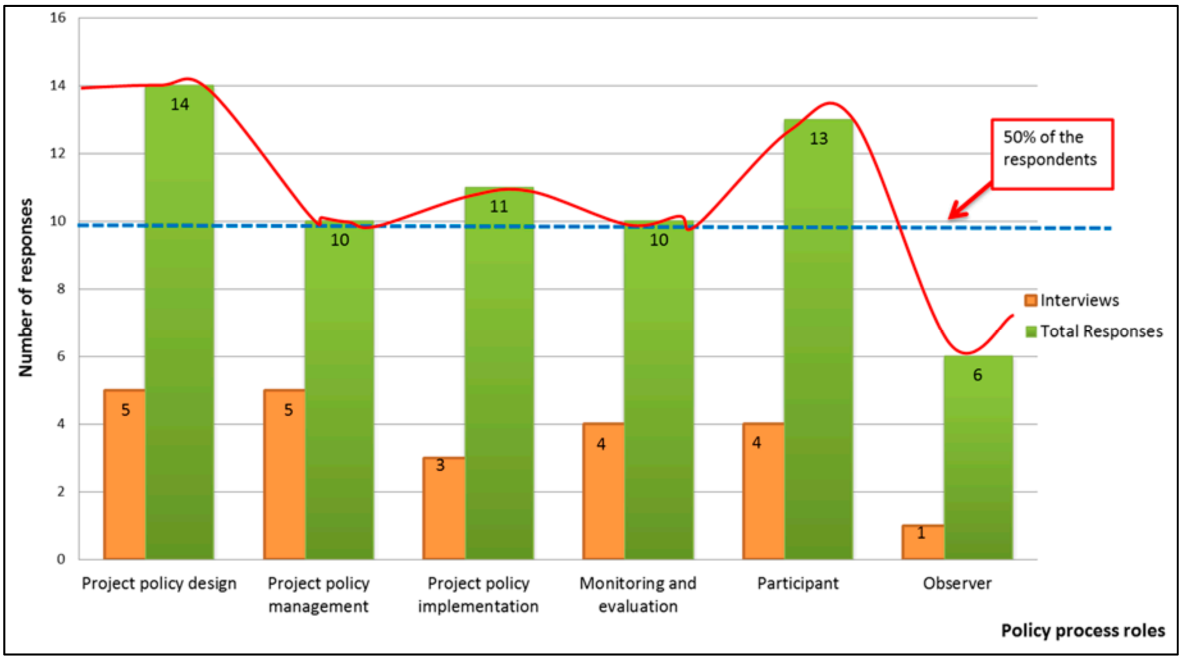

Figure 2 Roles held during the policy process

5.2 Role of participants during policy development process

Participants were requested to select all the roles where they had direct influence or management of the policy development process or where they were part of the team that developed policy. They were also given permission to select more than one role if they were engaged in more than one role during policy development processes. The results are presented in Figure 2

Figure 2 illustrates that in almost all the roles held during the policy development process, the majority of respondents (50% of the total responses) took part in the first five roles (design, management, implementation, evaluation and participation). The observer role seemed to have fewer responses where only six (6) respondents indicated that they held the observer role during the policy development process. This in a way indicates that fourteen (14) respondents did not take part as observers during any of the policy development processes they participated in.

5.3 Environmental Sector Integration of Risk Management into Policy Development Processes

Questions asked were to verify and determine whether policy and decision makers in the environmental sector integrate risk management into project planning during their policy development process.

(a) Defining risk management in the context of policy development:

Respondents were requested to select a definition they considered to be appropriate for defining risk management in relation to policy development. There was a list of seven (7) risk management definitions adopted from different sectors.

The results indicated that most of the respondents preferred:

> *"Risk management refers to the practice of identifying potential risks in advance, analysing them and taking precautionary steps to reduce/curb the risk".*

(b) Individual opinions and definitions of risk management in the context of policy: development

Firstly, all the words or phrases that were used the most for defining risk management were extracted from the responses in the questionnaires. The frequency or response count of these words were then tabulated and converted into percentages.

The results indicated that the majority of the respondents relate risk management to the identification, analysis, minimisation, assessment and mitigation of risk.

The results from the interviews and questionnaires indicated that risk management, regardless of the model or framework used, including the definitions provided by the respondents, follow the basic principles used by the risk management fraternity and only differs slightly in wording.

(c) Recognition of risk management as part of policy development:

Respondents were requested to provide their own opinion of whether policy and decision makers within the environmental sector recognised risk management as an important part of the policy development process.

The question intended to extract expert opinion of whether policy and decision makers recognised risk management as an important part of the policy process.

The majority of the respondents (14 out of 20 participants) agree that the South African environmental sector recognise risk management as an important part of policy development process.

The second part of the question was open-ended and required respondents to provide their expert opinion and understanding. All respondents completed the questionnaires and provided comments in the questionnaires while interviews with 10 of the respondents provided more insight with regard to these comments. Comments from the interviews were paired with comments from the questionnaire.

Two themes emerged from reasons offered from those who selected "No" and the themes were Theme A**:** Behaviour and Knowledge and Theme B: Capacity.

Four themes emerged from reasons offered from those who selected "Yes" and the themes were Theme C: Resources; Theme D: Implementation; Theme E: Expertise and Theme F: Engagements.

The two themes that emerged from those who said "No", who also mentioned that the sector does not recognise risk management during policy development are explained below. These themes were:

(i) Theme A: Behaviour and Knowledge

Respondents highlighted that some of the policy development managers and decision makers have limited training and skills, and this is further compromised by the fact that there are no set standards for integrating risk management during the policy process

(ii) Theme B: Capacity

Respondents highlighted that most policy decision makers and managers have limited exposure to risk management during policy development, have limited participation in risk management activities, and have inadequate capacity to implement risk management with regard to human resources, budgets and equipment.

The number of respondents that selected "Yes" as a choice was 14 out of 20 respondents. The reasons provided for making this choice were grouped into four themes. These respondents agreed that the environmental sector recognises risk management during policy development. These themes are explained below.

(iii) Theme C: Resources

Respondents indicated that risk management is recognised during policy development hence the reason why there is resource allocation for extensive stakeholder engagement to ensure that all stakeholder issues that have potential to cause risk are identified, quantified and addressed before, during and after the policy is developed.

(iv) Theme D: Implementation

Respondents highlighted that risk identification and risk management planning is done before policy is developed. They also mentioned that risk quantification is done so that risk management plans can be developed to regulate risk.

(v) Theme E: Expertise

Other opinions were that there are tons of tools developed and available for implementing risk management during policy development and that risk management principles are to a large extent followed (as is the case in any project) while in many instances, accountability and responsibility are assigned to various policy development role players and stakeholders to manage risk during policy development.

(vi) Theme F: Engagement

Respondents indicated that public participation/ engagement beyond just organisational participation was important as a way to mitigate risk by getting public opinion.

In summary, the majority of respondents agree that the environmental sector recognises risk management as an important part of the policy development process.

(d) Integration of risk management into policy planning during policy development processes:

Respondents were encouraged to provide their expert opinion on whether policy and decision makers within the environmental sector integrate risk management into their project plans during the policy development process.

The majority of the participants (13 responses) agree that policy and decision makers within the environmental sector integrate risk management into their project plans during the policy development process.

The second part of the question was open-ended and required respondents to provide their expert opinion and understanding. All 20 respondents provided comments in the questionnaires while interviews with 10 of the respondents provided more insight with regard to the comments made in the questionnaires. Comments from the interviews were paired with comments from the questionnaire.

Three themes emerged from reasons offered from those who chose "No" (7 out of 20 respondents) and the themes were Theme A: Expertise; Theme B: Knowledge and Theme C: Implementation. Respondents were of the opinion that the sector does not integrate risk management into their project plans during the policy development process. These themes are explained below.

(i) Theme A: Expertise

Respondents mentioned that there is no standard practice for risk management integration. They also mentioned that risk management is sometimes an afterthought.

(ii) Theme B: Knowledge

Respondents highlighted that there was a poor understanding of risk management, hence no risk management integration taking place; there was no identification and mitigation of risk during policy development processes; and no risk management strategy to deal with poor risk management in a policy development process.

(iii) Theme C: Implementation

In terms of implementation, the following comments were noted: integration of risk management into the policy process is not comprehensive; is often flawed; not effective and it affects policy processes and projects.

Furthermore, three themes emerged from reasons offered from those who selected "Yes" (13 out of 20 respondents) and the themes were Theme D: Process; Theme E: Management and Theme F: Strategies. Respondents were of the opinion that the sector integrates risk management into their project plans during the policy development process. These themes are explained below-

(iv) Theme D: Process

Some of the key comments mentioned in relation to process were that risk management integration does take place, especially when risk management challenges arise during the policy development process.

(v) Theme E: Management

In terms of management, the comments highlighted that risk management integration happens, although it is superficial and that there is room for improvement.

(vi) Theme F: Strategies

The final theme emerging from the comments is strategies. Respondents indicated that where there is a skills gap, risk management tends to be outsourced so that those with the expertise and knowledge can assist with the policy development process, making sure that all risk related aspects are addressed and integrated into the policy process.

5.4 Extent at which the Environmental Sector Integrates Risk Management during Policy Development

a) Project Management planning components where risk management is included during policy development planning:

Respondents were given permission to select more than one project management planning component.

Almost 10 of the 20 respondents consider risk management to have been included in the terms of reference, contracts, and budgets, monitoring plans and reporting.

b) Ranking of important risk management elements: The ranking scale was a point of reference to assess the extent of importance placed on each of the risk management elements. The results are presented in Figure 3.

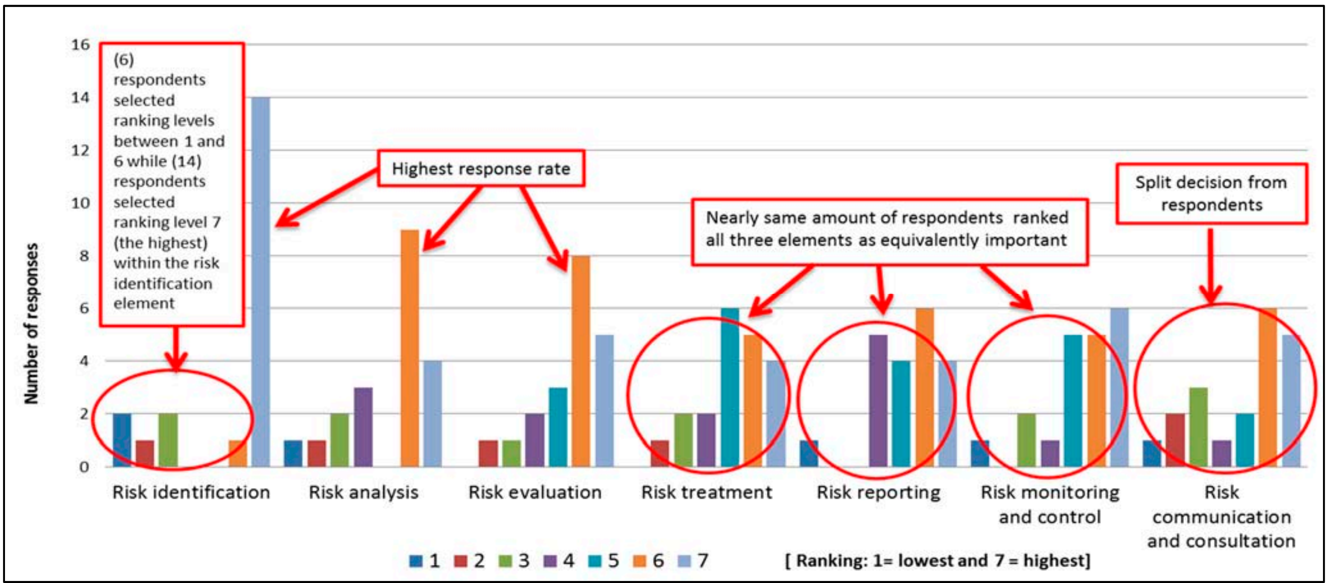

Figure 3 Ranking of important risk management elements

Results indicate that risk identification, risk analysis and risk evaluation received high ranking with risk identification ranked at level 7 (highest rank) by 14 out of 20 respondents, and risk analysis ranked at level 6 (second highest rank) by 9 out of 20 respondents while risk evaluation was ranked at level 6 (also at second highest rank) by 8 out of 20 respondents. This ranking implies that the majority of respondents were of the opinion that risk identification, risk analysis and risk evaluation are very important and are integrated into the policy development process.

In a nutshell, the results indicate that all the risk management elements presented in Figure 3 are important and comments from the respondents were very much aligned with what has already been reviewed in theory (literature review).

c) Ranking of extent of risk management integration into policy development processes:
The risk management elements included risk identification, risk analysis, risk evaluation, risk treatment, risk reporting, monitoring and control and communication and consultation. The policy development processes (also referred to as project management planning components) included policy design phase; policy work plan; budget; reports, and monitoring and control.

Respondents were given a choice of selecting ranking levels between "Very high, High, Moderate, Low and Very low". These ranking levels were used as a guide to distinguish the degree of integration of risk management elements into the listed policy development processes/planning components.

It was observed that in all five policy development processes/planning components, the majority of respondents selected the ranking level Moderate. This implies that most respondents (between 7 and 9 out of 20 respondents per policy process/planning component) considered risk management elements to be moderately integrated (or included) into the policy development process.

In summary, the findings confirm that the majority of the respondents agree that there is a Moderate extent of risk management integration into the policy development processes.

5.5 Improving the Integration of Risk Management into Environmental Policy Development Processes

a) Tools for improving risk integration into policy development processes:

Respondents were allowed to select more than one set of tools from the list provided in the research instrument. The list of tools included the following-
Risk identification tools (brainstorming, checklists, influence diagrams, cause and effect diagrams);
Risk analysis tools (probability and impact grids, event tree analysis, sensitivity analysis and simulation, Delphi techniques, expert judgement);
Risk response tools (influence predictability matrix, risk response planning chart);
Risk evaluation tools (decision tree analysis, portfolio management, multiple criteria decision making tools);
Risk reporting tools (risk register, risk management spreadsheets, organisational reports);
Risk communication tools (organisational reports, newsletters, lessons learned sessions/workshops, etc.).
The list of tools above was adapted from Zwikael and Ahn (2011) and Benta, Podean and Micean (2011).

In summary, it can be safely inferred that a majority of the respondents were of the opinion that risk identification, analysis, evaluation, reporting and communication tools are very important for improving integration of risk management into the policy development process. Risk response tools are also important even though these tools were selected by a few respondents.

b) Most preferred tools for improving risk integration into policy development processes:

Respondents were requested to select their top three most important risk management tools in order of preference along three scales of importance. The respondents were requested to select toolsets listed/identified in the research instrument.

Respondents were also given permission to identify additional tools that do not appear on the list provided, and to include those additional tools into the list of their top three most preferred tools.

The results indicate that participants regarded risk identification, risk analysis and risk communication tools as very important tools. These three tools were selected as first, second and third choice. Risk response and risk evaluation tools appeared with a priority rating on at least 2 of the 3 choices while risk reporting tools were selected as a third choice by only 2 out of 20 respondents.

These results strongly indicate that the respondents regard risk identification, risk analysis and risk communication tools as very important tools that can be adopted to improve the integration of risk into policy development processes.

c) Recommendations for improving risk integration into policy development processes:

Respondents were requested to select from a list provided, a set of recommendations they regarded as important for improving the integration of risk management into policy development processes. Respondents were also given permission to select more than one recommendation from the list.

It was evident from the results that all recommendations were considered to be important and that the following choices of (a) risk management included in policy design and (b) risks documented (i.e. lessons shared) received the highest responses. All recommendations identified in the questionnaire were selected by more than 10 respondents (above the blue dashed line that highlights the half mark of 20 respondents).

d) Most preferred recommendations for improving risk integration:

Respondents were requested to select their top three most important recommendations they consider as a priority for improving the integration of risk into policy development processes.

The results indicate that all of the recommendations were selected as important for improving the integration of risk management into policy development processes. Risk management included in policy design received an overwhelming 14 out of 20 responses (as a first choice/most preferred choice). None of the respondents selected this recommendation as a second or third choice, indicating that the majority of respondents were of the opinion that risk management issues should clearly be integrated into any policy design phase.

Participants also regarded (a) risk tools identified and used; (b) skilled and capacitated managers; (c) classification and quantification of risk and (d) risk documented and lessons shared as very important recommendations. These four recommendations were selected as first, second and third choices. The recommendation on risk communicated clearly received a priority rating on at least 2 of the 3 choices.

5.6 Summary of Results against Research Propositions

The following section provides a review of the results and prove/disprove these results against the Research Propositions. This process evaluates whether the Research Propositions identified for this study have been proved or disproved.

a) Research Proposition 1:

Proposition 1 was DISPROVEN since all the research findings clearly confirmed that the sector regards risk management as important for integration into policy development processes.

b) Research Proposition 2:

Proposition 2 was DISPROVEN since the research findings strongly confirmed that risk management matters are included during policy planning; and most risk management elements were ranked as important and integrated into policy design phase, work plans, budgets, reports and monitoring and control.

c) Research Proposition 3:

Proposition 3 was PROVEN. Current and future identified risk management tools require a better coordinated and managed modality so that risk management can be appropriately integrated into the sectors policy development process.

6. Conclusions and Recommendations

The study reported in this paper achieved its main purpose of assessing whether the South African environmental sector integrated risk management (RM) into policy development processes. It was evident from the literature review that extensive research has been carried out locally and internationally on RM, and that little to no information is available on RM integration into policy development processes.

6.1 Conclusion

a) Integrating RM into project planning during policy processes

The South African environmental sector integrates RM into project planning during policy development processes, amid some of the gaps and challenges already identified from the study.

b) Extent of RM integration during policy development

There is a moderate extent of RM integration during environmental sector policy development processes. Most RM elements are regarded as important for integration into the policy process, and get included in almost all project management planning components.

c) Improving integration of RM into policy development processes

The study was not able to retrieve convincing expert opinion on how environmental policy decision makers can improve the integration of RM into policy processes. It all goes back to RM training, skills development and expertise, hence the reason why it is important for these decision makers to have the necessary training in order to be able to identify and address any RM issues, as well as apply the tools and frameworks available at their disposal.

d) Limitations of this research study

This study was unsuccessful in collecting secondary data to generate a time series analysis to compare the time it took to develop environmental policies since 1994 to date, as well as to interrogate how RM was practically integrated into those policy development processes.

Some of the key environmental sector policy development champions earmarked for participation in this study could not take part in this research because they were already heavily committed to other engagements linked to midterm reporting of the MDG, SDG, CBD and amendments to local and national environmental legislation.

6.2 Recommendations

a) Environmental sector RM communication strategy

It is recommended that the environmental sector create a clear communication strategy that will enable the sector to have a common goal with regard to RM, especially in terms of how risk is defined and applied in relation to policy development. This will eliminate the misuse of concepts and words (those that are used interchangeably) which tend to result in misinterpretations.

b) Capacity and skilled experts

It is recommended that the environmental sector raise awareness on RM matters and the integration of RM into policy development through skills development, training and capacity building initiatives.

c) Sector specific RM frameworks and models

The sector should develop “environmental sector specific RM frameworks and models” (re:

management, strategies and processes) that will serve as fundamental sign posts for elevating the importance of RM integration during policy development. These frameworks and models can provide guidance and benchmarks for the sector when RM is adopted and integrated during policy development.

d) RM tools and ranking standards

Policy decision makers should understand and obtain in-depth information regarding RM tools, their application and how they can be prioritised. These decision makers should also conduct more research on the description and use of RM tools and how to integrate them into policy development processes.

e) RM implementation protocol and best practice

Decision makers should develop an implementation protocol for integration of RM into policy processes. This protocol should be an integral part of the project life cycle of the policy development process.

f) Further research studies

The following are potential areas for future research around this topic -

Profiling of environmental policy developers, looking at their academic or professional qualifications, and number of years involved in developing environmental policies. The intention should be around looking at the current skills level, in relation to RM and trying to match this with the type of training and capacity building required.

Research on RM tools, assessing which tools and sub-tools are available and how these can be integrated into policy development processes.

Conducting a time series analysis of South African environmental sector policies developed between 1994 and 2014, and how RM was integrated into these policies.

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Consistency among Strategies, Innovation Models and Project Styles

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According to a recent survey of major global manufacturers, producing innovation that follows the company's strategic approach is a top concern. From the viewpoints of the source of profit and the factor of profit creation, these strategic approaches are classified into next four types: resource, positioning, gaming, and learning approaches. On the other hand, innovation has the following four models in order of appearance: linear, Kline, hypothesis testing, and interactive models. However, it has not been clarified which of these innovation models fits into which strategic approach. That is considered to be one of the reasons why innovation according to strategy cannot be realized. Therefore, in this research, firstly, by analyzing the combination of strategic approach and innovation model of success cases in various industries, it was clarified that the optimum combination of both is as follows: resource approach and linear model, positioning approach and Kline model, gaming approach and hypothesis testing model, and learning approach and interactive model. In order to realize innovation according to the strategy, it is necessary to select a project management method suitable for the model. As a result of this research, it is suggested that the agile method is effective in realizing innovation of hypothesis testing model and interactive model.

Keywords and phrases: Strategy, Innovation Model, Project Style

1. Introduction

Recent efforts like the Industry 4.0 in Germany and Industrial Internet Consortium (IIC) in the United States have been remarkable (Murai, et al., 2016, Og, 2015). They aim to apply new technologies, such as IoT (Internet of Things), Big Data, AI (Artificial intelligence), and Block Chain (Kato, 2016), among others, to the industry in order to realize high added value and productivity. In response to these movements, the Japanese government has drafted a concept to link these new technologies to the realization of a super smart society called “Society 5.0” (Cabinet Office, 2016). This new society follows the hunting, agricultural, industrial, and information societies. In order to realize it, it is necessary to utilize the ICT as much as possible and to combine both cyber and physical spaces (real world). Many companies regard such a change in the external environment as a great business opportunity (Porter and Hepplemann, 2014 and 2015). Therefore, each company formulates the most effective strategy for its company, and aims to realize innovation according to it. However, according to KPMG's report “Global Manufacturing Outlook (2013),” the biggest concern of the top management of 300 major companies in the world is the realization of strategy-based innovation.

Various management strategies and innovation models have been studied so far (Study Group of Management Strategy, 2008). However, there are no research reports on the selection of an innovation model that follows management strategies, which is troubling to the top management of major global companies. In addition, to the best of our knowledge, there are no research reports on the choice of project styles suitable for various management strategies and innovation models. Therefore, in response to the research background and problem mentioned above, the primary objective of this research is to clarify the combinations of innovation models suitable for strategic approaches. The second objective is to suggest guidelines for selecting project styles that match combinations of strategic approach and innovation model.

In this paper, first, the author studies literature on strategic approach and innovation model to clarify the characteristics and essence of each. Next, the author examines the relationship between the two, and hypothesizes the optimum combination. The validity of the hypothesis is verified in the case of seven industrial fields in Society 5.0. Furthermore, the author will examine the project style that fits the combination of each strategic approach and innovation model, and present the results as guidelines.

2. Survey results of previous research

In this chapter, the author describes the results of the previous research on strategic approach, innovation model, and project style.

2.1 Four strategic approaches

Numerous strategic management theories have been studied by predecessors so far. In this research, four strategic approaches by Aoshima and Kato (2012) are briefly introduced. They are clear theories in considering the strategic approach and the consistency of innovation models and project styles.

Each company makes a strategy in accordance with its external environment and internal resources. The strategies are divided into two categories based on whether the factors to achieve the targets are "internal" or "external," or whether the analysis focuses on "factors" or "processes." The four approaches based on these two classification axes are summarized in Figure 1. They are as follows:

P (Positioning) : Focuses on external factors (Porter, 1980, 1985)

R (Resource) : Focuses on internal factors (Barney, 2010)

G (Gaming) : Focuses on external processes (Nalebuff & Brandenburger, 1997)

L (Learning) : Focuses on internal processes (Hamel & Prahalad, 1991)

Each company selects a strategy by considering the time axis, as well as the company's surrounding environment and its internal strengths and weaknesses. In an actual strategy, it is not necessary to consider only one approach, but it is important to prioritize to any one approach.

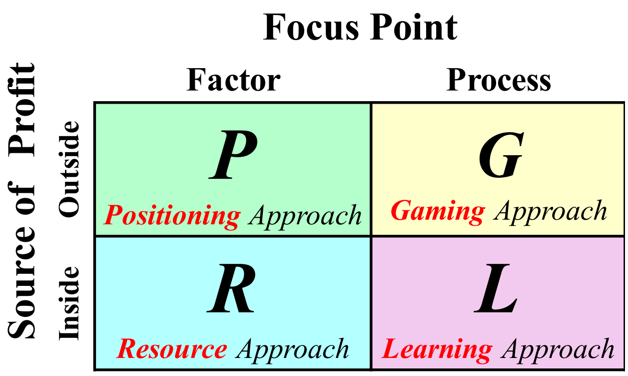

Figure 1 Four strategic approaches
(Aoshima and Kato, 2012)

2.2 Evolution of innovation models

In this section, the author describes the evolution of the innovation models in order to realize innovation conforming to strategic approaches.

The innovation models have evolved as shown in Figure 2 (Kameoka, 2003). When they emerge, they are each accompanied by a great social impact.

In Figure 2, numbers from generation 1 (Gen-1) to generation 4 (Gen-4) are numbered in the order in which each innovation model appeared. However, at present, not all the innovation models are consolidated in Gen-4. Each innovation model has its own characteristics. For example, Gen-1 (Linear model) is still being adopted by many manufacturing companies. Therefore, it is important to use it accurately.

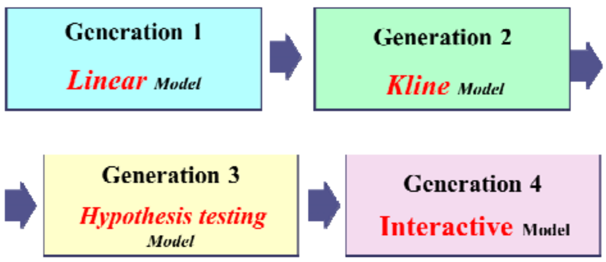

Figure 2 Evolution of innovation model
(Kameoka, 2003)

2.2.1 Linear model of Innovation (Gen-1)

This model is the simplest, and is called the "Linear model" (Kline, 1992). We consider that, when using this model, it is possible to create various innovations at each step in the research, development, manufacturing, and sales processes (Figure 3).

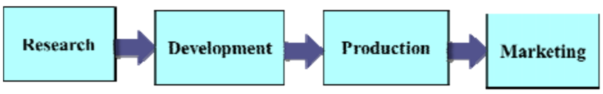

Figure 3 Linear model of Innovation
(Kline, 1992)

2.2.2 Kline (Chain-Linked) model of Innovation (Gen-2)

Kline (1992) argued that the linear model may provide inaccurate suggestions. Thus, he proposed a non-linear innovation model, known as the "Kline model" or "chain-linked model," which corresponds to Gen-2 noted in Figure 4. This model's objective is careful observation of customers and the market in order to discover their needs, where the innovation evolves from these observations. As shown in Figure 4, feedback from the market, accumulation of knowledge, and creation by research are continually added in the process from marketing to planning, research, development, evaluation, manufacturing, and sales. While "linear model" is a "product out" model, the "Kline model" is a "market in" one.

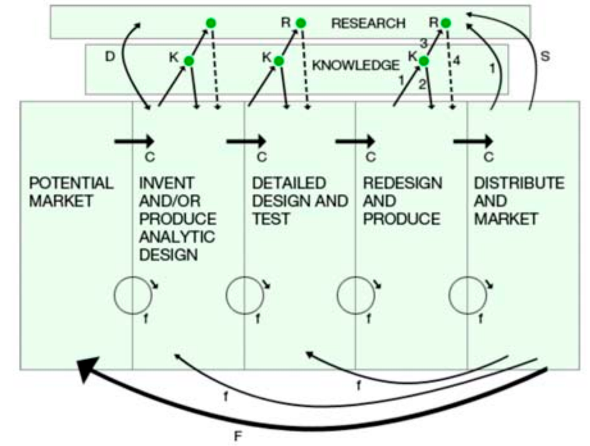

Figure 4 Kline (Chain-Linked) model of Innovation (Kline, 1992)

2. 2. 3 Hypothesis testing model of Innovation (Gen-3)

Gen-3 model is the "hypothesis testing model" that emphasizes "experiments in the market." This model is believed to be promising. It is characterized by innovation based on information and expertise acquired through actual experiments in the market, on the premise that true needs cannot be discovered simply through market observation. This thought process approximates the "expeditionary marketing" advocated by Hamel and Prahalad (1991). (Figure 5)

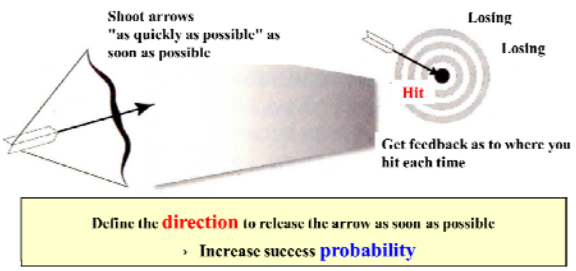

Figure 5 Hypothesis-testing model (Hamel and Prahalad, 1991)

2.2.4 Interactive model of Innovation (Gen-4)

More recent Gen-4 interactive models have been attracting attention as next generation innovation models. This co-creation process of users and companies is vague, so communication between them is important (Figure 6). However, by using this model, users and companies can collaborate and find potential needs that the users themselves have not noticed yet, and can create products and services.

Figure 6 Interactive Model of Innovation (Gen-4) (Study Group of Management Strategy, 2008)

2.2.5 Four Innovation models

Lester (2006) describes the organization's approach to Gen-1 and Gen-2 innovation models as "analytic" and its characteristics are "time limited," "projective," and "solve problem." He also stated that the efforts of Gen-3 and Gen-4 are emergent and their characteristics are "no time limited," "ambiguous," "communicative." (Figure 7)

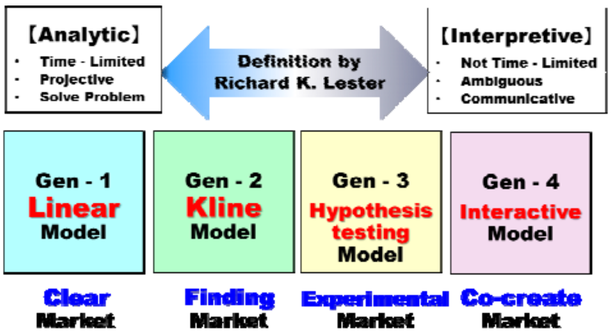

Figure 7 Transition of innovation model (Lester, 2006; Kameoka, 2003)

2.3 Project style required for Society 5.0

In this section, the author first describes the results of the literature survey on Society 5.0, and then the past research on the project style required there is described.

2.3.1 Overall view of Society 5.0

Figure 8 is the system image of service platform for Society 5.0. This figure indicates that Society 5.0 consists of a hierarchical structure in which real space and cyberspace are both connected by the Internet. Various sensors and actuators are arranged in the lowest level of the physical system in real space. This real space connects to cyberspace via the Internet, and data moves in both directions.

A substantial amount of big data accumulates in this system, and evolves in various ways from the AI's

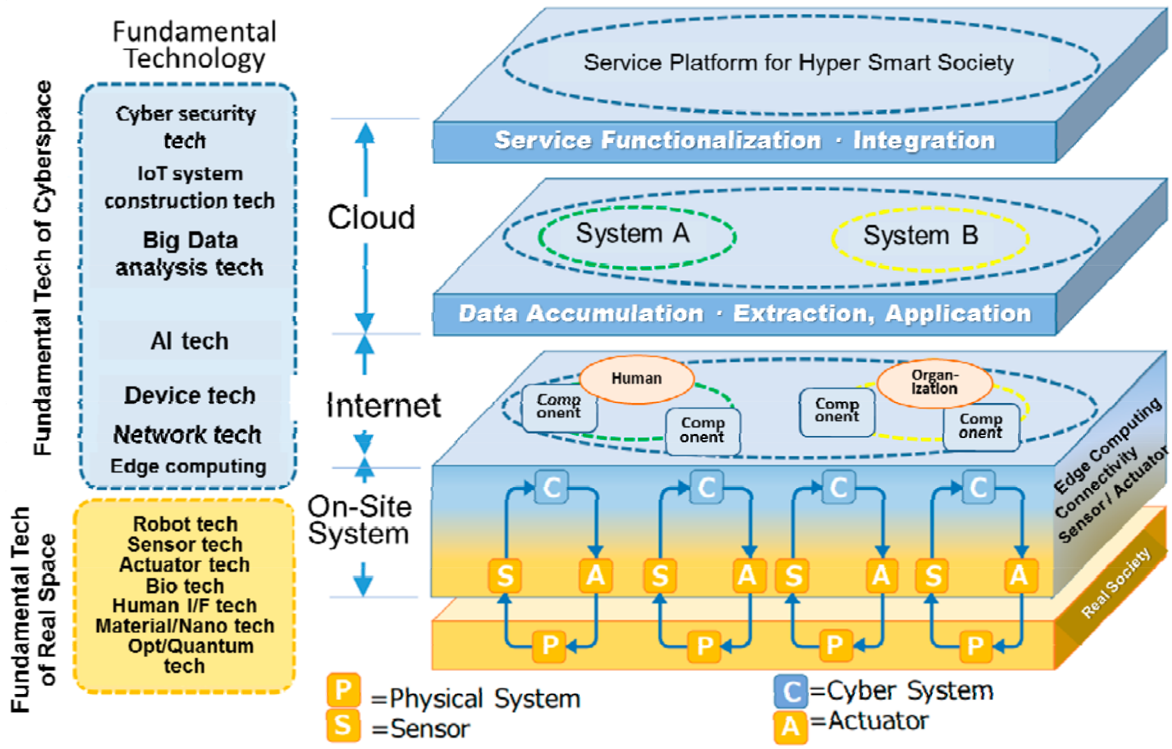

Figure 8 System image of service platform for Society 5.0.
(modified by the author based on 5th Science and Technology Basic Plan of Japanese Government, 2016)

learning function. This affects a wide range of industries, and these effects are enormous. In order to realize such a complex society, various innovation models are required, as this huge hybrid space is an online space that human beings have not previously experienced, and that has accumulated an enormous amount of information and knowledge. Moreover, this is a space that incorporates the AI's autonomy. However, when seen from companies' perspectives, these various innovations must also be consistent with their respective competition strategies (Porter and Heppelmann, 2014, 2015).

2.3.2 Trend of project style

In order to realize Society 5.0 mentioned in the previous section, various projects are required in terms of industrial field, system scale, hierarchy, software ratio, and so on. Here, the author describes the trend of the project style related to the second objective of this research.

Project styles are roughly divided into plan-driven (waterfall type, hereinafter referred to as PD) and agile (hereinafter referred to as AG) types. PD is a conventional style, and AG is a method whose adoption is rapidly increasing mainly in the software field (Hiranabe and Nonaka, 2013, Suzuki, 2016, Imani, 2017). In PD, the request is defined at the beginning of the project, and the project manager freezes it before the later implementation phase begins. On the other hand, in AG, reprogramming is performed iteratively. Although the outline request of AG is defined at the beginning of the project, prioritization of detailed requests and development judgment are repeated by collaboration between requester and developer.

PD and AG each have advantages and disadvantages. The advantage of PD is that it is easy to grasp the schedule and progress as more functions are implemented after completing the overall function design, and more people are accustomed to the development method. However, it takes time to start development, since the function is implemented after completing the whole function design in advance. Furthermore, in PD, if a problem is detected in the test, since the reworking number increases, as it becomes later, it becomes difficult to change specifications and additions during development.

On the other hand, since AG repeats "implementation -> test execution" in small units, even if a problem is detected, the number of reworking man-hours can be minimized. Moreover, it can respond flexibly to specification change and addition. On the other hand, its disadvantage includes its difficulty of grasping the whole schedule and progressing, and in controlling the management. In order to make AG successful, not only excellent technical skills, but also the ability to respond to specification change and communication skills is required.

Recently, a hybrid type (hereinafter referred to as HB) complementing the drawbacks of PD and AG has been studied (Imani, 2017, Naito, 2017). Imani (2017) notes that there are three types of HB, as follows:

1) Use PD or AG separately for each process.

2) Use PD or AG separately for each system unit.

3) Use multiple AG methods (e.g., Scrum, XP, etc.) selectively. HB is expected to have an effect of complementing the disadvantages of PD and AG, but in some cases, there is a possibility that each merit will be diminished.

The system configuration of Society 5.0 is diverse and complicated (Figure 8). The need for collaboration between researchers and engineers in the R&D and IT departments also increases (Porte and Heppelmann, 2015). Under these circumstances, companies need to adopt a project style that matches their own innovation model and strategic approach. Therefore, it is important to clarify the selection criteria, but no research report regarding this has been found. The selection criteria depend on the setting range of the project, scale, and criticality, among other factors; it is difficult to quantitatively clarify this selection criteria. Therefore, in this research, the author suggests qualitative selection criteria for project style suitable for innovation. As a result, the ideal combination of the strategic approach, innovation model, and project style, which is the second objective of this research, is presented.

3. Research Results

Based on the findings of the previous research, the author first proposes the optimal combination of four strategic approaches and four innovation models. Next, in order to verify the validity of the proposal, the author examines combinations of their strategic approaches and innovation models for 28 cases in seven industry sectors considered to be important in Society 5.0. Furthermore, the author considers and proposes effective project styles with these combinations.

3.1 Hypothesis of the optimal relationship between Strategic approaches and Innovation models

In this section, innovation models consistent with strategic approaches are theoretically considered, and the optimal combination of both is proposed as a hypothesis.

First, the Gen-1 linear model is considered to be highly consistent with the resource approach. If the product has a clear market and needs, there are clear requirements for necessary technology. Therefore, the company can use its core competency effectively at the research and development stage.

Next, the Gen-2 Kline model seems to fit well with the positioning approach. As a “chain-linked” innovation model from the starting point of “market discovery,” the company can observe and analyze customers and markets at each stage of planning, design, manufacturing, and sales. This will reveal the advantageous market position of the company.

Third, the Gen-3 hypothesis testing model is consistent with the gaming approach. This model gives priority to “experiments in the market,” and companies create advantageous innovation based on knowledge and expertise obtained from these experiments. This model seems to be closely related to the gaming approach, as it observes the reactions of the market and competitors, quickly creates and improves products, and changes sales methods.

Fourth, the Gen-4 interactive model is consistent with the learning approach. Potential needs are discovered and products are created by co-creation of users and companies. Differentiation in this process is possible not only from both parties' learning and acquisition of new knowledge, but also from effective use of this knowledge.

In addition, each company does not have to decide its own strategy as one approach, and can devise elements of several strategic approaches with strength; however, smaller the degree of strength, weaker the strategic factor. From this point of view, it can be said that “innovation follows the strategy.”

3.2 Verification of the previous term hypothesis in Society 5.0

In order to validate the hypothesis of the four optimal combinations of strategic approaches and innovation models mentioned in the previous section, the author studied these relationships for seven industries-apparel, manufacturing, LED device, computer, automobile, electric energy, and finance

Table 1 The Relationship between Strategic approaches and Innovation models (by the author)

Case	Strategic approach	Innovation Model	Reason for the Relationship
1	**R** Resource	Gen-1 Linear	If the product's market and needs are clear, the requirements for the necessary technologies will also be clear. Therefore, a company can effectively utilize its core competencies. The main stage for this will be research and development.
2	**P** Positioning	Gen-2 Kline	This is a "chain-linked" innovation model starting from the point of "market discovery." The analysis is conducted by observing customers and markets at each of the planning, design, manufacturing, and sales stages; this enables a company to discover an advantageous position in the market.
3	**G** Gaming	Gen-3 Hypothesis-Testing	This prioritizes "experiments in the market," and a company creates advantageous innovations based on the knowledge and expertise gained from these experiments. This is highly affiliated with the gaming approach, as a company quickly creates and improves products and changes sales methods while observing the reactions of the market and competitors.
4	**L** Learning	Gen-4 Interactive	Potential needs are discovered and products created from the co-creation between users and companies. Differentiation is possible in this process from both parties learning, acquiring, and effectively utilizing new knowledge.

related to society 5.0.

The management strategy is basically targeted at micro-level companies. Here, to show as widely as possible examples of strategies and innovation models capable to realize Society 5.0, an industrial strategy based on a macro perspective is also included. There are many other industries necessary to build Society 5.0 that range diversely from real to cyber space, but it is difficult to be exhaustive in this respect. Here, it is shown that any of the four combinations of strategic approaches and innovation models could realize Society 5.0. Below, 28 examples of combinations of strategic approaches and innovation models in the fields 1) to 7) are described.

The results of the analysis of 28 cases to confirm the validity of the hypothesis of the optimal combinations of strategic approaches and innovation models are shown in Table 2. Below, the verification results in seven industries fields of Society 5.0 are described in order.

3.2.1 Case study in Apparel Industry

The results of verification in the apparel field are shown in 1) in Table 2.

The first case is "Gore-Tex," manufactured by W. L. Gore & Associates (Homepage, 2017). This company manufactures durable weather protection gear. In addition, the company uses ingenious technologies and has excellent research and development capabilities. The company believes that, if they can develop fibers that are excellent in terms of waterproofness and breathable, it is clear that extreme cold-weather protection gear can be commercialized. Utilizing its core competence of specialty fiber research and development capabilities, the company achieved Gore-Tex's research and development and commercialization objectives using the linear model.

The second case is UNIQLO's thin and warm underwear "Heat Tech" (Saito, 2014). The company is a specialty store retailer of private label apparel (SPA) that produces and sells high-quality casual wear in large quantities. The company conducted careful marketing activities, and found this latent need. They constantly communicated with the market, and developed their products jointly with Toray. This case demonstrates successful innovation using the Kline model, while securing a position in the market.

The third case is ZARA's Fast Fashion (Saito, 2014). This company prioritized "experiments in the market," and created advantageous innovations based on knowledge and expertise gained from these experiments. This innovation model is strongly related to the gaming approach, as a company quickly creates and improves products and changes sales methods, while observing the market and competitors' reactions. ZARA's information on sales conditions at stores is fed back to production, and products that are selling well can be produced in large quantities within two weeks. Therefore, the Gen-3 hypothesis testing model is consistent with the gaming approach.

The fourth case is of wearable underwear that measures and communicates biological information, and is being jointly developed by the apparel company GUNZE and the IoT company NEC. In addition to being a joint development, this is also an example of the co-creation model, as they are collaborating with a transport company that wishes to use this product for the health management of long-distance truck drivers. Potential needs are discovered, and products created from the co-creation between users and companies. In this process, differentiation is possible not only from both parties' learning and acquiring new knowledge, but also from their effective utilization of this knowledge. The Gen-4 interactive model is consistent with the learning approach.

3.2.2 Case study in manufacturing industry

The results of verification in manufacturing field are shown in 2) in Table 2.

If a company adopts a strategy leading to competitive advantages through QCD (Quality, Cost, and Delivery) improvement by employing its own management resources, the linear innovation model is effective. By contrast, if consumer preferences are diversified and corresponding mass production is required, the Kline model works better. If the gaming approach strategy that draws out the potential demand from consumers and commercializes products in order to meet such demand faster than competitors is adopted, the hypothesis-testing type innovation model is effective. Thus, Seeed of China launched “Maker Space” in Shenzhen (Seeed, 2017), and aims to innovate through the “Maker Movement” (Anderson, 2012). GE is realizing the interactive model to learn alongside its customers through monitoring in-flight data on its jet engines, and feeding-back a customized optimal operations and maintenance plan (Ogi, 2015).

3.2.3 Case study in LED device industry

The results of verification in LED device field are shown in 3) in Table 2.

It is clear that if a blue LED with robust GaN could be realized, it would be possible to obtain a large share of the huge white lighting market (Taguchi, 2009). The company exploited its strengths in materials technologies to implement the linear innovation model. In the market for lighting fixtures using white LEDs, consumer preferences are variegated. Therefore, in this market, the company adopted the positioning strategy that resulted in an advantageous situation as compared to other companies, and it adopted the Kline model accordingly. As the method to make white LEDs by combining of red, green, and blue color LED is expensive, it spread slowly, and Nichia Corporation was unable to use its competitive advantage in patents (Nikkei-BP, 2012). Therefore, through the hypothesis testing model, for which white light could be obtained by combining the owned yellow fluorescent material and blue LED, the company was able to commercialize a product inexpensively and at an early stage. Another example is Toshiba’s co-creation with the Louvre Museum (Toshiba, 2012), one of its customers, in which results were achieved from the learning strategy for the museum’s lighting employing white LEDs.

3.2.4 Case study in computer industry

The results of verification in computer field are shown in 4) in Table 2.

The need to regularly update the PC model due to the expanded functions of Microsoft’s Windows and the higher performance of Intel’s MPU was evident. The linear model, which induces the maximum possible use of each resource, incorporated the manufacturers of peripherals, and maintained superiority over many years. With regard to this, ARM has succeeded in securing a dominant position in the mobile market from a license business for low-power MPU, based on the Kline model. In order to establish its superiority in the new smartphone market, Apple developed the API (Application Programming Interface) platform strategy and succeeded due to the hypothesis testing model, with a large number of application software companies. LINUX, which is a “free” and “open” OS (operating system), continues to evolve through a co-creation model of programmers from all over the world who agree on its overall form, and it has been applied in a variety of fields.

3.2.5 Case study in automobile industry

The results of verification in automobile field are shown in 5) in Table 2.

Electric vehicles (EV), which do not emit CO_2, will contribute to the prevention of global warming. Companies with this management resource are progressing in commercialization based on the linear innovation model accordingly. Manufacturers that acquired a superior position by meeting the needs of consumers willing to contribute to the prevention of global warming without sacrificing cruising distance and refueling time are commercializing hybrid cars under the Kline model. In order to realize a society in which cars utilize IoT and AI, it is essential to develop the hypothesis testing model from experts in the industry, but also from government agencies and other sectors like insurance, law, and academia. The success of Uber’s car sharing business is a result of the learning strategy from the interactive model of user evaluation.

3.2.6 Case study in electrical energy industry

The results of verification in electrical energy field are shown in 6) in Table 2.

The need to improve the conversion efficiency of solar cells is apparent. Companies with their own development resources will advance based on the linear model. The ultra-high-efficiency multi-junction compound solar cell is expensive, but there is a need for it in the space satellite market, and its development has been advancing within the Kline model. The Smart Grid Aggregator will realize innovation under the hypothesis testing model with various stakeholders in order to secure superiority over many competitors. In the demand response-type megawatt deal, the adopted strategy is based on learning from co-creation between various electrical energy producers and customers, and building knowledge assets.

3.2.7 Case study in finance industry

The results of verification in finance field are shown in 7) in Table 2.

As it is clear that the block chain technology that is equipped with scarcity and route history is spreading in the financial market, engineers have developed it in a systematic manner (Kato, 2016). A FinTech venture company intends to employ the Kline model to establish an advantageous position that will benefit its customers. The venture company is aiming to replace banking operations (such as deposits, loans, and exchanges) with FinTech, and is taking on the challenge of innovation from the hypothesis testing model. Through crowd funding for co-creation with customers, it will grow, while building knowledge assets in the learning process.

The above description has clarified that companies in various fields can aim at realizing Society 5.0 from innovation models that conform to their own strategies.

4. Discussions (Guideline for choosing project styles)

In this section, the author examines project styles that fit the combination of each strategic approach and innovation model, and presents the results as guidelines.

In the upper half of Figure 9, the optimal relationship between strategic approaches and innovation models described in 3.1 are shown as straight lines. Organizations aiming to realize an innovation model based on each strategic approach will inevitably become a project style because they need to achieve goals under their own objectives and limited deadlines and management resources. As mentioned in the survey result, in section 2.3.2, of the previous research, there are three project styles: plan-driven (PD), agile (AG), hybrid (HB).

Table 2 Validation of the hypothesis on the optimal relationship between strategic approach and innovation model (by the author)

Strategic approach→	R (Resource)	P(Positioning)	G (Gaming)	L (Learning)
Innovation Model→	Gen-1 (Linear)	Gen-2 (Kline)	Gen-3 (Hypothesis-Testing)	Gen-4 (Interactivel)
1) Apparel	Breathable waterproof fiber (Gore-Tex)	Thin and warm underwear "Heat Tech" (UNIQLO)	Fast Fashion to produce and sell popular clothes at shop front in a short time (ZARA)	Wearable underwear with biological information (GUNZE & NEC)
2) Manufacturing	Improvement of QCD	Mass customization	Maker Movement (e.g., Seeed in Shenzhen)	IoT Maintenance services of jet engine (GE)
3) LED Device	Blue LED by GaN	Various lighting instruments using White LED	White LED with yellow phosphor & blue LED (Nichia Corporation)	Cooperation between Architectural Light Designer & LED Equipment maker (Louvre museum & Toshiba)
4) Computer	Improved function & performance by OS & MPU (Microsoft & Intel)	MPU suitable for mobile applications (ARM)	Various software based on API (Apple)	Free and open source software LINUX
5) Automobile	Electric Vehicle without CO2 emission	Hybrid Vehicle with high fuel consumption, high speed filling, low CO2 Emission	Common social implementation of automatic driving by arious experts	Car sharing combined with user evaluation (Uber)
6) Electric Energy	High Efficiency Photovoltaic Module	Ulra High Efficiency Multi-junction solar cell for space	Smart Grid Aggregator	Demand Response & Nega Watt Deal
7) Finance	Block chain with scarcity & full history	FinTech Venture aims for customer benefits	FinTech Venture challenges substitute for deposits, loans, currency exchange	User participation in Cloud Funding

Therefore, as project styles consistent with the combination of the four strategic approaches and the four innovation models, it is only necessary to consider a combination with these three. There are three types of HB as shown in 2.3.2 1)–3), and in this section, all of these are included.

Considering the characteristics of each innovation model and the merits and demerits of each project style described in 2.3.3, a good combination of compatibility between them is shown in the middle of Figure 9; that is, a combination of PD for the linear model, PD or HB for the Kline model, HB or AG for the hypothesis testing model, and AG or HB for the interactive model is good. According to the results of three project style mathematical studies by Imani (2017), PD has less total manpower when the criticality is high and the project scale is bigger, and the reverse stands true for AG. Additionally, HB is in an intermediate position between the two. At the bottom of Figure 9, the features of each project style are shown.

Since Figure 9 shows the overall combination of each strategic approach, each innovation model and each project style, it is considered that Objective 1 and Objective 2 of this research were achieved.

5. Conclusion

Based on the results of the previous research of four strategic approaches and four innovation models, the authors hypothesized the next optimal combination between the two. The optimal combination is as follows.

1) The linear model for the resource approach,
2) The Kline model for the positioning approach,

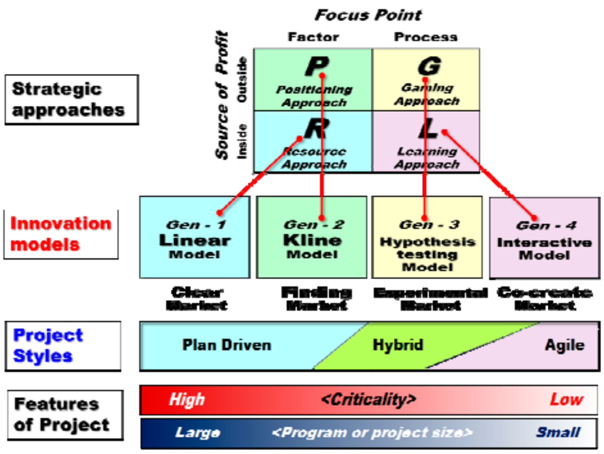

Figure 9 Consistency among Strategies, Innovation Models and Project Styles (by the author)

3) The hypothesis testing model for the gaming approach, and
4) The interactive model.

Its validity was verified by 28 case studies in the seven industry sectors of Society 5.0.

In addition, the author examined project styles that are compatible with the combination of these four strategic approaches and innovation models. As the result, the guidelines of PD for 1), PD or HB for 2), HB or AG for 3), and AG or HB for 4) above were indicated.

No research on optimal combinations of strategic approaches and innovation models and project styles has been reported so far, and hence, there is novelty. In Society 5.0, which requires a diverse and complicated new system in the future, the suggestion of this research is meaningful.

In this research, since the combination of project styles suitable for each innovation model is only a logical consideration, verification of its validity is a future task.

Acknowledgements

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Proposal of Anti-pattern Utilization Method for Loss-cost Reduction

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Loss cost is defined as an additional cost for implementing a different plan from the original. We work on activity to reduce loss cost (loss-cost management) resulting from unneeded process repetition or additional man-hour cost for design improvement. In order to reduce loss cost, it is important to grasp predictive information of loss cost as early as possible and to take appropriate measures. We are working on establishing a risk management method using project failure model which is focused on the propagation structure of risk leading to loss cost. In this paper, we propose a method to create and utilize anti-patterns by classifying project failure structures as one method of utilizing failure structure model. We believe that the anti-patterns can be used as a common language of failure information within an organization.

Keywords and phrases: Loss-cost Management, Risk Management, Causal Model, Study of Failure

1. Introduction

To improve profit rate, it is important to reduce unneeded cost and loss. We have been working on establishing risk management methods using models explaining the generation mechanisms of loss costs of the past projects (risk propagation model). Up until now, we have studied; modeling methods of the risk propagation models (Uchida, 2015), planning countermeasures considering the possible failure scenarios and their impacts (Uchida, 2016), prediction methods using ideas such as trigger information and early warning indicators (Okeya, 2016).

In the studies, we have defined subsets of risk propagation model as project management anti-patterns (PM anti-patterns). PM anti-patterns are elements of risk propagation model which organizes sets of risks beginning from an arbitrary project state and leading to certain form of losses.

In a trial where risk propagation model itself was presented as the predicted loss-cost scenario, we obtained comments such as the following; “while it is beneficial to visually accept the failure structure, the information of the risk propagation model alone lacks impact and does not appeal very much.” We learned that we need some modification in the presentation of the models in order to create greater impact to the readers. We have developed the PM anti-patterns to overcome such challenge.

In this paper, we propose the information structure and the utilization method of PM anti-patterns to facilitate the understanding of the failure scenarios.

2. Development approach for the information structure of PM anti-patterns

Anti-pattern is an idea advocated by Andrew Koenig. It consists of organized patterns of wrong solutions often seen in failing software development and some tips to avoid failures. Previous studies are conducted in this subject such as one by Rising et al. (Rising, 1998). Anti-patterns, as seen in literatures of Oda (2009) or Demarco (2008), come with explanations and measures of the failure as well as names briefly describing their content.

Based on the idea, we have defined and developed the project management version of anti-patterns (PM anti-patterns). In a general anti-pattern collection, anti-patterns are comprised of “pattern names” and “expository text for pattern explanation”. We have sought for improvements on the information structure of the anti-patterns, bearing in mind that they are going to be referred to by ongoing projects. In particular, we have supplemented the expository text with subsets of the risk propagation models, and organized them alongside the pattern names. We have considered the information structure based on interviews on PMO (project management offices) members and project managers.

3. PM anti-patterns utilization scenario

One way to utilize the PM anti-patterns is to use them as a precaution of project failure. An image of the usage is shown in figure 1.

In the utilization scenario, the staffs supporting the target project (we suppose them to be PMO members) search for the appropriate PM anti-patterns. They are searched from a collection of PM anti-pattern sheets developed from the past failure cases. PMO members then present the searched patterns to the project members, notably to the project managers. The project managers use the anti-patterns to consider the specific risks the patterns imply, and set preventive measures against the risks. The PM anti-patterns can also be used, after the measure is set, to monitor the project status to check the effectiveness of the measures.

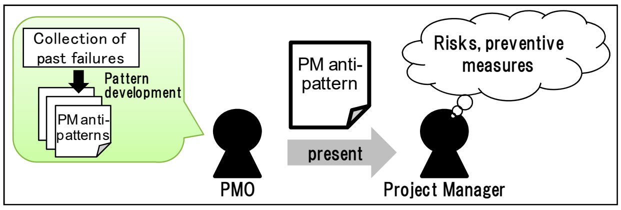

Figure 1 An image of the PM anti-pattern usage

4. Information items of PM anti-patterns

Assuming the utilization scenario, we have defined the format of PM anti-patterns comprising of the following information items.

(1) Pattern name
(2) Simple explanation of how the project fail (expression by text)
(3) Visual expression of how the project fail (expression by risk propagation model)
(4) Relevant project phase
(5) Information for searching: information used to select the appropriate PM anti-patterns
(6) Trigger information: information identifying the appropriate timing to present the PM anti-patterns

Items (1) to (4) are information items for comprehension of the pattern itself, and (5) and (6) are items used for searching the appropriate patterns.

We have decided to divide the information and locate them onto two different documents. One is the collection of “PM anti-pattern sheet”. PM anti-pattern sheet is a summary of information items (1) to (4) representing an anti-pattern. The collection of the sheets functions as a thorough catalogue of PM anti-patterns. The other document is “PM anti-pattern list” where mainly the information items (5) and (6) are organized in a list. Each of the documents is described in the following.

4.1 PM anti-pattern sheet

A sample of a PM anti-pattern sheet is shown in figure 2. In the sheet, information items (1) to (4) representing an anti-pattern are summarized in a case -per- page format.

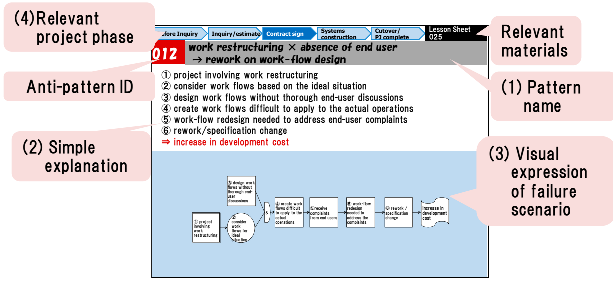

Figure 2 A sample of a PM anti-pattern sheet

The content of the sheet is described bellow.

[A] Relevant project phase ((4))

Describe the phase where the cause of the project failure is located. The phases are chosen from the following five; “Before inquiry”, “Inquiry/ estimate”, “Contract sign”, “Systems construction”, and “Cutover/ PJ complete.”

[B] Relevant materials

Describe relevant materials to further understand the PM anti-patterns. This can be, for example, an ID of a lesson sheet which organizes project failure in a case-per-page style. The idea of lesson sheet is described by Uchida (2008).

[C] Anti-pattern ID

Display the ID of the PM anti-pattern which the sheet describes.

[D] Pattern name ((1))

Display the name which describes the anti-pattern. The names are to be expressed in words describing the project status of the possibly failing project and the consequence of the failure, rather than metaphor or the causes of the failure. In particular, they are presented in an equation-like expression representing the failure structure. Basically, it is expressed in a format of “a x b -> c”, implying the possibility of “c: unfavorable consequence” arising from the “b: change in project status or occurrence of an event” interacting with the “a: project characteristics.” Note that for multiple “a: project characteristics" and "b: change in project status or occurrence of an event", the constituents on the left-hand side of the equation increases.

[E] Story of how the project failed ((2))

Describe the failure story of the project in an itemized format. Basically, the items correspond to the main branch of the [F] project failure structure model, and each node within the main branch is numbered and listed. At the bottom of the list is a right-pointing arrow indicating the failure consequence which is followed by the final item corresponding to the loss node. If the description in the node alone is hard to understand, we add complementary information so the readers can understand each of the items on its own.

[F] Project failure structure model ((3))

Display the subset of the risk propagation model as the visual story showing the anti-pattern.

4.2 PM anti-pattern list

A sample of PM anti-pattern list containing the information items (5) and (6) is shown in figure 3.

No.	Pattern name	Lesson sheet	Relevant project name
012	Work restructuring × Absence of end user→ Rework on work-flow design	025	Project XXX
013			
:			

Information for searching		Trigger information
PJ characteristics	Relevant phase	
project involving work restructuring	requirement definition phase	absence of end user

Figure 3 A sample of PM anti-pattern list

In the PM anti-pattern list, relevant project name, project characteristics and relevant phase as information for searching, and trigger information are listed together with the items from the PM anti-pattern sheet; "[B] Relevant materials (Lesson sheet)", "[C] Anti-pattern ID", and "[D] Pattern name".

Trigger information is extracted from the nodes composing the risk propagation model of the PM anti-pattern. Information for searching comprises of project characteristics and the project phase to enforce the countermeasures.

5. Utilization method of the PM anti-patterns

The usage of the PM anti-patterns extends across two phases, namely the selection phase and the post-presentation phase. The main users in the selection phase are the PMO members, and in the post-presentation phase the project managers. The patterns are first used as a precaution of project failure, and then as a guidepost of project monitoring.

5.1 Usage – the selection phase

In the selection phase, the PMO members supporting the target project search for the appropriate PM anti-patterns to present to the project manager of the target project. The selection phase consists of the following 3 steps (S1 to S3).

[S1] Characteristics and keywords extraction

An image of characteristics and keywords extraction is shown in figure 4. From project records, various report documents, and the knowledge about the project, the PMO members extract characteristics and keywords of the target project. "Quick delivery" and "systems replacement from other companies" are two examples of characteristics and keywords of target projects.

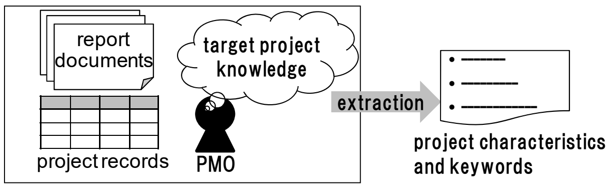

Figure 4 An image of characteristics and keywords extraction

[S2] PM anti-pattern filtering

An image of PM anti-pattern filtering is shown in figure 5. By comparing the project characteristics and keywords extracted in Step 1 to the items in the PM anti-pattern list, the PMO members obtain the candidate patterns to present to the project managers. The items to check in the list are pattern name, information for searching (project characteristics and relevant phase), and trigger information. The comparison between the target project characteristics/ keywords and a row of items in the list are to be made within a few seconds.

In the list, rows with items that share the same idea or have close relations with the characteristics/

keywords of the target project are given a "Yes" indicating a row corresponding to a candidate anti-pattern. On the other hand, rows with items that have least relation or resemblance to the characteristics/ keywords are given a "No" indicating a non-related anti-pattern. Rows with items that are difficult to judge their relations are also given a "No".

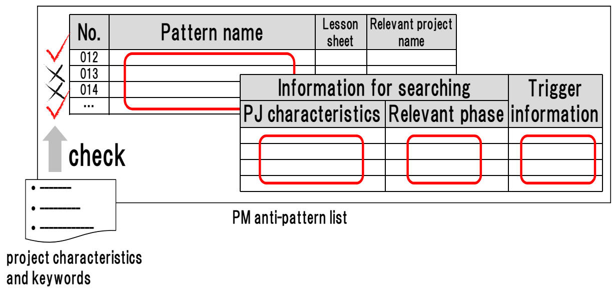

Figure 5 An image of PM anti-pattern filtering

[S3] PM anti-pattern match check

An image of PM anti-pattern match check is shown in figure 6. For each candidate anti-patterns obtained in Step 2, the PMO members check the corresponding PM anti-pattern sheet and decide whether it is worth presenting to the project manager. In particular, the PMO members check the failure explanation by text ((2)) and the failure explanation by the risk propagation model ((3)), and classify each candidate pattern as one of the following three classes (C1, C2, C3).

C1. Worth pointing out

Patterns of which the scenario is highly likely to happen

C2. May be a good reminder

Patterns of which the scenario is somewhat likely to happen or may happen in the relatively far future, and may possibly be useful to present

C3. Unrelated

Patterns of which the explanation text and model proved that they have no relation to the target project.

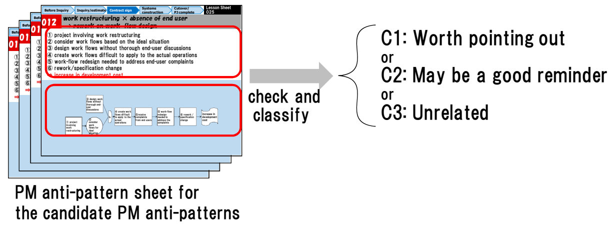

Figure 6 An image of PM anti-pattern match check

After the selection phase, the PMO members present the patterns classified as C1 to the project managers. The PMO members may also make a judgment to present the patterns in the C2 class according to the presentation situation.

5.2 Usage – the post-presentation phase

In the post-presentation phase, the project managers use the presented anti-patterns to identify the project risks, set preventive measures against the risks, and monitor the project status to check the effectiveness of the measures. This process of risk management can be described as the following 3 steps (R1 to R3). The process is taken for each PM anti-patterns presented.

[R1] Fact confirmation

The image of fact confirmation is shown in figure 7. The project managers check each of the project events and statuses the nodes represent starting from the head of the model. The red colored nodes in the figure represent the "ON" confirmed nodes, where "ON" means that the event the node represent has happened or that the project is in the state the node represents.

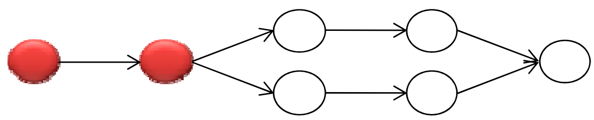

Figure 7 An image of fact confirmation

[R2] Measures planning/ enforcement

The image of measures planning/ enforcement is shown in figure 8. The project managers plan when and what measures to take, and activate the measures according to the decided plan. The green arrows in the figure represent the planned/ enforced measures. The measures do not need to be taken right away, and is to be planned in a strategic way as to block off the link somewhere in the model leading to the loss. It is important to plan strategically on which nodes or edges the measures are taken.

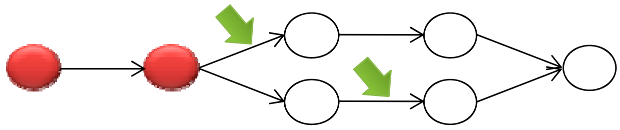

Figure 8 An image of measures planning/ enforcement

[R3] Monitor/ control

The image of monitor/ control is shown in figure 9. The project managers monitor the risk propagation and adjust the measures to take control of the project risks. The effectiveness of the measures can be checked through monitoring the risk propagation status. The blue colored node in the figure represents the “OFF” confirmed node, where “OFF” means that the event the node represent has been confirmed to not happen or that the project is confirmed to not be in the state the node represents. In the project situation of figure 9, the first measure was effective and the risk propagation to the top path has been blocked off. The project managers adjust the measures according to the propagation status to control the risk of the project.

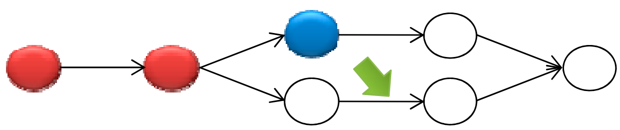

Figure 9 An image of monitor/ control

6. Evaluation of the PM anti-pattern

We have created 12 PM anti-patterns and evaluated their applicability in the following 2 ways.

(A) Evaluation on the failure scenario presentation

For the purpose of evaluating the advantage of failure scenario presentation (and its presentation format) according to the information of the target project, we chose 2 ongoing projects as targets, and performed trials. We tested the appropriate PM anti-pattern search and presented the searched patterns to the relevant PMO members to obtain feedbacks.

From the PMO feedbacks, we were able to confirm that the presented patterns are convincing, and are indeed possible risks and failure scenarios from the point of view of the project assessors. The PMO members also pointed out that the presented failure scenarios can act as a complementary resource for project management experience. That is, an unsophisticated project manager can leverage the presented failure models to make advanced judgments.

The result shows the advantage of the risk management method using the risk propagation model. Though it does not directly prove the advantage of the PM anti-pattern format itself, it indicates that our study in going along the right track.

(B) Evaluation on the PM anti-patterns applicability

To evaluate the applicability of the PM anti-patterns, we focused on the coverage of the patterns. We checked the relations between the 12 PM anti-patterns we created and the 45 risk items obtained from PMO monitored projects in a certain time span. As a result, 35 out of 45 items (78%) were linked to any of the 12 PM anti-patterns. Though the relation was checked manually one by one in a qualitative manner, we think the result implies that the PM anti-patterns have a certain degree of coverage and that the classification by the patterns is successful.

From the above (A) and (B), it can be concluded that the PM anti-patterns are capable of classifying the risk of projects and can be considered as a valuable information in risk management.

7. Conclusion

In this paper, for the purpose of deterring loss-cost, we have proposed a risk management method comprising of a classification format (PM anti- patterns) of project failure and its usage as one utilization method of the failure structure model.

In the proposed method, we use the followings; PM anti-pattern sheets which are anti-patterns in project management summarized in a case-per-page manner, and PM anti-pattern list for searching the patterns to present. Bearing in mind that they are going to be referred to by ongoing projects, we defined the information structure of the anti-patterns having the characteristics in the naming rules of the pattern names and in the expression of the project failure scenarios.

We have defined a utilization method of the PM anti-patterns. The usage extends across 2 phases, the selection phase and the post-presentation phase. The patterns are first used as a precaution of project failure, and then as a guidepost of project monitoring.

We have also evaluated the advantage of the project failure structure model (risk propagation model) and the applicability of the PM anti-patterns and obtained implications of the PM anti-pattern effectiveness.

Our future challenges are the followings; defining the creation steps to continuously accumulate PM anti-patterns, and evaluating/ improving the patterns through application to actual projects.

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A Study for Apply and Consolidate Project Management Skill to PBL in University Education

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In this paper, to apply and consolidate project management skill to Project Based Learning (PBL) in university education is proposed. Standardized Project management curriculum will help to understand knowledge of PM skill for students, and will be freed from complexity of establishing guidance by teachers and assistance lecturers. This effort is based on the results and improvements in the 6 years, and adds further relevant trends. Remarkable development of PBL in recent years is known as "the reflection of the IT trend". On the other hand, problem can be identified about in acquiring and establishing the project management part from students' report. From recent project management standard process and techniques, guidance is developed and modified every year. But target students have just learned the basics and exercises of programming or IT foundation, so they do not have enough knowledge of team activities and/or project management. From this background, students feel the gap, and furthermore they are requesting improvements to teachers and corporate-lecturers. Questionnaire was conducted for teacher and learned the necessity in teaching guidance or request for reference curriculum. Based on the above, a direction of guidance for project management education in PBL is proposed for the future with the view to applying "Project Management Standard Curriculum" being formulated by Education and Publication Committee. The committee is one of the organization of The Society of Project Management(SPM).

Key Words and Phrases: PBL, Curriculum, Education, Framework, Standard

1. Introduction

PBL has been generalized as a learning method in universities and corporations. It is known as practical and comprehensive learning system. Universities, especially those include system building using IT, students experience PBL within the first six month to a year. For students, however, completing a project as a team, from start up to the end, includes many inexperienced issues. Therefore, although the importance of PBL lies in facing problems & solving issues related to the essential part of project outcome, such as design and development, students are instead often found facing common & project support side of the issues, methodology and information management. In this paper, to apply the PM skill education as a prerequisite of PBL is proposed.

Using curriculum pre-designed and authorized is one on of the way for build a new beneficial knowledge education.

2. Issues – Background and Finding

Learning by PBL style is a new method for learners (in this article, it means as university or college students) to gain new experiences and knowledge by using knowledge that they already acquired. It is also known to be made up of cooperative activities with the same purpose. PBL is expanding because it is known that affects including social activities and research promotions. On the other hand, issues in each position of students at learning, teachers at instructing, and corporate lecturers at support instructing are also becoming a problem. From classroom lecture style study, changed into the way that explosively expand in scope, outcomes and proceeding, the students feels confusion due to lack in knowledge and experience. And the teachers or lecturers side also lags behind dealing with the expansion of the issue and they can't take best measures.

From the technical aspect, it is also possible to investigate further expertise and applied knowledge by books and the Internet knowledge site from previous learning, and to interview to seniors and colleagues who have specialized skills. Instead of that, due to lack of skills about clarification of problems and effective process for progress in project, causes waste the time. And these also causes unstable quality, delay of schedule and significantly scope loss than expected in the start time.

As it is becoming obvious that the knowledge on the project management area which is one of these causes is not sufficiently obtained, countermeasure for the future is proposed in this paper.

2.1 Issues from Reports by PBL Students

The main research is conducted at Hakodate Future University (FUN), where PBL had been adopted since academic year 2002. IBM's participation as a support lecturer started from Academic Year(AY) 2011. The support projects since AY2011 are shown in Table 1 PBL at the FUN is conducted in the 3rd year with duration of one academic year. It involves start up, planning, implementation, management and completion of a project cycle.

Table 1 Support Projects List

Academic Year	Project summary
AY2011	1. Facility reservation
AY2012	1. Business, 2. Marine and Auto-drive 3. Local Tourism 4. Curriculum Portfolio
AY2013	1. Ticket Reservation 2. Event announcement
AY2014	1. Education 2. Local Tourism 3. Business 4. Bookstore Promotion (A, B)
AY2015	1. Local Tourism 2. Education 3. Medical support
AY2016	Mirai Keitai (3 projects)
AY2017	Mirai Keitai (4 projects)

During 5 years (from 2011 to 2015) of PBL at the FUN, review sessions were set at the end of each year after projects completion, together with opinion survey on PBL. Apart from positive feedback, "Issues", "Reflection", "Improvement Requests" were received.

Those feedbacks fell into "Issues", "Reflection", and "Improvement Requests" categories were extracted and categorized into following groups.

(1) Skills for project management
 a. General, basic, standard
 b. Quality, criteria, verification
 c. Communication
(2) Skills of technical knowledge and experience
 a. Expectation for new experience
 b. New technologies
(3) Environment, preparation and support by teachers
 a. Support for real time
 b. Environment (IT infrastructure, share tools)
(4) Guidance and Participation by corporate lecturers
 a. Schedule of lecture
 b. Frequency of participation and depth of lecture
(5) Others

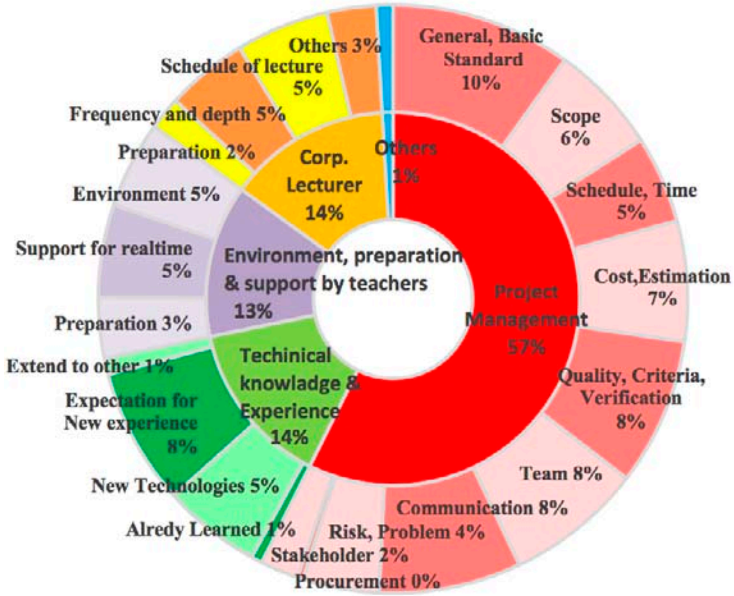

Figure 1 Concern point from students' report

Data background: Questionnaire from 2011 to 2015, total comments number is 333, at the end of each PBL period.

These are closely related to essential of the project and its output of "Completion of something with Originality within fixed term" and are the surrounding environment itself. It is the students' request to minimize non-essential side of issues as much possible to be able to concentrate more on the essential part of the project, design and development - and this is exactly what instructing side would also like to support.

2.2 Issues from Teachers' Side

Based on the results of the questionnaire of students, it is aggregated result that project management is the most impressive issue (see Figure 1) than technical area. Most teaches are not specialized in project management because research guidance and technical teaching in their field is the original mission. But it is a possible case to incorporate the PBL method as a part of the practical training. Reason is that in school first and second grade teach the basics, and at third grade, from the problem definition to the solution can be learned consistently for the purpose of comprehensive exercise and knowledge consolidation. There are following countermeasure cases as results of interviewing.

(1) Instruct project management knowledge by teacher himself/herself with tried and error.
(2) Ask for help to other teachers who have sufficient knowledge.
(3) Invite company lecturer as an expert or an experienced person.

Although it seems necessary to reduce the burden on the teacher for the future, there is no definite model for reference. In other words, there is no project management guideline for school education, that is the root cause.

2.3 Issues from Corporate Lecturers' Side

The following two points are the issues of corporate lecturers. The first is that human resources are different from ordinary familiar environments. Secondly, corporate lecturers can't keep sufficient time to lecture and communicate like teachers. For this reason, more efficient way should be discovered.

When business people participate in PBL as a company lecturer, a lot of confusion arises in the difference from the business project. It is common sense to collect certain skill members and concentrate them on estimated period and full day assign in a project, that is accustomed by business person. The "skill" here refers to various skills that are standardly acquired by "doing work", such as cooperation with interpersonal relationship processing, project management, as well as technical aspects. Meanwhile, since students' PBL doesn't have common business sense of companies, it is necessary for lecture to prepare and understand project implementation as completely different from their usual business sense.

The special circumstances mentioned above, it is useful way to restricting targets and clarify focus area. For example, teaching the know-how of the cutting-edge IT technologies, like AI, IoT, or Agile method. In 6 years lecture, the specific technology was tried as a temporary scope. But gap was found between the expansion of coverage with depth of guidance and time the lecturers spend with students, as years go by. For this reason, emphasis is put in transition on "project management technique" which is a method to grasp the whole operation of the project and to proceed smoothly. Changes in the guidelines that have been practiced reflecting this transition appear in the Table 2 as the ratio for each support areas and activities.

Table 2 Transition of corporate lecturer's assist

Support Area / Year	Project management skills education				Technical assist			Guidance as a predecessor		
	Basic lecture	Providing materials	Remind session	Progress review	Specific lecture	Technical guidance	Quality review	Presentation skill	Advice to TA	Teaming activity
2011	15	10	10	20	10	10	15	5		5
2012	15	10	10	20	10	10	15	5		5
2013	15	10	10	20	10	10	15		5	5
2014	15	10	10	25	5		20		10	5
2015	10	10	10	40			15		10	5
2016*	5	30		50			10			5

Score is percentage of workload balance
*From 2016, relationship has changed from regular lecturer to reviewer because of support for the inter college project.

3. Proposal for Effective Knowledge Acquisition

To plan to master the basics of project management in the first and second grade is the proposal. Students do not study PBL implementation and project management at the same time. It is because both students and teachers can have a common understanding on project and management by adding permanent knowledge other than specialized fields. Since cooperate lecturers usually understand these knowledge in practice, it is highly expected that the quality of guidance and conversation with students and teachers can be improved, or the efficiency can be improved.

Until now, there was no common material that could be used as the basis, but in 2017 the "PM Standard Curriculum" for undergraduates is being shaped by The Society of Project Management Committee of Education and Publishing. Currently it is state of draft of company experts, but it will be prepared for publication after being scrutinized and collaborated with professional teachers in this field from now on. If this "PM Standard Curriculum" is incorporated and adapted to the specialize field of each school, all students can have certain knowledge about the management of the projects, and smooth PBL practice and high-quality output will increase. The current draft version of "PM Standard Curriculum" is shown in the following figure 2.

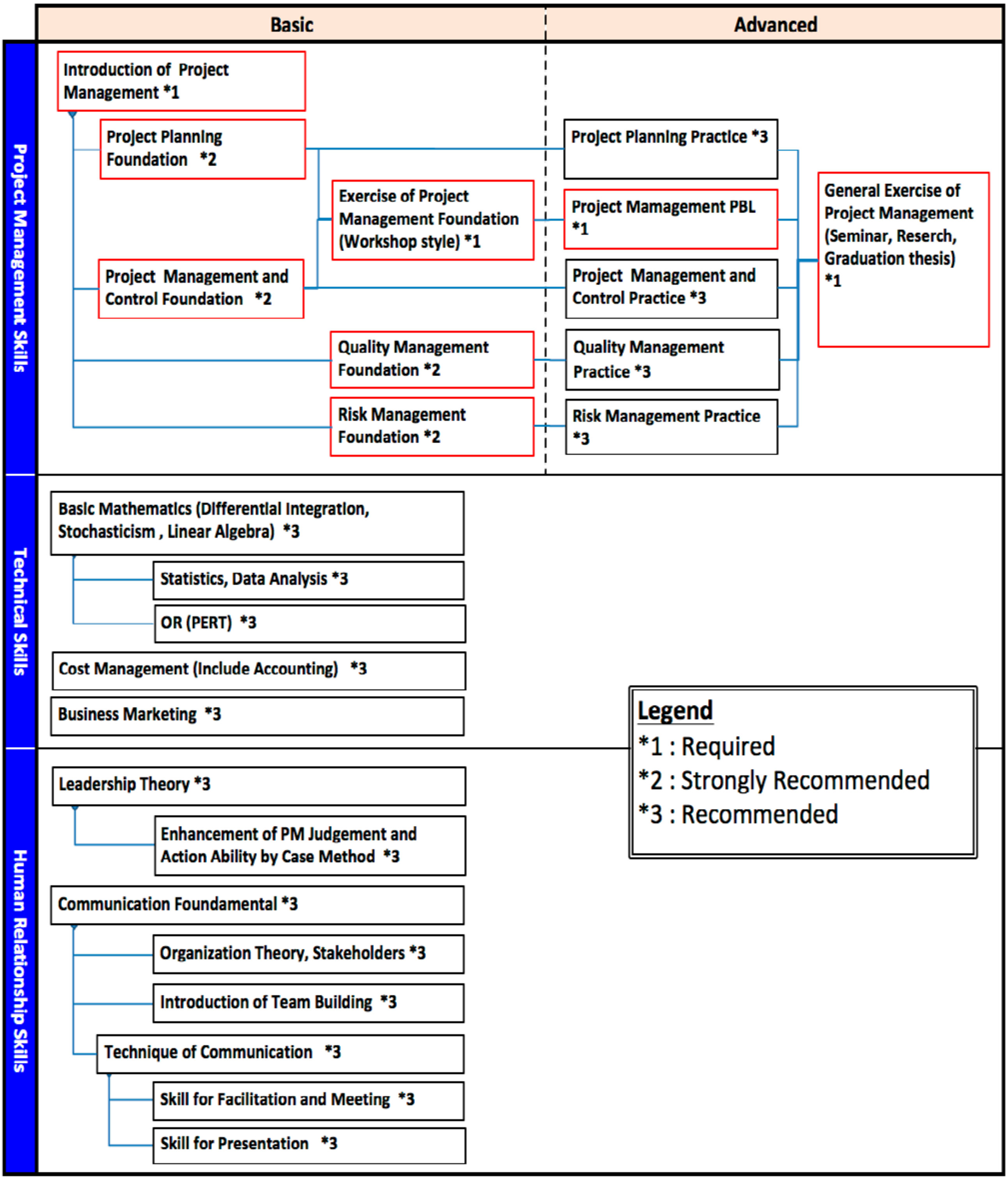

Figure 2 PM Standard Curriculum (draft)

This curriculum is under shaping by The Society of Project Management Committee of Education and Publishing.

3.1 Curriculum Stability for PBL Teaching

The basic policy of this curriculum that The Society of Project Management Committee of Education and Publishing (2017) has defined is "Not only the academic system that specializes in project management", "this curriculum is aware of the learning system that school or teachers use it as secondary specialize learning system". Application in the IT system, handled in this paper, or making PBL as the passing point of learning are conforming to the scope of that thought.

3.2 How to Use the Curriculum Focusing on PBL

There is a possibility that the description of subjects posted in this PM Standard Curriculum will continue to change. But, as a fundamental way of thinking are defined by The Society of Project Management Committee of Education and Publishing (2017) as follows, "This curriculum is not all of the nature that it must be align this way, there are two positions. First, as essential subjects on compliance with this curriculum. Second, as recommendations of this curriculum. It is assumed that the educational institution decides adoption of subject in this curriculum." Based on the above definitions in committee's report, it is desirable to reinforce points that are considered to be insufficient in the PBL by incorporating them according to the actual circumstances of each university or by modifying the contents.

The following solutions are expected by comparison between students' report what was introduced in 2.1 and the subject in the standard curriculum.

First, every student can raise common awareness by taking the most basic subject in Project Management Skills named "Introduction of Project Management".

Secondly, the subject named "Project Planning Foundation" covers the upstream process faced right after the start of the PBL period.

Thirdly, the subject named "Project Management and Control Foundation" which is useful in the management scene from the activity phase start actually. According to students' report, the timing of start is most confusing the management knowledge. There was some statement in report that the delay or unstable status at the beginning couldn't be recovered, and possibility of affecting to the end of project.

These three subjects are considered most essential in all subject in the curriculum. These three subjects are placed the priority "Required" and "Strongly Recommended" by Committee.

In addition, in order to make PBL, the whole year activity more effective, the subject named "Exercise of Project Management Foundation (Workshop style)" should be incorporate to conduct a comprehensive preliminary trial in the second grade. It helps students to become familiar with team activities and communication.

4. Approach to Adoption and Verification

The expectation of plan to master the basics of project management in the first and second grade, using "PM Standard Curriculum" is described in the contents of the proposal. These contents also describe that how to combine the curriculum with past activities.

As a summary, from the viewpoint of a teacher who is practicing PBL, the curriculum that defines the system to learn project management is a situation that confirms the completeness with interest or expectation whether it is worth considering use.

Also, as a corporate lecturer, advantages are found in the curriculum that many of teaching contents what to be tried and errored so far, are learned beforehand.

Both seem to be direction to solve many of the current problems. Details are as follows.

4.1 Assumption on issue solving for students

Specific results from students' impressions are not known unless actual adoption is made. The major difference between students and teachers (include company lecturer), is that students are only one time in the experience and therefore nobody can see the report of comparison.

When checking each description of the report, the ratio of initial problem is high and continues till the end of project. The fact that students feel gaps especially in the project management rather than technology, is caused from the difference in degree of knowledge holdings in study at first and second grade. This analysis means that the lack of basic and common knowledge of project management causes state of unstable project. The fact of requests for the glossary were also considered to be the same root cause.

Learning from the fundamental is indispensable, not emergency material supplying at the battlefield. The systemized education that curriculum based subjects lead to peace of mind for students.

4.2 Expected Value from Questionnaire to Teacher

Questionnaire of the expectation value for the "PM Standard Curriculum" has conducted to university teachers who have cooperative relationships with PBL. Relationship in this sentence means that corporate lecturer supported PBL more than a year, or had annual exchanging ideas in PBL Summit or other meetings. From the background, result is more frank and realistic than public questionnaire. The distribution of questions and answers is as shown in Table 3 below.

Because the questionnaire was carried out at the time when the draft version (see Figure 2) described this time was not completed, it is a questionnaire survey with the contents briefly outlined.

Beginning of the question is interest in the standard curriculum, so 60% of teachers, who are majority, are interested.

Included answers that were not able to be judged because introduced the contents of the curriculum by several lines, there is a possibility that interest will be gained by completing the future curriculum.

In order to improve the completion of the curriculum, cooperation of a teacher who is the leader of the actual educational site is necessary. Participation in discussion work by the daily committee is most preferable, and certain effects can be expected even in participating in events such as information exchange meetings planned at the autumn convention. Questions on these are reflected to 2 and 3. Although the prospect of support is about 30% at present, there are also situations in which it is impossible to judge that detailed information is not provided at first, and it is also possible that participation may be requested. There are also 20% teachers saying that they do not participate in the creation even though they are interested. So in terms of utilization of curriculum is considered. Participation in the event to the autumn competition can’t expected.

The last question is whether it will be adopted at school on completion. As expected it is not available as main part at the moment, but instead 60% positive response, such as partial prospects of utilization, seminar use, depending on achievements in other academics. Although conditions in terms of limitation of number of lessons are considered and judgment based on content, 30% positive response is made.

4.3 Integration with Efforts of Last Year

One of the initiatives of last year, PMO function was proposed and applied. As a result of consideration between corporate lecturers and teachers, a part of PMO framework was applied.

Table 3 Teachers’ Expectation for Curriculum

Q1. Are you interested in "project management standard curriculum"?

very much	qute a lot	neither	a little	not at all
20%	**40%**	**30%**	**10%**	**0%**

Q2. Which of following applies to creation and creation of curriculum?

I want to participate	Can participe when conditions are met	I would like to provide support such as reviews	I would like to ask in detail	Am not interested	No need about curriculum
20%	**10%**	**20%**	**10%**	**10%**	**0%**
Can not answer because what kind of work is needed	Interested in it, but difficult to participate	Interested in curriculum system and subjects, but difficult to join			
10%	**10%**	**10%**			

Q3. Presentation and an exchange of opinions at the autumn competition

want to participate at Fukuoka	want to participate if it held in Tokyo	time does not match/far/ expensive	less interest	no interest	interest in discussion but don't want to go
0%	**0%**	**80%**	**10%**	**0%**	**10%**

Q4. After curriculum is released, assume to use it at your university?

a possibility of considering it as a main curriculum	partial adoption that meet policy such as department or specialize	after having achieved achievements in other academic disciplines	Although it evaluates the contents, it is reluctant to actively use it	never use it	I would like to consider using it in seminars
0%	**40%**	**10%**	**0%**	**0%**	**10%**
want to adopt, confirm constraints of operation or number of frames	necessary for mastering management skills is clarified, it may be useful	unclear what the curriculum will be specifically	not treat about curriculum		
10%	**10%**	**10%**	**10%**		

PMO framework for business use is described in PMI Japan Ed. (2009), but last year activities are arranged applied for students in PBL learning. These contents are considered and arranged that based on students’ report and request from teachers.

As a providing method, link to relevant information is set in the project DB, and each material according to the framework is posted. Students used the method of referring to it appropriately and utilizing it for project management. As a result of this enforcement, participants in the leader class had a certain degree of comprehension and confirmed the effect. These results are reported in Kinoshita(2016) as the study of assist for PBL.

Rather, it can be inferred that enhancing the basic understanding that can be cooperated without conscious of the project manager as a whole by the project member is more effective. From last year's initiative Lesson Leaned, applying this curriculum seems to be a desirable solution. It is based on the following practical achievement.

(1) The information described in the phase definition and the output definition was echoed that it was useful as the judgment standard of the leaders. This is expected to be learned in detail by "Introduction of Project Management" and following subject "Project Planning Foundation". Those are shown in the draft curriculum map figure 2, as the required and strongly recommended.
(2) Knowledge DWH that aimed at efficiency by reusing the glossary and past project information that was also requested by the teacher can be considered as part of "Quality Management Foundation".
(3) Problem or issue management is often different tools and sorting methods for each team, and it is also an annual occurrence that problem events and risk events can't be clearly defined. "Risk Management Foundation" can be expected to be able to understand the management method and to practice with appropriate criteria rather than to individually teach these parts.

As described above, if contents that have been similarly guided each year have been learned in advance as part of learning, corporate lecturers can provide and concentrate on guidance as practical expert.

5. Conclusion – Summary and Issue

The issue of this paper is that PBL students can't have enough knowledge of the project management. As a solution to the issue in the field of the current PBL, it is very useful to raise the common knowledge level by adopting the "standard curriculum" which systematically acquire as the prerequisite learning.

Main issue is that the curriculum is not yet officially issued. The enactment work is expected in the future activities of the committee, and participation and acceleration will be continued. There are still many steps to decide the first version. However, it is useful to try it by referring to the composition, and if practice occurs, "PM standard curriculum" can also be updated to more realistic contents with feedback from practice. I would like to introduce the contents of the latest "PM standard curriculum" to the teacher asking the questionnaire and negotiate the adoption.

Acknowledgements

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A Case Report of Innovative Human Resource Development by Putting the Skill Map to Practical Use Effectively.

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In System Development, in order to succeed and to prevent to be a Red Project, it is important to assign appropriately customer's application expert and IT engineer. However, human resource information managed by our company was only business career experience, holding qualification, training history. As a result, the skill level by each employee was not completely grasped. Therefore, it was not always possible to allocate appropriate personnel to the project. Regarding training, official qualifications are not existed because of customer's unique business work. Therefore the appropriate training goal was not able to set because skill level of employee was judged by superiors' subjectivity. In response to this issue, we challenged to consider and put into practice skill map operation. This challenge is aimed to allocate optimally human resource with skill which required to achieve a business plan on system development and to train efficiently individual employees. We considered following specific efforts, and proceeded them. (1) Subdividing skills which is necessary for business execution and formulating skill map classified by category. (2) Regarding skill mastery, establishing clear standards for criteria that were different for each evaluator, and evaluating based on the criteria. (3) Quantitative training target setting and achievement evaluation are implemented regularly. (4) Allocating appropriate personnel assignment to development projects depending on the skills and levels of each employee. In this paper, we report on efforts and issues for formulating skill map, operation mechanism, results of this implementation and future prospects

Keywords and phrases: Skill map, Project Human Resource Management

1. Introduction

Our company has been involved in maintenance and development of many mission-critical systems and accumulated knowledge over a quarter century. Therefore, these experiences make us confident of our skills and techniques for high-quality system development. However, several Red Projects had occurred. Hence, in order to prevent future occurrence, we analyzed the causes of Red Projects in recent years. Although several causes were extracted, one of the main reasons was the lack of technical skills of employees.

Moreover, as a result of analyzing the cause of lack of technical skills of employees, the cause was concluded that human resource development was carried out by individual subjective judgment of manager. Therefore, employees did not possess sufficient skills to carry out work. As a typical case that the person in charge lacked technical skills, there are cases that technical skill was judged by number of years experienced. It is considered that this case is occurred not only in our company but also in many IT companies.

Therefore, human resource development had to be changed based on clearer and objective criteria. Conventionally, human resource information managed by our company was only business career experience, holding qualification, training history. As a result, it was impossible to grasp completely the skill level by each employee.

For this reason, we had to develop a new framework to indicate objectively the concrete content of the skills required of the employees and status of acquisition skills.

Our company is organized in divisional system. Therefore, it was decided to develop a new framework for each department. The division which we belong is organized by about 200 employees. This framework was developed by a group called "Business Promotion Group". It is not in charge of development and maintenance the system. Business Promotion Group is primarily in charge of budget management, business strategy, and human resource development.

This paper is a case report on innovative human resource development by putting the skill map to practical use effectively by Business Promotion Group.

2. Development of a new framework

2.1 Creating a skill map with a clear purpose

As a first step in the development of a new framework, we worked on visualizing skills. In order to visualize skills, it is effective to use skill map. In the past, we also used a skill map to grasp the individual skill level of employees, however it was never used effectively, moreover it became in name only. That because, the skill item was listed without purpose, therefore the purpose of use and criteria for identifying skill level were unclear.

Thereby, it was considered to create a new skill map with a clear purpose is needed, and needed to consider again about skills required for employees. Skills required for employees are necessary skills to carry out tasks. Furthermore, considering from high viewpoint of business execution in a company, it can be thought as an activity for realizing management strategy and business plan.

Many IT companies are constituted effective organizations to realize management strategies and business plans. Therefore, we focused on the skills needed to carry out tasks in the organization and considered about defining skills.

In this way, the method for organizing skill maps focusing on the realization of management strategies and business plans is already exist. It is "i Competency Dictionary (iCD) (IPA HDR Initiative Center, 2015)" promoted by the Information-technology Promotion Agency (IPA). "I Competency Dictionary (iCD)" uses a skill map that shows the relationship with the task dictionary and the skill dictionary. The task dictionary contains detailed contents of task to be carried out. And skill dictionary contains the skill to be needed to carry out the task. Therefore it is very clear and easy to understand.

However, we analyzed that the task definition of "i Competency Dictionary (iCD)" was too detailed and not suitable as a unit for relationships with skills. For this reason, the individual system in charge in our organization was set as a unit for relating detailed skill items.

For example, in our large customer IT system, the development organization is constituted in consideration of the system characteristics, such as funds settlement system, statistical information system, security countermeasure system etc. Therefore, we classified the technical skills necessary for each IT system in a minimum unit that can visualize proficiency of skills for each category (Business field, system infrastructure technology field, development technology, management etc.).

By doing this, employees can understand required skills clearly. In addition, the manager of each system can accurately grasp what kind of skill holding personnel are necessary.

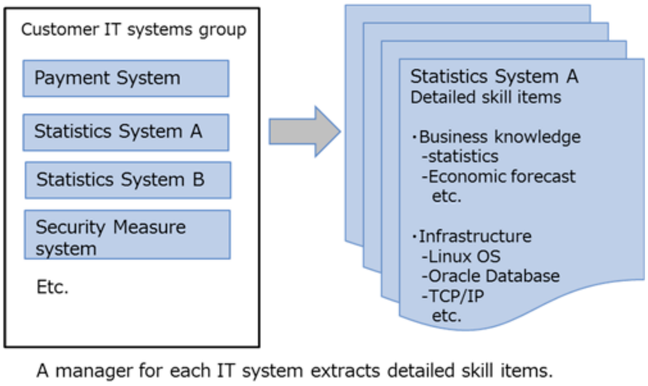

Figure 1 Image diagram for extracting detailed skill items

2.2 Defining skill level

In order to judge the skill level of employees accurately, it is necessary to clarify the definition of the skill level. Definition of skill level is organized in "IT skill standard V3 (IPA IT Skill Standards Center. 2012)" promoted by Information-technology Promotion Agency (IPA), and it is a standard in Japanese IT companies. However, definition of skill level in "IT skill standard V3 (IPA IT Skill Standards Center. 2012)" is difficult to image needed level to execute business because it is defined serially.

Therefore, based on the idea of the IT skill standards, the skill level is defined to handle easier for us. Although in the IT skill standard, the skill level is defined in seven stages, we classified the skill level into three layers. It is defined that, layer 1 as the entry level, layer 2 as a level recognized as a leading expert in charge of work, and layer 3 as a level recognized as a high-end IT professional outside the company.

Furthermore, we defined the layer 2 as divided into two levels. Level 2 of layer 2 corresponds to IT skill standard level 4 and level 1 of layer 2 corresponds to IT skill standard level 3. Layer 3 corresponds to levels 5 to 7 of the IT skill standard. By doing this, it has become possible to indicate clear targets to employees. In other words, we would like employees to aim at level 2 of layer 2 first, after that to aim at layer 3.

2.3 Criteria for judging skill level

It is difficult to judge skill level objectively, because there are little information on how to measure skill level achievement fairly. Even though "IT Skill Standard V3" defines criteria for skill level certification, information is lacking in thinking about operation that certifies high fairness.

In considering judgment criteria, we referred to the "professional CDP system (IPA IT Skill Standards Center. 2010)" NTT DATA Corporation conducts within group companies. In the "Professional CDP System", higher-level certified experts interview the candidate of lower-level certification. (For example, certified interview at the associate level by senior level certified specialists) based on clear criteria. By doing this, fair authentication will be realized.

Although there is few published information on the details of the "Professional CDP System", as close to this, "approach to in-house professional certification (Tanaka, 2009)" is published by the Information-technology Promotion Agency (IPA).

Based on these, we clarified the criteria for qualitative and quantitative evaluation in order that the manager judges the skill level of the employees correctly. (See Table 1)

Furthermore, since it is necessary to master knowledge comprehensively for attaining level 2 of layer 2 as a leading expert, we added the passing the designated test to the Criteria for determining level reach. In the system infrastructure technical field, such as "database related technology", we selected Examination by public organization such as Database Specialist Examination. With regard to the field of "company-specific skills", there is no Examination by public organization like system infrastructure technical field, "in-house unique test" is created and implemented.

In preparing the "in-house unique test", it took about six months to prepare for implementation, because there were only few information, as a reference example, but it was an effective methods to grasp the holding skills quantitatively. In addition, for applicants, by taking the examination, weak points are clarified, and it is easier to make future goals to be set up, and they can get the opportunity to learn knowledge indirectly related to the most recent task execution. There are above merits. It is not easy to prepare and try "in-house unique test", but it is very worth to try.

3. Develop skill map operation

An operational cycle that realizes employee skill improvement based on the study results was decided. The cycle of operation is basically one round in one year, and it was decided to carry out by the following process.

3.1 Five-year training plan definition (Plan 1)

At the beginning of the fiscal year, the manager of each system creates a training plan for employees who assigned his project.

The manager defines target skill item and level

Table 1 Criteria for determining level reach

<table>
<tr><th>ITSS Level</th><th colspan="2">Our Level</th><th>Criteria for determining level reach</th></tr>
<tr><td>Level 5～7</td><td colspan="2">Layer 3</td><td>qualitative assessment
・Achieve recognition within not only the IT market but also Customer's industrial field（ex.Publication of a paper outside the company,Instructor outside the company）</td></tr>
<tr><td rowspan="3">Level 4</td><td colspan="3">Layer 2</td></tr>
<tr><td rowspan="4"></td><td rowspan="2">Level 2</td><td>qualitative assessment
・Has responsibility for deliverables of assigned application in whole phases of IT system development, in design, development, construction,installation, and testing. Has experience and performance of achieving project success one times or more.
・passing Applied Specified Examiination. (ex.Information Technology Engineer Examination,In-house unique test)</td></tr>
<tr><td>quantitative assessment.（Decide by manager's interview）
・Coordinate with the customer about IT system requirements
・Develops subordinates (as a leader by mentoring, coaching, and Collect and send technical information.)
・Perform all assigned duties in whole phases of IT system development independently.</td></tr>
<tr><td rowspan="2">Level 3</td><td rowspan="2">Level 1</td><td>qualitative assessment
・Experience IT systems development over three years</td></tr>
<tr><td>quantitative assessment（Decide by manager's interview）
・Understanding Customers requirements or Product specifications correctly.
・Solve the problem on their own skills</td></tr>
<tr><td>Level 1～2</td><td colspan="2">Layer 1</td><td>quantitative assessment.（Decide by manager's interview）
・Perform assigned duties under the supervision of higher-level IT professionals.</td></tr>
</table>

as a training plan. At that time, in the next five years, the level to be achieved each year is considered. In defining, the manager should consider not only management strategy and business plan but also employee careers (job categories, specialty fields, which should be aimed at as engineers). Because there is risk that the manager is not able to give employees necessary experience to develop their career by considering only management strategy and business plan.

For example, the manager assigns tasks that only change an existed database an employee who aims to a career as a database engineer in order to achieve management strategy and business plan, then employee cannot get design experience which is needed to be database engineer. This situation must be avoided.

For this reason, the manager plans a level up target of detailed skill item for his subordinates throughout considering the role (projects and measures to be implemented in the next five years) and target image (application specialist, database specialist etc.) of the each subordinate.

Table 2 Example of personal development plan

Role		General statistical system leader					
The careers and skills required		Application Specialist					
Sub System	**Detailed skill items**	**Current status**	**FY2017**	**FY2018**	**FY2019**	**FY2020**	**FY2021**
statistical system A	statistics	L2lv1		L2lv2			
	Oracle Database	L2lv1			L2lv2		
	JAVA	L2lv1	L2lv2				
statistical system B	statistics	L1		L2lv1			L2lv2
	Economic forecast	L1		L2lv1		L2lv2	L2lv2
	SQL Server	L1			L2lv1		
	ASP.net	L1				L2lv1	

Table 2 is a specific example of the five-year plan which is created individually for each employee. It is reviewed by the manager every year at just before the beginning of the fiscal year, and are revised if necessary.

3.2 Interview with the manager and employees for goal setting (Plan 2)

At the beginning of the fiscal year, the manager interviews the employee to decide skill-up goals. The skill-up target is set for each detailed skill item unit, and it was set both short-term goals aiming at achievement in half a year and long-term goals. In an interview, the manager explains the reason that is necessary to improve that skill and motivates the employee. The employee realizes the necessity of skill improvement and checks whether there is a problem in career development. If employee feels that the skill-up target presented from manager makes him disadvantageous in terms of career development, the employee mentions opinions to the manager at this timing. In this way, the most important point is agreement by manager and employee.

3.3 Carrying out skill up (Do)

The employee carries out his tasks with considering skill up. The manager checks the skill upgrading situation of the employees at appropriate timing such as the progress meeting, and gives advice if necessary.

3.4 Confirm the target achievement degree (check & Action 1)

The manager and the employee hold a semiannual interview to confirm achievement of skill-up target. The employee aiming at level 2 of layer 2 has to take the examination of public organization or the in-house unique test before this interview and to clarify the pass or fail. At this time, if the skill-up target has been attained, the next target will be set. Otherwise, shortage point for the skill-up has to be clarified in the interview and employee takes actions to achieve the target again.

3.5 Monitoring (check & Action 2)

Basically, the skill level certification was done by the manager, but we decided that Business Promotion Group’s staff monitors skill improvement status of employees who set the targets for level 2 of layer 2 in half a year or a year later respectively. This monitoring is done to prevent unevenness of training policies and evaluation policies between each manager.

As a matter of course, it is ideal to monitor all employees, but since the operational burden is heavy. Therefore, it was limited only level 2 of layer 2. Even only this range, since it was able to make consciousness between Business Promotion Group’s staff and all managers, it was considered possible to achieve the objective to prevent unevenness among all managers.

Specific monitoring methods are as follows.

(1) The manager reports skill items which are targeted by employees targeting level 2 of layer 2 and actions which will be taken to achieve them to Business Promotion Group’s staff .

(2) The manager reports the achievement

status of the target every quarter to Business Promotion Group's staff. When the goal is achieved, the manager reports rationale for judgement that was achieved as a third party can understand.

(3) When there is a doubt about the goal achievement or achieving process of the goal, Business Promotion Group's staff requests additional explanation for the manager and if necessary, requests correction.

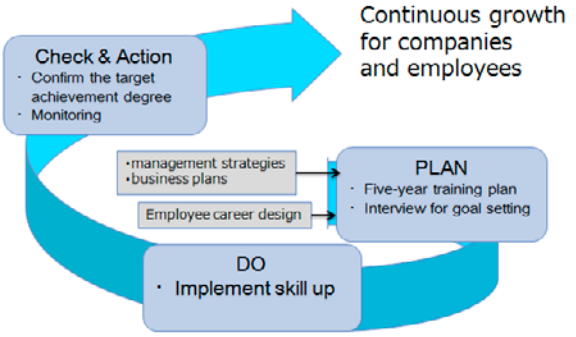

Figure 2 Image diagram for skill map operation

By doing this, it becomes possible to realize highly objective evaluation based on clear criteria.

The overview of the framework described so far is shown in the following figure.

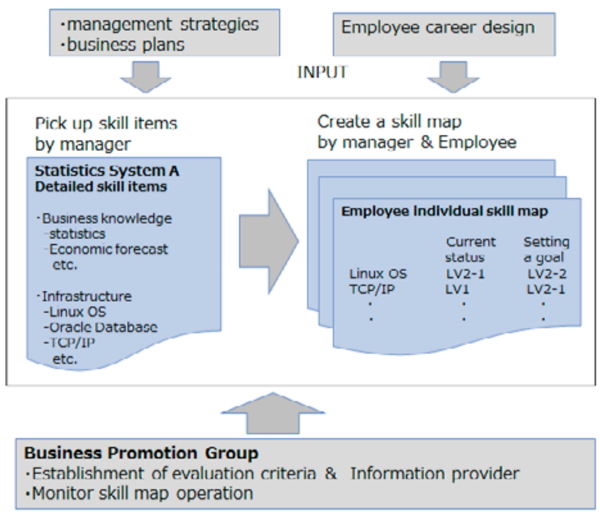

Figure 3 Overall image of skill map

The framework described so far was not completely prepared from the beginning, however it was completed by solving and improving the issues described below.

4. Issues after developing a skill map

Many issues were solved before establishing the skill map operation so far described. For these issues, we will show examples thought to be useful to the reader.

4.1 Issue1 On consensus building of certification criteria

In the initial certification criteria of the skill level, although we decided the rule that the evaluator judge comprehensively from the quantitative and qualitative viewpoint and certify, it could not be formed a consensus sufficiently between planner of skill map and evaluators. Because evaluators had strongly particular thoughts about human resource development, therefore they could not easily accept our opinion and rule. In order to form a consensus among stakeholders, it was necessary continuous discussion to eliminate unevenness. For that reason, a briefing session on certification criteria was planned. We thought the best time to hold the session is before the first skill evaluation. It is just before the evaluator and the employee confirmed the goal certification interview. At the session, the biggest issue was a concept on the quantitative evaluation of level 1 of layer 2. Regarding certification criteria, initially the rules of quantitative evaluation was possession of qualification. In particular, criteria of level 1 of layer 2 was possession of IPA Applied Information Technology Engineer Examination. Since this qualification is positioned as a driver's license for a system engineer, it was considered initially that qualification is suitable for measuring the skills of level 1 of layer 2. However, knowledge required for qualification was not tied to all items of the skill map. In addition, if judging by possessing qualification or not, employee with skills was not grasped skill level correctly. These problems might cause an impact on the optimal allocation of personnel. For these reasons, discussion point was whether evaluation could be implemented appropriately depending on the possession of qualification. As a result of the discussion, in the case that it is considered that employee had equivalent skill to pass the Applied Information Technology Engineer Examination, possession of qualification is not mandatory, and on the condition that the reason of skill holding is clarified, it become out of the criteria for quantitative evaluation.

4.2 Issue2 unevenness of the skill level judgment

Although certification criteria were agreed, there was an unevenness of judgment by the evaluator. The main factor of the unevenness is evaluating based on interpretation of each evaluator. It was due to difficulty to share the criteria correctly among the evaluators by explaining the certification criteria only a once. In order to perform an appropriate skill recognition operation, it is necessary to exclude the evaluator's own interpretation thoroughly, and it is essential that the evaluator understand the evaluation criteria correctly. For this reason, we decided to explain the certification criteria again at the briefing session.

The most unevenness was the qualitative evaluation of level 2 of layer 2. Just by only referencing to the certification criteria, it was difficult to image what kind of action is needed and role in charge of level 2 of layer 2 employee. Therefore we introduced a specific model case (For example, explaining a behavior of the specific employee) and explained. With such efforts, all evaluators could have the same recognition and understanding of the judgment standards. And evaluator understood criteria sufficiently, it was possible to evaluate appropriately without unevenness.

4.3 Issue3 Efforts toward effective human resource development

For the practical operation of skill map, although briefing sessions were held repeatedly, new questions and problems arose one after another at each discussion. We listed questions, problems and managed as considered issues. The main issues are as follows.

(1) About management of long term training

Human resource cannot be developed in a short-term. Some skill requires a lot of time to train. Therefore, initially we set the target setting every half a year as a rule, but in addition, we planned a new long-term training plan and decided to manage it.

(2) About skill items not requiring level evaluation

The detailed skill items can be categorized into skills that can only grasp whether employee possess or not and skill item aiming at a higher level. It was decided to manage the level evaluation of the basic tool which does not need advanced knowledge and skill only the experience of use, with experienced or no experience. Basic tools are operational techniques of telnet terminals, utilization techniques of single test tools, and so on.

(3) Further establishment of skill map

In order to monitor the operation status of the skill map, the sheet was managed centrally filling out by each evaluator. Operation is one cycle in a year. We carry out the following.

- Setting goals
- Collecting and summing up skill map, feedback of summary results
- Confirm the achievement of the target
- Evaluation

At the beginning of the operation, few evaluators submitted the skill map by the set deadline date because the recognition of the skill map could not be penetrated. And, a lot of mistakes of filling out occurred frequently, so it was hard to operate the skill map. However, As a result of continuous efforts to improve such as the briefing session, now, one year has passed since the start of operation, and it finally operates stably.

4.4 Issue4 About the concrete personality and certification unit of layer 3

Layer 3 corresponds to levels 5 to 7 of "IT skill standard" promoted by the Information-technology Promotion Agency (IPA). The definitions of levels 5 to 7 of "IT skill standard" are "Intra-firm high-end player","Internal high-end player", and "Internal high-end player and world class player". Initially, our criterion of layer 3 is defined "certificated from an external organization such as paper certification (submission of peer-reviewed papers to an authoritative organization)". However, it was difficult to imagine specific human figures from this definition. And a problem occurred that certification in the system unit same as under level 2 of layer 2 is appropriate or not. For this reason, we reexamined the concrete personality of layer 3 and the optimum certification unit.

(1) Concretization of layer 3 human figures

The figure of the high-end player might be a problem of the whole IT industry, because there is not often a high-end player in the field of general development of IT systems. Especially, regarding to levels 6 to 7 of "IT skill standard", in the 2010 survey conducted by the Information-technology Promotion Agency (IPA)

(IPA IT Skill Standards Center.2010), the composition ratio of IT human resources is only 0.8%. Therefore, it is difficult to imagine the figure of high-end player, and we had a hard time to consider this problem.

The initial definition of layer 3 is only that "certificated from an external organization such as paper certification (submission of peer-reviewed papers to an authoritative organization) ", and concrete figures of layer 3 was not still defined. Therefore, discussions took place to refine human figures, and initially the concept is defined as "layer 3 is on the extension of level 2 of layer 2 ", but the problem, whether the concept is correct or not, arises. On the extension of level 2 of layer 2 is the following idea.

A) Layer 3 is on the extension of layer 2-Initial concept

Initially, layer 3 is considered as a level on the extension of level 2 of layer 2. In other words, as shown in Figure 3, people who is certified level 2 of layer 2 for all the detailed skill items in the system unit aims at layer 3. However, with continuous discussion, it began to realize that layer 3 would not be the leading person who is familiar with the customer's IT system, and the foremost person in the industry / business field.

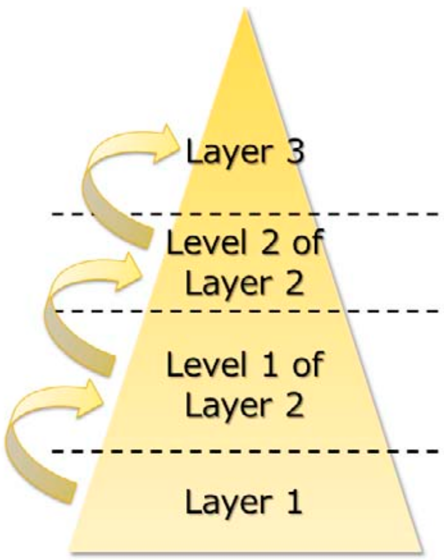

Figure 4 Initial conceptng of layer 3

B) Layer 3 is not on the extension of layer 2-redefined concept

Although layer 3 is not necessarily to be a specialist on a customer system like level 2 of layer 2, layer 3 needed to possess a wide knowledge as a leading person in that industry / business field, and can transmit the concept of the industry / business future. In other words, as shown in Figure 4, layer 3 and under level 2 of layer 2 has a clear distinction.

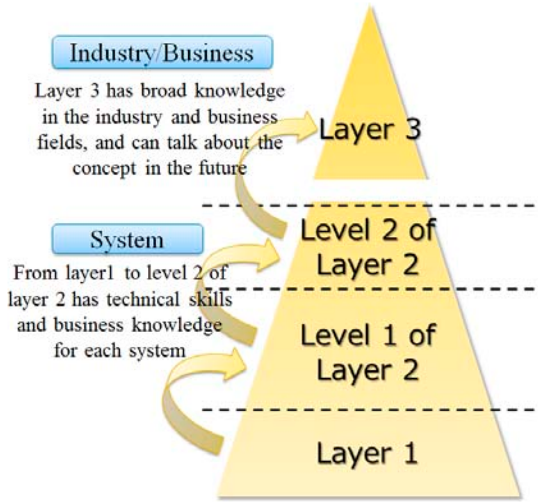

Figure 5 Concept of layer 3 after redefinition

Based on the above idea, layer 3 was redefined as "a person who possesses advanced expertise in the industry field or has advanced skills in the element of development technology, and can make business proposals to customers".

Training of layer 3 is unlike layer 2. Training plan is shifted to mid and long-term planning from short-term, and employee is required to be changed consciousness from skill development to career development. Furthermore, in skills, it is required to acquire highly specialized skills such as advanced proposal skills, grasping industry trends / business analytical skills, and grasping new technologies. By pursuing expertise, it will lead to human figures that can be active as an industry recognized expert.

The activities are as follows.

- Advancement of new business areas through business proposals to customers
- Creation of new business using latest element technology
- Presentation at forums and conferences in target business

(2) Layer 3 certified unit

Initially, layer 3 was supposed to be set for each customer system of skill map. However, based on the above layer 3 human figures, it is appropriate to set unit of layer as kind of industry and the business unit, not only to the foremost person in the each system or subsystem unit of the skill map. Based on these ideas, we conclude that from layer 1 to level 2 of layer 2 is certified by system unit, layer 3 is certified by industry / business unit.

5. Achievement of the skill map introduction

By introducing the skill map, skill level certification criteria of employees is standardized. And it has become to appropriately evaluate the degree of achievement of the certification level for each technical skill item of each personnel. We organize the achievement from the viewpoint of performing business and training personnel by this program.

5.1 Enabling optimal personnel assignment for system development project

We analyzed the skill items, levels and number of personnel required for each system development project based on the project contents and difficult level. Next, personnel were assigned to the project based on the skill level of each person in the skill map.

Before the introduction of the skill map, since individual level of technical skill was not properly certified based on unified standards, a project was developed by assigning personnel who is assumed to possess individual technical skills with reference to past experience of system development and information recognized by project manager. As a result, even though there was a high skilled member, that member could not be assigned to the project, and personnel who did not reach the expected skill level were assigned to the project. Due to inappropriate assignment of personnel, in the development phase, the risk of system development such as occurrence of trouble, development problem, delay of progress became obvious.

By introducing skill map operation, employee skills were visualized, as a result, it was possible to assign to the project proper personnel who satisfy the skill items, levels and number of skill holders which is needed. In addition, it became possible to grasp the absence or shortage of personnel with the required skill level in advance, and it was possible to procure such personnel externally. Thereby, it was able to contribute to the reduction of project risk.

Table 3 The number of project risk occurrence related to technology and personnel per system development scale of our division

Year	The number of project risk occurrence (number/Kstep)	Remarks
2015	0.2	
2016	0.0	Skill map opertion started
2017	0.0	

5.2 Enabling definition of long term training plan for employees based on long term business outlook

In order to introduce skill map, business skills and IT technology necessary for developing customer system were extracted comprehensively. As a result, the skill items to be trained for employees became clear and it was possible to intensively train skill items defined in skill map in developing and maintaining customer system. In this way, in business execution, it has become possible to focus on training important skill items intensively. In addition, the business environment surrounding customers and IT technology environment are changing and progressing day by day, and its speed is accelerating compared to the past. In order to provide IT service which is satisfied by customer, it is important developing strategic business and continuing to get advanced technology acquisition. Under this circumstance, not only the skill items of the current system, but also the skill item which is intended to systemizes and new technologies expected to be adopted in the future will also be defined in the skill items of the skill map, and it is set as training target. For daily environmental changes, in order to avoid obsolescence of technical items of skill map, skill items of skill map are updated on a yearly basis. We are trying to train efficiently necessary technical items from present to future perspectives.

5.3 Definition carrier design of employee

By accumulating development experience, our company employees aim at one of the personnel types of business specialists, infrastructure IT specialists, and project manager who play an important role in system development. In order to become a personnel type that each employee is aiming for, it is now possible to clarify necessary skill items through efforts of a long-term skill improvement plan. And it is able to share the OJT (On the Job Training) plan in system development with a superior and employees. By doing this effort, it became possible for the superior and employees to share efforts to grow and growth process annually, and employees are able to grasp expected roles and levels. As a result, employees are actively working on own growth. Since it has only been in operation for one year since started, we would like to improve as necessary while confirming the training effect.

5.4 Skill improvement in 2016

In 2016, the first year of skill map operation, one employee was certified as level 3, and 38 employees were certified as level 2 of layer 2. It cannot implement quantitative evaluation because it is the first year of skill level certification criteria. But these efforts improve the awareness of training at our department and contribute to the growth of employees.

6. Conclusion

With this introduction of the skill map, it was able to evaluate properly the skill level of employees based on the certification criteria and visualize the holding skills. Regarding the certification criteria and concept of each skill level, continuous review was repeated by the evaluator and trial and error was repeated. Among them, regarding the skills related to the business specifications of the IT system, which can't be judged by public qualification, we created in-house unique tests and conducted unique in-house efforts to evaluate skills. Based on these facts, we believe that our skill map operation has become an innovative framework in that skill level can be objectively judged. In addition, the layer 3 was defined not by the idea of stacking up skills like up to level 2 of layer 2, but by a unique idea as a person who can transmit the concept of the industry / business future vision.

As a result of these efforts, we realized that it is a great achievement that it has led to the optimal allocation of personnel to system development projects, reduction of project risks, and formulation of training plans for employees looking at long-term business view. However, it is still insufficient to verify how this framework is effective on our business execution. As specific verification contents, the following will be implemented.

(1) Rising degree of certification rate of employee's P-CDP.
(2) Reduction cost related to technical risk.
(3) Reduction degree of trouble caused by lack of technical capability.

These verifications require time of several years, but it has to be kept observing.

We hope that this paper will help for IT companies considering innovation in human resource development.

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Project Management with an Emphasis on Customer Satisfaction

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In software development projects, product quality (outcome quality) derived from QCD is improved. However, since strong correlation between outcome quality and customer satisfaction is not found in various researches, it's difficult to say that customer satisfaction is improved. Customer satisfaction is the key factor that contributes to the medium- and long-term competitiveness and profitability for companies. Project manager must understand strongly that other factors other than outcome quality have an impact on customer satisfaction. Although conventional project management approach by the PMBOK (Project Management Body of Knowledge) are contributing to improve outcome quality, but other point of view need to be considered in order to ensure the management of customer satisfaction. In this paper, we considered the role of project management software development in order to win customer satisfaction with the perspective of service science since software development belongs to "service industry".

Keywords and phrases : IT Project, Service Science, Stakeholder, Customer Satisfaction,Customer Expectation

1. Introduction

Since software development industry encounter a shift from mainframe to client / server system and Web system, functional differentiation of products becomes so difficult that business competition is intensifying. On the other hand, customer's demands are becoming diversified and so complicated that it's getting hard to lead projects to success.

Despite this background, the success rate of projects is improving in terms of compliance with baselines of software quality, cost and delivery schedule (QCD) by accumulating project management methods such as PMBOK and other related vendor-specific management know-how.

Although it is said that the criteria of project success from the customer's point of view should be customer satisfaction than the quality and delivery time of products, strong correlation between outcome quality and customer satisfaction is not found in various researches(Japan Information Systems and User Association,2014). In other words, for the sake of customer satisfaction, different factor must be taken into account in addition to the outcome quality. Moreover, since software development has characteristics of "service industry" with many collaborative works with customers, it is necessary to understand that customer satisfaction greatly affects mid- and long-term competitiveness and profitability for system vendors.

Therefore, in order to consider factors other than outcome quality, we apply the concept of service science to analyze scientifically. In the service science field, "customer satisfaction is generated by the instrumental function and the expressive function of the provided service".(Shimaguchi,1994) The instrumental function is an attribute of being provided "naturally" for that consideration such as outcome qualities controlled by QCD in software development. If one of these attributes is missing, it can be a cause of customer dissatisfaction. On the other hand, since the expressive function is not natural for the consideration, it is an attribute of "happy" when provided with products such as the process quality derived from the impression of the project member or feeling of security in software development. If there is one superior attribute of expressive function, it can improve total customer satisfaction. Figure 1 shows the structure of customer satisfaction in software development.

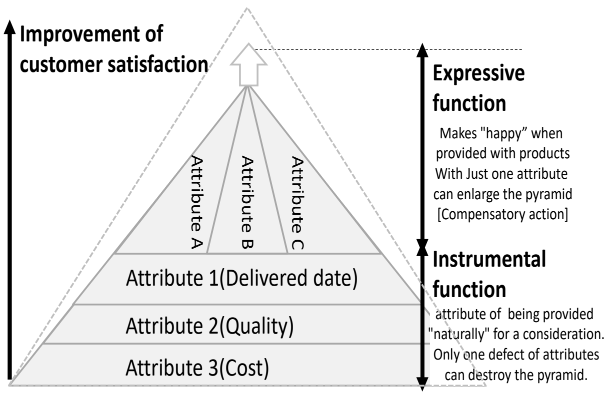

Figure 1 the structure of customer satisfaction (Shimaguchi,1994)

Engineers tend to consider the conventional project management methods based on PMBOK as the way to ensure instrumental function (outcome quality) in many cases. Therefore it can be assumed that those views make it difficult for them to increase customer satisfaction-oriented efforts. Although PMBOK is a generic management method for not only tangible products but also intangible services originally, it is presumed that those misunderstandings is caused by the fact that many contracts are agreements for the guarantee of products.

In this paper, in addition to the method based on PMBOK, we consider the way of project management to improve customer satisfaction by incorporating the viewpoint of service science with the view that software development belongs to "service industry".

2. Definition of customer satisfaction

Since QCD (outcome quality) of software is an objective and quantitative indicator, customer satisfaction is a subjective indicator of the receiver (customer). Therefore, in considering customer satisfaction, it is necessary to define the "customer" and the index of "satisfaction".

2.1 Customer setting

In software development projects, there is a method to segment customers based on the role in the project and the characteristics of the expectation value for the vendor. Table 1 shows an example of customer segmentation reported by the customer information segmentation team of Japan Users Association of Information Systems(JUAS) Advanced Study Group. In order to manage customer satisfaction, it is necessary to segment customers to this level.

Table 1 Segmentation of customers

No	Customers	Characteristic of expectation	Type
1	System owner	1.Aggressiveness 2.Involvement of decision 3.Evaluation criteria	1.Offensive 2.Defensive Other 6 types
2	Project promoter	1.Aggressiveness 2.Ownership of the operation	1.Expect proposal 2.Utilize vendor Other 6 types
3	Specification requester	1.Sense of resistance 2.Problem solution approach 3.Specificity of system utilization	1.Require finely 2.Take easy ways Other 6 types
4	System user	1.Understanding the background 2.Sense of resistance 3.Adaptability	1.Expect vaguely 2.Anxiety Other 4 types

2.2 Satisfaction index

In the field of service science, there are six basic indicators of service quality: "accuracy" " rapidity " "flexibility" "empathy" "sense of security" "good impression" (Suwa ・ Yamamoto,2015). Customer satisfaction is the gap between customer's expectation and actual experience in terms of these service qualities. Table 2 shows representative examples of indicators evaluated by customers in software development projects.

Table 2 Service quality indicators and examples (Suwa・Yamamoto,2015)

No	Service quality indicator	Cases to be evaluated
1	Accuracy	Misspellings / designations of design documents
2	Rapidity	Response speed for inquiries
3	Flexibility	Viewpoint of total optimization without adhering to the plan
4	Empathy	Understanding of customer's challenges
5	Sense of security	Timely report to customer's anxiety factors
6	Good impression	Manner of project member at meetings

2.3 Degree of satisfaction

Customer satisfaction is defined by the extent of the gap between actual experience and customer's expectation for each service quality indicator in the previous section.

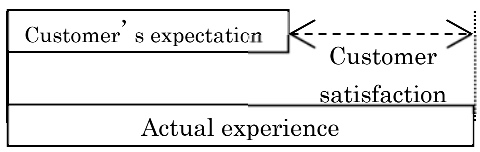

Figure 2 Customer satisfaction configuration (Shimaguchi,1994)

2.4 Impact on customer satisfaction

Based on the previous section, the impact to these service quality indicators by project management (conventional management) which emphasizes software QCD is considered in Table 3.

Project management with PMBOK tends to focus "accuracy" so that QCD is controlled correctly as planned. For that reason, "empathy" and "good impression" are not taken into consideration, and "rapidity" and "flexibility" are sometimes interpreted negatively.

Table 3 Impact of traditional project management on service quality

No	Knowledge area	Accuracy	Rapidity	Flexibility	Empathy	Sense of security	impression
1	Integration	o		#		#	
2	Scope	o		x	#		
3	Time	o	#	x		#	
4	Cost	o		x	x	#	
5	Quality	o	x	x		#	
6	Human resources	o				#	
7	Communication	o	#	#	#	o	
8	Risk	o		#		#	
9	Procurement	o					
10	Stakeholders	o	#	#	#	#	

o : Management of the area contributes to improvement of indicators

: Management of the area influences the indicators.

x : Management of the area can be negative effect to the indicators.

3. Application of service science to software development project

Based on the characteristics of service science, we consider the following six perspectives to strengthen management in software development project.

(a) Strategic approach to customer satisfaction
(b) Management of customer's expectation
(c) Responsibility and authority for customer satisfaction
(d) Satisfaction level of project members
(e) Manualization of service process
(f) Evaluation of customer satisfaction

3.1 Strategic approach to customer satisfaction

In order to improve customer satisfaction, it is necessary to improve the six service quality indicators, but as shown in Figure 1, it is unnecessary to raise all the attributes of the expressive function (process quality). Moreover, it is unnecessary to raise them for all stakeholders shown in Table 1. Selection "stakeholder" and "attributes" strategically is important to improve customer satisfaction by standing on the premise that to secure outcome quality (QCD of software) is an essential function.

3.2 Management of customer's expectation

In general, in pre-projects to receive software development orders, customer's expectation tend to be expanded overly and it is difficult to rectify their baselines after the project starts. In other words, it is necessary to set the expectation baseline to a reasonable position before starting the project.

3.3 Responsibility and authority for customer satisfaction

Customer satisfaction is the accumulation of what is generated each time at countless contact points, such as meetings or chatting with customers and results differ depending on the each customer and circumstances(even for the same customer). In other words, all project members who are in contact with customers must have responsibility for customer satisfaction. Therefore the management should define the responsibilities of the project members involved in the service and also give them the authority to execute them.

3.4 Satisfaction level of project members

In service science, there is a notion that satisfaction level of employee providing services lead to customer satisfaction(Kitashiro,2009).Similarly in the software development project, it is indispensable to improve the satisfaction level of project members for customer satisfaction.

Since the project and its structure are terminable, it is difficult to improve the satisfaction level of project members. The royalty and placement, evaluation, and reward need to be considered in order to contribute to customer satisfaction.

3.5 Manualization of service process

In the software development project, the manual for customer service has not been developed. Good service can not be provided by a general-purpose manual, but manualization seems to be effective for securing the service quality of the lowest baseline and encouraging project members to become more aware of services to monitor or control.

3.6 Evaluation of customer satisfaction

From the viewpoint of service science, the most insufficient element of conventional project management is evaluation of customer satisfaction. Although there is a process of obtaining customer's evaluation during the project closing phase, its method and contents are not systematized. It does not lead to the analysis or evaluation that contributes to the competitiveness and profitability of companies in the medium to long term.

It is necessary to have a mechanism that can systematically evaluate not only outcome quality of software but also the quality of service.

3.7 Applicable measures

Based on the consideration up to the previous section, following four measures could be effective in this paper.

(1) Measures 1: Classify stakeholders in detail, and set policies to respond. (Viewpoint of a)
(2) Measure 2: Determine the attribute to focus and management method for service quality. (Viewpoints of a and c)
(3) Measure 3: Apply "agreement list" as setting method of realistic customer's expectation. (Viewpoint of b)
(4) Measure 4: Utilize the Web sharing system with customers. (Viewpoint of e)

4. Case study and effects to the project

In order to consider the effect of measures mentioned in the previous chapter, each measure was applied to actual system development projects. Due to constraints of each project, each measure was applied for different projects.

4.1 Classify stakeholders in detail and set policies to respond

In classification and response policy of stakeholders, we classified them according to 30 types shown in Table 1 and set policies to respond. In the stakeholder registry shown in Figure 3, items of "classification", "important index", "response attitude" were set up by the results up to the pre-project and the consultation with the sales staff.

Num.	Customer information			Assessment result			
	Name	Position	Role	power of influence	Attitude type	Quality	Policy of response
1	Uuu	General manager	Project Owner	Middle	Togetherness	Accuracy Flexibility	Think total optimization and act flexibly
2	Xxx	Sectional chief	Project Manager	Low	Indecisiveness	Security Empathy	Keep good control by crediting him for the state
3	Yyy	Assistant Manager	Project Leader	High	Holding project in control	Accuracy Flexibility	Share the situation at all time and follow him
			Specification requester	High	With high expectation	Accuracy Flexibility	Build a relationship with logical explanation
4	Zzz	Staff	Project executant	Low	Get along with each other	Empathy Impression	Hear attentively and explain simply for him

Figure 3 Example of stakeholder registry

4.2 Determine the attribute to focus and management method for service quality

Based on the stakeholder registry in the previous section, we set important quality of service and management method in the project management plan. For this project, "flexibility" was set according to the preference of influential customer's project leader.

In order to ensure flexibility, it is important to respond to changes and emerging demands. In the original project management, it is necessary to deal with the change request after passing the change management committee, but the mechanism that can respond promptly for customer's request for changes in detail and other support. Therefore, as a management method, we defined the person responsible for customer satisfaction for each stakeholder on the organization and clarified authority to have flexibility(Figure 4). In addition, we decided to utilize the issue register for customer's various requests as a management index of the flexibility to be provided, and to evaluate by classifying the flexibility. In order to grasp requests from customers accurately and promptly, online pending management systems among project members including customers was adopted.

3.1 Project structure and roles

Num.	Role	Abbrev.	Responsibility	Authority
1	Project Manager	PM	Management and Execution of contracted project Management of satisfaction for Customer's PM	To modify overall schedule To use management reserve
2	Project Leader	PL	Management of progress and quality at each phase Management of unplanned task Management of satisfaction for Customer's PM member	To modify detail schedule To use risk budget for each phase
3	Group Leader	GL	Management of progress at each phase Management of satisfaction for Customer's project member	To contribute customer's requests flexibly under the baseline of Group's QCD

Figure 4 Example of project management plan description

Table 4 shows examples of management methods assumed for other service quality attributes.

Table 4 examples of Service quality management methods

No	index	Example of management method
1	Accuracy	Measure misspellings for documents
2	Rapidity	Measure the level of the inquiry and answer response
3	Flexibility	Measures acceptability of customer support work
4	Empathy	Describe the value to the customer about the issue
5	Feeling of security	Share project status with online system
6	Good impression	Manualize behavior and words at meetings

The opinions from my project members applying "4.1" and "4.2" are shown below.

· There was no viewpoint of service so far. It brings good awareness for me and also for other members.

・Up until now, I responded for customer's expectation implicitly on my own judgment. It motivated me with positive feedback because the project set this goal.
・I was passive to deal with only what I had planned, but I began to think about how flexible we should respond through communication with customers.
・ My responsibility to protect QCD makes me conservative(decline). It would be better for incentives to pursue quality of service.

4.3 Apply "agreement list" as a practical method of setting customer's expectation

In ordering activities (pre-project) in software development, the conversation with the customer focuses on their merit. As a result, customer's expectations tend to be ambiguous and bulging. It is important to reconfigure customer's expectation to a reasonable level and make it visible before the project begins. Originally it is desirable to use contracts and service specifications. However, contracts are strongly influenced by customs and cultures of customer organizations, so it is difficult to make major changes. In addition, there are few cases where detailed conditions can be described. On the other hand, service specifications presented by vendors tend to be closer to the vendor's point of view that makes it difficult for customers to feel empathy. Therefore, this time we tried to control customer's expectation by attaching a worksheet "Agreement List" with the terms of the contract.

Tasks	Documents	Items	Agreement
General	service specifications	2.4 Project Outcomes	Include additional outcomes below. Report xx | To analyze medical cost | Mar.2017
General	service specifications	3.6 Reliability of the system	(1)Sub-system A Maximum tolerable downtime is xx Recovery Time Objective is xx (2)Sub-systems without A Maximum tolerable downtime is xx

Figure 5 Example of agreement list

The opinions from my project members applying the agreement list are shown below.
・Since contracts and specifications are created by customers on their own initiative, and service specifications are often created by vendors on their own initiative, it makes both sides argue for their interests at the time of negotiations about the contents. The name "agreement list" made negotiations easy to create the list together with consultation.
・Before this, we just explained service specifications since acquiring formal signing was not easy. In this time, I think that it was effective because I agreed to arrange the requirements of reliability and availability at a realistic level and attaching it as a contract.
・Since we had to pay attention to the customer's point of view, we could not claim to reduce our own risk. Then some parts had to leave ambiguity.

4.4 Utilize the Web sharing system with customers

In software development, project management is usually executed by vendors to report. By using the Web system with customers as a project management tool, "feeling of security" can be improved. Also, "empathy" and "quickness" can be improved by sharing request items from customers and visualizing the situation immediately.

Figure 6 example of web system usage

The opinions from my project members applying the web system are shown below.
・ Visualized situations with customers made my awareness of the deadline increased.
・Compared to e-mail, cost of communication with customers is reduced by visualization of situations, unifying them on the web and defining the method.
・Frequent requests from some customer increased my stress.

5. Conclusion

In this paper, we considered the role of project management software development in order to win customer satisfaction with the perspective of service science in addition to project management approach by PMBOK.

As a result, the following conclusion was obtained.
(1) I could define customer satisfaction level in project management and propose application method of service science in software development project.
(2) I could propose a strategic approach to customer satisfaction that introduced stakeholder

classification and management method for service quality
(3) A strategic approach to customer satisfaction led to motivation for project members.
(4) I could propose a management method of customer's expectation by using the web sharing system and the agreement list.
(5) As a result of applying project management for improving customer satisfaction to system development projects,I was able to confirm its effectiveness.

In this paper, customer service is considered from the viewpoint the customer by the software development vendor.However customers and vendors are required to understand mutual position and interests, and then required to reform their fundamental awareness as collaboration partners to create new value in essence.

We would like to grasp that the viewpoint of services is an approach to this reform.

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Ultra Short-Term Development Realized by Reducing Requirement and Improving System Introduction Training for Customers without IT Department

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The companies in Japan account for 99.7% of small and medium enterprises. For small and medium enterprises, due to its budget limitation, there are many small and short-term system development projects. In my case, it was necessary to agree on the requirement definition at the early stage, do not make customization as much as possible, and further shorten to the shortest development period of my company. Due to no IT department in this customer, I need to manage 12 user departments directly by myself. Therefore, it was necessary to make consensus of all divisions in the requirement definition phase. What I did to ensure delivery time and quality are follows. "After visualizing the requirements, I described how to realize the requirements into operation manuals, and reduced system customization to just one case. ", "Based on the idea that the operation manual is also a system in a broad sense, I made a manual specialized for each user departments. ", "Operation training by each department, deepen the contents, user themselves is familiar with the operation according to the manual. " As the result of these efforts, I have succeeded the delivery on-time with good quality, and improving the customer satisfaction. At the last chapter, I suggested which case this approach works fine and future improvement.

Keywords and Phrases : Product Application, Many Adjustment Targets, Requirement Definition, Minimization of Customization, Training by Department

1. Introduction

Of the number of companies in Japan in total of 3,820,000 companies, there are 11,000 large companies and 3.81 million small and medium enterprises (After that, written as SMEs). It is indicated by Survey Room for Small and Medium Enterprise Agency (2016) that the number of companies is 99.7% for SMEs. According to the question on the IT situation to SMEs, the reasons for not doing IT investment are "They have no human resources who can introduce IT. ", "They don't know the IT introduction effect well, or have no skills which estimate the IT introduction effect properly. " and "Cost can not be secured enough. " This research was done by Survey Room for Small and Medium Enterprise Agency (2017). The breakdown of "They have no human resources who can introduce IT." means that the IT department itself may not exist or the IT department may exist but IT personnel is short at all times. In another survey by Information-technology Promotion Agency (2015), the ratio of the number of IT engineers in Japanese customer companies and IT companies is 10:30, and the ratio of IT engineers in US customer companies and IT companies is 25:10. IT investment is 0.75% of sales (average value of trim in all industries). This 0.75% number is indicated by Japan Information Systems and User Association (2016). Therefore, of course, IT budgets are small in SMEs as compared with large enterprises. This trend in Japan is reported by Ministry of Internal Affairs and Communications (2016).Such system development projects in SMEs are often small-scaled and short delivery due to the budget of IT investment. On the other hand, management elements are the same regardless of the magnitude of the development scale or the length of the delivery date. So in order to comply with the delivery date and to ensure quality, condensed work in a short period of time is required. In this respect there is the difficulty of project management in small-scale and short-term development.

The project I was in charge was an ultra short term project. It was 3 months from proposal to actual operation, and actual development period was 2 months and a half. It was a project in which the customer company did not have an IT department. In this paper, I first describe the background and problems of the project. Next, I report concrete contents and outcomes such as method to visualize requirements and how to customize user operation manual. Finally, consider the conditions to which these methods can be applied and future issues.

2. Problem caused by interruption of scratch development

2.1 Background of scratch development interruption

Customer J, who had done information management for each department so far. For this reason, the person in charge in Section A was unable to directly use the information in Section B. When information on other departments was needed, each person in charge requested to another department to receive the information each time. J project was to solve this problem by "building a mechanism that person in each departments can use information across departments from one search system(Figure 1). "

Initially, it was planned to build a data extraction and data calculation (processing) system with dedicated screen (scratch development) for 6 months. It was named a general-purpose search system, in the sense that search operations of each department can be covered by this one. This general-purpose search system was planned to be used by 12 departments. "The person in charge of 12 departments can not meet in the same meeting (some people are absent).", "Discussion/review does not end at two-hour meeting.", "As a result of circulating the proceedings to the absent department, information is not transmitted accurately. And we need a meeting again." For these reasons, even after 2 months from the beginning, the requirement definition could not be finished. On the other hand, it was indispensable to defend the delivery date due to customer's budget. After all, it turned out that the delivery date could not be kept. We gave up on scratch development and decided to re-propose the general-purpose search system using our products. And I was assigned as PM. Normally, attempts to realize customer requirements by utilizing products do not go well, and there are many cases to switch to scratch development. The feature of the J project was its opposite. In other words, it was a project to realize the system which scratch development did not go well in short term with product function. The development team consists of 6 people, and the consignment phase is RD (Requirement Definition phase) ~ OT (Operation Test and Transition phase). However, since it took 2.5 months to decide to stop scratch development and 1 month to agree with the customer to apply the product, the actual development period was 2.5 months.

2.2 Shorten the shortest delivery date of our products

In terms of our past achievements, the period from requirement definition to operation was 4 months. Therefore, it was necessary to further shorten the shortest delivery date by 1 month.

2.3 Instantly complete the requirements definition phase

In order to satisfy all customer requirements, it was necessary to customize our products. However, increasing the number of customization will increase the development volume. For this reason, it was necessary to narrow down the scope of product deliveries and to negotiate customization as early as possible with customers.

2.4 Lead quality activities

Since the IT department does not exist in the customer, it was difficult to be presented the quality criteria clearly in the requirement definition phase. But quality assurance of the system to be offered was obviously essential. It was necessary for the vendor side to support customers, to decide quality criteria and to protect it.

3. How to solve the delivery date and quality?

<Approach to the problem of 2.2>
(1)To perform requirement definition and prototyping in the same period
(2)Make the most of in-house know-how (design documents, tools, test cases, and environments)
(3)Provide with the same system configuration that introduced previously
<Approach to the problem of 2.3>
(4)Visualization of requirements
(5)Provide manuals specific to customer departments and implement training specialized for customer departments
<Approach to the problem of 2.4>
(6)Reduce the number of customization functions and reduce development scale
(7)Have each user handle the operation using the manual actually with the operation training

These approaches are interrelated. For example, (3) is also an approach to shorten the delivery date in the sense that it can make the most of its know-how, and it is also an approach to quality assurance in the sense that it is based on achievement. (5) is an alternative method to narrow down the scope of the

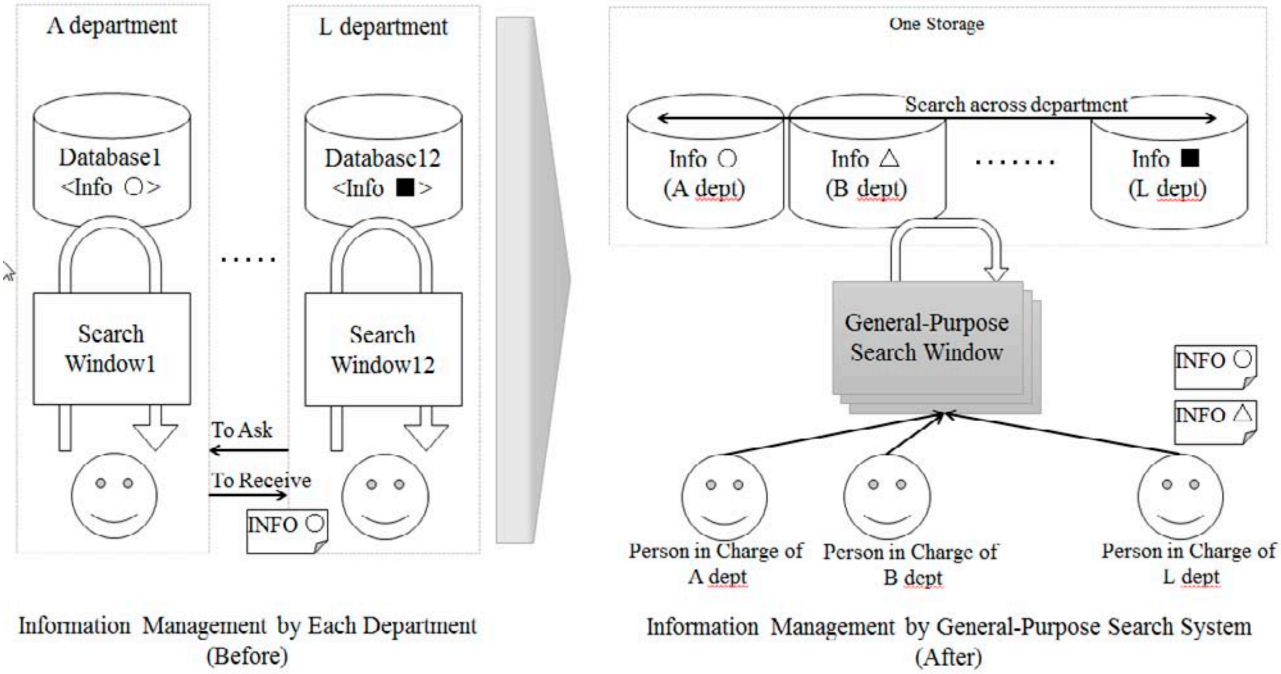

Figure 1 Overview of General-Purpose Search System

product and is also an effort of quality. Particularly devised (4), (5), and (7) are explained in this paper.

3.1 Visualization of requirements

3.1.1 Why is the requirement definition phase not completed?

- ✓ Because there is no IT department, representatives of each department are required to attend the meeting and determine requirements.
- ✓ IT skills / knowledge is low, IT terms are not well understood.
- ✓ Approval of all departments is necessary, but there is no adjustment function between users' departments (vertically divided / silo structure).
- ✓ When circulating the proceedings to the absence department, inconsistency of information transmission occurs, and as a result it will be redoing the meeting.

In a way to define customer requirements for the IT department as before, this project did not progress. In order to solve the problem of not knowing radio box and check box and inconsistency of information, I thought that it is necessary to implement the functional requirements talked by customers as they are and show them to customers actually.

3.1.2 Using the demonstration machine and do business operations with customers

For example, it is such as "extract data corresponding to A or B and data corresponding to A and C, respectively, and combine the results into a unit number of each case number to sum up the amounts". I ask the customer to talk about the operation that is being carried out on the daily work. I will carry out the keyboard input of the demonstration screen. Whether or not the functional requirement can be realized is clear as it can be judged whether or not the CSV file as the operation result matches with the form created by the current manual creation.

It is difficult to understand overview of new system even if explained by mouth, because IT skill is low. It is therefore important to show whether it can be done in front of customers.

Also, the operations of the demonstration machine and the forms left as all records. It can be used as test data of the verification phase and as document of requirement definition. As a result, it was possible to prepare test data with high work efficiency and good quality.

3.1.3 Visualize the information that becomes the evaluation axis

Next, we gathered the information which is the background of the requirement and organized it so that

Table 1 Requirement priority table

No.	Title	Contents /OverView	Requestor	Lead Time in Current Business	Frequency	Customization Period	Customization Fee	Priority
1	○○○	Total for each case XX grouping by X	A dept	1 hour	everyday	5days	¥100,000	Low
2	△△△	Calculation of the month end of the A and B departments	Ministry of XXXX	2 weeks	monthly	8days	¥140,000	Hight
3	■■■	Ranking for semi-annual X work	E dept	2-3weeks	Once in half a period	6days	¥110,000	Low
4	....	....	.....	....	....	....	.....	...

the user can judge objectively. I asked the customer what they are doing every day, who they are asked for, the lead time in current business, etc., and summarized them in a matrix table (Table 1). Also, in the matrix table, customization period and cost for automating each requirement are described.

Section 3.1.2 has done concretization of the form required by each department. Until then, the information was closed in each department, but similarities and differences between own department and other departments were clarified, making consensus formation inside the customer easier. According to the method described in Section 3.1.3, I can quantitatively express the frequency of use of requirements, users, purpose of use, operation avoidance measures, efficiency when systemized and systemization cost. As a result, it became easier for users to select requirements, and the requirements definition progressed smoothly.

3.2 Manuals specialized for each departments and operation training by each department

3.2.1 What are the reasons behind the customization request?

One-third of the requirements were as follows. "It is a complicated operation and it takes much time to create. The person in charge often can not create successfully, and it will be redone many times." Because their IT skills were low, there was a desire to rely on the system. In other words, systemization (automation) was not indispensable if it was possible to create a target form with reliable procedures even if manual work occurred.

3.2.2 Manuals specialized for each departments

We have created a customer's specialized "manual". Just like a properly implemented software program can output the correct form as per the specification, according to the manual, everyone in the customer can create the correct form. In the "specialized" manual, I explained all operations related to work with hard copy. In addition to the screen operation of the general-purpose search system which is a product function, manual work (Excel operation) was also made with hard copy and sentences.

3.2.3 Operation training is held for each business department

Because there is a difference in the IT skills of each customer, there were voices that only "specialty" manual is not enough.

So, initially I planned common operation training for all departments (12 departments), but devised as follows. The first half of the training is a common content that explains the outline of the general-purpose search system, explanation of each screen, basic operation, inquiry method and so on. The second half is the content of operation training for representative business and annual operations of each department (held separately for each department). In addition to the manual, I was able to narrow down the product customization to 1 case by carrying out fine-grained operation training with different contents for each of the 12 departments.

<Breakdown of requirements>
Realized by product function
* * * * * 10 cases
Product customization (systematization)
* * * * * 1 case
Product function + some manual operation
* * * * * 7cases

3.3 Customers practice in operation training

We and the customer agreed to position customer's operation training as the final verification process of the manual. Normally it only delivers manuals that have been reviewed inside the company and have already been reviewed by customers' desks, never practicing all manuals. However, this time "specialized" manual and operation training is an alternative to system customization. Therefore, I thought that it was necessary for the customer to verify that the form created according to the manual matches the CSV file visualized by the requirement definition phase.

In the departmental training described in 3.2.3, each customer did business operations on the new system while referring to the manual alone (without support from engineers). In addition to being able to operate, they compared the form outputted by the new system with the form of the current work, and confirmed that there is no discrepancy (difference) in the item and numerical contents. Errors discovered during the operation training were reflected in the manual before the operation of the new system started.

4. Effect of these approaches

4.1 Early determination of specification and compliance with delivery date

By Visualizing the superiority or inferiority of requirements using matrix table, by requirement definition work using demonstration machine, by concrete form, it was able to progress smoothly from the requirement definition phase to the basic design phase. No backtracking occurred in the subsequent phases.

I was able to have a system configuration with a proven track record. I was able to narrow down the customization requirement to one. From the above, I achieved ultra short term development of two and a half months and I was able to comply with the delivery date.

4.2 Ensuring Quality

- ✓ Using a proven construction method
- ✓ Reducing the development scale and allocating more time to the verification work

(Approach of (2), (6) without explanation)

As a result, there were no faults after the integration testing phase. There were no faults after the new system was in operation. Regarding the contents of the operation training, there were no inquiries after the operation of the new system.

In this development, I agreed to use operation training as a process of customer desk verification and user test, realizing efficient quality assurance efforts for a limited period.

4.3 Improvement of customer satisfaction

I was able to receive high evaluation from the questionnaire after operation training. Customers said that it was more beneficial to the user to enhance the operation correspondence such as manuals and training than automation by the system. If customized to automate the form creation processing in this project, the customer can obtain only the targeted form. However, as customer learned how to use the new system including manual work, customers can utilize the system not only for ordinary work but also for accidental data aggregation creation work.

5. Conclusion

Ideal project management is to manage to build a system that realizes all customer requests. However, it is not always possible to manage under the circumstances where it is permitted. Sometimes it is necessary to narrow down the scope of systematization. In this project, I considered alternatives for requirements and this method accepted by customers.

However, in general, it is rare for the customer to accept the alternative plan and to reduce the requirement. Finally, I would like to summarize by describing the case where the solution in this paper is appropriate and future issues.

<Cases suitable for application>

- ✓ If the customer does not have an IT department (or exists but always has insufficient personnel)

- ✓ If there are many relevant departments, and it is difficult to make an approval because there are many adjustment destinations
- ✓ Project managers and project leaders have advanced communication skills that can bring out the needs and wants of customers
- ✓ Delivery time First priority and short delivery time
- ✓ When the current operation is on a manual operation basis (in case of first systemization)
- ✓ The type of system that is easy to apply are internal work efficiency improvement, user service operation support, etc.

In such a case, I think that it will be helpful for efficiently advancing the requirement definition or for reducing customization when applying the product.

The future issue is whether to agree with the customer ongoing development and provision if it is a requirement that can not be provided in the short term. The way of "narrowing the scope of deliverables" and "presenting alternatives to requirements" is a management method for completing system development at one time. From now on, customers of SMEs should also switch to methods that repeat short-term development. By doing so, it is possible to realize high priority systemization request from time to time, and I consider that it is necessary to match the growth of the customer's business with the growth of the system.

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Project management technique in the AI project

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It has long been said that the third AI boom, but recently business expectations for AI are rising. The broadening of the range of utilization of big data accompanying the development of cloud business is the background. As a result, cases of projects using AI technology are increasing, but these projects have characteristics, and the challenges faced by PM of conventional projects, so-called non-AI projects are becoming clear as well. Since agreement with Clients in quality management and stakeholders are also often diverse, management becomes more important than conventional projects. It was tried to verify the effectiveness of incorporating AI's point of view into conventional project management method. Lessons learned from the experience of actual AI projects are shared and project management methods that can be utilized in similar projects are proposed.

Keywords and phrases: AI, Agile, Expectation Management, Quality Management, Stakeholder Management, Risk Management

1. Introduction

The so-called AI boom has the first boom from the 1950s to the 1960s, the second boom in the 1980s, and the third AI boom which has been around since the year 2000.It has been said that AI boom several times so far, but it ended up in boom for various reasons. (Buchanan, 2005).

Although the third AI boom has already been said to be a boom for several years, the expectation for AI has not yet declined and is showing a rise. It has become possible to utilize the enormous amount of information data caused by the expansion of social media such as Social Network System by popularization of mobile phones, smartphones, tablets, utilization of big data according to it, expansion of use of cloud environment, and so on. Because of this social background, projects using AI technology are increasing.

On the other hand, projects using AI technology often have challenges from their characteristics. While implementing projects using several AI technologies, challenges faced by conventional PMs have come to be clear. The cause that AI projects come to have challenges in comparison with conventional projects is regarded as three of the next. For the first, AI projects have higher client expectations than conventional projects. The second is difficult to set quality control criteria from the characteristics of AI technology. The third is to construct the system that has never been before, so it is difficult to make sure the business value, so it is often used a new methodology such as an agile methodology. Application of the new methodology requires a sufficient understanding of the stakeholders. Due to these factors, AI projects are often more challenging than conventional projects.

In this paper, the definition of AI technology is described in chapter 2 and characteristics of the AI project and challenges faced by conventional PMs are clarified in chapter 3. Project management methods to be incorporated in the AI projects are proposed and verifications of their effectiveness are described in chapter 4.

2. Definition of AI technology and AI project

First of all, clarify what AI technology is.

It is said that AI has strong AI and weak AI. According to Ministry of Internal Affairs and Communications (2017), strong AI refers to AI that thinks like human beings, recognizes and understands things, and can make decisions. The machine can do the same thing as a human, do not need instructions or judgment from humans in order to think itself. On the other hand, a weak AI substitutes a part of human intelligence, and solves problems and inferences in a limited area. It is this weak AI that is put into practical use at the moment, and this type of AI is generally taken up in the news as AI. Searle (1980) considers that there are three types of "recognition", "prediction" and "execution" that AI plays in actual service, and case examples utilized by AI are posted.

The core technology in these AI is deep learning. Deep learning is machine learning using a multilayered neural network, and it is one of elemental technologies of AI. Its feature is to do "learning" and "inference", and the machine automatically learns the feature by extracting the feature from the data by having the machine learn the data with correct answer. These mechanisms require a large amount of data and continuous learning is necessary because accuracy improves depending on the amount of data and data quality.

For the purposes of this paper, the term AI technology will be taken to mean using such deep learning technology and the term AI project is defined as a project using AI technology.

3. Characteristics of the AI project and challenges faced by conventional PM

The AI project has aspects different from ordinary projects by using the AI technology as described above. The characteristics of the AI project and the challenges faced by conventional PM are summarized.

3.1 Gap of the expectation

The task to be faced at the very beginning is the gap between the expected value between what the customer thinks and the actual system in the AI project. Thanks to recent AI boom, clients' understanding of AI is increasing, but expectations are still very high. When starting the AI project, when explaining the solution outline, it is always said that "AI can do anything just like a human?", "Can the machine replace humans?". In these backgrounds, there is a misunderstanding that AI can do the same thing as human beings. However, as mentioned in the previous chapter, what is practically used at present is a weak AI. Although it may become possible to recognize, predict, and execute closer to humans by combination, it is a technology that only predicts in the learned range to the last. For that reason, it is the current situation that Gap comes out for a certain amount of client's expected value and what can actually be provided.

3.2 Difficulty in setting quality standards and final goal setting

In general project quality management, quality can be quantitatively determined by test plan, test case, number of defects, test density, defects density, etc. In AI project, there are parts that can be evaluated by them and parts that are not due to the characteristics of AI technology. For example, in the case of constructing a system using the AI technology, it is possible to perform quality evaluation by guaranteeing the operation of the function by a conventional functional test. On the other hand, in terms of the accuracy of deep learning, it is impossible to measure whether or not the behavior is businessally effective with the same criteria as before.

In addition, continuous learning is necessary as a feature of AI technology as stated earlier. If it is an ordinary project, you can define the requirement and proceed with the design, you can assume the rough way and what kind of system can be done. On the other hand, in the case of the AI project, continuous learning is necessary, so it is difficult to define clear criteria at which timing to declare service start. Furthermore, the recognition function in the AI technology does not take a movement according to a predetermined rule like a system, learns a rule from enormous data, and gives the answer that is the closest by weighting it . Therefore, there is only one correct answer in a normal system, and if it is correct, it is possible to set a criterion of goal, whereas it becomes difficult to set the criterion. From that point of view, it is difficult to define go-live criteria.

In the case of a solution for general consumers, if releasing it in a state with too poor precision, a situation arises where it is not possible to respond to a demand to consumers. If consumers use the system once and judge that the accuracy is bad, there is a high possibility that it will not be used afterwards. Therefore, some clients think that it can not be released unless accuracy is improved. On the other hand, if pursuing to increase the accuracy, the service can not be started indefinitely. AI may lose the opportunity to learn from actual data and a dilemma that the range of learning data does not expand may occur.

3.3 Client understanding by using agile

According to Ohara, M. et al. (2016), the AI project is recommended for incremental and agile approaches. Introducing AI at once in a wide range of system areas complicates the project and it will lead to an increase in investment recovery risk. As a characteristic of the AI project, it is necessary to continue the evaluation of the business viewpoint after go-live and it is not the end if it was realized the functions defined in advance like the conventional type system. Therefore, incremental and agile approaches are recommended as it is effective when trial and error is required to respond to business needs in this way. In addition, solutions using AI technology are diversified, it is easy to recognize the completed image to try to make something that has never existed, the objective is to use AI technology and it is easy to lose sight of real requirements etc. For the reasons, it is assumed that development methods such as Agile are often adopted. As a result, the conventional PM faces challenges that did not occur with conventional waterfall type methodology.

4. Proposal of project management method to be incorporated by AI and verification of effectiveness

In addition to conventional project management methods, the following management methods formed a hypothesis that they were effective and inspected the effectiveness for the challenges mentioned in the previous chapter.

4.1 Risk reduction by expectation control

Consider how to control the expectation gap, which is the problem of the previous chapter 3-1. The state where the expectation gap and the actual situation is occurring is as follows. For example, if the expectation is small but the actual situation exceeds it, the evaluation will rise because it will result more than expected. (Expectation <Actual Condition = Evaluation up) Conversely, when the expectation is high and the actual condition has not reached it, the evaluation falls. (Expectation > Actual Condition = Evaluation down).

As mentioned above, the client's expectation in the AI project is reasonably high. Therefore, first of all, it is necessary to reduce excessive expectation to an appropriate level. As means for achieving an appropriate expectation value for AI, explain the mechanism of AI technology and understand what is possible and what can not be done with current technology at the early stage of the project . Below, verify based on actual case.

4.1.1 Evaluation of expectation control

A reference case A was considering the introduction of AI as the first step in addressing the declining birthrate and aged society that will occur in the future. When confirming the client's request in the consulting phase, they understood that "AI is a substitute for human beings" and "what can be done on behalf of human beings" as mentioned in the previous example. Since the risk of the expectation gap was clarified, it's confirmed how the customer understood AI. Their AI understanding is "AI learns freely by self-learning through dialogue with the outside", "Based on the data input from outside, AI arbitrarily analyzes and guesses the situation and speculates, It will correspond to the response. " Both of these are the result of expanding interpretation of "learning" and "inference" of features which appear in deep learning.

It was able to reduce these gap by explaining what can be realized with the current AI technology in the reference case A. As a result, there was no significant detachment of requirements in the subsequent production phases.

In the above case, it was possible to reduce the gap of the implicit requirement by implementing the expectation control at the initial stage of the project, and it was made clear that the method is effective.

On the other hand, the reference case B is presumed that the same phenomenon occurred, but it made ambiguous explanation of what can be done with AI and proceeded to the production phase. As a result, in the production phase, when looking at what actually moves, the expected system was different from the completed system, which caused trouble in request.

Even with these cases, the importance of controlling expected value in the AI project is clear to reduce risk. From the viewpoint of risk management, it is necessary not only to lower expectations but also to show the possibility of technologies that are progressing rapidly in the future, to share future road maps with clients and to agree on It is also important to do. These positive risks are as stated in Inokawa et al. (2016).

4.2 Quality management using business evaluation and setting of go-live criteria

The AI project differs from the conventional project in that it is difficult to set quality management standards and go-live criteria from its characteristics. In this chapter, discussion will be made as to what to evaluate quality and what criteria to judge go-live based on criteria.

Even in the AI project, it is possible to carry out the test and evaluate in the same way as in the conventional system. Systems evaluation methods in AI technology include methods such as holdout method and cross validation method. In the hold-out method, data with correct answer is divided into two, one is set as test data, the other is used as training data, and a test is performed to confirm the accuracy. In the cross validation method, data is divided into a plurality of data, and one of them is used as test data and the rest are used as training data, in contrast to the hold-out method splitting the data into two pieces. The test is repeated according to the number of divisions, and the average value of the accuracy is confirmed. For example, assuming that data with correct answers is divided into 5, 1/5 of them is used as test data and 4/5 is used as training data to confirm accuracy. Next, 1/5 of the 4/5 that was used as the training data is set as the test data, and 1/5 of the test data earlier and the remaining 3/5 of the training data are combined and evaluated as training data. Since the cross validation method uses the average value of the test as an evaluation, deviation of test data or the like is unlikely to occur, and accuracy is higher than the hold-out method. Therefore, this cross validation method is generally used in the AI project. It is a system-oriented test to decide certain accurate indices and evaluate them in this test.

However, it is not synonymous that system evaluation is high in the system test and that it is a business-effective system. This is because the test is performed on a limited range of data, so that the test data does not ensure business effectiveness. Therefore, it is suggested to incorporate business tests in addition to systematic testing. A business test is a mechanism to have actual users use it and evaluate their suitability, satisfaction degree, effectiveness, etc. Although it is a test that contains the subjectivity of the user, it can be used as an index for judging whether it is business-friendly by asking multiple people to evaluate and taking the average value. For evaluation, it is advisable to conduct a test with more evaluators in order to eliminate variations in evaluation values. As a similar test method, MOS (Mean Opinion Score) applied when evaluating voice quality is available.(NTT network technology Laboratories Communication Traffic & Service Quality Project, 2009).

As described above, it is possible to clarify quality improvement and go-live judgment criteria by satisfying both indicators of systemic test and business test and not only quantitative evaluation but also incorporating qualitative evaluation.

4.2.1 Evaluation of quality management with business test

Compare the reference case C which did not apply the above method and the reference case D which applied it, and confirm the effectiveness.

It is a case where the case C did not apply business test. The case C is because there were no such findings as the project was started at the stage of few AI project cases. At that time, the quality goal for AI technology was internally targeted to achieve a systematic test accuracy of around 80%. However, clear criteria were not set for clients. Therefore, the go-live criteria was ambiguous. Instead of setting clear quality control criteria, visualization of the deliverables was carried out by adopting the agile methodology. By showing to the client what runs each Sprint, our clients understanding of the system had deepened. However, in the sprint review, since the demonstration of the preset scenario was carried out, the review from the viewpoint of the effectiveness of the work was insufficient. As a result, it was concluded that go-live could not be judged just by the result of the demonstration and accuracy.

In case D, the project was started in advance by planning to conduct systematic tests and business tests. In the systematic test, cross validation was adopted and an accuracy of over 70% on average was achieved. Moreover, from the viewpoint of business testing, evaluation was carried out by comparing the case where the client performed the equivalent work and the case of carrying out by the AI, the user's satisfaction as the index. As a result of business tests, the result of comparing the client and the AI was higher for AI and higher for client satisfaction level than for middle. By sharing these two evaluation results with clients, clients were confident that the AI system was effective, and we were able to judge the go-live.

From the above, it can be verified that the use of business evaluation contributes to the setting of quality control standards and go-live judgment criteria.

4.3 Agile development and stakeholder management

In agile development, one product owner needs to decide requirements and prioritize work based on business value. Regarding the value of business, there are many cases that clients are familiar with, and in general, clients will be responsible for the product owner's role, and its role will be very important. Therefore, if the product owner does not understand its role, it becomes a big risk. Also, for stakeholders other than the product owner, it is necessary to have the same vision in the same position as the product owner. However, if the roles of the product owner are not understood and plural stakeholders other than the product owner say that they overturn the judgment of the product owner, or the sponsors and the product owner's vision do not match, the situation occurs where things you created cannot be accepted. In order to reduce these risks related to agile, it is important for all stakeholders related to the project to fully understand its mechanism.

For that purpose, it is important to conduct agile training for all stakeholders including clients before starting the project, establish initial sprints after the project starts, and thoroughly understand Agile. The first is to recommend planning these thoroughly as communication management, the second is to recommend these communication each time new participation members came.

5. Conclusions

In this paper, a project management method that can be utilized in similar projects on the challenges faced by conventional PM was proposed.

First of all, the importance of the action to eliminate the gap between the clients expectation and the AI technology.

Secondly, quality management by importing tests from a business point of view, setting of go-live standards, and finally, cautions on adopting Agile methodology have been described.

These are only a part of the challenges faced by conventional PM in AI projects, but it would be greatly appreciated if they helped those who carry out similar projects.

In the future, we believe that the number of AI projects will increase further with the acceleration of the AI boom, so that more effective project management methods can be verified and suggested. We hope to continue to report on this paper as the beginning of our research.

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Effect of IBM Quality Inspection in Project Management

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Conventionally, various techniques in order to produce high-quality software, such as Mining Software Repositories(MSR) of use and reviews have been utilized. However, with the increasingly sophisticated embedded systems, system complexity, tend to also increase the scale of development. In the conventional technique, it has become very difficult because it requires a great deal of time to the measures is to develop a high-quality software. Such a trend, there is a great impact on the development budget and schedule in the project. For this reason, it is important to produce high-quality software in a short period of time than the conventional method in software development in the future. In this paper, as the target of the design artifacts and source code in software development work, we describe the results of the comparison of the Review and the IBM Quality Inspection Practice (IBM-QI). As a result of the comparison, those of the IBM-QI than Review was confirmed to have excellent efficiency. This result is in software development in the future, indicate that to reduce the impact on the development cost and development schedule.

Keywords and phrases: IBM Quality Inspection Practice(IBM-QI), Review, Mining Software Repositories(MSR), Lightweight ontology, Data-oriented

1. Introduction

In recent years, embedded systems such as car navigation system receives the request of the market, multi-functionality and high performance of the system has progressed continuously. As a result, the scale of development of embedded systems, as shown in Fig.1 has expanded rapidly (Yahiro, 2008). In addition, low-quality software is an increasing trend in the embedded system as shown in Fig.2 (Ministry of Economy). From these trends, low-quality software tends to increase with an increase in the development scale of embedded systems. In other words, in a large-scale embedded system development, it is becoming difficult to produce high-quality software in existing development methods.

The existing development methods for making high-quality software, there are mainly review and Mining Software Repositories (MSR). Reviews (Visual Inspection) is the approach to detect the defect of the development-related documents and source code that was created by software development (Fig.3). In general, the importance of verification of quality by the review has been widely recognized (Fagan, 1976), (Wiegers, 2002). Furthermore, in recent years, it has been made widely quality activities using the MSR method (Fig.4). Development data contains the data of the development-related documents and source code, and bug ticket or the like which is created by the software development. For example, there is analysis, such as the following in order to produce high-quality software.

- Defective to predict the module (Caglayan et al., 2009), (D'Ambros et al., 2012), (Hassan et al., 2005, 2009), (Matsumoto et al., 2010), (Zimmermann et al., 2009).
- The position of the defect to predict (Canfora et al., 2006), (Servant et al., 2012), (Zhou et al., 2012).
- To analyze the mistakes of engineers (Livshits et al., 2005).
- To predict the time required to correct the defect (Weiss et al., 2007).
- To analyze the correction mistake of the defect (Shihab et al., 2012).

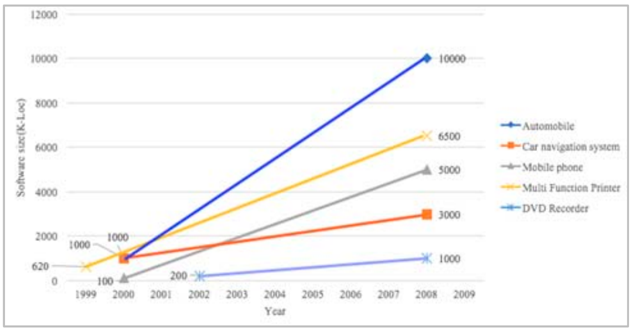

Figure 1 Trend of the development scale

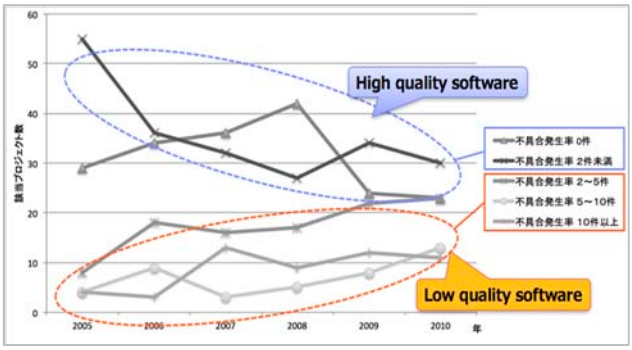

Figure 2 Trend of software quality

A common problem of these two approaches is that it takes a long time to detect the defect. Reviews are visual inspection of the development-related documents and source code. For this reason, it takes time to detect the defect. Because if the development scale of the embedded system is large, there is a limitation of the number of reviewer, it is likely to take more time. MSR requires a model of the analysis result of the development data. The model of the analysis result is required manpower. For these reasons, reviews and MSR requires time to detection of the defect. For this reason, it is difficult to sufficiently secure the modification period of the detected defect. In other words, in order to create a high-quality software is likely to give a significant impact on the development cost and development schedule.

Therefore, in this paper we focus on speed to detect the defect. And to discuss the objective method for evaluating the quality of a large amount of development-related documents and source code. To achieve the above object, applying the IBM Quality Inspection Practice (IBM-QI) (Hosokawa, 2009, 2010). In addition, it defines the evaluation rules in order to quantify the quality of development data to be inspected. Then, to verify the following by using the Visual Inspection and IBM-QI.

- To verify the inspection speed.
- To verify the validity of the IBM-QI from the comparison of the detected result.

This paper is organized as follows. In Section 2, to introduce more information about the IBM-QI. In Section 3, to define the evaluation rules in order to quantify the quality of development data to be inspected. In Section 4, we describe the detection performance and effectiveness of the IBM-QI by comparing the Visual Inspection and IBM-QI. In Section 5, on the basis of the consideration of Section4, to verify the effect of improving the quality using the IBM-QI.

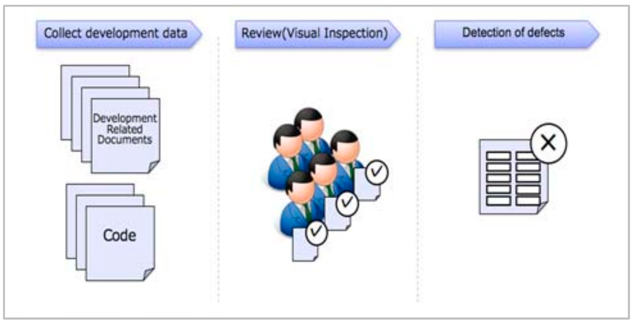

Figure 3 Review process

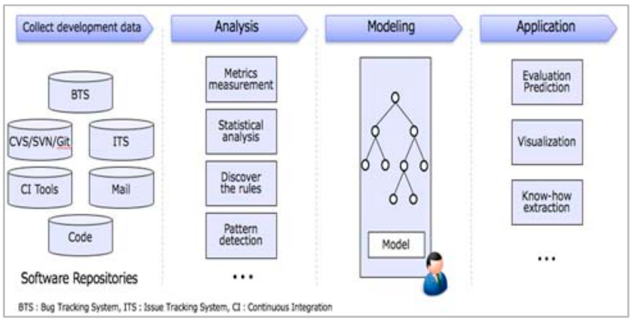

Figure 4 MSR process

In Section 6, we summarize the paper, and presents its findings.

2. IBM Quality Inspection Practice(IBM-QI)

IBM-QI is part of the MSR described so far. In addition, it is inspection speed as a feature of the IBM-QI is faster than general MSR. In addition, IBM-QI is a quality verification services of IBM Japan Ltd. For this reason, it is a large amount hold the analysis and proven data of the past 17 years since the service started. As shown in Fig.5, IBM-QI uses data stored as an alternative to the model in the MSR. For this reason, IBM-QI does not create the model. Therefore, IBM-QI is the inspection speed faster than the general MSR. IBM-QI has the following process.

- Data collection process
- Data analysis process
- Application process

Through the three processes, and measures the defect.

2.1 Details of data collection process

To collect development data to be inspected. Development data includes development-related documents, source code, bug ticket and the like. When collecting, to make sure that there is no shortage in the development data. This is important in order to prevent deterioration of the accuracy of predicting the defect.

2.2 Details of data analysis process

Input of the data analysis process is the development data. First, apply the analysis tools to development data. Analysis tools to extract the information about the components and the description content of the development data. In addition, the analysis tool to visualize the quality based on the extracted information.

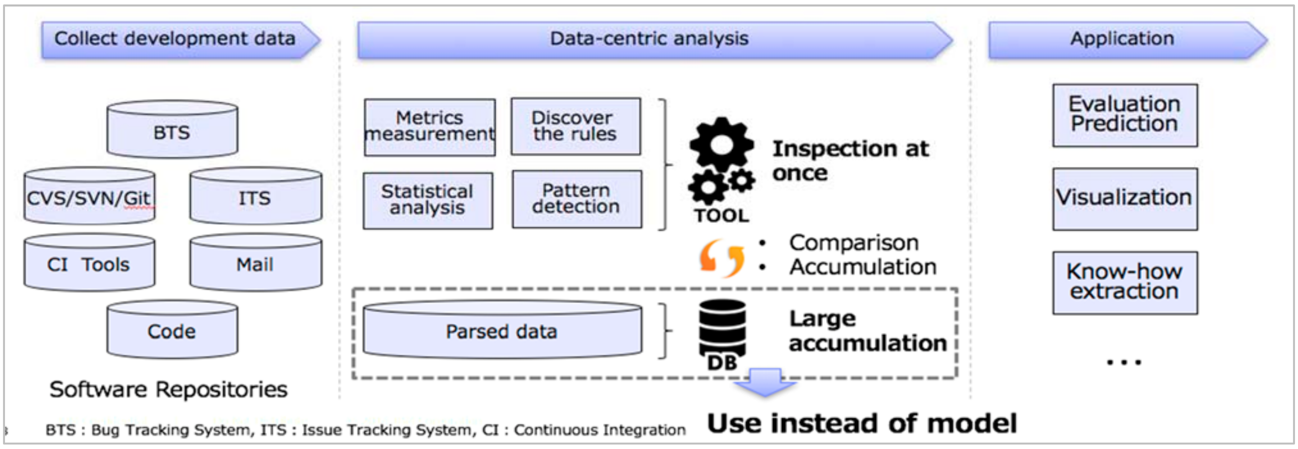

Figure 5 IBM-QI process

By extracting the features of the development data by visualization, it estimates the position of the defects contained in the development data. Identify the location of the defect on the basis of past analysis data that are similar.

Through these processes, the analyzed data is stored in a database. Analysis requires a historical analysis data, knowledge of the analyst is not required. In other words, the analysis process in IBM-QI is a data-centric analysis. In this way, we exclude that the analysis result is dependent on the analyst's skill. In addition, to detect a defect in a very short period of time.

2.3 Details of application process

Measures of the detected defect is done in this process. For fast detection of the defect, it is easy to ensure a period of time to measure the defects compared to the general MSR. This point is a great feature of the IBM-QI.

3. Definition of evaluation rules for the quality of development data

In this paper, we analyze the quality of development data that is created by software development. The target object are mainly development-related documents and source codes. development-related documents contain the requirements documents and design specifications and test specification. As figures in documents are treated as information to supplement the text, we exclude them from the analysis.

In this paper, we define the criteria of development data on the basis of the following two objectives.

- Inspection speed is objectively possible to quantify.
- The quality of development data is objectively possible to quantify.

3.1 Quantification of inspection speed

In order to determine the inspection speed, to calculate the scale of the development data per inspection time. It adopts the size as an indicator of the scale of the development-related documents. In addition, to adopt a number of lines of code as an indication of the scale of the source code. Therefore, the following shows how to quantify the inspection speed.

- development-related documents: document size (Mbyte) / inspection time of development-related documents (hour).
- Source code: the amount of code (K-Loc) / inspection time of source code (hour).

3.2 Quantification of the quality of development data

In order to judge the quality of the development data, the detected defect is classified by the impact on the business.

- Lv.1: there is a significant impact on the business.
- Lv.2: impact on the business is limited.
- Lv.3: business impact is slight. Or there is no impact.

Further, as a method to quantify the quality of the development data, we show the total number of defects that are classified based on the evaluation criteria defined here. However, in order to improve the evaluation quality by enhancing the classification accuracy of the detected defect, it is necessary to create a more specific evaluation criteria. Therefore, based on the expertise obtained by visual inspection of the development-related documents and source code, we show a concrete detection item of the corresponding criteria in Table.1.

Table 1 Criteria and corresponding detection items

Impact	Detection items(Excerpt)
Lv.1: There is a significant impact on the business.	**Documents :** • Omission of description • Missing consideration • Ambiguous expression • Inconsistent expression **Code :** • System freeze • System reset • Memory leak • Implementation leakage in specification etc.
Lv.2: Impact on the business is limited.	**Documents :** • Omission of description • Missing consideration • Ambiguous expression • Inconsistent expression **Code :** • Incorrect judgment • Show incorrect words etc.
Lv.3: Business impact is slight. Or there is no impact.	**Documents :** • Typographical errors • Disunity of terms • Excessive description **Code :** • Typographical errors • Lack of explanation • Uninitialized variable etc.

4. A study of the validity of the quantification of the quality of development data

Based on the evaluation criteria described above compares the detection performance of the IBM-QI and reviews.

Fig.6 shows the flow of the comparison of the IBM-QI and reviews. In addition, it indicates the development scale and overview of the project, which was investigated in Table.2.

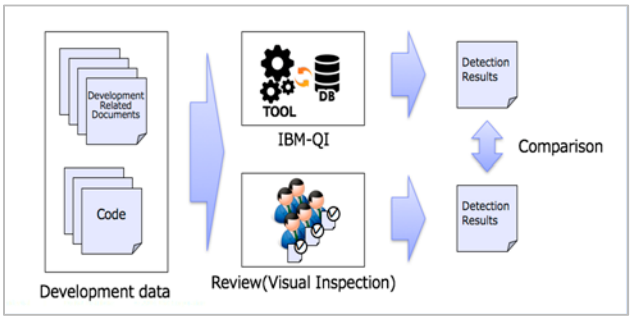

Figure 6 Comparison of the experiment of the IBM-QI and reviews

Table 2 Description of the project to investigate

Project name	Development products	Development period (month)	Development data
PROJECT 1	Car Navigation System	12	**Document:** 102 files(210Mb) **Code:** 26,204 files(4,242K-Loc)
PORJECT 2	Car Navigation System	18	**Document:** 658 files(578.5Mb) **Code:** 87,287 files(40,562K-Loc)
PROJECT 3	Automotive Meter System	16	**Code:** 2,707 files(3,622K-Loc)

Table 3 Comparison of inspection speed for development-related documents

Project	IBM-QI	Review
PROJECT 1	434.57	2.09
PROJECT 2	550.95	0.72
PROJECT 3	-	-
Average	**492.76**	**1.40**

Inspection amount per hour[Mbyte/h]

Table 4 Comparison of inspection speed for source code

Project	IBM-QI	Review
PROJECT 1	828.65	2.54
PROJECT 2	2060.98	1.84
PROJECT 3	2412.19	3.08
Average	**1767.31**	**2.49**

Inspection amount per hour[K-Loc/h]

In this paper, the development data of the target to investigate the requirements document, functional specifications, design documents, detailed design documents, test specifications, source code.

4.1 Comparison of the detection performance of the IBM-QI and reviews

In order to compare the IBM-Q and reviews of detection performance, apply the evaluation criteria of the development data of the above-mentioned. Evaluation compares divided the development-related documents and source code.

4.1.1 Comparison of inspection speed

Table.3 shows the comparison result of the inspection speed of development-related documents. Inspection speed of the IBM-QI was 492Mbyte/h compared to the review of 1.40Mbyte/h. Therefore, inspection speed of the IBM-QI for development-related documents shows that 350 times faster than the reviews.

Table.4 shows the comparison result of the inspection speed of the source code. Inspection speed of the IBM-QI was 1,767.31K-Loc/h compared to the review of 2.49K-Loc/h. Therefore, inspection speed of the IBM-QI for the source code shows that 710 times faster than the reviews.

4.1.2 Verification of the validity of the detection result

In this section, to verify the validity of the defects detected by the IBM-QI. Development scale was investigated by using the largest PROJECT 2. Fig.7 shows the comparison result of the number of detected defects that require correction in the development-related documents. Correlation coefficient in the detection number comparison of the defects of the IBM-QI and reviews was 0.48. Not detected in the IBM-QI, the defects detected in the review are as follows.

- Description that can not be realized specifications.
- Description using the wrong term.

In addition, Fig.8 indicates the percentage of description language of development-related documents. IBM-QI can not inspection of the documents by using a language other than Japanese. Therefore, it is necessary to compare again with the exception of the document other than the Japanese.

Fig.9 shows the comparison results of the number of detected defects that need to be modified in the source code. In the source code, the correlation coefficient is detected number comparison defects IBM-QI and reviews were 0.93. This indicates that there is a strong correlation. Not detected in the IBM-QI, the defects detected in the review are as follows.

- Lack of explanation.
- Implementation leakage in specification.

Defect that could not be detected in the IBM-QI is evaluating the description content of the development-related documents, and requires a comparison of source code and specifications. For this reason, it is difficult that the tool automatically detected.

However, there is a strong correlation to the number of defects detected by the IBM-QI and reviews. Therefore, defects detected in the review shows that there is a tendency to be detected by the IBM-QI. In other words, many of the defects included in the source code can be detected in the IBM-QI.

Figure 7 Comparison of the number of defects that require correction in development-related documents

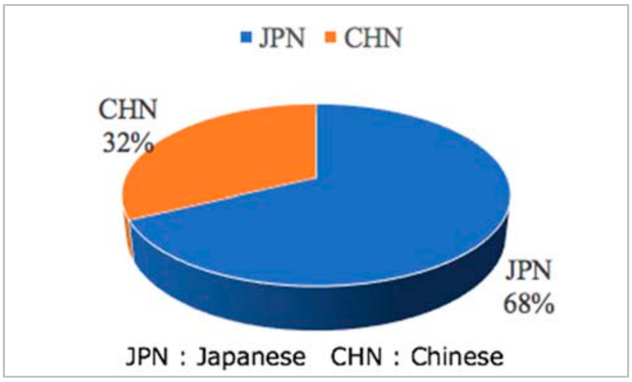

Figure 8 Language that was used in the development-related documents

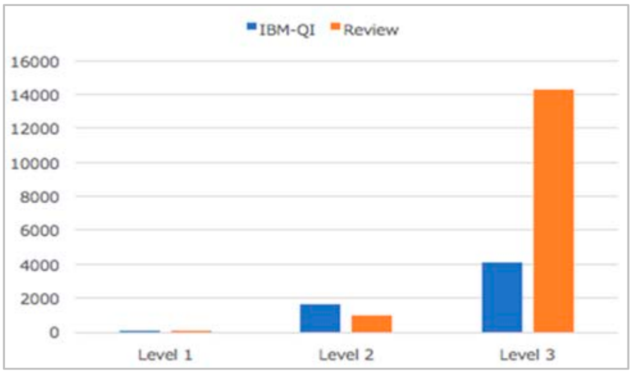

Figure 9 Comparison of the number of defects that require correction in source code

Therefore, IBM-QI is not perfect. However, it suggests that the number of defects detected by the IBM-QI is reflected as the quality of the source code.

5. Comparison of the detection performance of the IBM-QI and reviews using the development-related documents

In this section, we investigate the detection performance by using the development-related documents written in Japanese. Investigation of the subject is the document that a language other than Japanese has been used in PROJECT2.

Table.5 shows the comparison result of the inspection speed of development-related documents using only Japanese. Inspection speed of the IBM-QI was 415.81Mbyte/h compared to the review of 1.33Mbyte/h.

As a result, the inspection speed of the IBM-QI for development-related documents shows that 312 times faster than the reviews. Therefore, inspection speed of the IBM-QI has suggested that sufficiently faster than the reviews.

Fig.10 shows the comparison result detection of the number of defects that need correction of development-related documents using only Japanese. In the development-related documents, the correlation coefficient in the detection number comparison of the defects of the IBM-QI and reviews was 0.63. This indicates that there is a correlation to the number of detected defects in the IBM-QI and reviews.

Table 5 Comparison of inspection speed for development-related documents using only the Japanese

Project	IBM-QI	Review
PROJECT 1	434.57	2.09
PROJECT 2	397.05	0.57
PROJECT 3	-	-
Average	**415.81**	**1.33**

Inspection amount per hour[K-Loc/h]

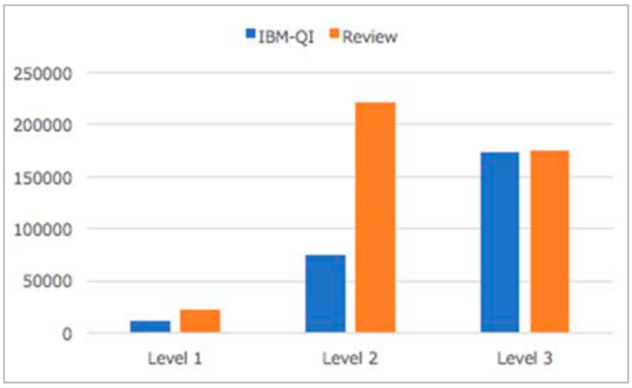

Figure 10 Comparison of the number of defects that require correction in development-related documents using only the Japanese

5. Conclusions

In this paper, we focused on speed to detect the defect. And we discussed the objective evaluation method for the quality of the development-related documents and source code. We have defined the evaluation criteria for objective evaluation of quality. The quality of development data has been quantified based on the number of detected defects. IBM-QI was able to measure quickly and objectively the quality of development data. Therefore, it is possible to reduce the duration and time to create a high-quality software. Therefore, the application of the IBM-QI in the embedded software development is valid.

It also became clear that there is a defect that can not be detected by IBM-QI. Therefore, to consider the following as future tasks.

- Increase the rate of detection of defects in development-related documents.
- To detect a defect of development-related documents other than Japanese is used.
- To investigate the effectiveness of the IBM-QI in the non-embedded system development.

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A Study of the Management for a Large Number of Stakeholders

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In a large-scale system development project, it is difficult to identify and manage a large number of stakeholders who have influence on the project operation. In addition, in order to communicate with the stakeholders by a team, it is necessary to have a common recognition among the team members. However, because the amount of information is huge in the conventional method of simply listing stakeholders from a project organization chart, there is difficulty in properly sharing and maintaining information. For that reason, we have utilized a mind map to identify the stakeholders and have been able to solve issues quickly. In this article, we introduce a case study of identification and analysis of the stakeholders by the utilizing of mind map, and consider how we appropriately share and rearrange stakeholder information.

Keywords and phrases: Information System Development, Stakeholders, Mind Map

1. Introduction

In a large-scale system development project, there are a large number of stakeholders inside and outside the company. In management of stakeholders, we need to pay attention to the following three points.

First, it is necessary to respond to requirements from stakeholders after correctly understanding stakeholder's position and the impact on the project.

If you incorrectly understand the requirements or if you misjudge the priority or deadline, conflicts with stakeholders will occur, and those will be major obstacles to the project completion.

Second, it is necessary to understand the important stakeholders on the project operation correctly.

There are ways of listing important stakeholders by understanding their position and authority from a project organization chart or other documents. However, in the actual project, because other factors such as clout, relationship with related stakeholders, interest in the project, or skill set are often emphasized, there is a possibility that they cannot be listed correctly. If you mistakenly recognize important stakeholders, it will have a major impact on success or failure of the project.

Third, in order to communicate with the stakeholders by a team, it is necessary to have a common recognition among the team members. However, a lot of projects do not maintain a stakeholder management list created at the time of the project launch. As a result, it becomes worthless. Also, because the amount of information on stakeholders is huge, there is difficulty of properly sharing information.

2. Issues and solutions for stakeholder identification

We have often used an organization chart when understanding important stakeholders for the project. However there are the following issues.

(1) As an organization chart is mainly written in the development department, consideration of stakeholders such as operation department and product vendor may not be sufficient.

(2) As an organization chart is used to describe roles and authorities, information on development skills related to projects, interests in projects, or human relations are rarely described.

(3) As the amount of information on stakeholders is huge, there is difficulty of properly sharing information in a large-scale system development project.

For that reason, even if we prepare an organization chart at the launch of the project, influence of each stakeholder on the project is often recognized while we advance the project.

In order to address these issues, we have utilized a mind map to comprehensively identify stakeholders before creating a stakeholder management list.

In this article, we describe a series of these tasks.

3. Practice for the target project

In the following, we describe the result of identifying and analyzing stakeholders for large-scale projects newly developed by our company.

3.1 Project outline

In this project, in order to provide operation functions to other systems developed by each vendor, we have newly developed a system that aggregates operation functions such as job automation and system monitoring. The image of the system is shown in Figure 1.

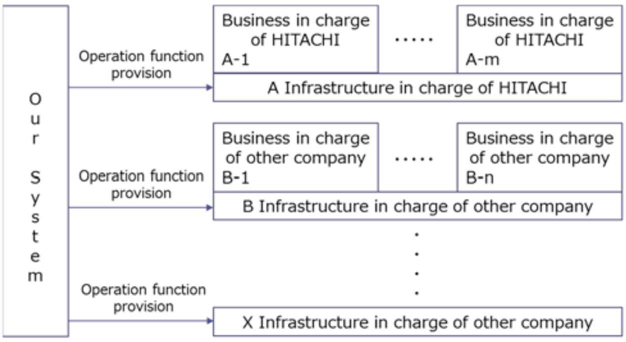

Figure 1 System overview

The other systems provided with operation functions from our system consist of an infrastructure layer and a business layer. Infrastructure layer provides a foundation for business layer and business layer provides application functions that run on infrastructure layer.

Our system provides operation functions to the infrastructure layer of other systems. For this reason, coordination related to the provision of operation functions of our system is carried out with the infrastructure layer member of the other system. It is agreed that adjustment with the business layer member is basically performed by the infrastructure layer member of the same system. The project has the following features.

(1) We have many stakeholders of related infrastructure layers.
(2) The infrastructure layer team of the other system consists of members from multiple vendors.
(3) We are also in charge of infrastructure layers and business layers of other systems. In our company, several regular meetings are set up and operated for reporting and adjustment.
(4) A transverse organization crossing the entire project exists for each keyword such as infrastructure, test, transition, and batch. Various adjustments are made by the organization.

3.2 Stakeholders identification

A mind map is a method and tool to visualize the relationship of each element. Ideas, images, events, keywords, or persons could be the core. Like tree branches, we spread elements that make up the core and related contents.

In the project, we identified stakeholders in the following procedure.

(1) Put the project to the center of mind map. Pay attention to the relationship with the project and specify related organizations and systems as elements.
(2) Break down the organization and system defined in (1) as shown in Figure 2. The main purpose of utilizing the mind map is to understand the whole picture and identify important stakeholders. Therefore, we should break down the mind map to the level where all important stakeholders can be identified

Figure 2 Mind map of the project

3.3 Stakeholders analysis

Next, we analyzed the stakeholders identified in 3.2 by the following procedure.

(1) To write the stakeholders specified by the mind map in the stakeholder management list.

(2) To evaluate the impact on the project, the following 6 items related to the influence on the project are evaluated in 4 levels (extra large = 4, large = 3, medium = 2, small = 1) for each item.
 (a) Degree of interest in this project
 (b) Clout in the project community
 (c) Experience and skills in this project
 (d) Relationship with this project
 (e) Range of responsibilities
  (scale of development etc.)
 (f) Official authority

(3) To calculate the average value for the evaluation results of 6 items evaluated in (2) and to quantify the influence on the project.

Figure 3 shows stakeholder management list of this project.

Stakeholder	Company	Position	Degree of interest	Clout	Experience and skills	Relationship	Scale of development	Authority	Average	Influence
A	Hitachi	Executive (Infrastructure)	3	4	-	2	4	4	3.4	Extra large
B	Hitachi	Sales director	2	4	-	2	4	4	3.4	Extra large
C	Client	Project manager	4	3	3	3	3	3	3.2	Extra large
D	Client	Staff member	4	3	4	4	2	2	3.2	Extra large
E	Hitachi	Executive (Infrastructure)	2	4	-	1	4	4	3.0	Extra large
F	Client	Executive (Infrastructure)	2	4	-	1	4	4	3.0	Extra large
G	Client	Director (Infrastructure)	3	4	-	2	3	3	3.0	Extra large
H	Hitachi	Executive (Business)	3	3	-	2	3	3	2.8	Large
I	Client	Executive (Business)	1	4	-	1	4	4	2.8	Large
J	Client	Director (Business)	3	3	-	2	3	3	2.8	Large
K	Hitachi	Director (Business)	2	3	-	2	3	3	2.6	Large
L	Hitachi	Director (Business)	2	3	-	2	3	3	2.6	Large
M	Hitachi	Sales manager	3	3	-	2	3	2	2.6	Large
N	Client	Director (Infrastructure)	2	3	-	2	3	3	2.6	Large
O	Client	Staff member	4	2	3	4	1	1	2.5	Large
:	:	:	:	:	:	:	:	:	:	:

Figure 3 Stakeholder management list of the project

As the important stakeholders for this project, we extracted the following seven people with an average value of the 6 items above 3.0.
 (a) Our executive
  in charge of infrastructure layer (A)
 (b) Our sales general manager (B)
 (c) Project manager of client company (C)
 (d) Staff member of client company (D)
 (e) Our executive
  in charge of infrastructure layer (E)
 (f) Executive of client company
  in charge of infrastructure layer (F)
 (g) General manager of client company
  in charge of infrastructure layer (G)

3.4 Reflection of stakeholder analysis results

Finally, we reflected the result of the stakeholder analysis in the mind map. Since the influence on the project is difficult to understand because there are many elements on the mind map, we performed the following tuning.

(1) As a result of evaluation by the stakeholder management list, not to display stakeholders with little impact on the project on the mind map.

(2) As a result of evaluation by the stakeholder management list, to express stakeholders with a large impact on the project in bold, italic, and color on the mind map.

Figure 5 shows the mind map before tuning, and Figure 6 shows the mind map after tuning.

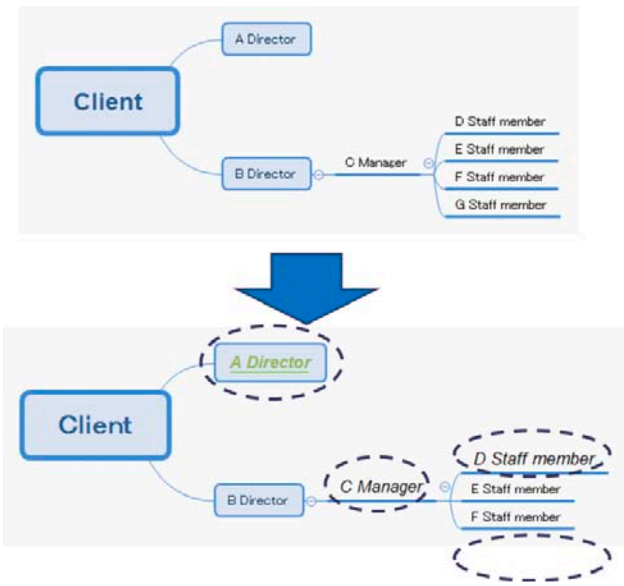

Figure 4 Tuning example of the mind map

4. Advantages of utilizing the mind map

In the following, we describe effects of applying the mind map.

4.1 Advantages on identification of stakeholders

Utilizing the mind map and the stakeholder management list, we assessed the impact on stakeholders on the project. As a result, we got the following effects.

(1) We have been able to comprehensively organize the stakeholders by breaking down the structure, focusing on the relationship with the project.

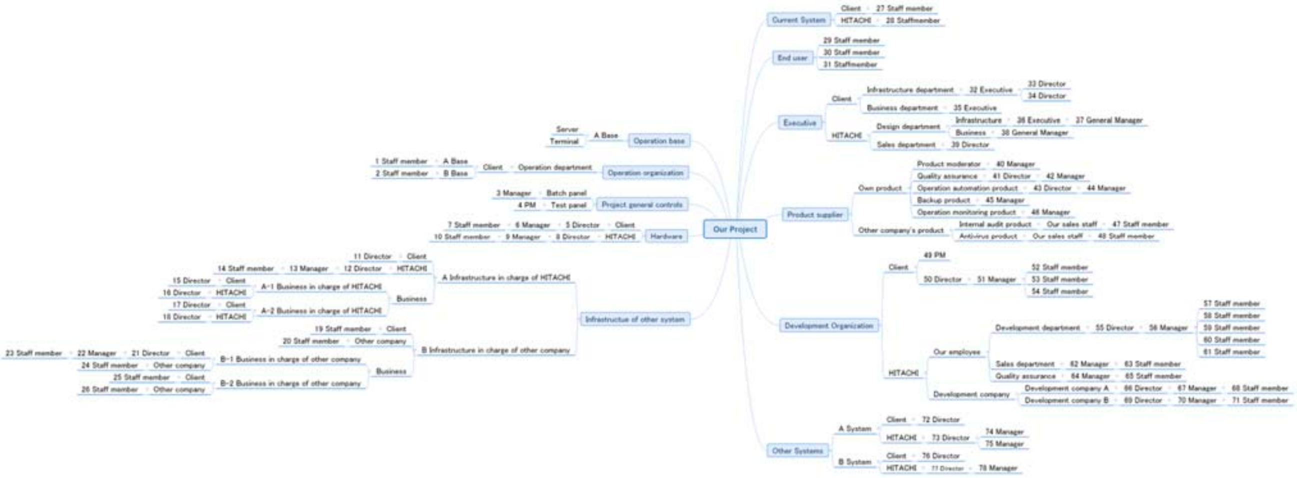

Figure 5 The mind map of the project (before tuning)

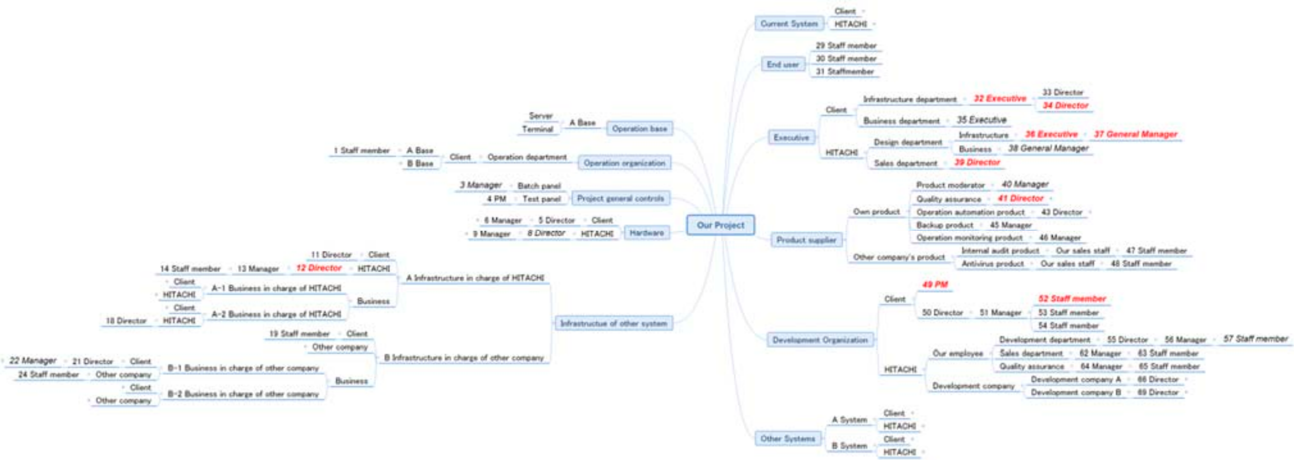

Figure 6 The mind map of the project (after tuning)

(2) We have been able to visualize the degree of influence on the project.

(3) It has become easier to visually understand stakeholders, by hierarchy with the mind map. As a result, stakeholders information have been appropriately shared among project members.

4.2 Advantages on project promotion

By utilizing the mind map tuned in 3.4, it has become possible to make decisions quickly when issues occur, and it has become possible to solve those promptly. Specific examples are shown below.

(1) Case examples on customer requests for improvement

In the project, jobs were sometimes executed under conditions that software products do not anticipate. As a result, an end time of a job was delayed. Countermeasures of the event itself were done through design change.

Also, we received customer requests to add information getting command in our software product to judge occurrence conditions of the event.

Because there are lots of stakeholders, it was assumed that adjustment to request improvements with the software product developer would be difficult.

Therefore, by specifying and persuading important stakeholders of the software product developer on the mind map, we were able to achieve the improvements to the software product.

(2) Case example to address improvement requests from our company

Our company was also in charge of infrastructure layers of other systems. We received requests for improvements concerning usability of an

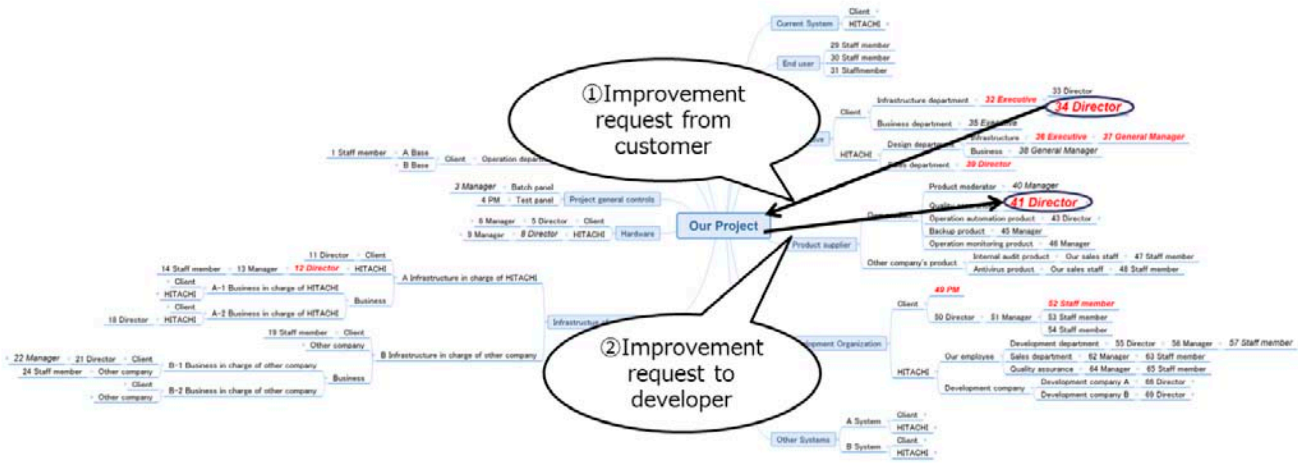

Figure 7 Example to address improvement requests from customer

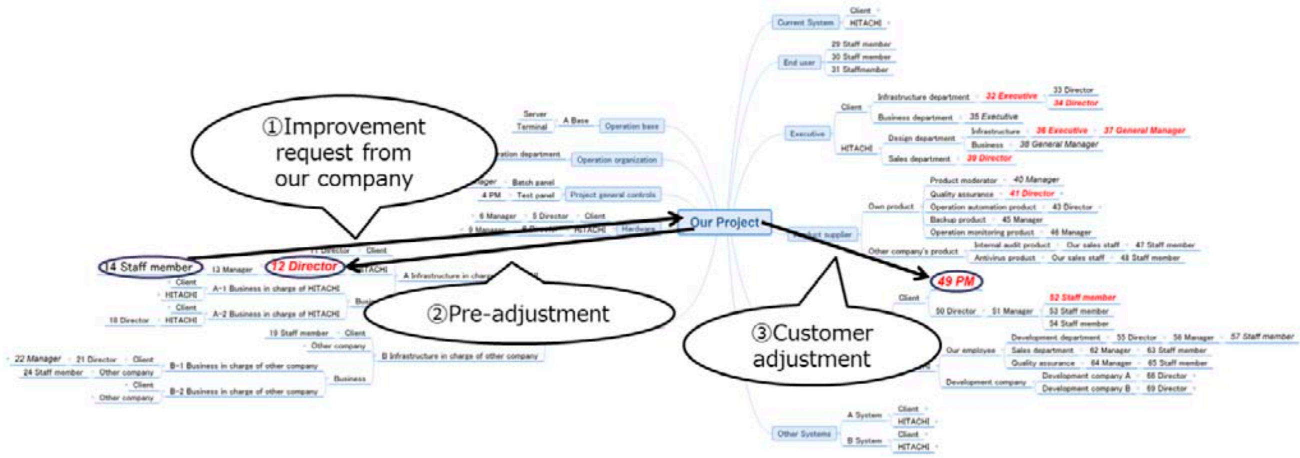

Figure 8 Example to address improvement requests from our company

operation management tool provided by this project from the person in charge of each infrastructure layer. In case of responding to the improvement requests, since the modification was needed on the tool, it was expected that it would be difficult to coordinate with the customer of the project.

For this reason, we specified important stakeholders in our company on the mind map and coordinated realistic countermeasures with the important stakeholders. After that, we made adjustments with the customer, and we got an agreement on the improvement of the tool.

5. Consideration

As examples where identification of stakeholders by a mind map is effective, we provide the following two cases.

First, it is effective for a large-scale project of new development. In new development projects, many stakeholders such as customer's user department and operation department, hardware vendor and software vendor are involved, because there are many items to be newly designed. Also, in large-scale projects, development with other companies or connection with other systems is common. Therefore, in large-scale new development projects, it is effective to apply a mind map to comprehensively identify stakeholders.

Second, it is effective for a project with a large number of stakeholders. We can adjust the amount of information of the stakeholders on a mind map, such as not showing stakeholders with a small impact on the project. Therefore, the more the number of stakeholder increases, the greater effect of utilizing a mind map we would get. In a mind map, it is possible to express a large amount of information radially. Therefore, if classification of related projects, other systems to be connected, internal organizations, or customer organizations can be listed up not lower than 32 (8 main branches and 4 sub branches for each main branch), we recommend utilizing a mind map to identify stakeholders.

However, if we show too many stakeholders in a mind map, it would be an issue. Therefore, the following two points are important.

When breaking down the mind map, if important stakeholders are identified, stop the breakdown at that level. Stakeholders that have little impact on projects by evaluating the impact on projects by stakeholder management list should not be written in the mind map.

On the other hand, projects with few stakeholders or projects with stakeholders already explicitly defined on the organization chart have less effect of utilizing a mind map. Therefore, there is little need to utilize a mind map to identify stakeholders.

6. Conclusion

6.1 Summary

In a large-scale system development project, we have utilized a mind map to identify the stakeholders and have been able to comprehensively organize the stakeholders. Stakeholders information has been appropriately shared among project members by having visualized the degree of influence on the project.

We could address some issues promptly with the mind map.

6.2 Future Issues

Degree of involvement of stakeholders might be analyzed when a project is executed. We will continue to study how degree of involvement can be expressed more effectively on a mind map.

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Adaptation of Large-scale Scrum Methodology for Development of Internet Banking System

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In recent years, large-scaling approach for Scrum, one of agile software development has been started to show and introduced. Especially development for financial system such as Internet Banking system should be focused on not only robustness, but also User Experience and flexibility for differentiating factor. To correspond to the request, we devised methodology for solving problem what occurred in development by large-scale Scrum. In this paper, we provide the knowledge for project that plan to apply scaled Scrum through arrangement point, problems and solutions in a case that we introduced large-scale Scrum methodology what we developed to project that developed Internet Banking system.

Keywords and phrases: Agile, Scrum, Large-scale Scrum, Internet Banking System

1. Introduction

Scrum is a framework for small-scale development project which consists of one Product Owner (PO) and Scrum Master (SM) and three to nine members of Developer team. Scrum has been adopted by 58% of agile software development project. Moreover in total only using Scrum and scheme combined Scrum and Extreme Programming (XP) have been adopted by 68% of agile software development project (Version One, 2017). As mentioned above, Scrum is suited for small-scale project because of consisting of at most only eleven members in Scrum team so that Scrum has two characteristics such as flexible, adaptable to change. Therefore more valuable system can be constructed by Scrum than conventional development framework. To apply these characteristics to large-scale development project, large-scaling approach for Scrum has been started to show and introduced.

Especially, in the financial industry, IT vendors develop not only enterprise system such as accounting system but also customer-used system such as internet banking system. That kind of system should be focused on robustness and tend to be large-scale system and customer-used system need to have high flexibility and high User Experience (UX) as a different factor with competitors. To develop high UX and hit flexibility system, it is suited to be developed by agile software develop such as Scrum. Therefore, we develop methodology for large-scale scrum project defined roles, events and artifacts as same as Scrum. In this paper, we introduce our large-scaled scrum methodology and the knowledge for projects that plan to introduce large-scale Scrum through arrangement point, problems and solutions in a case that we introduced our methodology what we developed to the project that developed large Internet Banking system.

2. Large-scale Agile development

2.1 Scale-up of agile development project

In this part, we introduce how to scale-up an agile software development which is not limited to Scrum. Juyun proposed hybrid development model combined with Scrum and Rational Unified Process (RUP) to correspond large-scale project (Juyun, 2009). In this model, the roles, events and artifacts of Scrum were embedded into phases defined in RUP such as Business Modeling, Analysis & Design, Implement, Testing, Deployment and Configuration phase. The Product Backlog could be created as a part of the business modeling phase. Scrum Master could play the usual role defined in the conventional Scrum. Juyun proposed this model would maximize the strengths of both conventional development model and agile methods. Shvetha and James proposed the agile development process for small-scale system and larger scale system using combined Agile Requirements Generation Model (RGM) and conventional software engineering methods (Soundararajan, 2009). The approach of the proposed process for larger-scale system consists of 3 phases such as Requirements/Tasks phase, Architecture, Design, Code, Unit Tests, I&T phase and Customer Acceptance phase. Requirements/Tasks phase is repeated iteratively and even though new requirement is discovered, this requirement are derived from stories.

2.2 Scaling-up of Scrum project

Nowadays, there are some methods for large-scale Scrum development. Scaled Agile Framework (SAFe) is a framework developed to correspond agile development from enterprise level to development level, so that this framework describes many new roles, events, artifacts, management methods and technical solutions (Scaled Agile Inc, 2017). This framework can be divided to four stage depending on adapting area such as Essential SAFe, Large Solutions SAFe, Portfolio SAFe and Full SAFe.

Nexus Framework is a large-scale scrum framework provided by Scrum.org that organization has been providing conventional Scrum framework's guideline (Scrum.org, 2017). The difference between conventional Scrum and Nexus Framework is which is considering interaction and dependency problem between Scrum teams. Moreover Nexus Framework defines a new team called Nexus Integration team or not. This team has responsibility for integration of Increment of each Scrum teams.

Large Scale Scrum (LeSS) is also a framework for large-scale Scrum project (The LeSS Company, 2017). LeSS can be divided to two frameworks, one is conventional LeSS which is corresponding to at most eight Scrum teams. Another one is Less Huge which is corresponding to over eight Scrum teams and a few hundred developers in one project. Scrum's rule and principle can be protected in LeSS. Each three framework's usage percentage in all large-scale agile project is showed at Table 1 (Version One 2017).

Table 1 Large-scale Scrum framework's usage

Framework	Usage (%)
Scale Agile Framework (SAFe)	28%
Nexus Framework	1%
Large Scale Scrum (LeSS)	3%

There is an example developing and adapting original large-scale framework in a company. Ville et al. created Product Owner team (PO team) based on conventional Scrum (Heikkilä, 2013). Product Owner team consists of Chief PO and a few Proxy PO, Proxy PO has responsibility for their own feature and can handle team depending on size of feature. One single proxy PO who has responsibility for small feature can handle a few teams by him/herself. Included two to three of Proxy PO called PPO groups who has responsibility for big feature can handle several teams which is developing the big feature. Chief PO has responsibility for whole product as a decision maker and he/she have to coordinate stakeholders. These existing large-scale Scrum method is equipped with organization and process, but there is no document of project plan and some template for detailed management.

2.3 Issues of large-scale Scrum

The scrum guide recommends Developer team has three to nine members to enable team do their work in one Sprint (Scrum.org, 2017). When Developer team's members are less than three, to set Product Owner and Scrum Master become overhead for their costs and not leads productivity. Further when Developer team's members are over to nine, inner communication of Developer team become overhead for productivity. When Scrum will be scaling-up, it is necessary to scale of the Scrum team, instead of scaling of the member of Developer team. When scaling of the Scrum team, dependencies between to another Scrum team and the other team should be removed and project should provide the environment that Scrum team can concentrate to develop their own Backlogs and tasks.

Dingsøyr et al. (Dingsøyr 2014) referred to the issue of scaling team. When scaling team, project needs for coordination of work appear on two levels such as the team's level between the team and rest of the organization, and team members, need to collaborate effectively within the team members and outside the team, e.g. designers, architects and other stakeholders (Issues #1).

Dikert et al. (Dikert, 2016) referred to the coordination of between the teams. One of most difficult issue when scaling team is dependencies. This issue cannot be resolved if rolling-out of team. Dependencies between teams made managing development difficult (Issues #2).

Further Scrum team of conventional Scrum has tasks of integration and release. However in large-scale Scrum project, it is not clarified who integration and release task are done by (Issues #3). These three issues are shown at Table 2. In next part, we propose large-scale Scrum methodology which resolve these issues.

Table 2 Issues of large-scale Scrum

Issue No.	Description
1	Collaboration with other teams.
2	Dependencies with other teams
3	Obligation of integration and release

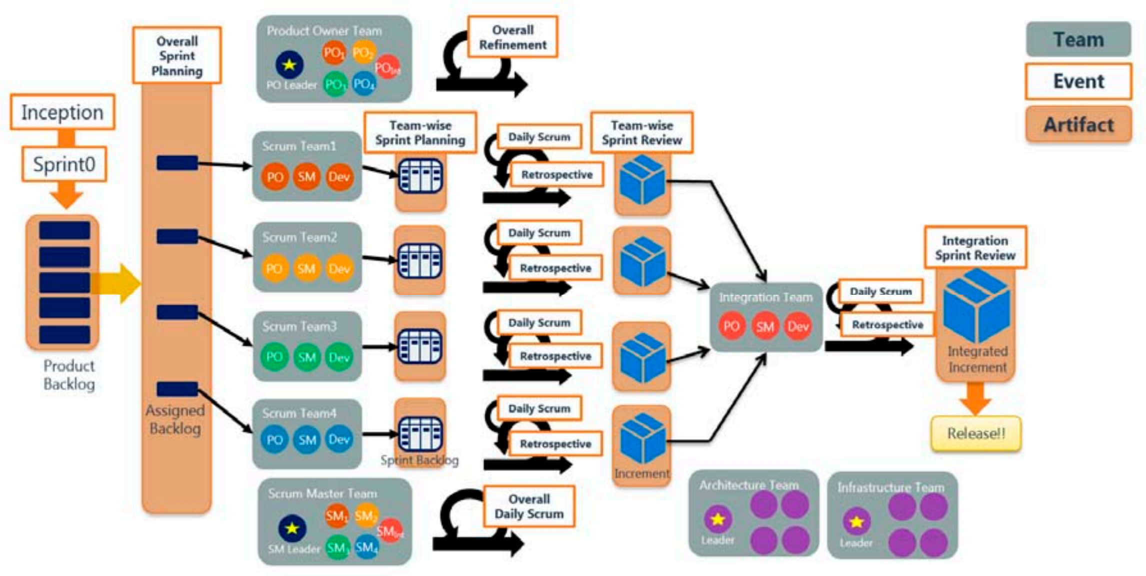

Figure 1 Proposed large-scale Scrum methodology process

3. Proposed large-scale Scrum methodology

In this part, we propose large-scale Scrum methodology. This methodology consists of Process, Role, Event and Artifact.

3.1 Process

Process of proposed large-scale Scrum methodology is shown in Figure 1. Our large-scale Scrum methodology consists of three elements such as role, event and artifact. We define organization and process to enable Scrum team members can concentrate to develop their own Backlogs and tasks. The events which is defined in conventional Scrum are divided into overall event and team-wise event.

Our methodology has one Product Backlog for whole project, and this backlogs are distributed to each Scrum teams at Overall Sprint Planning. Each Scrum teams develop Increment in a Sprint and in end of Sprint, each Scrum team's Increments are reviewed by Product Owner of each Scrum teams. In next Sprint, Integration team that assuming integration task is doing integration for previous Sprint's Increments. This Integrated Increment is reviewed by Product Owner of Integration team and Product Owner Leader. Therefore project's Increment which can release to end-user is intermittently created from Sprint 2. In next section, we explain role, event and artifact which forms our methodology.

3.2 Role

The role which is defined our methodology and team organization example are shown in Table 3 and Figure 2. In our methodology, Integration team which doing integration task is new created to clarify obligation of the integration task (Resolution for issue #3 in the table 2). Moreover we new create Product Owner team, Scrum Master team, Architecture team and Infrastructure team.

Table 3 Role Definition

Role	Description
Scrum team	Multiple Scrum teams that will perform development in parallel.
Integration team	This team will be responsible to integrate the artifacts from each Scrum teams.
Product Owner team	This team will be structured around the product owners from Integration team and each Scrum teams and leader
Scrum Master team	And this team will be structured around the scrum masters from Integration team and each Scrum teams and leader.
Architecture team	Has the responsibility for all architecture of the project.
Infrastructure team	Has the responsibility for all infrastructure of the project.

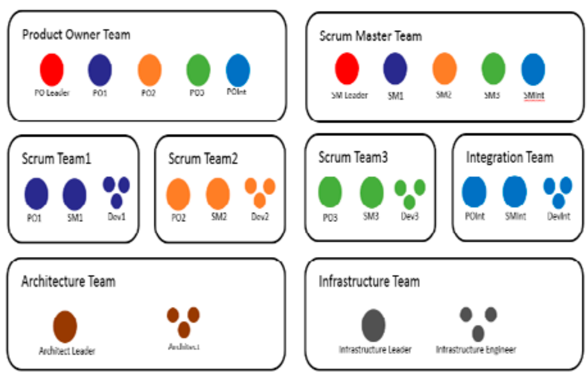

Figure 2 Example of team structure

Table 4 Event Definition

Event	Description
Inception	Discussion and clarification of Project characteristic and make sure between client and developer so that every project member can understand project's purpose.
Sprint 0	Preparing to start the development and integration such as setting up environment, Technical verification etc.
Overall Sprint Planning	Assigning Product Backlog to each Scrum teams, and Integration team determine integration Backlog.
Team-wise Sprint Planning	Performs the task breakdown for the items that was decided in Overall Sprint Planning for each Scrum teams or Integration team. Project can provide independent Product Owner and Scrum Master to each Scrum teams, this task can be held in parallel. This task is same as Topic2 for Sprint Planning for conventional Scrum.
Overall Daily Scrum	The scrum masters gathers as part of Scrum Master team and perform sharing team's progress and current problem so that all project member can know current overall problem.
Team-wise Daily Scrum	Perform as per the conventional scrum. If project can provide independent Scrum Master to each Scrum teams, this task can be held in parallel.
Overall Backlog Refinement	To be Re-prioritized and cleared definition of done of Product Backlog so that maintaining Product's value.
Team-wise Backlog Refinement	To be Re-prioritized and cleared definition of done of Product Backlog for each Scrum teams.
Integration Review	The demo of the integrated increment of the Integration team is given to the Product Owner team, and verified if is acceptable or not.
Team-wise Sprint Review	Similar to conventional scrum, the demo of the Scrum increment developed by each Scrum teams is given to the Product Owner,
Overall Retrospective	Similar to the conventional Scrum. Discuss the actions and improvement points for the team. If project can provide independent Product Owner and Scrum Master to each Scrum teams.
Team-wise Retrospective	Important (if possible all) members of the Scrum Master team, each Scrum teams and the Integration team discuss the actions and improvement points

3.3 Event

As we mentioned in section 3.1, all events which is defined in conventional Scrum are divided into overall events and team-wise events (Resolution for issue #1 in the table 2). Event definition is shown in Table 4. In previous term of development, Inception and Sprint 0 are participated for sharing project information and preparing development. In development, dependencies between teams can be discovered and visualized in two stage of Daily Scrum, Sprint Planning and Refinement.

In team-wise Sprint Review, increments of each Scrum teams named Scrum Increments are reviewed by each team's Product Owner, and also in Integration Review, increment of Integration team named Integrated Increment is reviewed by Integration team's Product Owner and Product Owner Leader. Developers in Scrum team participate only conventional Scrum events and they can concentrate to develop only their works. In Overall Retrospective and team-wise Retrospective, we often use one of agile practice named “KPT”.

Example of one week Sprint schedule is shown in Figure 3. As same as conventional Scrum schedule, each Daily Scrum take fifteen minutes, other events take 2.5% of overall work time in Sprint. Also every teams should observe the Time-box of each event and Scrum team implement their own Backlog and Integration team integrate Scrum Increment in remaining time.

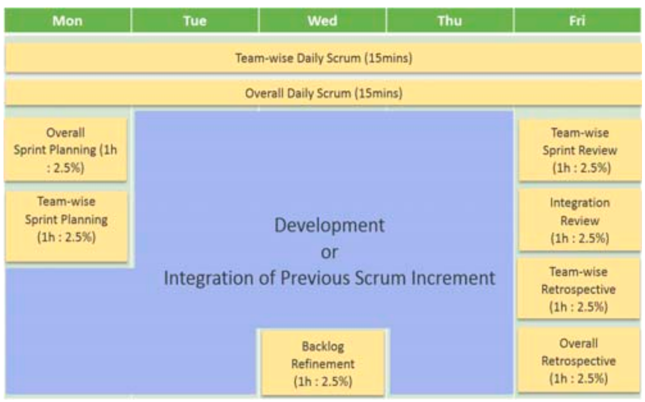

Figure 3 Example of Sprint schedule

Table 5 Artifact Definition

Artifact	Description
Product Backlog	Similar to conventional Scrum. This list includes Backlog for Integration team.
Sprint Backlog	The board contains broken down to items by Scrum team and Integration team on team-wise Sprint Planning.
Scrum Increment	Increment as per the conventional Scrum. This item that satisfy the acceptance criteria of Definition of Done (DoD) as specified in the Product Backlog List by each Scrum team's Product Owner.
Integrated Increment	Increment that integrate the Scrum Increment that can be released to the customer. This item that satisfy the acceptance criteria of Definition of Done (DoD) as specified in the Product Backlog by Integration team's Product Owner.
Impediment List	All issues, risks list for each Scrum, Integration team to improve transparency. This List should be updated at team-wise Daily Scrum
Dependency List	The list of Issues what affect between multiple team such as Blockers for Backlog, Technical issues, Process issues and Business or customer issues. This list should be published with all member of the Project.
Sprint Burndown Chart	Similar to conventional Scrum. It shows the total effort against the amount of work we deliver each iteration.
Velocity Chart	Similar to conventional Scrum. This chart shows the amount of value delivered in each Sprint, enabling you to predict the amount of work the team can get done in future Sprints.
Release Burndown Chart	Similar to conventional Scrum. It shows the total effort against the amount of work deliver until release date of Product.

3.4 Artifact

As same as role and event, we define some artifacts for large-scale Scrum project in addition to artifacts of conventional Scrum. Artifact definition is shown in Table 5. As we mentioned in section 2.3, dependencies problem are occurred in large-scale Scrum project, therefore this problem should be visualized for overall project. Hence our methodology provide artifact to manage dependencies problem between teams named Dependency List (Resolution for issue #2 in the table 2). Sprint Burndown Chart and Velocity Chart is similar to conventional Scrum. Release Burndown Chart shows the total effort against the amount of work deliver until release date of whole Product.

4. Application to project for Internet Banking system

4.1 Project information

We applied our large-scale Scrum methodology to project for Internet Banking system development. This project has these characteristics as below.

Requirements: Development of front-side application and back-end system connecting some channels
Programming Language: Javascript (Front-end)
Java (Back-end)
Term: Six months after apply our methodology
Members: 80 members

In this project, they changed development process from Water-fall model to Scrum model due to client desired to develop high UX and more flexible system. Although before being applied our methodology, there were six Scrum teams, and each Scrum team's Velocity was problematized due to Sprint term of each Scrum teams were not lined up and each team integrate other team's Increment. In fact, average of velocity of each teams was achieved only 20 % of plan. Thus we applied our large-scale Scrum methodology for improvement of velocity.

After being applied our methodology, we created new five Scrum teams and new teams defined in our methodology. And we consolidated Sprint term of Scrum team and we enabled only Integration team can do integration task. Product Owners of each Scrum team could not assign to each Scrum teams one by one, so that we made one Product Owner can handle few Scrum teams and adjust schedule of each Events.

4.2 Application result

After being applied our methodology, average of velocity of each teams was improved 3.5 times on nine Sprints. And we received feedback comment from clients such as below.

- ✓ Productivity was improved by this methodology.
- ✓ We could predict and early detect dependencies problem.
- ✓ Information was visualized to whole project members so that communication between teams was improved.

4.3 Discussion

In this section, we examine about arrangement point, problems and solutions during apply our methodology to project.

[Arrangement point]

The project valued system quality because it was development for financial system, so product must be tested on two client testing environments in addition to project testing environment for system testing phase. Further system testing on client environment was done by client staff in charge of Quality Assurance (QA). Therefore testing on client environment was removed from tasks of Integration team.

Second arrangement point was making each Scrum teams have functional theme and basically each Scrum teams implement functions in part of these theme. In our methodology, it was defined that project has only one Product Backlog and this should be distributed to each teams. However, there was a possibility of occurring dependencies problems if distributed to each teams by business priority. Hence, we made each Scrum teams have functional theme and we adopted Microservices Architecture to reduce dependent problems between functions (Hasselbring, 2016).

[Problems and solutions]

There were some problems that some bugs which should be detected by Scrum team were detected by Integration team, so Integration team's task was increased. To solve this problem, we defined some rules of coding review and test case. Furthermore, we added these rules to Definition of Done and made each Scrum teams observe these rules. Thus we made Integration team could concentrate all their thoughts on their integration works.

5. Conclusion

In this paper, we proposed original methodology for large-scale Scrum development and we described arrangement point and problems and solutions from our experience of applying our methodology to an Internet Banking system development project. In the project, we achieved positive result that average of velocity of each teams was improved 3.5 times. Further issues that we need to work on is verification of a good method to distribute Product Backlog to each teams and more efficient method to resolve dependencies problems.

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Immune Mechanisms in Project Management

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The immune system in project management is a set of components that allow you successfully implement the project within the stipulated time and budget, and protects it by identifying and destroying pathogenic resources and viruses, which are the effect of the external and internal environment, as well as risks. The ultimate goal is the destruction of the immune system of a foreign agent. The immune system of project management has several approaches to detect and remove foreign agents: this process is called immune response. The immune response is a reaction by the manager of this event, namely, the possibility of solving this problem: by either seeking other suppliers as soon as possible or put the project on hold, or to increase the duration of the project, or to withdraw funding. A similar situation can be traced to the contractors and general contractor if the work performed or service delivered is substandard. Immune response, in this case, would increase the quality control. The notion above implies that the immune response in project management is the protection aimed at successful implementation of the project as a system.

Keywords and phrases**:** Convergence; Innovative Methods and Models; Making Project Decisions; Similarity Management Systems

1. Introduction

Modern stage of project management methodologies and programs development requires the creation of innovation models, methods, and mechanisms, based on the convergence of knowledge of various subject areas. Over billions of years, nature has created a variety of living organisms and unique management mechanisms based on acquired knowledge, which forms parts of genetic codes and immune memory of organisms (Haitova R, 2010). Considering organizations as systems of living organisms, they actively use two types of memory mechanisms – genetic and immune. Memory is the ability to preserve and reproduce past experience and any information about the external world and the internal state of the organism. Knowledge transfer models from one subject area to another were formed within the framework of the theory of similarity of mechanical and electrical systems in the 1960s. Laws of similarity of systems were developed on the basis of the unity of differential equations describing such systems. Then, in the 1970s, the models of benchmarking (transfer of best practices based on knowledge) were formed. Today, key trends in the development of project management and programs` of organizations are searching for effective mechanisms for storing and applying knowledge, which is built by the transfer of knowledge and best practices. An important law for the understanding of immunology in project management is "The Law of Requisite Variety”. Ashby states the Law as "variety can destroy variety". He sees this as aiding the study of problems in biology and a "wealth of possible applications". There are some similarities between Project, program and portfolio management system and Biological systems as modern biotechnology and molecular genetics (Bushuyev and Bushuyeva 2010).

2 Analysis of recent achievements and publications

One of the essential components of project management is prediction which is reduced to determining possible ways of solving management problems based on the available knowledge and experience. Such prediction is based on a generalization of experimental data and knowledge of objective laws of the development of observed phenomena (Yaroshenko, Bushuyev and Bogdan, 2012, Bushuyev and Bushueva, 2010). The implementation of such functions is based on knowledge and best practices, which are stored in the structured memory of project managers and organizations (Bushuyev and Wagner, 2014).

There is an arbitrary and involuntary memory in psychology and physiology; by the nature of manifestation there are imaginative, verbal-logical, mechanical, emotional and conditioned-reflex memories; by the type of perception there are visual, auditory, olfactory, motor and visceral memories. One of the main characteristics of memory is the time or the length of storage of information. By storage time, memory is divided into short-term and long-term. In the first case, the information is stored for a period of seconds or minutes, in the second - for days, months and years. A detailed analysis of the temporal characteristics of memory shows it’s fractional division into sensory or ultrashort (storage time less than one second), primary (few seconds), secondary (from a few minutes to several years) and tertiary (information is stored for life). Sensory and primary memory is referred to as short-term memory, secondary and tertiary is referred to long-term one.

Immune memory - the ability of the immune system to respond to secondary penetration of foreign objects by the rapid development of specific responses by the type of secondary immune response. The realization of this effect is provided by stimulated reaction mechanisms that do not perform effector functions (Bushuyev, Haritonov and Rogozina, 2012a). Considering the organization in analogy with the behavior of a living cell, determine the key characteristics of immune memory. The phenomenon of immune memory manifests itself in both humoral and cellular responses. The memory cells circulate in a resting state and in the case of repeated contact with a foreign object, a reaction is formed, which is called "immune response". The immune memory may persist for a long time and requires training based on new knowledge and experience in implementing organizational development programs (Bushuyev, Kharitonov and Rogozina, 2012b, Danchenko and Poskripev, 2014).

The immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease. To function properly, an immune system must detect a wide variety of agents, known as pathogens, from viruses to parasitic worms, and distinguish them from the organism's own healthy tissue. In many species, the immune system can be classified into subsystems, such as the innate immune system versus the adaptive immune system, or humoral immunity versus cell-mediated immunity. In humans, the blood-brain barrier, blood–cerebrospinal fluid barrier, and similar fluid–brain barriers separate the peripheral immune system from the neuroimmune system, which protects the brain (IPMA Global Standard, 2015).

Pathogens can rapidly evolve and adapt, and thereby avoid detection and neutralization by the immune system; however, multiple defense mechanisms have also evolved to recognize and neutralize pathogens. Even simple unicellular organisms such as bacteria possess a rudimentary immune system in the form of enzymes that protect against bacteriophage infections. Other basic immune mechanisms evolved in ancient eukaryotes and remain in their modern descendants, such as plants and invertebrates. These mechanisms include phagocytosis, antimicrobial peptides called defensins, and the complement system. Jawed vertebrates, including humans, have even more sophisticated defense mechanisms, including the ability to adapt over time to recognize specific pathogens more efficiently. Adaptive (or acquired) immunity creates immunological memory after an initial response to a specific pathogen, leading to an enhanced response to subsequent encounters with that same pathogen. This process of acquired immunity is the basis of vaccination.

Disorders of the immune system can result in autoimmune diseases, inflammatory diseases and cancer. Immunodeficiency occurs when the immune system is less active than normal, resulting in recurring and life-threatening infections. In humans, immunodeficiency can either be the result of a genetic disease such as severe combined immunodeficiency, acquired conditions such as HIV/AIDS, or the use of immunosuppressive medication. In contrast, autoimmunity results from a hyperactive immune system attacking normal tissues as if they were foreign organisms. Common autoimmune diseases include Hashimoto's thyroiditis, rheumatoid arthritis, diabetes mellitus type 1, and systemic lupus erythematosus. Immunology covers the study of all aspects of the immune system.

Immunity of man - a state of immunity to various infectious and generally alien to the human genetic code organisms and substances. The immunity of the organism is determined by the state of his immune system, which is represented by organs and cells. The same exists in the field of project management is given below.

The immune system in project management - is a set of components that allow you to successfully implement the project within the stipulated time and budget, and protects it by identifying and destroying pathogenic cells and viruses, which are the effect of the external and internal environment, as well as risks. The ultimate goal is the destruction of the immune system of a foreign agent.

In the immune system of project management, there are many ways to detect and remove foreign agents: this process is called immune response. For example, the suppliers do not meet the conditions of the contract, and as a result did not put the equipment and materials on time and thus put the completion of the project at risk. In this situation, the immune response is a reaction to the manager of this event, namely, the possibility of solving this problem: either by seeking other suppliers as soon as possible or put the project on hold, or to increase the duration of the project, or to withdraw funding. A similar situation can be traced to the contractors and general contractors if they performed work and provided substandard services. Immune response, in this case, would be: enhance quality control. The above implies that the immune response in project management is the protection aimed at successful implementation of the project as a system.

"Strangers agents", like viruses, affect projects. They are dangerous to the immune system of the project. When a virus is detected and evaluated, it is necessary to decide on an adequate response to it.

This is done by the responses such as the reduction or preservation, forwarding and participation.

1. Reduction. Generally considered the first alternative is to reduce the impact of the virus. A bridge construction project is an illustration of the reduction agent. The new bridge project for the coastal ports had to use an innovative process of continuous pouring of cement, developed by an Australian company in order to save time and cost. The main impact of the virus was the fact that the continuous

casting process in each section of the bridge should not be interrupted. Any failure could lead to the fact that the entire section of the concrete (hundreds of cubic yards) had to be dismantled and restarted all over again. In assessing the potential viruses all attention was paid to the delivery of cement from the factory. Concrete could be on the way or the plant could be idle. Such viruses could lead to huge costs for rework and late schedule. The virus is reduced by constructing two additional mobile concrete production plants on different highways just 20 miles from the planned bridge in the case of failure of the main plant supplier. These two additional plants are enough for a whole section of the bridge, and additional trucks were always ready when needed for continuous concrete pouring.

2. In some cases, the virus deliberately preserved. Some viruses are so large that they simply cannot be diverted or reduced (for example, an earthquake or a flood). Project owner simply accepts this virus, because the possibility of such infection is very low.

3. Forwarding virus the other side - it is quite normal; Forwarding does not change the value. Redirecting virus to the other side almost always results in the payment of allowances for it. The contracts with a project. Fixed prices are a classic example of risk diversion from the owner to the contractor. A contractor understands that his company will pay for any virus that manifests. An easier way to redirect this virus is insurance.

4. Participation in the virus means that the different parties take on its impact. For example, the Airbus A300V project. Risks in the area of research and development were distributed among European countries, including Britain and France.

Autoimmune reactions - is the disease associated with dysfunction of the human immune system, which begins to take its own tissue as foreign and damaging them. These diseases are called systemic, because, as a rule, the whole system is affected, or the entire body. These days we often speak of new infections, which are a threat to all humanity. This is, first and foremost, AIDS and SARS (SARS), avian influenza and other viral diseases. If we recall history, most dangerous viruses and bacteria were overcome largely due to the stimulation of human immune system (vaccination).

3. The purpose of the study and the statement of the problem

The purpose of this paper is to analyze the structures of immune memory and construction of a mechanism for managing development programs based on knowledge of immune memory.

The objectives of the study include:

- analysis of the best practice transfers (including the transfer of immune mechanisms from project to product) in the development of an organizations technology;

- examination of existing structures of immune memory based on analogies with wildlife;

- a conceptual model construct of an immune memory and usage of immunological knowledge in development programs of organizations.

The main hypothesis of the research is that the key factor in the success of development programs of organizations is an active application of knowledge based on best practices and lessons in management processes. This article suggests the immune memory adaptation mechanisms of living organisms as storage structures and application of best practices.

4. Knowledge transfer technology (benchmarking) in the management of development programs

Benchmarking technology provides the following steps (Figure 1).

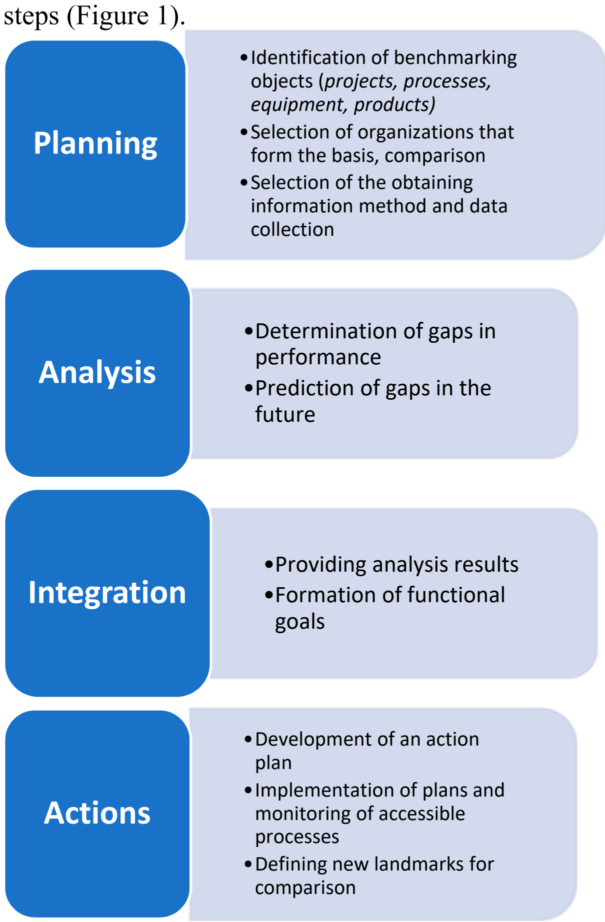

Figure 1 Benchmarking steps

Solving the problems of enterprise development, creative technologies and methods of developing solutions have a special strategic coverage (P2M, 2015). In this case, creative technologies are used in the accumulation of immunological knowledge of management to improve the production efficiency, its competitiveness, reduction of costs and growth of labor productivity.

Active use of the best global practice is realized on the basis of benchmarking creative technology.

During the last 20-25 years, benchmarking has become an effective method for assessing and developing the capacity of enterprises by making detailed comparisons with other companies.

Benchmarking includes:

- comparison of the companies and its individual units with other most successful companies (their units) regardless of industry and country affiliation;
- comparison of managerial and technological processes with the best similar processes in other companies;
- comparison of products and services offered by the company, with products and services produced by its most powerful competitors;
- implementation of the best practice found in the activities of the company;
- prediction of the future trends in best practices and effectively respond to these trends.

The main benefits of the use of benchmarking include:

- benchmarking provides an opportunity for the firm to learn the experience of others while saving time resources and minimizing the threat of mistakes repetition made by other companies;
- benchmarking provides an evaluation of the company's effectiveness in comparison with the best competitors;
- benchmarking expands the information base and increases the objectivity of organizational analysis;
- benchmarking helps to formulate priorities detailed plans for corrective (improving) programs.

Additional strategic advantages of benchmarking include:

- an increase in the desire and need for change management;
- the formation of partnership philosophy among managers in relationships with other organizations;
- ensuring synergy in the implementation of corrective programs;
- higher sensitivity to new ideas and also mobilization of own innovative potential;
- the use of a multivariate approach to solving problems that appear before the company;
- focus on the maximization of the consumer`s value of the produced products and services;
- the tendency of top managers to use more active strategies.

Motives for the active use of benchmarking in transferring knowledge in international practice include:

- browsing existing and forming new goals of the company;
- the search for best ways to achieve goals;
- the definition of gaps between the effectiveness of the organization and the performance of its strongest competitors;
- the need for radical improvements to maintain competitiveness;
- identification of priorities for corporate restructuring;
- high level of overhead costs;
- the backlog of competitors in equal qualities of products/services;
- considerable time expenditure on the commercialization of the product compared to competitors;
- the need to predict new strategies of competitors;
- participation in quality competitions most of which provide the usage of benchmarking as the required condition;
- timely identification of signs of lagging behind competitors.

5. Knowledge transfer methods in the management of development programs of organizations

Consider the existing methods of knowledge transfer.

Imitation Transfer occurs when transferring existing solutions from one workplace to another with other performers.

Internal Transfer is carried out between different departments of one organization by means of information exchange.

Rotational Transfer: project team - management - project team - staff from different departments on an individual plan temporarily participates in the work of the management team of restructuring and development projects and thus their abilities are checked.

Expertise Transfer large companies collect special solutions by organizing a tender for free, that is why many well-known project companies try to hide the details of the proposal with the participation.

Contractual Transfer the customer (the owner) transfers the tasks related to related to monitoring and planning of subcontractors` work to the general contractor; in this way, the general contractors transfer their knowledge to the subcontractor and the customer.

Vertical Transfer occurs between a large company and its suppliers, usually medium-sized or small-sized firms when they are influenced, for example, to use high-tech equipment as a strategic management system or as a system of continuous improvement of product quality.

Complementary Transfer occurs between one company and another joint venture or a company formed as a result of the merger with another company.

Analogue Transfer exists between branches, for example, a transition from the application of the computer in trading organizations to usage in banks.

Know-how Transfer between systems of higher education, research and the industrial sector, sector of government is the most common form of technological transfer.

Disciplinary Transfer is a transfer between scientific disciplines, for example, between mathematics and other sciences, such as computer science, economics.

Terminological Transfer between different technical languages. It is necessary to avoid different interpretations of technical meaning due to the mismatch of technical languages in different countries.

All these methods used by the project manager for establishing immune system of output and outcome of the project as the security in the different area of deliverables.

6. Classification and functional areas of immunity projects

Consider the types of immunity that are presented in the following structure of immunity (Figure 2).

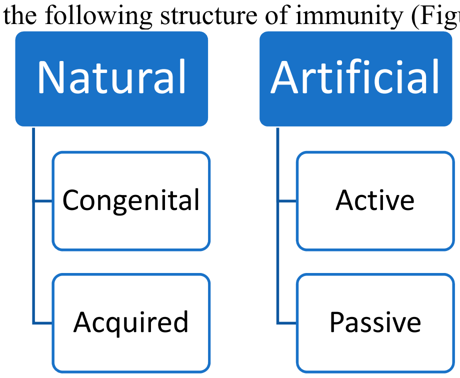

Figure 2 Structure of immunity

The natural immunity of the project is related to the immunity of the organization or a team implementing the project. This immunity can be congenital, determined by the competence of project managers or acquired based on the transfer of lessons and best practices in the organization (IPMA OCB, 2013).

Artificial immunity is formed in the organization on the basis of lessons from previous projects and best practices. It can be passive when the management team is exploring other people's lessons and best practices and active when the team uses their own competence.

The considered types of immunity are used by a management team in the context of functional areas.

There are highlighted the following functional areas of immune mechanisms:

- information security;
- staff safety and performance;
- organization maturity/competence;
- technics and technology;
- etc.

In each functional area, there are technologies for constructing immune mechanisms, which protect the project from the penetration of malicious resources.

The state of the functional activity of the immune system is vitally important for the organism and is denoted by the term "immune status". The immune status is a quantitative and qualitative characteristic of the state of the functional activity of the organs of the immune system.

The immune response is a set of processes occurring in the immune system in response to the implementation of a foreign resource (antigen). The mechanisms involved in the immune response are called immunocompetent. A complete immune response determines the organization's response to penetrative threats. From this definition, it follows that the immune response is reactive. The formation of a complete immune response of the organism (organization) is that from the selected scenarios of its movement between the points, where the next threats may appear - points of bifurcation - it is necessary to form a project for managing the implementation of the program. This approach transforms the style of managing organizational development programs into proactive ones. The program will be formed on the basis of projects that create a complete immune response. And it is necessary to know:

- the content of each scenario;
- endpoint options where we are going, including probability, size, aftereffect;
- to form a step-by-step scheme of the immune response - to form movements in the project in such a way as to work out all threats.

Autoimmune reactions - is the disease associated with dysfunction of the human immune system, which begins to take its own tissue as foreign and damaging them. These diseases are called systemic, because, as a rule, the whole system is affected, or even the entire body. In our time, often speak of new infections, which are a threat to all humanity. This is, first and foremost, AIDS and SARS (SARS), avian influenza and other viral diseases. If we recall history, most dangerous viruses and bacteria able to win, and largely due to the stimulation of the immune system's own (vaccination).

the main feature is by analogy with the human body, there is an autoimmune reaction in project management - a disorder that are characterized by the destruction of the whole system as a consequence of the existence of threats in the middle of the project, which leads to failure and thus do not allow to realize the project in full. An example of such an autoimmune reaction to acts of corruption in the project. Corruption - a term denoting usually use their official powers and rights entrusted to it, as well as the associated status of official authority, opportunities, contacts for private gain, contrary to the laws and moral precepts.

Corruption may be subject to any official having authority in the field of distribution of any not owned by him at his discretion resources. The main incentive for corruption is the possibility of obtaining economic benefits associated with the use of power, and the main deterrent - the risk of exposure and punishment. There are three possible approaches to reduce corruption.

Firstly, it is possible to tighten the laws and their implementation, thereby increasing the risk of punishment.

Second, you can create the economic mechanisms that allow officials to increase their income without violating the rules and laws.

Thirdly, it is possible to enhance the role of markets and competition, thereby reducing the size of potential profit from corruption. It also provides the latest competition in the provision of public services, provided that duplication among government agencies of other organs.

Another difficulty, especially when manifested by large-scale corruption, when most individuals give bribes, known in psychology and game theory as a "prisoner's dilemma". On the one hand, if all people stop giving bribes, they will all benefit from it. However, if only one individual refuses bribes, it will put itself in extremely unfavorable conditions.

7. Immunological memory of projects and immune mechanisms

Immunological memory is the ability of the organism's immune system to respond with specific reactions to repeated injections of a foreign resource, manifested by the acceleration or intensification of the response to the antigen. There are short-term, long-term and lifelong immune memories.

Consider the following types of the immune memory of the project manager (Figure 3).

These types of the memory switch on intuitively or based on drivers that determine possible migration patterns of project managers' knowledge and experience. Cognitive memory is integrating all other types of memory, which allows to form immune response scenarios and run them through immune mechanisms.

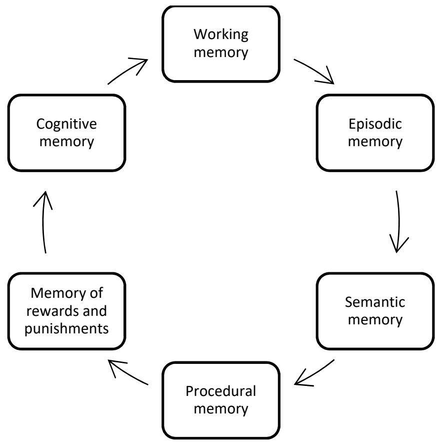

Figure 3 Types of project managers immune memory

These types of the memory switch on intuitively or based on drivers that determine possible migration patterns of project managers' knowledge and experience. Cognitive memory is integrating all other types of memory, which allows to form immune response scenarios and run them through immune mechanisms.

There are various mechanisms for influencing the immune system, which is designed to bring its activity back to normal. These mechanisms include immunorehabilitation, immunostimulation, immunosuppression and immunocorrection.

Immunorehabilitation is the mechanism of impact on the immune system. The purpose of immunorehabilitation is to restore functional and quantitative indices of the immune system to normal values. Immunostimulation is the mechanism of influencing the immune system to improve immunological processes, that occur in the organism, and also increase the responsiveness of the immune system response to internal stimuli. Immunosuppression (immunodepression) is the suppression of immunity for different reasons.

Immunocorrection is the restoration of the immune system. Immunocorrection is carried out for preventive purposes, in order to increase the resistance of the organism during periods of activation of threats, to improve the recovery of the organism as a result of the implementation of anti-crisis programs.

8. Conclusion

In this research have been considered definitions and examples of viruses immune systems and mechanisms, as well as the autoimmune reaction in the project management. From the above we can draw the following conclusions, to the system (management object) is not subjected to autoimmune reactions, which can cause irreparable damage, it is necessary that it meets a number of requirements:

The first requirement is ingeretnost, that is a sufficient degree of consistency with the environment created by the system to create a project has been agreed with the environment, with which it will operate, would be included in this environment not as a foreign element, but as a natural part.

The second requirement - easy project management mechanism.

Finally, the third requirement is that the immune system of project management - is adequate. The adequacy of the system means that you can use it to achieve its objectives of the project in accordance with the laid down criteria. The adequacy of the system means that it is sufficiently complete, accurate and true. Enough is not general, but to the extent that allows you to achieve this goal.

As a result of the studies performed, the following conclusions can be drawn:

- a systematic approach to the use of knowledge of immunology makes it possible to use the knowledge accumulated in biology in project management and development programs of organizations;
- the formation of new project management mechanisms, based on analogies. The formation of new project management mechanisms can be realized through the convergence of knowledge and its integration.

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Keys to Success of the Project to Streamline and Optimize the Mission-Critical IT System

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Hitachi Systems provides 24/7 maintenance services at about 300 service sites throughout Japan. These services are delivered based on a large-scale, mission-critical IT platform. From 2013 to 2015, we carried out a complete renovation of this maintenance service IT platform, aiming to greatly reduce the size of our software assets. This paper reports the reconstruction project, started in 2014, of the Field Services Management (FSM) system. The FSM system, originally released in 2007 for standardizing and improving the efficiency of maintenance services, had created a heavy burden due to use of high-cost packaged software products. To significantly reduce operational costs, we tried to streamline the IT system by terminating the use of the packaged software and consolidating the functions with connecting systems. Also, we tried to improve business efficiency by reviewing and drastically changing business processes. We needed to address the challenge of how to implement the streamlined IT system along with significant consolidation of the functions. To solve it, we thoroughly overhauled the entire system, including discontinuation of unnecessary functions, consolidation of similar functions, and utilization of existing programs. Although well-prepared task team was indispensable to achieve this project as planned, we faced a shortage of experts who had both technical and business knowledge. By devising allocation of development team, we successfully reduced the software size from 4.7 MLOC to 2.9 MLOC (LOC: Lines of code). For drastic review of the business processes, we standardized the schedule planning process, which previously depended on individuals at each service site, and deployed tablets which support field maintenance services. As a result, we streamlined the maintenance organization and improved the business efficiency.

Keywords and phrases : Streamline the IT System, Reduce Operational Costs, Terminating the Use of the Packaged Software

1. Introduction

Hitachi Systems is a leading IT service provider specializing in developing and implementing business systems for customers of diverse sectors and sizes. We also operate, monitor, and maintain those systems by using a multi-tiered service infrastructure comprising data centers, network and security operations centers, contact centers, and a nationwide network of around 300 service sites. Ever since the dawn of the Japanese IT industry, we have been at the forefront of the IT revolution, using our rich experience to provide end-to-end services ranging from consulting customers on their systems needs to designing, implementing, operating, and maintaining systems to operating a help desk, all with the goal of supporting customers' business management and day-to-day operations.

A mong these various services, our maintenance service operations mainly consist of two tasks: a failure-handling task and a planning task (inspection, on-site installation, machine refurbishment, and solution work). In these operations, the FSM system is used by approximately 2,000 customer engineers (CEs) and by schedulers. This system supports all the business processes from service request receiving and instruction creation to reporting and approval, handing 10 million customer devices and 1,300,000 jobs annually. FSM is implemented mainly with six functions of work instructions, scheduling, tracking, progress management, work reporting, and approval, together with an integrated database (master information such as integrated job information, contract information, and customer information). (An outline of FSM is shown in Figure 1 below). The failure-handling system acts as a backbone system that deals with about 900,000 jobs a year.

2. Project Overview

This project was the fifth phase of the In-house Systems Streamlining Program, which was conducted between 2012 and 2016.

The In-house System Streamlining Program aims to reduce costs and optimize our operation and maintenance organization by halving the number of bloated software assets in operation (some legacy systems are as old as the 1990s) and through

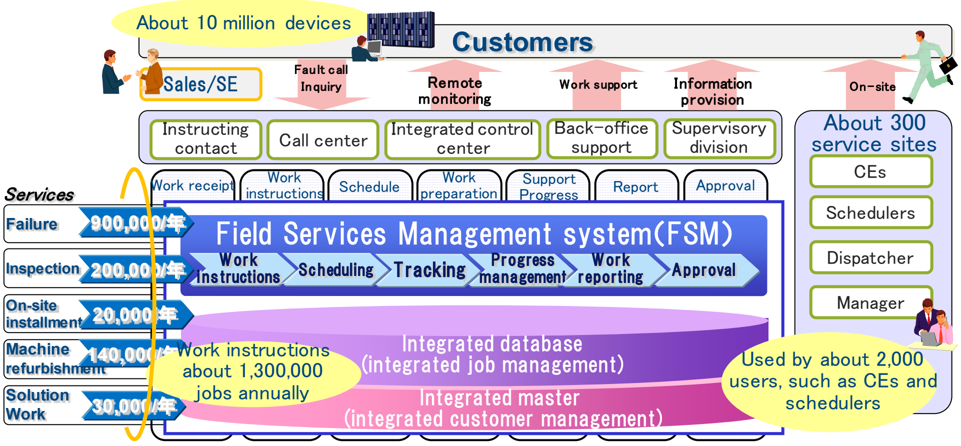


Figure 1 Outline of FSM

operational optimization (operational innovation). The overall schedule for the In-house Systems Streamlining Program is shown in Figure 2, and the changes in the system size in Figure 3.

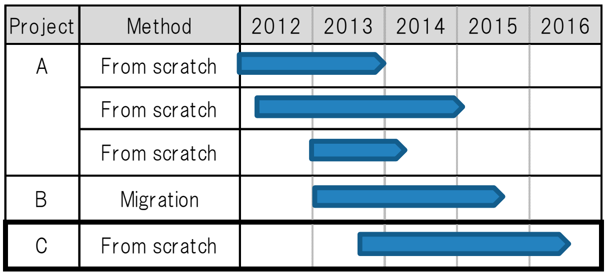


Figure 2 Schedule for the In-house Systems Streamlining Program

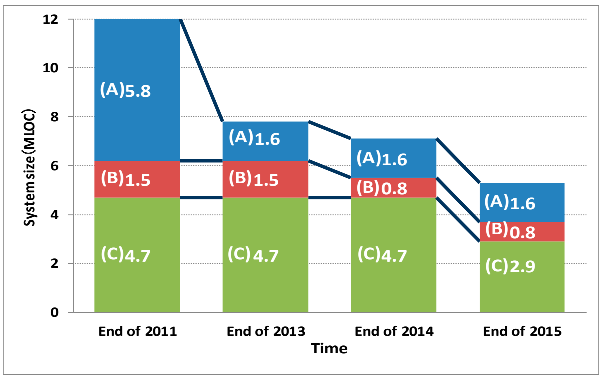


Figure 3 Changes in the system size

This project C, started in FY 2013, carried out the reconstruction of FSM, the backbone system of the maintenance services. The version of the FSM system before Project C was released in 2007 with the use of packaged software products. The support costs were high however, creating a huge financial burden. When FSM was built with packages in 2007, some functions were not provided by the packages, therefore they were developed as add-ons and incorporated into FSM. However, some of the functions developed as add-ons were found non-conformable to the business and remained as FSM-connected systems without having been integrated. As a result, two or more systems had similar functions and data items. This required modifications in several locations even for adding just one new item, resulting in poor maintainability.

2.1 Objective of the project

In this project, we attempted to reconstruct FSM to accomplish the following two objectives:

(1) To streamline the system

Terminate the use of packaged software products and consolidate the functions with connecting systems to streamline the system and reduce operational costs. Reduce the software size by 40% (from 4.7 MLOC to 2.9 MLOC).

(2)To optimize business operations

Together with streamlining the system, review and change business processes thoroughly for significantly improved business efficiency.

2.2 Key points in implementing FSM

In addition to FSM, there were three FSM-connected systems: the failure-handling support system for supporting failure-handling maintenance operations, the job management and execution system for helping perform planning maintenance operations, and the service job integration management system. The FSM reconstruction program, as illustrated in Figure 4, had the following 4 implementation objectives: (1) Consolidating the information segmented for each business system to manage centrally and allowing users to access necessary

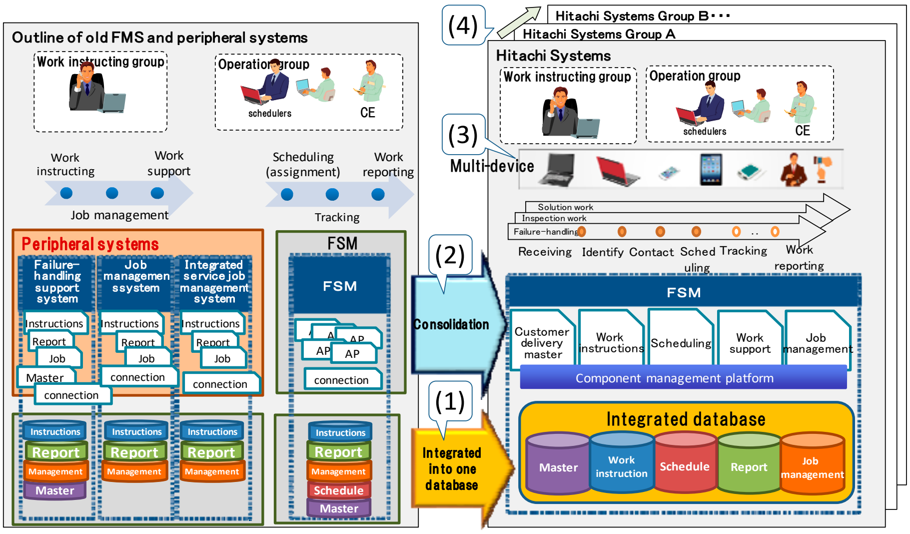


Figure 4 Conceptual diagram of the old and new FSM system

information whenever they want, (2) Reconstructing the functions to be implemented as components to achieve more flexible system development and service provision, (3) Making use of tablets and optimizing the processes to provide more enhanced support of CE operations, and (4) Enabling multi-tenancy to deliver the system to group companies as a common system.

2.3 Project schedule

Figure 5 shows the schedule of this project. This project aimed to achieve the streamlined system and improved business processes. We thus pushed ahead with the development by dividing the project into phases (Ph1 and Ph2) to immediately realize its effect.

In Ph1, we employed an agile development approach for the purpose of improving business processes, whereas in Ph2, we used a waterfall approach for streamlining the system. In addition, during these phases, we divided and assigned development periods and members for each development method, and developed the system on a functional-block basis so that we could manage the project while changing development and testing methods.

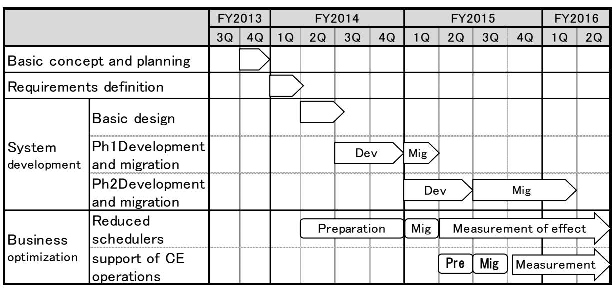


Figure 5 Schedule of the project

3. Issues on reconstructing FSM

The primary objective of the In-house Systems Streamlining Program was to cut operational costs. To attain this reduction goal, the target for the size of the completed system, including FSM and its connected systems, must meet the reduction from 4.7 MLOC to 2.9 MLOC after the reconstruction. We have defined operation and maintenance efficiency as KPI, and this operation and maintenance efficiency is represented by the software size per man month. In order to increase operation and maintenance efficiency and reduce operation cost, it was necessary to make the system size 2.9 MOC in this project. We therefore had the following three issues when running the project:

(1)Issues on the software size reduction

Before we started reconstructing FSM, we estimated the size of the system to be developed as 4.7 MLOC on the basis of the pre-reconstruction system at the time of planning. If we developed the whole system from scratch based on this estimated size, development costs would be expected to be enormous. Our first issue to meet the objective was to effectively reuse and utilize our existing assets to hold the size of the programming within 1.0 MLOC.

(2)Issues on how the existing assets are reused and utilized

To develop the system and provide services flexibly, we decided to develop the new FSM system as an application control platform and to run each function as a component on this platform. The most important point here was how the functions or the existing assets could be implemented as components in order to ensure the reduced size of the developed system.

(3)Issues on the phased operational migration achieved by parallel operations of old and new systems

As a large-scale, mission-critical IT platform, FSM provided the 24/7 maintenance services for IT products. If the system had been shut down due to system migration, there could have been a possibility of having a great impact on the provision of the services. It was thus inevitable to operate the old and new systems in parallel, to minimize the impact on users through phased operational migration and to migrate the system without any system outages.

4. Solutions to the issues

4.1 Solutions to the issues on the software size reduction

To effectively reuse and utilize the existing assets to hold the software size within 2.9 MLOC, simply reducing and integrating the functions was not sufficient. Thus, we attempted to fulfill our goal by combining various development patterns (IPA,2017) as shown below. As a result, we succeeded in developing 45% of the new system in entirety by reusing the existing functions, as shown in Figure 6.

(1)Reduction of the size (downsizing by reduction of the functions)

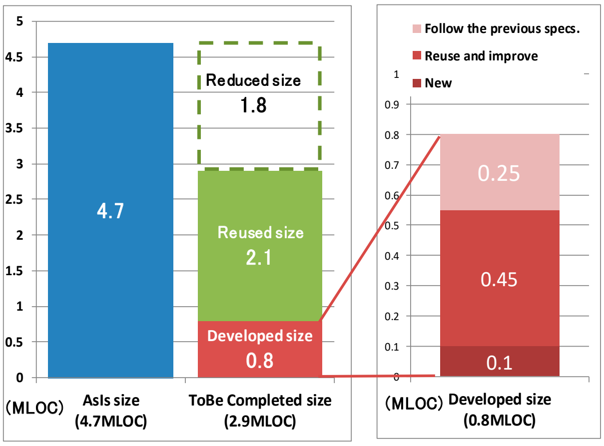
Remove duplication in data, business functions, and system interfaces caused by distribution of the systems.

(2)Number of functions to be reused (development size reduction by the reuse of the functions)

- If logic was complex and specific to the existing business operations, re-host the existing services for reuse.
- If F tier process (input check of the identical items on the multiple screens) that can possibly become a common logic is diverted as a common part.
- If functions were shared and standardized based on the three-tier Web framework and if there is no change in the screen display item or business logic, reuse the programs for them (in P, F, and D tiers).

(3)Size of the development

- Functions that do not exist in old systems, or all have new requirements functions, develop the system from scratch.
- Even in functions requiring new specifications, we rebuilt using existing programs as much as possible. (reuse and improve).
- Functions that need to ensure the specifications of packaged products were rewrite using the specifications of packaged products as they are. (follow the previous specifications/follow and improve the previous specifications)



#	Business component	Size(ASIS)[MLOC] FSM	Size(ASIS)[MLOC] Others system	Size(ASIS)[MLOC] Total	Size(ToBe))[MLOC] Reused size	Size(ToBe))[MLOC] Developed size	Size(ToBe))[MLOC] Completed size	Size(ToBe))[MLOC] Reduced size
1	Work instructions	0.7	0.5	1.2	0.3	0.2	0.5	0.7
2	Schedules	0.1	0.0	0.1	0.0	0.1	0.1	0.0
3	Work support	0.3	0.1	0.4	0.1	0.1	0.2	0.2
4	Job management	0.1	0.3	0.4	0.1	0.1	0.2	0.2
5	Master management	0.1	0.5	0.6	0.5	0.1	0.6	0.0
6	Others	0.1	1.9	2.0	1.1	0.2	1.3	0.7
	Total	1.4	3.3	4.7	2.1	0.8	2.9	1.8

Figure 6 Breakdown of the development size

4.2 Solutions to the issues on how the existing assets are reused and utilized

We consolidated the functions of the existing systems (removed the duplication) and streamlined the duplicate information (databases) in these systems into a unified database. We also built the new FSM system as the application control platform and developed a processing architecture in which each function can operate as a component on the platform.

4.2.1 Application control platform and functions developed as components

In this project, we worked on the development by creating components of the existing functions in the F tier, required for transfer of the business logic, and reusing the existing assets (programs and services). (Screens in the P tier were totally re-created.)

Also, the application control platform was developed so that the components running on the platform could be executed separately or successively through the definitions of events configured with parameters. This was based on a further expansion of our unique framework, which had been built up for the FSM-connected systems. In this project, we added common parts to "wrap" the existing services and make them available as components so that the existing assets could be reused and utilized. Figure 7 illustrates the application platform and how to reuse the existing assets.

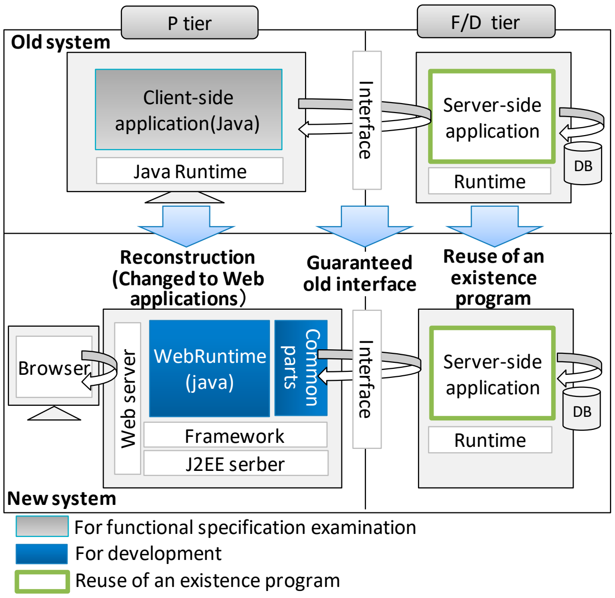


Figure 7 Application platform and how to reuse the existing assets

4.2.2 How to ensure the existing functions used as component functions

During the development process in which the existing assets were reused, we followed the steps shown in Figure 8 to ensure that the specifications of the existing functions were met and to assure the quality. In the design preparation step, when we identified the existing specifications, all we had to do were to meet the specifications of and to reconstruct the input check editing (unit check and correlation check) of the fields on the screens and screen-rendering functions, because business logic in the F tier could be reused. Therefore, personnel who had no technical and business knowledge in the existing system could identify the specifications to ensure them. Then, in the detailed design step, we used the common check control function provided by the framework for the input checks at each field on the screens. On the other hand, we defined global common functions for correlation checking of the same screen fields that were stored for multiple screens. We were able to reduce the size of the development with these approaches.

In the test step, we confirmed that the existing specifications were thoroughly met by verifying that the screens of the old and new systems matched each other through comparison of label names and content of the screens. Another check we conducted was to examine whether the fields in the databases of both systems matched each other by carrying out all fields verification and all digits input check for the databases.

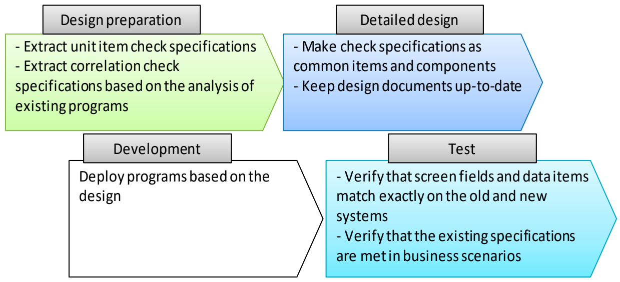


Figure 8 Development steps for reusing the existing assets

4.2.3 Removal of duplication

When FSM was built with packages in 2007, both FSM and FSM-connected systems had multiple similar functions, which then acted as the main and sub functions on each of these systems. Also, to maintain data integrity among these similar functions, interfaces between the systems were required, causing the systems to be bloated. In this project, we used an approach where duplicate data was removed and then related functions were integrated. Thus, we first used ER diagrams to extract similar data. Then, related functions were identified by using a CRUD table for each piece of similar data, and whether they could be terminated or consolidated as similar functions (screens) was considered. This approach resulted in the decreased numbers of screens and databases, which contributed to the smaller development size, as shown in Table 1.

Table 1 Reduce the number of resources

	Screens	DB
Old system	425	429
New system	317	333
Reduction rate[%]	25.4	22.4

4.2.4 Team management

To solve the issues and drive the project smoothly, we needed to flexibly and carefully organize teams, in accordance with the development methods described in Section 4.1. In this project, we created some patterns for implementation methods, consolidation methods, and processing methods on a function (program) basis to define development methods. Normally, we allocate development members to functional units, but in this project we assigned development members to each processing pattern unit. For example, we assigned development members on a program tier basis, like members developing only the P tier and members developing only the D tier. In addition, we prepared members only to extract the specifications of the old system, members who only do unit tests, and effectively utilize members who can not develop. If any of the development methods needed to be changed during development, the development team was reorganized as needed to carefully control the assignment of members to the team so that the skills of the members were suitable for that method. This is carried out by the team with members from the system owner division, by the leadership of a member who had experience in agile development, and by monitoring the development(IPA,2012) through a daily morning meeting. We implemented such countermeasures, and we were able to proceed with development as planned, with few experts.

4.3 Solutions to the issues on the phased operational migration achieved by parallel operations of old and new systems

We had to provide the 24/7 services, FSM system can not be stopped due to system migration. FSM, used by almost 2,000 users throughout Japan, also faced a high level of both usage frequency and immediate demand. With the aim of reducing the risk of business disruption, we thus took a phased-migration approach with three steps, as illustrated in Figure 9. Furthermore, we secured a sufficient period of time (two months) after the first migration (Step 1), based on the lessons learned in the previous migration of FSM to the production environment.

As shown in the above figure, we selected operation divisions across the country and expanded the migration target by taking into account regional characteristics, business styles, and types of work.

On the other hand, for the nation-wide follow-up divisions (work-instructing division, supervisory division, and back-office support division), their business operations were migrated to the new system in the first migration (Step 1). The purpose of this plan was to eliminate the need for the nation-wide follow-up divisions to use both old and new systems

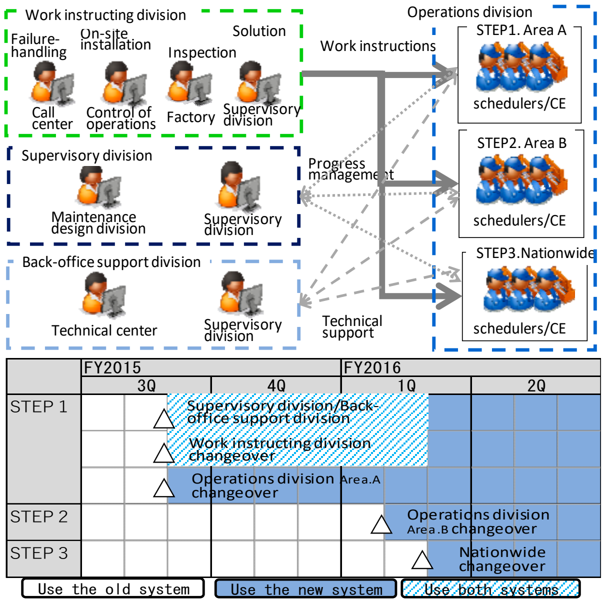


Figure 9 Schedule of the phased operation migration

for different user divisions while the operation divisions across the country were using a combination of both the systems. To achieve this, the new system was designed and developed to have the capability of referencing the information in the old system. (An application example of parallel operation of old and new systems is shown in Figure 10)

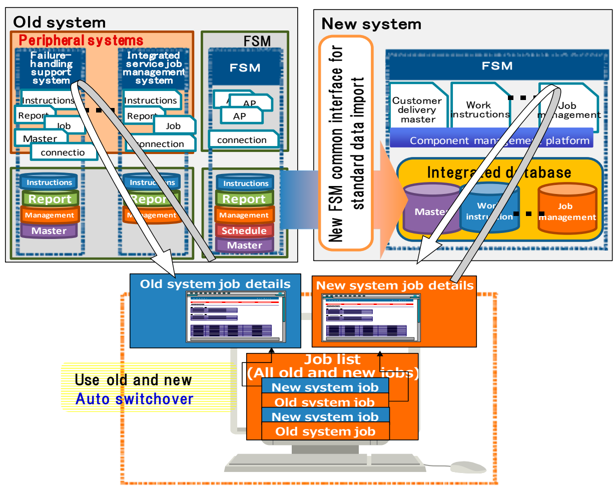


Figure 10 Outline of operating old and new systems in parallel

5. Results of the Project

5.1 Achievements

This project achieved successful results listed in Table 2 through the efforts described in Chapter 4. In addition to the streamlined system, business processes could also be improved as shown in Table 3.

Table 2 Achievements of the project

Assessment	Actual
Reduction in the system size	40% (From 4.7 MLOC to 2.9 MLOC)
Operational cost savings	38% (Reduction from the previous year)

Table 3 Other achievements

Assessment	Actual
Scheduler operations	Improved efficiency in the organization of nationwide dispatchers → Decreased the number of dispatchers to 70%
CE operations	Enhancement of support for CE operations through the use of tablets and optimized processes → Saved the working hours of CEs (approx. 18,000 hours/month as of February 2017)

5.2 Future initiatives

We have completed the FSM in-house delivery. Currently, we are proceeding delivery to group companies with expansion of customize functions in FSM. Also, to improve work quality and effect, we started a trial of image sharing that is applied for wearable device to support customer site work remotely (started in April 2017). In next phase, we are planning to promote automated validation check of system date by character recognition, wearable operation by voice recognition, and simplified character input. (An application example of wearable devices is shown in Figure 11)

6. Conclusion

In this project, we attempted to gain high efficiency by building on our previous experiences in various projects and assigning the right approaches, methods, and members for development in the right places. We also carried out this unprecedented development project from scratch to remove the package software,

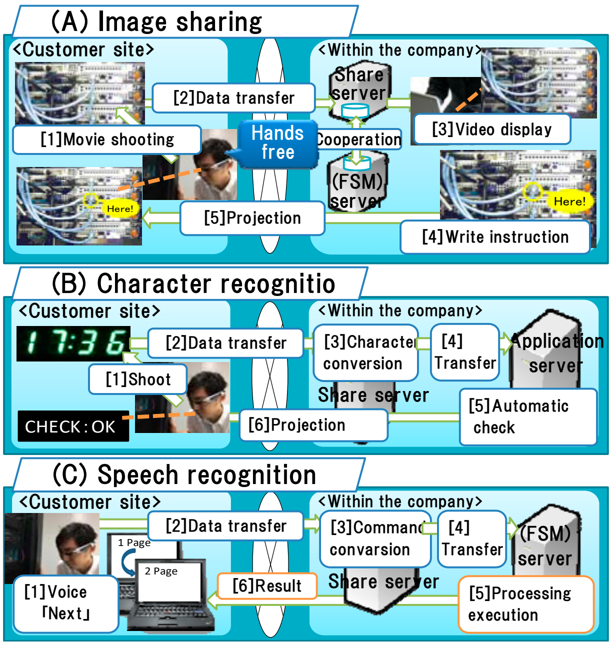


Figure 11 Efforts using wearable devices

and saw it through to the end. Additionally, we were able to gain a broader view of the application of systems for delivery of new services in the future, by aiming to build a standardized system that is not limited to specific business operations.

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How to Systematically Learn Lessons from Projects:
The Paradigm of Project Reviews

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Learning lessons from projects is becoming increasingly critical to organizations and has peaked academics' and practitioners' interests. Although for many reasons in practice, the process of learning today to avoid making the same mistake tomorrow does not necessarily take place throughout the project's lifecycle. This paper is based on research aimed at examining the measurable impact of systematic Lessons Learned, on Project Reviews. Multiple semi-structured interviews were conducted in-depth with project managers working in various industries and with different levels of experience. The focus was on gathering practical savoir-faire and knowledge within projects and understanding their nature, timeframe, barriers and implications for developing a systematic approach for future projects. Generally, the nature of lessons occurring in projects converges from one to another but generate different situational impacts. Despite Lessons Learned being fundamental in avoiding reinventing the wheel, preventing knowledge loss and capitalizing knowledge, literature does not suggest a clear integrated model to help project leaders with theses. Given the nature of systematic Lessons Learned, as explored in this paper, results have shown contradicting practices compared to past studies, regarding realistic timeframes to initiate project learning reviews. Although the knowledge fragmentation paradigm persists in existing, the results validate practical learning paradoxes and attempt to fill the gaps in literature for a greater understanding of how to systematically learn from projects. Ultimately, this paper develops a model to support systematic learning from projects. The research also led to several recommendations to be adopted in order to improve Lessons Learned processes in projects.

Keywords and phrases: Lessons Learned; Project Learning; Project Management; Systematic Learning Process; Project Reviews

1. Introduction

In the past decades, projects have encountered various issues, which made them more vulnerable and fragile, and called into question their success. Although the failure of a project may be caused by various factors, organizations should develop the ability to learn from such experiences, and even more vitally, the ability to both reuse the knowledge from project (A) into a new project (B) and "stick" it into the organization (Anbari et al., 2008). The aim of this paper is to determine the role and impact of implementing systematic Lessons Learned into the reviews of projects. Surprisingly, neither the identification of Lessons Learned in Project Reviews nor the implication of implementing systemic mechanisms have been widely studied (Goffin and Koners, 2011; Duffield and Whitty, 2015). The framework is based on a research project based on a theoretical model (Darfeuille, 2016) encompassing critical concepts, continuous reflection and suggesting key factors for sustainable learning. This will be presented in order to understand the role of a systematic implementation of Lessons Learned in a project. Moreover, this paper also establishes how typical Lessons Learned can be assimilated throughout a project and to what extent timing would affect the review of Lessons Learned.

2. Literature Review

First, learning is vital for organizations. It should build capabilities for the future and help to overcome periods of uncertainty and changes (Linder and Wald, 2011). Organizations know more than they can tell (Hannisch et al., 2009) but the inefficacy of a learning culture, primordial to success prevents organizations building a strong organization memory (Terzieva, 2014). Despite both 85% of Project Management (PM) staff gain knowledge from experimental learning (Williams, 2007) and learning happening mostly on the job (Savelsbergh, 2016), learning remains paradoxically hard to be adopted and implemented in project based organization (Fuller, 2011).

Second, Knowledge Management is the core of learning (Hannisch et al., 2009; Terzieva, 2014) and represents a key factor of success (Linder and Wald, 2011). In definition, knowledge can be either tacit (through individuals' experiences sharing, social interactions and stories) or explicit (codified and managed through databases, intranet, and books) (Williams, 2007). Schindler and Eppler (2003) argue that there is a lack of discipline - experiences are not captured, documented nor reviewed and after a project the "organization amnesia" phenomenon becomes more common. In fact, projects are not consistently reviewed both due to their temporary and unique nature and contextual differences that occur from one project to another (Fuller, 2011), making learning between projects difficult.

A systematic review' of project learning in this study refers to two meanings. First, there should be a process driven approach to learning, clearly defined by both system thinking (Williams, 2007) and PM practices (Schindler and Eppler, 2003; Kotnour, 1999). Second, timing is involved in the learning review process but has not received similar emphasis (Bakker et al., 2011). Questions such as "when" and "how often" lessons need to be extracted, shared and reviewed, increasing the ability to build a model or standard which organizations could gain inspiration from (Schindler and Eppler, 2003). This will help to avoid making similar mistakes in the future, reinventing the wheel (Schacht and Maedche, 2013), developing continuous improvement across levels and develop both comparative advantage and organizational memory (Terzieva, 2014).

Finally, 'Lessons Learned' (LL) are in fact considered as best practices in projects, supporting collaborative retrospectives and generating the LL vital to project learning (Williams, 2007; Fuller, 2011; Schacht and Maedche, 2013). They should aim to address: (1) What did we set out to do? (2) What actually happened? (3) Why did it happen? (4) And what are we going to do next time? However, lessons generated from this process are neither consistent, understood nor considered, and are consequently forgotten (Darfeuille, 2016).

3. Problem Statement

Companies have "failed to learn" and "learned to fail" (Kasi et al., 2008). Major industries such as R&D (Williams, 2007), IT and software (Kotnour, 1999), construction (Carillo et al., 2013) and NPD (Goffin and Koners, 2011) have failed in successfully conducting systematic reviews (Fuller, 2011); Darfeuille, 2016). Consequently, this research was conducted to identify the roots of learning inconsistencies in between projects and it created an alternative model to systematic project learning, capitalizing on the various LL using an in-depth qualitative approach.

4. Methodology

The aim of this research was to develop a richer picture and understanding of the existing theoretical perspectives present in the literature (Bryman, 2012). This led to the analysis of how experienced project managers could systematically integrate learning lessons by conducting review sessions during and/or at the end of the lifecycle of each project undertaken. This interpretative research intended to explore this complex phenomenon and attempted to embrace projects' context, experiences and learning processes.

First candidates volunteered via professional social networks and provided an adequately large and diverse sample to answer the research questions. On average, participants have more than 10 years of experience and have worked in 3 different industries over that period (26 / 8 = 3.25).

Table 1 PM Industries

Strategy	2	IT	7
Banking	5	Environment	1
Public Sector	4	Transportation	3
R&D	2	Life Science	2
Total			**26**

Despite some limitations, such as the sample size (Bryman, 2012), ten intensive interviews were conducted which enriched the content. Therefore, to match the variability and reliability of data, interviews continued until data saturation (Bryman, 2012). The study purposely sought a certain degree of homogeneity in the selection of participants to reach a high level of data validity. Participants' details are coded and shown in Table 2.

This research encompasses a series of semi-structured interviews designed to be conducted in a short timeframe in order to capture a "snapshot" of project managers' experiences, what their projects' contexts were and what they learned while conducting LL sessions (Bryman, 2012). A pre-established guideline was created to ensure coherence and clarity between the different interviews (Kvale, 1996) and the four main sections: (1) participant's background; (2) the use of Lessons Learned in project; (3) the Lessons Learned process; and (4) how to improve project learning. To facilitate the analysis and establish a transcript, a recorder was used with the participants' agreement while collecting data (Kvale, 1996).

Table 2 Interview Coding

Interview #	Years of experience	Country	Final code
1	6	UK	INTER#1UK6
2	17	UK	INTER#2UK17
3	4	UK	INTER#3UK4
4	2	UK	INTER#4UK2
5	12	UK	INTER#5UK12
6	7	FRA	INTER#6FRA7
7	13	UK	INTER#7UK13
8	18	UK	INTER#8UK18
9	19	FRA	INTER#9FRA19
10	15	FRA	INTER#10FRA15

As each interview elicited various constructs several times (challenges and typical lessons), the categorization took place under the form of codes: e.g. if the team experience was considered, the lesson would be coded as "TEAMEXP". The procedure of coding was supported by definitions and constant comparisons, which maintained the connection between the data and the conceptualization of the studied phenomena (Bryman, 2012).

5. Analysis

5.1 Analysis of Lesson Learned occurring in projects

Through the interviews, participants were asked to relate and connect their experiences with the subject of the study: Lessons Learned. Naturally, stories, metaphors and anecdotes were used to illustrate the issues, the challenges and necessary actions taking place in projects. Those are the studied constructs. This following technique was highly effective in guiding participants to articulate what lessons they had learned along the project life cycle. 453 constructs have been highlighted across the 10 interviews (on average, 45.3 constructs have been mentioned per participant).

To clearly demonstrate research reliability and viability, each construct throughout the interviews were first defined, categorized by codes (e.g. TEAMEXP) and finally classified according to their levels of importance. The latter is based upon a variability average, also used in a previous study (Goffin and Koners, 2011), referring to the measure of the spread of ratings or variance, against a particular construct in an individual interview. Each interview has generated a different set of lessons categories and as a result, a different variance for each of them. To measure and compare variability of a construct, data was treated with an excel spreadsheet (figure 1), and the variance average were calculated and a normalization process was used (Bryman, 2012).

Figure 1 Example of data treatment by variability average

Given that each interview has elicited an average of 45.3 constructs, the average variability of a construct was 2.21% (100 divided by 45.3). If the average normalized variability is above 2.21%, the construct will be considered as important and qualified as “high”. In the opposite situation, it would be stated as “low”. The example shown above is demonstrating that the average of team experience is inferior to 2.21% and thus the pattern is considered to have a low importance.

As a result, six LL categories have registered a variability higher than 2.21%: process (PROC); scope (SCOPE); time (TIME); organizational culture (CULT); organizational complexity (ORGCOMPLEX) and; responsibility and ownership (RESP&OWN).

Finally, this part set up an analytical comparison between the research results and Goffin and Koners’ findings (2011). Each construct was assigned to a rank in order to evaluate their importance and depending on their variability: the higher the variance, the more critical the construct. Through this process, it enables an evaluation of the reliability and validity of the research data and analyze the resulting congruence and divergence. Similarly, some LL categories can be considered as equivalent. For instance: both product specialization and project objectives have similarities with scope. However, knowing the different focuses that both researches have chosen (specific sector: NPD) and (general experiences across industries), results can change from one study to another. Each construct has been associated with a rank and rated to their importance from 21 (lowest) to 1 (highest).

Although there are some connections between constructs, the most critical finding is by far the respective gaps in learning aspects (13th against 3rd), clear responsibilities (1st against 21st) and show strong dissimilarities between the two studies. Consequently, to the overall participants, knowing who is doing what and who has been allocated each specific task, are the primary concerns in conducting LL. Whereas, Goffin and Koners (2011) demonstrated the importance of agreed project objectives (1st), which is aligned with the research results’ perspective: the necessity for a clear scope (2nd). Table 3 gathers the results of the first part of the research.

5.2 Elaboration of a conceptual model to improve Learning Lessons process

In Section two of the interview guideline, the discussion was focused on the process of the capturing, documenting, sharing and reviewing of what have been learned in projects. Interviewees were asked if they had taken part individually in any learning lessons stages.

Table 3 Comparative results with Goffin and Koners (2011)

Goffin & Koners (2011)	Variability (high/low)	Rank (according to variability)	Research findings	Variability (high/low)	Rank (according to variability)
Technical complexity	Low	10	Database storage Technical complexity	Low Low	14 12
Transfer Marketing	Low Low	12 11			
Bureaucracy	Low	16	Organizational Culture	High	3
Organizational Complexity	High	9	Organizational Complexity	High	6
Time	High	7	Time	High	4
Testing Project Management Project Manager Problem Solving	Low Low Low High	19 15 14 6	Risk Management Process Stakeholder Management	Low High Low	15 5 17 (a)
Communication	Low	13	Communication	Low	9
Teamwork	Low	17	Engagement Teamwork	Low Low	10 16 (a)
Learning	High	3	Learning Quality	Low Low	13 16 (b)
Product Specifications Project Objectives	High High	5 1	Scope	High	2
Team Experience	Low	18	Team Experience	Low	11
Budget Resources	High High	2 4	Resources	Low	8
Strategic Importance	Low	20	Value Strategic Aspects	Low Low	7 17 (b)
Clear Responsibility	Low	21	Responsibility & Ownership	High	1
Other	Low	8			

It is important to mention that some practitioners are used to doing the same activity twice at any stage of the project lifecycle. For example, they might share the knowledge acquired at the beginning (from past projects) and at the end (current project). Significantly, interviewees stated that documenting and reviewing are usually taken place at the end of a project or a milestone, whereas the capturing and the lessons sharing occur at various periods. Arguably, capturing issues and lessons seem to be an ongoing task, initiated at the start and progressing throughout. On balance, most activities do not take place through the whole project: sharing and reviewing the content of these lessons seems to happen once the project is completed. Interestingly, a wide number of participants neither share (40%) nor review (30%) project learning.

To build a credible and viable model, the research undertook an analysis of how these Lessons Learned sessions were articulated and what kind of changes would make these LL more effective. Thus, and throughout the interviews, participants naturally stated their current practices, either developed through experience or enforced by the organization. They also gave their opinions for improvements, which were referred to as best practices. Importantly, the term systematic emerged seven times in total across interviews, and to avoid confusion and clarify it for the purpose of the study, definitions of categories were needed. Thus, 19 practices were gathered, defined, categorized and classified (by the number times mentioned). Features registering high attention (>10 mentioned in best practices) with regard to improvements were highlighted in bright blue (table 3).

Regarding the findings, five practices have highlighted as an increase for improvements: communication (COMM), the use of a database and repositories (REPOSITOR), an all-inclusive process (INCPROCESS), reflection (REFLECT) and the collection of experience (COLLEXP). Clearly, the need for a more consistent and structured process had been mentioned most (32), followed by what can constitute a tool or part of this process: database (31). Undoubtedly, other constructs are also to be considered: some of them have recorded twice or three times more such as the need for training projects' members (TRAINING) to "refresh memory" or "homogenize skills" in the team. Additionally, the use of a facilitator (FACILIT), application of corrective action (ACTION) and recording changes (REC CHANGE) in projects developed similar phenomena.

Table 4 Categories of current and best practices from PM

	Code	Category Definition	Current Practices (times mentioned)	Best Practices (times mentioned)	Total
Having a systematic/ all-inclusive process	INC PROCESS	Consistent; regular; one structure; adaptable and flexible to any project.	12	20	32
Involving the right people	INVOLV	Inviting project participants, leaders, and other stakeholders to the relevant session.	9	6	15
Gathering various experiences	COLL EXP	Participants with different skills, specialties, background, etc.	4	10	14
Having the PM as a leader	PMLEAD	PM is responsible for conducting LL session.	10	4	14
Communicating & Contributing	COMM	Open discussion with stakeholders, exchange of ideas, and stories.	15	10	25
Up front preparation	PREP	Individual activity, identify key points of discussion, content, presentation, etc.	4	1	5
Turning lessons into action	ACTION	Clear actions to initiate changes and avoid making similar mistakes.	5	8	13
Analyzing in depth	ANALY-SIS	Roots & causes analysis, mind map, "speed boat", etc.	8	6	14
Using database/ repositories/logs	REPOSI-TOR	Tool enabling data retrieval, lessons and logs from past projects.	13	18	31
Using a facilitator	FACILIT	External contributor to project, leading workshop.	4	9	13
Starting early	EARLY START	Proactive approach to generate contingency.	5	4	9
Running training (skills)	TRAINING	Skills homogenization & personal development.	2	6	8
Scoping requirements	REQUIR	Clear requirements, planning, project initiation, common goals, etc.	5	6	11
Recording changes	REC CHANG	Project features and deliverables tend to change throughout time.	5	8	13
Allocating owner	OWNER	Distribution of lessons within the team (shared responsibilities).	4	6	10
Signing the customer off	SIGN CUSTO	Validation/confirmation of project report and learning lessons by the customer.	7	3	10
Using reflection practices	REFLECT	Individual initiative to reflect upon what happened in the project (stepping back)	11	17	28
Generating more positive comments	POS/NEG	Value with confidence both positive and negative experiences.	4	7	11
Scheduling workshop/meetings	WORK-SHOP	Intersessions, team meetings to gather learning and group requirements.	10	1	11
			137	**150**	**287**
			47,7	**52,3**	**100**

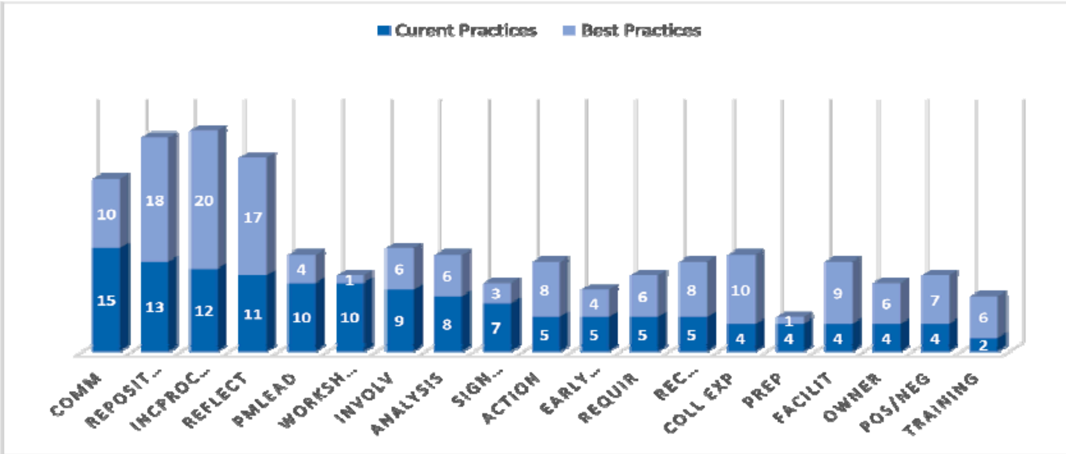

Figure 2 Potential improvements in the lessons learned process

Knowing that project length and nature varies according to context, environment and organization, a generalization of a typical project is needed to the coherence and validity of the research. It was noticed that on average, interviewees were (during the data collection period) involved in a project for a period of three years. To facilitate the development of the modal, a three-year project segmented in stages has been chosen as a reference to build a comprehensive model. Additionally, to answer the need for consistency and structure, a "go live" approach was preferred (stated as a best practice by participants) to enable learning through LL. Subsequently, the process enlightened four features: two adjacent projects and learning lessons lifecycles, regular permission gates, integrative learning loop system and a final feedback loop.

a) Project and lessons lifecycles: The Project Lifecycle (PLC – shown in green) and the Lessons Learned lifecycle (LLLC – shown in red) are split into three stages: the beginning (initiation and project plan), the project core (design, execution and implementation) and the closure. Each stage implies various LL activities and evolves over time. "Conducting Lessons Learned should not be a separate activity from managing a project. It is an integrative activity and should take place throughout by all team members" (INTER#3UK4).

b) Permission gates: Such gates will be initiated at the end of each important phase or delivery of a deliverable, resembling a traffic light system. Conformity and quality standards of the products delivered as well as an evaluation of what has been done, what happened and how it has been mitigated will take place. In summary, according to an interviewee: "the team has to ask the following question: "can we proceed to the next stage?" Then an analysis of the resources and feasibility can proceed as well as the validation of the customer consent" (INTER#10FRA15).

c) Integrative Learning loop system: Each phase will contain a capture, document, share and review process, which based on a Lesson Learned structure, will be used to articulate retrospectively as an ongoing reflection through a preparation, implementation and recapitulation of previous stages. A participant claimed: "we believe that by implementing learning points straight at the beginning [as part of a project plan] we will have more drive and control over time of what we need to do, what risks and changes may occur" (INTER#2UK17).

d) Feedback loop: A feedback loop was added at the end of the project closure. Once completed and documented, the project report would be stored and shared in a central area and must be visible to other practitioners across projects. Discussions and recommendations regarding the project and how it has been conducted would enhance learning within the team and between projects and would result in knowledge reuse. INTER#4UK2 stated: "It is a shame we have to start over again. We need to close the loop and this sustainably".

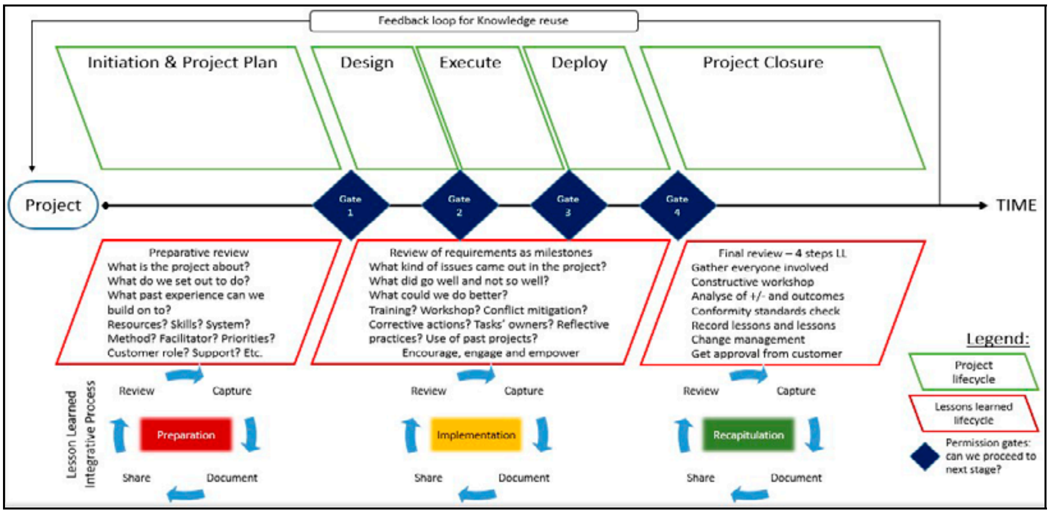

Figure 3 Model of an improved lessons learned process in "Stage Gate" project

5.3 Evaluation of timing: relevance & effects on reviewing

To evaluate the relevance of timing on reviewing lessons after the completion of a project, it was necessary to ask the participants to reflect on review nature and on how often they should review lessons. Through the analysis, it has been noticed that the review of project learning was occurring more occasionally than organically. Interviewees stated if they thought that such practices were initiated by groups or individual and if either had been implemented formally or informally. Regardless of how interviewees perceive reviews and how they can be articulated, most practices interestingly relate to individual initiatives and remain developed informally across projects (inexistent of structure, process, tool or guidance). Most of the reviews of project lessons and the whole learning from experiences concept results in a formal collection. Participants claimed that looking for past reviews and sharing project experiences can be both a practice to connect individuals and collect knowledge.

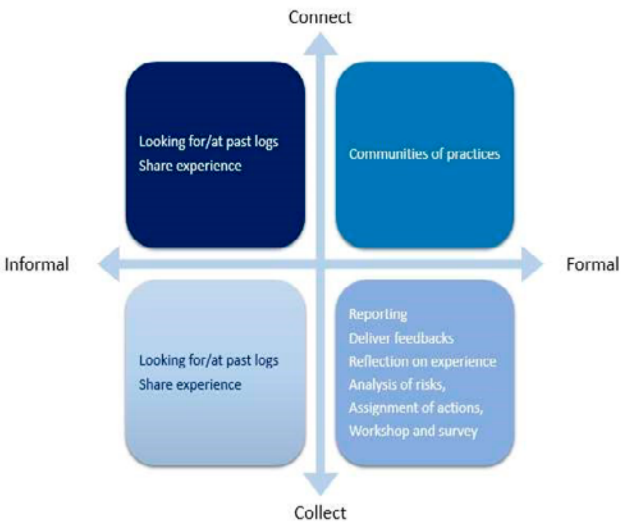

Figure 4 Review learning lessons approaches - adapted from Milton (2010)

Subsequently, the research revealed the fact that practices are implemented formally or informally may have an impact on when they could occur within projects (Milton, 2010). It is critical to establish a clearer understanding on when lessons should be reviewed to identify this relationship. Incontestably, practitioners do not proceed with the review of lessons neither after three to six months nor after one year once the project is terminated. Two practitioners explained that they would review what they did in projects after one year in order to refresh their memory and apply this knowledge to future projects: "once the project is completed, lessons will be reviewed one more time by the project board" (INTER#3UK4). Whereas three other PMs have stated that they did not review lessons at all, this is partly because of certain barriers highlighted in the previous section such as an inexistent repository system or a lack of time. Nevertheless, other factors may help understand this new phenomenon. Obstacles such as being part of the Benefit Realization or being a "no value added" activity were stated many times across interviews.

Part of the Benefit Realization	5
No value added	3
Individual initiative	2
No depository	1
Only done informally	2
Done too late (at the end)	2
People move on to new project	2
Occur organically	3
Not included in the scope	2
Total	**22**

Table 5 Reason limiting the review of lessons post project

First, the fact that Lessons Learned are not seen as part of the project any longer but part of the Benefit Realization process (mentioned five times). One said: "we do another formal review at the closure of the project and capture lessons a part of the Post Project Review. Then once it is done, the Benefit Realization process takes the lead and we review it once more"

(INTER#8UK18). Second, participants do not see it as a valuable task either (three quotes): “Generally, there is a lack of interest and value perceived […] People need to see the benefit for them before doing anything” (INTER#1UK6).

6. Improvements and Recommendations

To improve Project Learning within a company, it was important to understand and determine both the role and impact of implementing a systematic mechanism for Lessons Learned and Project Reviews. This could be done through (1) the assimilation of recurring LL in projects; (2) the construction of a model for a systematic implementation of lessons; and (3) the impact of timing in Project Reviews.

6.1 How can typical Lessons Learned be assimilated throughout a project?

As lessons can be seen as an issue or an event occurring during the project, they initiate reflection and learning processes within the team. Also, lessons should lead to learning from experience and be done inherently, naturally, before project or in an accelerated manner. Due to their unexpected nature in projects, lessons are hard to be generalized and contained. However, the study of constructs has shown some clearly distinctive tendencies.

Tasks’ ownership and clear responsibilities are determinant to learning from projects and vital to capitalize on knowledge in an organization (Kotnour, 1999). To some extent, the sponsor is peripheral to projects and should ensure governance and interface between client and project team, champion project learning and be the motor of engagement (Schindler and Eppler, 2003; Linder and Wald, 2011; Fuller, 2011). One participant said “the PM should adapt its methods to the members, encourage reflection and contribution and always be critically positive in throughout the project lifecycle (INTER#9FRA19). Throughout projects, once corrective actions have been set out to initiate changes to improve performance, each task should be allocated to a project member (routine) and frequently reviewed (weekly, monthly or iteratively) (Schacht and Maedche, 2016).

Defining a clear scope at the strat and reviewing it continuously through the project plays a major role in monitoring what has been done (Williams, 2007). This is efficient preparation by reviewing history, documents, plans and reports. Anbari, Carayannis and Voetsch (2008) insist on the participation of the customer in the review of LL. Practitioners are aware communication between parties will limit scope creep, schedule slippage, cost overruns, and ensure better control, change management and task prioritization.

Consequently, timing issues such as contingency planning, looking for past lessons, stepping back and reflect upon what has been achieved are coming up constantly (Savelsbergh, 2016). One said: “in a meeting, one told that next time, we should plan our time better. In Project Management, you will always lack time, you need to reformulate the problem itself by thinking: next time we run out of time, what can we do?” (INTER#6FRA7). To some extent, lessons may occur again also because project members cannot think outside of the box and try to see the problem from another angle. Preparation and prioritization are keys to avoid blaming external parties or factors (Fuller, 2011; Carillo et al., 2013).

Lessons can only be learned if and only if they are the outcome of a thorough diagnosis shared within the team and across the organization and initiate actual changes. But changes can only be made if the whole organization sees the opportunity to explore new learning (Milton, 2010). Subsequently, 2 out of 6 categories that have registered a high variance in both studies, are related to organizational aspects (complexity and culture). By consistently optimizing learning between projects, disseminating the knowledge across the organization and prioritizing staff development, the wheel will stop being reinvented and projects will consequently deliver better outcomes.

This leads to the concept of systematic or process driven approaches (Duffield and Whitty, 2015; Darfeuille, 2016; Schacht and Maedche, 2013 & 2016). An all-inclusive process would result in merging and maximizing the capture, document, share, and review of objectives and achievements through the projects. This is to establish what did go well and not so well, and identify what could be done differently including a proper corrective set of actions. Obviously, this system would change depending on projects, needs and size of the organization. However, this study is aiming for generalization in the application.

6.2 What role can a systematic implementation of Lessons Learned play in project?

Learning systematically is not automatic (Kasi et al., 2008). Even with existing systems or learning structures, knowledge is still vanishing once projects are completed, which creates its fragmentation and reinvention (Bakker et al., 2011). Project members tend to have difficulties in capturing and sharing knowledge during each project. Similarly to Kotnour’s survey (1999), the majority of practitioners conduct LL at the end rather than throughout it. One of the key factors of success is regularly capturing knowledge through milestones (Schindler and Eppler, 2003).

Despite using appropriate best practices combining shared repositories, communication across layers and accumulation of experiences through reflection exercises, there is still room for changes and improvements. This could be seen as a knowledge management strategy as Carillo, Ruikar and Fuller (2013) refer to. This research validates this tendency: 20% of the PMs do not capture lessons, 40% do not share and 30% do not review them once the project is over. To some extent, knowledge that PMs keep in their own post projects’ logs encourages its fragmentation: “project teams use logs less and less nowadays. They tend to talk to each other instead and get practice and experience in a more informal way. So if I leave, the knowledge goes with me” (INTER#6FRA7).

PMs suggest that the involvement of the right people is primordial. By inviting participants with different experience, juniors and seniors, from different department and divergent views on the project and how it went will enrich the discussion and analysis. Avoiding blaming external factors or each other might be done by conducting a thorough roots and causes analysis or receiving a general contribution from everyone, highlighting positive aspects and applying corrective actions. Therefore, the use of a facilitator has been strongly recommended too (Williams, 2007; Fuller, 2011).

The theoretical model suggested aims for boosting LL performances and is segmented in stages. Each of them are aligned with the project lifecycle and would initiate a preparation (search for past experiences, gather lessons, share them across the team, reflect and brainstorm ideas for further implementation). Some argue that preparation should be done at the start of the project and at each iteration to enhance knowledge reuse (Schacht and Maedche, 2013 & 2016). Inherently, it will help to proactively flag and handle issues on the job, and analyze what could be done differently. It is also important to recapitulate lessons, not as retrospectives like in the two first phases, but rather as a proper Lessons Learned session (Milton, 2010; Carillo et al., 2013). A final workshop to review the achievements and compare to what was set out initially, gather individual experiences, analyze the causes, conform lessons report to standards, get the approval from the client and upload it for sharing.

There are two important features included in this mechanism: permission gates and the feedback loop. Firstly, gates are working as conformity standards (quality, cost and time). The customer is providing his/her approval, and if a mitigation of all identified risks has been established successfully, then permission to go through to the next stage can be given (Anbari et al., 2008). Secondly, a learning loop is seen as an integrative part in the literature (Williams, 2007; Terzieva, 2014) and surround the rework cycle (Schacht and Maedche, 2013), where participants should critically assess, reflect and correct causes behind the problematic action, and explore new alternative relationships for a future project (Savelsbergh, 2016). One said: “an ideal model should be aiming for continuous improvements and a closed loop of corrective actions process […] a structured approach, by which executives see value in putting more effort and money” (INTER#4UK2).

6.3 To what extent would timing affect the review of Lessons Learned?

The impact of time over Project Reviews needs to be better controlled once the project is completed. Although there is no research that has clearly highlighted the timing and frequency aspects of Project Reviews (Goffin and Koners, 2011), revaluating past experience in projects brings consistency and effort continuity to reuse the knowledge. LL can be referred to a bridge between two projects (Anbari et al., 2008), which enhance both inter and intra project learning. The analysis has shown there is no clear impact of timing regarding LL reviews. Due to its high influence on project context, it generally happens on the job (contradictory to some literature) (Savelsbergh, 2016). Reviews are seen as a recapitulation or an opportunity to close the loop and that such practices should also happen at the beginning of each iterations as preparation (Duffield and Whitty, 2015; Schacht and Maedche, 2016).

However, few points need to be kept in mind in this context. First, the establishment of the nature of project reviews. Interestingly, the majority of them are conducted by individuals and remain mostly formally implemented when it is required. This confirms the existence of the studied paradox: there are ways to formally connect with practitioners and collect knowledge but cultural obstacles are numerous. Second, most practices occur notably when there is an “appetite for learning” or in an incidental manner (Terzieva, 2014). One of the participants said that “learning mainly occurs on the job [through the project] but not in the review” (INTER#2UK17), which arguably converges towards Savelsbergh’s conclusion (2016). There is no proper guidance of how lessons reviews should be done or structured nor the existence of a project learning body of knowledge that could help to use the available tools, develop PM individual learning paths and their ability to lead projects (Darfeuille, 2016). As a result, most of the practices relate to informal learning channels (reflection on experience, assumptions influencing how to make sense of these experiences and questioning ways of being). Practices such as storytelling, communities of practices, social networking and sharing lessons between PMs (coffee or lunch breaks) remain implemented informally but are seen as an integrative part of the culture of the organization (Savelsbergh, 2016). In another interview, reviews should be implemented automatically or even “naturally” into projects. They are related to social connection, and the use of stories and metaphors (Goffin and Koners, 2011; Duffield and Whitty, 2015).

Finally, the time dedicated and value perceived are crucial to reevaluate what has been learned in projects and should take place three to six months after a project or one year after. It has been argued against general thinking, that learning will appear uninhibitedly during the project (Savelsbergh, 2016). One reported “Executives need to see the value in them (Project Reviews) because it would benefit not only the project but the global organization as well” (INTER#5UK12). It is one the numerous paradoxes that the research tried to reveal and discredit.

7. Conclusion

The overall research aimed to address the question regarding systematic use of project lessons reviews and how the learning can stick within an organization and be reused. Clarity and practical implication were the two pillars of the study, based on a thorough literature review and a critical analysis. To build an appropriate approach, ten in-depth interviews with highly experienced Project Managers from three different countries were conducted leading to an extensive data followed by a comprehensive analysis. Findings indicated that recurring lessons must be captured documented, shared and reviewed at the beginning, throughout and at the end of a project and if possible, across (or among) different projects. This could maximize learning from projects and help organizations to evolve, grow sustainably and get competitive advantage.

However, based on the evidence from practice and research in actual project environments, learning from projects does not seem to be a priority, remains informally implemented and takes time and resources to be developed. Although many contributors have tried to understand and generate conceptual models, techniques and tools to initiate change and better use of knowledge and learning generated from projects, their nature is hard to grasp due to context and evolution throughout time. Time will tell. The suggested model is an example of contribution that will help both academics and practitioners to converge ideas, agree on innovative concepts, generate valuable best practices, and fill the gaps in the existing project learning body of knowledge.

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Ukeoi Promotion and its Relation to Employees' Mindset Development and Company's Growth

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Our company has been promoting Ukeoi (undertaking contract form) as an effort to strengthen our competitiveness in SI business. By doing so, we hope that each employee will be empowered to independently engage in the project they are assigned to, which will lead to their own growth that will eventually lead to the growth of the whole company. We started changing the contract form from SES (System Engineering Services) to Ukeoi in the project we are engaged to, since last fiscal year. We evaluated and analyzed the effect of the proposed effort. As a result, we found that the leader layer generally developed the expected mindset changing. While in the contrary there was big difference among the members layer regarding the infiltration degree of changing contract form. By analyzing the cause of the difference, we concluded that it is important to foster mindset by internal motivation based on the following three elements: autonomy, mastery, and goal. The three of them serve as key factors for an effective infiltration. It is indispensable to develop effective mindset for each and every employee in order to effectively promote Ukeoi. We report and propose the result of this evaluation and analysis as an input for future Ukeoi promotion.

Keywords and phrases: Contract Form, SES, Ukeoi, Motivation, Mindset, Work engagement

1. Introduction

Nowadays, in the IT field which is very competitive, we are demanded to act swiftly to fulfill customer advanced requirements and to provide stable products. Facing this condition, some companies are addressing the optimization of employees, which considered as the most important asset one company can possess, as their biggest issue. They want to effectively let them grow, that will eventually lead to the vitalization of the whole company.

In our project, as a part of developing our employees' mindset, we are participating in Job Crafting training program conducted by University of Tokyo (Department of Mental Health, Graduate School of Medicine) as a part of their Job Crafting research. Job crafting is defined as a way to find and optimize the worthwhile and significance of work. This Job Crafting training program aims to clarify the effect of promoting work engagement and improving productivity (TOMH, 2012).

Work engagement is defined as enthusiastic attitude toward work characterized by 3 elements: "vigor", "dedication", and "absorption". We hope that each employee will engage to their work lively and optimize their own performance.

Beside of that, our company has been promoting Ukeoi since last fiscal year. The background and detail of which will be described later. The objective is to allow both the organization and the employee to grow by carrying high awareness toward "goal", in an "autonomy" environment aiming to reach their respective "mastery".

Daniel Pink advocates about the impact of implementing those 3 factors (i.e. "autonomy", "mastery" and "goal") as an intrinsic motivation in his book "Drive" (Pink, 2015). The promotion of Ukeoi we are currently engaged in, is a mean to build an environment for the implementation of the mentioned 3 elements "autonomy", "master", "goal". As a result, we expected that each employee will develop "vigor", "dedication" and "absorption" as defined in Work Engagement. Refer to figure 1 below.

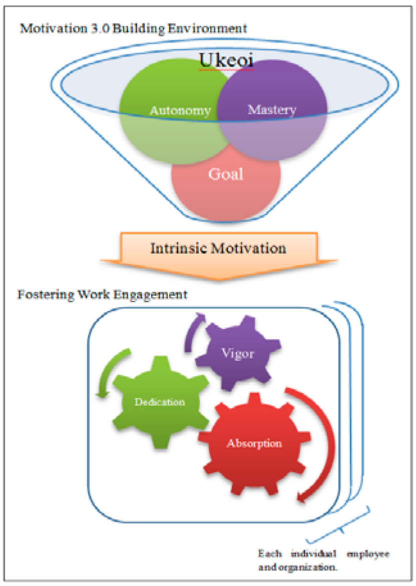

Figure 1 Motivation 3.0 and Work Engagement Relation

At this study, we evaluated and analyzed how Ukeoi Promotion affected employees' "vigor", "dedication", and "absorption". We conducted a questionnaire based on the most commonly used measurement scale in Work Engagement, Utrecht Work Engagement Scale (UWES) (Schauteli et.al 2002) (Shimazu, 2014). By doing so we aim to clarify how Ukeoi factors (i.e. "autonomy", "mastery" and "goal") affect employee's individual growth and also company's growth. We also hope that this study will become an input for another project promoting Ukeoi in the future.

1.1 Motivation 3.0

Motivation 3.0 that was advocated by Daniel Pink shows how to optimize the performance and how to deepen the satisfaction of both individual and organization by using the 3 elements of behavior: "Autonomy", "Mastery" and "Goal". Autonomy is a demand to be able to decide the direction by ourselves. Mastery is the urge to steadily improve our abilities. Goal is the desire of human being to become a part of something bigger than ourselves (Pink, 2015).

1.2 Work Engagement

Work engagement is psychological term expressing the active involvement attitude toward work. Quantitatively measurement scale was developed by the University of Utrecht in the Netherlands (i.e. UWES). If an employee scores high in UWES, it doesn't only imply that this employee is able to deal with stressors in workplace, but also implies that the mentioned employee has quite productivity performance. Just as each job differs on their employees' engagement toward work, UWES score defined by what kind of work the employee is assigned to and also by the corporate culture self per se.

Work engagement per se is a compound concept consists of "vigor", "dedication" and "absorption". Vigor is described as possession of high level energy in work and also the psychological resiliency. Dedication is strong involvement toward work, the significance sense of work, the pride of doing the work. Absorption is the focus and immersion on work. Thus, an employee who has high work engagement feels the worthwhile of their job pride.

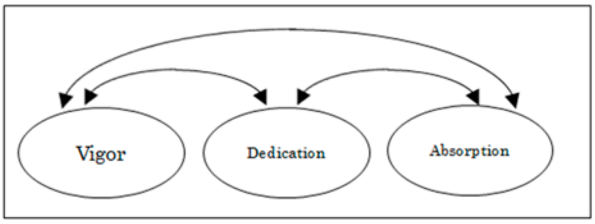

Figure 2 3 Elements of Work Engagement

2. Our Company's Ukeoi Promotion

2.1 The Meaning of Ukeoi

We at NTT Data System Technologies belong to NTT Data group and we mainly cover system maintenance and development for financial field. Our mission is to continue to strengthen our competitiveness in the SI business and fulfill our role as a functional company. There are 2 contract forms commonly known in Japan's IT industry: SES (System Engineering Service) and Ukeoi (undertaking). The contract form decided on how does the company participates in the project. The characteristics of each are shown in Table 1 below.

Table 1 Main Contract Form in Japanese IT Industry

Contract Form	Details / Characteristic
Ukeoi	Task completion duty. The contractor undertakes a contract to perform a specific job while the client is obligated to pay incentives in return.
SES (Substitution contract)	Duty of diligence. The mandatory is obligated to handle the delegated task according to its gist with due care of a prudent manager.

As one of our solution to strengthen our competitiveness in SI business we started promoting Ukeoi. By doing so, we hope that each employee will be empowered to independently engage in the project they are assigned to. We are fulfilling our responsibility as a functional company while aiming for our employees' growth that will eventually lead to the growth of the whole company. The expected effect of our Ukeoi Promotion is defined in Figure 3, while the ideal state of Ukeoi we are aiming for is shown in Figure 4.

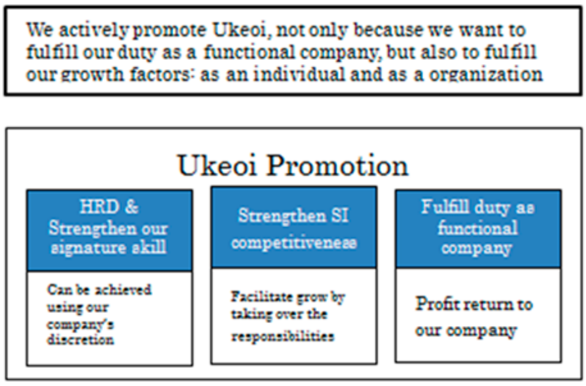

Figure 3 Effect of Ukeoi

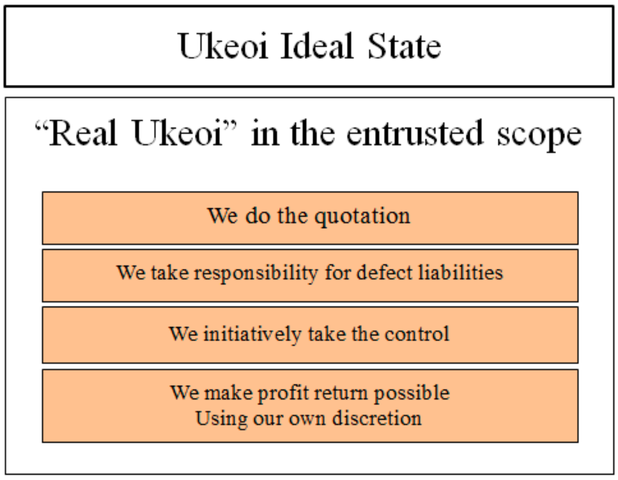

Figure 4 Ukeoi Ideal State

2-2. The current situation and issues of our company's Ukeoi

(1) The characteristic of our company's contract form and Ukeoi rate

Ukeoi rate in our company during FY 2016 in total is 42.2%, A services division (The division that became the basis foundation of our company and is where we belong) rate is 78.0%, B services division rate is 45.0% and C services division is 34.0%. Overall, the proportion of projects that we responsibly undertook as a functional company based on Ukeoi is less than half.

(2) SES related issues and Ukeoi failure cases

Hereafter we will introduce several cases our company has experienced in the past: SES manifested issues and Ukeoi failure cases, to the extent that related to employees' mindset.

Example 1: Motivation of the person's in charge of training (i.e. trainer) and the employee's (i.e. trainee) was decreased due to the mismatch of training policy and the actual working task.

Employee's training policy is set between the trainer and trainee, while the actual task in a SES system development project is mostly decided by the client side. Which means the employee will have to carry out working task that might be not aligned with the training policy set forth.

Example 2: Employees lost their initiative as they couldn't set their own goals and control their work at their own responsibilities.

Always working under client's instruction caused employees to set task completion per se as their only goal. They didn't manage to maintain positive attitude

Since they always worked under client's instruction caused employees to set task completion per se as their goals. They didn't manage to maintain positive attitude toward work. Such as seeing the whole picture and find room for improvement.

Example 3: Employees' personal risk management became diluted as the defect liability does not affect them and they always earn rewards for their labor.

Even though we were to fulfill our duty of care and duty of diligence but since the defect liability is not attributable to us, all we did was reporting any risk possibility to our client. This actually cause our employees to lose their initiatives and only able to give ad hoc responses.

3. Our Division Effort on Ukeoi

Our project has been started promoting Ukeoi since last fiscal year. During the initial period we provide briefing for each employee involved. About what is Ukeoi, its meaning and its goals. We also explained to our Client's managerial line (NTT Data) about our effort and we received great cooperation and understanding for it.

3.1 About our Ukeoi Effort

We participated in NTT Data's package product development and maintenance since 4 years ago. Our main tasks are to maintain already-provided products, package's version update development for both foreign and domestic market, and also performing some technical verification. The organizational structure is shown in Figure 5 below.

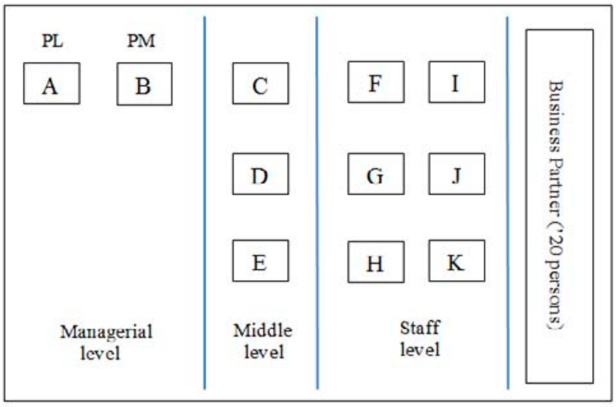

Figure 5 Our Project Organization Structure

The organization structure before and after Ukeoi is shown in Figure 6.

We joined the project under SES contract until FY2015 and since FY2016 we did it under Ukeoi contract (while some remained SES).

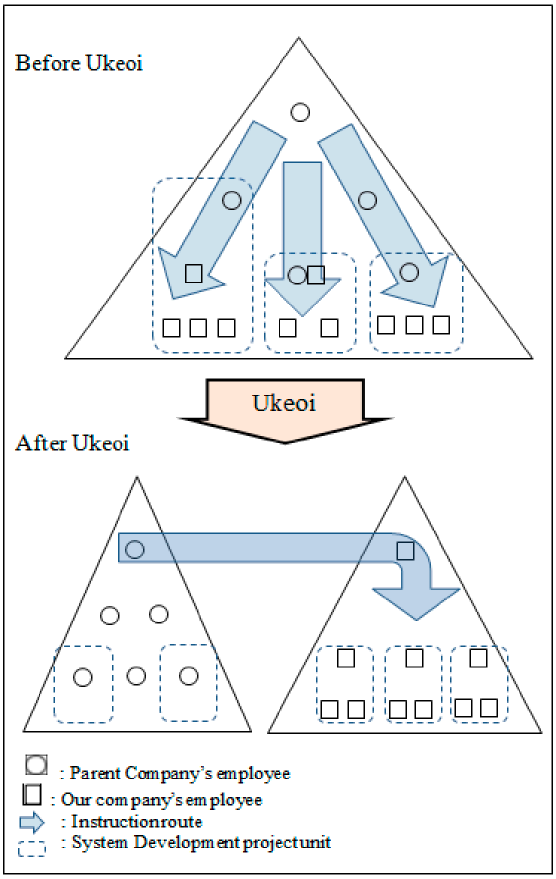

Figure 6 Control Route Before and After Ukeoi

As shown in Figure 6, before undertook Ukeoi contract (during SES term) we did our job based on the instruction of our client's employees. After Ukeoi, instruction route changed and by doing so we secured "autonomy", while aiming toward our division establishment "goal" and achieving "mastery" aligned with employee's training policy. We also did process improvement in order to increase our organization's accomplishment ability. The case examples are as follow:

(1)We initiatively solved tasks and problems of the project we carried out and began to function effectively as one independent functional organization.
- Establish require definition implementation guidelines
- Establish quotation implementation procedure
- Establish quality management implementation guideline
- Establish library management implementation guideline

(2)PDCA cycle began to function since the defect liability became ours. We performed cause analysis, correction and relapse prevention.
- Review corrective and relapse prevention measure
- Responsibility for warranty

(3)We were able to allocate more effort and time for employees training program.
- Allowing them to join self-development training program
- Challenge themselves to join ProMAC 2017

4. Measuring Effects

In Table 2 we listed our project's member, their position and characteristic (our business partners are not included).

We performed a questionnaire (before Ukeoi and After Ukeoi) to measure the effect of Ukeoi on mindset development. We used the Japanese (Shimazu (2014)) short version of Utrecht Work Engagement Scale (UWES, Schaufeli et.al. 2006) developed by Schaufeli.

It consists of 9 questions that will measure the 3 elements of work engagement, which are "vigor", "dedication" and "absorption" (Shimazu, 2014).

4.1 UWES Questionnaire

Respondent answer 9 questions with any of the 7 scale answers:
6: Always (every day), 5: Very often (A few times a week), 4: Often (Once a week), 3: Sometimes (A few times a month), 2: Rarely (Once a month or less), 1: Almost never (A few times a year or less).

Table 2 Project member and their characteristic

Employee	Position	Characteristic
A	Senior Manager (PL)	Abundant experience in Ukeoi. Have know-how in Ukeoi implementation
B	Manager (PM)	Have high interest in employees training Substantial administrator of this organization Not a top-down type administrator but a type that respects employees' initiative
C	Deputy Manager	Understand almost all technical aspect of organization Mostly handle clients' inquiries including troubleshooting which is uncertain (SES contract)
D	Deputy Manager	Abundant experience in Ukeoi Have experience in managing Ukeoi projects Established quality management implementation guideline when we started Ukeoi contract in our organization.
E	Assistant Manager	Technology improvement oriented Development project's project leader
F	Assistant Manager	Technology improvement oriented Common group's sub-manager Established library management implementation guideline when we started Ukeoi contract in our organization
G	Assistant Manager	Technology improvement oriented Development project's project leader Contributing in establishment of implementation guideline when we started Ukeoi contract in our organization.
H	Staff	Technology improvement oriented Decided to take challenge in ProMAC2017 presentation
I	Staff	Technology improvement oriented Established require definition implementation guideline when we started Ukeoi contract in our organization Decided to take challenge in ProMAC2017 presentation
J	Staff	2nd year employee Mostly handle programming task
K	Staff	1st year employee Mostly handle programming task

1. At my work, I feel bursting with energy Vig-1
2. At my job, I feel strong and vigorous Vig-2
3. I am enthusiastic about my job Ded-1
4. My job inspires me Ded-2
5. When I get up in the morning, I feel like going to work Vig-3
6. I feel happy when I am working intensely Abs-1
7. I am proud of the work that I do Ded-3
8. I am immersed at my job Abs-2
9. I get carried away when I am working Abs-3

4.2 Questionnaire Result

We asked each employee in our organization to fill in the questionnaire based on how they felt before and after Ukeoi. Since the number of subject to be measured is quite small, we improved the evaluation accuracy by asking them to write down the reason and impression of their answer. As for the scale aggregations method, we took the average of each element (vigor, dedication, absorption) by multiplying scale (0-6) with the question answered. For reference, Japanese workers average score is said to be around 2.8.

Table 3 UWES Result (Individual based)

Employee	level	Vigor		Dedication		absorption		Contract Form
		SES	Ukeoi	SES	Ukeoi	SES	Ukeoi	
A	manager	3.00	4.33	4.00	4.33	3.00	3.67	Ukeoi
B		2.33	2.67	4.33	4.33	3.00	4.33	Ukeoi
C	middle	2.67	1.67	3.33	2.00	3.33	2.33	SES*
D		3.67	3.67	4.00	4.00	4.67	4.67	Ukeoi
E		1.00	1.00	0.00	0.00	1.67	1.67	Ukeoi
F	staff	2.67	1.33	3.67	2.33	3.67	2.00	SES*
G		3.67	4.00	5.00	5.33	4.33	4.33	Ukeoi
H		2.67	2.67	2.00	3.00	2.67	3.33	Ukeoi
I		2.67	1.33	2.33	4.00	3.33	3.33	Ukeoi
J		3.67	2.67	3.33	3.00	3.67	2.67	Ukeoi
K		2.67	2.67	3.67	3.67	3.67	3.67	Ukeoi
Total		2.79	2.55	3.24	3.27	3.36	3.27	
Total (Ukeoi)		2.81	2.78	3.19	3.52	3.33	3.52	

*: Maintenance task (Troubleshooting, inquiries, etc.) contract form is SES.

Table 4 UWES Result (Level Based)

	Vigor			Dedication			absorption		
	SES	Ukeoi	Tendency	SES	Ukeoi	Tendency	SES	Ukeoi	Tendency
Manager	2.67	3.50	↑	4.17	4.33	↑	3.00	4.00	↑
Middle (Ukeoi)	2.33	2.33	→	2.00	2.00	→	3.17	3.17	→
Middle (SES)	2.67	1.67	↓	3.33	2.00	↓	3.33	2.33	↓
Staff (Ukeoi)	3.07	2.67	↓	3.27	3.80	↑	3.53	3.47	↓
Staff (SES)	2.67	1.33	↓	3.67	2.33	↓	3.67	2.00	↓

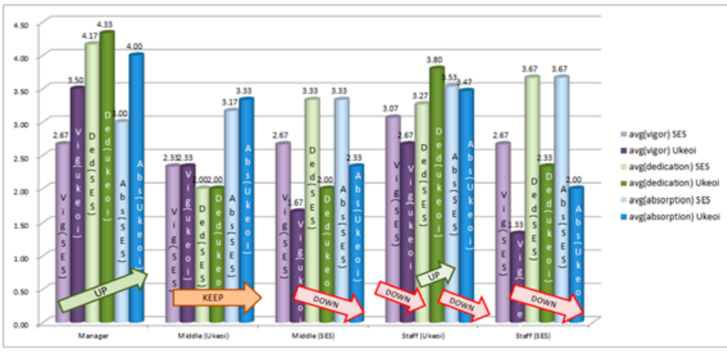

Figure 7 UWES Result (Level Based)

4.3 Discussion

Quantitatively the tendency of those who work under Ukeoi contract form score is higher during Ukeoi term. While those who work under SES contract form scored lower after Ukeoi. Among those who work under Ukeoi, employees belong to management level scored the highest. We found that "dedication" (e.g. the most expected one to improve among the three) is actually improving just as we expected. The qualitatively analysis is defined hereafter. During the aggregations we found that employee's level showed a different tendency so we did analysis based on these groups: managerial level, middle (sub manager) level, and staff level.

(1)Managerial Level

After Ukeoi all of the 3 elements, "Vigor", "Dedication" and "Absorption" were high. Some of the comments are: "The responsibility is heavy but since I was able work at my own discretion, the work was worth doing", "I became more engaged to work by thinking on how to work more efficiently", "I felt like my work skills have improved since we started Ukeoi". By seeing this we can see that the managerial level score high in work engagement. They are in the position to succeed the project by aiming toward the goal (e.g. project's completion), having the sense of responsibility, and determining policies at their own discretion. In other words, as the one who started Ukeoi mission, the managerial level succeed in initiatively used intrinsic motivation as a key success to "Autonomy", "Mastery" and "Goal". Those motivations also improve their work engagement.

(2)Middle level (Ukeoi member)

Employees who belong to middle level and work under the Ukeoi contract form showed no change in all of the three elements, "Dedication", "Vigor", and "Absorption". We analyzed that, this is because the members who belong to this level possess abundant experience in Ukeoi and they have already developed the mindset needed to undertake Ukeoi. Those members belong to this level initiatively performed process enhancement by establishing quotation and quality implementation guideline. In case the middle level members didn't have any Ukeoi experience before, we think that the managerial level needs to explain the expectation of Ukeoi and push their back to make their intrinsic motivation works.

(3)Middle level and staff level (SES member)

The score of "Dedication", "Vigor", and "Absorption" went lower after Ukeoi. We thought that was caused by the contra effect of Ukeoi, we concluded so based on a comment we received saying that: "The unification feeling with the client vanished and it became more difficult to work". This also felt by our client. In a SES contract, the unity feeling bonded by working together and helping each other through difficult times. The unity feeling is irreplaceable since both client and contractor are aiming toward the same goal. Under the support of the client, we think it is necessary to build unity feeling by doing Kick-off meeting on the start of a project, explaining the project's policy and goal to all members related, by holding regular communication meeting to explain issues and current situation to each other.

We understood the difficulties of doing Ukeoi in operation and maintenance task but we decided to give it a try. However, we found that scope management, quotation work and cost control become such a burden for our member and we actually failed in doing so.

In the guideline (JISA, 2016) published by Japan Information Technology Services Industry Association (JISA) defines that even though the contractor may be able to perform operation and maintenance task by themselves, it is hard to reach agreement in defining the details of task completion goal. Thus, they recommend to operation and maintenance work under SES contract form.

(4)Staff Level (Ukeoi)

The result differs based on the staff position: the one who give instruction (e.g. instruction giver) or the one given instruction (e.g. instruction receiver).

(A)Instruction giver (Staff G, H, I)

Employees belong to this position shows higher score after Ukeoi. We concluded that members who able to control work in their own discretion were able to develop the expected mindset and have a high work engagement. This condition can be viewed by reviewing their comments such as: "I was able to control on how to I want to proceed with the task", "I was able to do what I wanted to do". Members of this level show that their "dedication" development score is quite high. This shows that performing Ukeoi by having responsibilities, relentlessly and initiatively working on originality and ingenuity will deliver the most expected result.

(B)Instruction receiver (Staff J, K)

There was no difference between before and after Ukeoi on this level of members. Those belong to this level are saying that "I saw no difference between Ukeoi and SES", "The motivation change depends on how fun the project is, or how good of progress I made during the project". Seeing so, we concluded that the mindset development (i.e. intrinsic motivation) was not as expected. We think that this was because they didn't get enough explanation about the merit of Ukeoi and what was needed to succeed in Ukeoi. Inexperienced member needed to get explanation based on their skill level with easy-to-understand words and concrete examples. They also need to experience success in small work in order to understand the merit of Ukeoi. Just as they need instruction on what to do on work, they also need to be pushed to let their intrinsic motivation works.

5. Recommendation

Based on work engagement result at this study we managed to clarify that Ukeoi key factors, "Autonomy", "Mastery" and "Goal" affected employee's individual intrinsic motivation and also played an important role in mindset development. We also managed to clarify the effect and issues exist in each employee level. Below, we proposed factors to improve the effect at each level and also the countermeasures for issues exist.

(1)Managerial level

(A)Their motivation raised the most since Ukeoi helped them to develop their responsibilities and they are in the position to control the project in whole.

(B)The required skills are: have abundant Ukeoi experience, is able to control project on their own, have abundant management tools and its know-how (System development implementation guideline templates).

(C)Communication skill is essential to facilitate a close communication with client's managerial side. As a result of Ukeoi, we are to carry out an autonomy project by ourselves. Differ from SES, this caused the communication with each employee level on client's side to decrease.

(2)Middle level

(A)They are the pillars to build development environment (implementation guideline, operation rules, etc.) for the whole organization. As well as managerial level, it is desirable to arrange employees who have experienced Ukeoi project beforehand.

(B)If we are about to assign an Ukeoi inexperience middle level employee, we need to politely explain the purpose of Ukeoi. We need them to understand about autonomy and goal aspect of Ukeoi and to let them know that they are the one who work for the growth of the organization. By doing so we are pushing them to let their intrinsic motivation works.

(3)Staff level (instruction giver)

(A)Since they are the members who have the willingness to lead projects on their own, this level of employee is the most expecting ones to bear fruit on showing Ukeoi effect on "Autonomy". By pushing their back to let their intrinsic motivation work we can optimize the effect. They should be encouraged to lead and control project by setting their own goals considering the following things: what they have done until now (e.g. things they are able to do) and things they want to do. If possible they also need to be encouraged to think about what they ought to do.

(4)Staff level (Instruction receiver)

(A)We need to push their back to encourage their intrinsic motivation by letting them finding what they want to do. We need to explain what Ukeoi is, its merit and background using easy-to-understand words and concrete examples.

(B)It is more effective to let them experience the merit of Ukeoi by letting them enjoying success in early stage.

(5)General remarks

By promoting Ukeoi in our organization we were able to secure "Autonomy". For every employee on each level we need to push their back by giving encouragement for them to be able to shift from doing "things they are able to do" to "things they are ought to do". By doing so we are encouraging their intrinsic motivation to work. This can enable the growth of each employee with the growth of the whole company.

6. Conclusion

We have engaged in Ukeoi as promoted by our company for around a year. Even though we experienced difficulties during the initial time, we can say that our organization's attitude toward work has changed. Our employees started the initiation to handle issues and perform improvement. They fostered mind that is willing to work initiatively to create a better work environment. We also did visualization using work engagement measurement for each level of employee to summarize our recommendation for others who are about to promote

Ukeoi. Even though fostering mind always differs on each workplace; since it depends on each work environment, resource, etc., but we are more than happy if our recommendation has somehow give the slightest hint to those who are currently engaged in promoting Ukeoi.

The situation is always changing. Employees and organizations, that have their mind fostered, are also facing the risk of deteriorating over time. To maintain fostered mind we need to always challenge our employees with new issues on new themes.

Finally, last but not least, we would like to express our gratitude to NTT Data's General Manager, Mr. Fujioka and also Senior Manager, Mr. Otsuka and also everyone on the section, who have helped us during our Ukeoi promotion progress.

We would also like to say thank you to Miss Asuka Sakuraya, who not only introduced work engagement to us, but also helped us during the writing of this paper.

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A Study for Improving Accuracy of Risk Management Education Based on Research of Project Risk Perception

Society of Project Management Kansai Branch Software Project Study Group

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Risks and Issues are identified as events before and after the factors, but various views are obtained when asked about specific events. The authors are particularly conscious of the current situation that not only for inexperienced students but also for experienced project experts do not have common recognition about risk events on projects. The purpose of this study is to clarify the difference in risk recognition between experienced project experts and graduate students and to define the essence of risk management education to graduate students who do not have full-scale project experience. First, as the previous study, the literatures including project risk management in PMBOK are reviewed the basic concept and indicators. Next, the research is conducted as survey based on questionnaires regarding the actual situation of the project risk event on the experienced project experts and the graduate school students. Through the T test and correlation analysis, it is considered the actual state of risk recognition and the essence of risk management education for the students of graduate school. This research will be for raising the level of the project risk management education in graduate school and to contribute the success of actual projects for future as well.

Keywords and phrases: Risk Driver, Project Risk Perception, Risk and Issue, Effect of Education, Graduate Students and PM Expert, List of Correlation, t-Test, Kendall's Rank Correlation Coefficient

1. Introduction

Risk management conducted in software development projects is one of 10 knowledge areas classified in PMBOK (PMI 2013) and has been already known widely.

However, the interpretation of the term "risk" itself depends on each person. Even experienced project managers are often faced with cases where it is mixed up with "issue." There is no uniform identification even among graduate students learning information technology regardless of the presence/absence of the registration of associated subjects. Risk is not an event which has already occurred, but an "uncertain event" which may occur in the future. Paul. S Royer defined "Risk" as "Potential events or circumstance that pose a threat to the performance of the planned project" (Royer 2004).

On the other hand, issue is an event which has already occurred, which means a "clear fact." It means several problems occurring in daily projects. For example, some tests cannot be implemented on schedule due to a great number of bugs.

From the point of view of project management, risk management requires grasping of uncertain events potential to occur in advance and planning of countermeasures to avoid any negative impact on a project. In other words, it is "proactive management." Issue management is to deal with problems which have already occurred and take measures after the fact in the same way as "troubleshooting." It is intended to minimize an influence caused when the problem occurs.

Projects need both risk and issue management. As preventive medicine has recently attracted attention also in medical science, risk management which prevents problems is obviously essential for success in projects.

This research is subject to graduate students including overseas students and experts engaging in project practices. We conducted questionnaires to confirm the understanding of "risk" and "issue" about the risk event driver based on the "Practical Approach to Risk Prevention of IT Projects" of Information-technology Promotion Agency (IPA 2013) for factual investigation. Further, graduate students answer the same questionnaires before and after the lecture associated with project risk management. We analyze and confirm its educational effect of each student quantitatively. The research results are also intended to help people recognize risk management in the future and suggest that appropriate education should be provided to current and potential project experts at companies and universities.

2. Previous Research

This chapter is intended to confirm and define terms associated with risks and models, assuming research about risk perception since perception concerning risks deeply depends on models to express them and terms used for it.

2.1 Risk Model by P.G. Smith, G. M. Merritt

First of all, we introduce the model of the standard risk (Smith and Merritt 2002). Among the simple risk model, standard risk model, cascade risk model and Ishikawa risk mode introduced in (Smith and Merritt 2002), we focus on the "standard risk model." There are two reasons. First, while each of the four model has both advantages and disadvantages, the standard risk model is simple and easy to understand and highly evaluated since it is the most suitable model for modeling of a project risk models. Second, it is the foundation of (IPA 2013) "Risk Event Prevention Model" introduced in the next section. As shown in the Figure 1 the "standard risk model" is a model to separate a risk event from its impact for understanding and regard the impact as what results in loss.

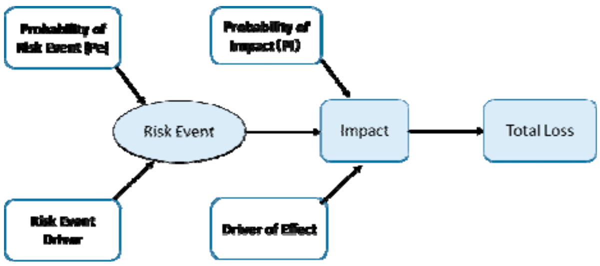

Figure 1 Standard Risk Model

Source: Smith, G. P. and Merritt, G.M. (2002)

Seven elements constituting standard risks are described as follows.

(1) Risk Event: Events or status "causing" losses.
(2) Risk Event Driver: What exists in the project environment and is considered to cause a specific risk event to occur.
(3) Occurrence Probability of Risk Event: Likelihood (probability) that a risk event will occur.
(4) Impact (of Risk): Potential losses as a result of the occurrence of a risk event
(5) Impact Driver: What exists in the project environment and make you ensure that a specific impact will occur.
(6) Occurrence Probability of Impact: Likelihood (probability) that an impact is caused under the circumstance that a risk event occurs.
(7) The number of gross losses: Number of losses caused when a risk event will occur. Indicated by the number of days or amount of money.

2.2 Risk Event Prevention Model by (IPA 2013)

Then, we describe (IPA 2013) "Risk Event Prevention Model" based on the model of standard risks (Smith and Merritt 2002). While it is the same as that a risk event causing a negative impact on the IT project and risk event driver causing the event are distinguished as different elements, it is characteristic that two kinds of countermeasures to avoid and mitigate risk event drivers corresponding to causes are considered and, in addition, metrics are used to understand risk event drivers objectively and confirm effectiveness of countermeasures to risk event drivers.

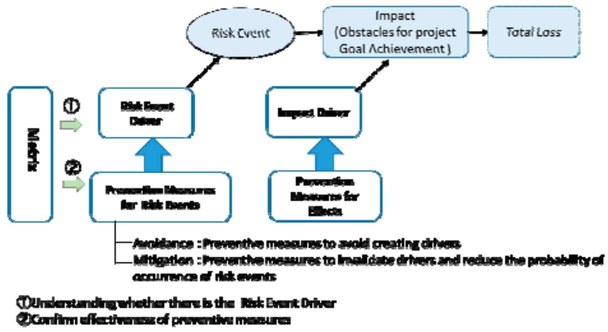

Figure 2 Risk Event Prevention Model

Source: IPA (2013)

2.3 Definition of Risk and Issue

The definition of "risk" depends on standards or guides concerning risk management. Incidentally, Smith and Merritt (2002) describes "issue" "Events such as risk, except what certainly occurs," which means all events including risk.

Kino (2005-2006) regards risk as an event and describes that the event (risk) is not what occurs in the past or will occur in the future but an event potential to occur in the future and has two attached attributes. One is related to possibility that "an event may occur" before it actually occurs, which is represented as "possibility," "uncertainty" or "occurrence probability." The other is related to a matter after an event occurred, which is represented as a "result" or "impact." However, it is just future "prediction" based on an event which has already occurred.

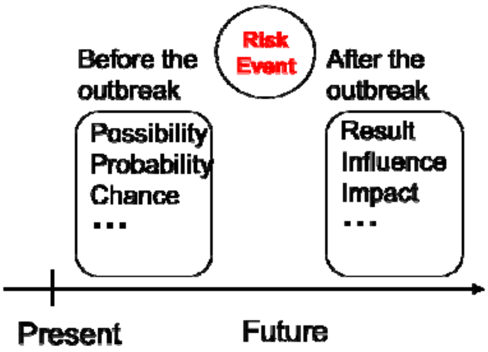

Figure 3 Standard Risk Model on Guide book

Source: Kino, Y. (2005-2006)

Following this description, this research defines risk not as the past or current event but an event potential to occur in the future and defines an issue about it as an event which has already occurred so far.

3. Research Method

In this chapter, the research purpose and the methods are described in section 3.1, 3.2 and attached Appendix A.

3.1 Research Purpose and Sample

This research is subject to project experts at a company and graduate students learning IT and intended to confirm risk perception.

We created questions and conducted questionnaires to measure the perception concerning risks quantitatively. Respondents are graduate students and project experts at a company. Questionnaires for graduate students were conducted to two groups of A. Foreign Students group those are taking the course in English (It's called "Foreign Students" below.) and B. group consisting mainly of Japanese Students those are taking the course in Japanese. (It is called "Japanese Students" below.) All graduate students are taking the course of project risk management. Questionnaires for A. foreign graduate students group were conducted both before and after the class and those for B. group consisting mainly of Japanese graduate students were conducted only after the class. Questionnaires were prepared in the Google Form and conducted during the class using Moodle, or an e-learning platform.

Questionnaires for workers were conducted by distributing and collecting questionnaires to and from project experts at Company M.

3.2 Risk/Issues Perception Questionnaire

Questionnaires consist of following two types.

(1) Risk/Issues Perception Questionnaire

(2) Risk/Issues Importance Ranking Questionnaire

(1) was created from the list of 24 items of "Driver of Risk Events" described in (IPA 2013). Although we considered to set "risk events" as a questionnaire at first, they might be easily identified by checking if a verb is the past tense or future tense since their expressions are specific. Therefore, we adopted "Driver of Risk Events" as a questionnaire. With regards to (2), two items were randomly chosen (6 items in total) from each classification (Main Process, Support Maintenance Process, Organization Process) of the "Risk Event Driver" consisting of 24 items. Then, we ranked them according to the importance of Risk/Issue and request students to answer the questionnaire. (Appendix A)

4. Result from Statistics

The result of questionnaires are shown with statistic charts in this chapter. The research sample and the number who answered the questionnaires are as follows.

Table 1 Respondents' ratio

Sample	Head count
1.Project Experts	46
2.Foreign Students (Before Training)*(1)	37
3.Foreign Students (After training) *(1)	37
4.Japanese Students (After training)	22

*(1) exactly same students

4.1 Ratio of age-group and years of experience

4.1.1 Project Experts

Figure 4 shows 92% the sample of project expert are 40s to 50s, and 91% of them has more than 10 years' experience.

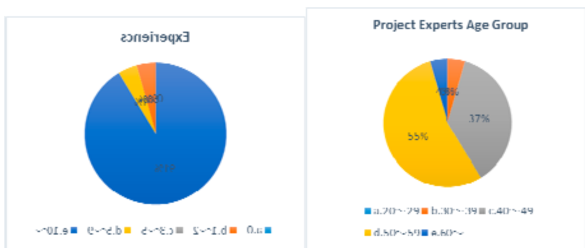

Figure 4 PM Expert Age-group and Experience

4.1.2 Foreign Students

Figure 5 shows 94% of the sample of project expert are 20s to 30s, and 28% of has no experience about project and 56% of them has less than 2 years' experience.

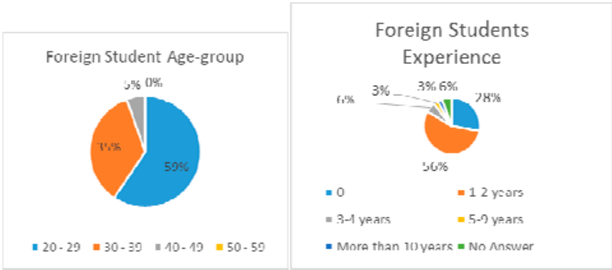

Figure 5 Foreign Student's Age-group and Experience

4.1.3 Japanese Students

Figure 6 shows 91% of the sample of Japanese Students are 20s and all of them are under 30 years old. 82% of the students has no experience of project.

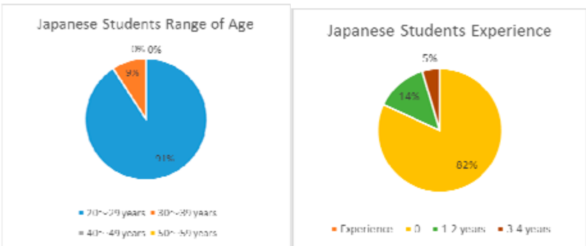

Figure 6 Japanese Student's Age-group and Experience

4.2 Risk and Issue Perception

4.2.1 Project Experts

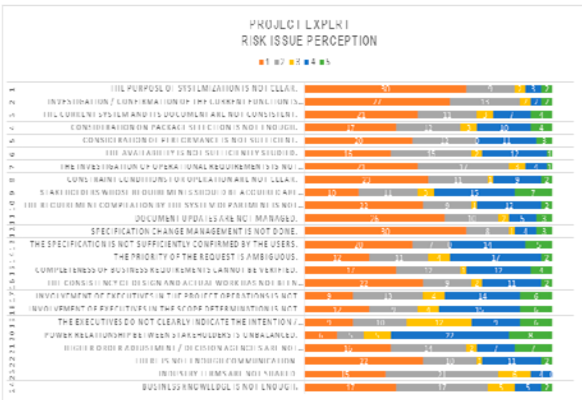

Figure 7 Project Experts Risk/Issue Perception

The figure 7 shows the result of the questionnaires that asked the items of Risk drives are risk or issues to project experts. It tends to be recognized as "Issue" than "Risk". In particular, 30 of 46 (about 65%) respondents answered "Absolutely Issue" in "1. The purpose of systemization is not clear." and "12. Specification change management is not done."

4.2.2 Foreign Students

The figure 8 shows foreign students' risk and issue perception. Each item has variations in recognition. Especially, 27~28 people in 37 people (73%~75%) answered "Issue" or "Absolutely Issue" about item"3. The current system and its document are not consistent" and "11. Document updates are not managed ". In "10. The requirement compilation by the system department is not sufficient." 23 of 37 people 64%) answered "Risk.

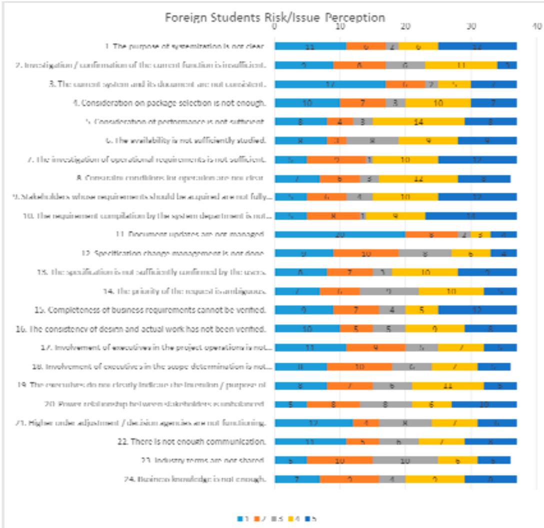

Figure 8 Foreign students Risk/Issue Perception

4.2.3 Japanese Students

The figure 9 shows Risk/Issue perception of Japanese students. It looks similar as foreign students. However, 17 of 22 (about 77%) respondents answered "Absolutely Issue" or "Issue" in item 24 "Business knowledge is not enough".

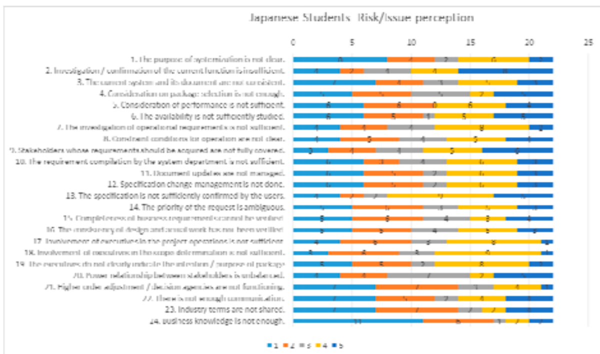

Figure 9 Japanese students Risk/Issue Perception

4.3 Importance Ranking

In this section, the distribution of responses for questions asking about risk importance is explained.

Table 2 summarizes the answers to questions about importance ranking of Risk Driver. The 6 items are selected from 24 of Risk Event Driver. Items are chosen at random from the three categories of Risk Event Driver. The distribution of each sample group is introduced in each section.

Table 2 Risk Driver Importance Ranking

Risk Event Driver	Raniking of Importance (Average)		
	Project Experts	Foreign Students	Japanese Students
a. The purpose of systemization is not clear.	1.739	2.306	1.8182
b. Investigation / confirmation of the current function is insufficient	2.978	3.111	2.7727
c. Specification change management is not done	3.826	3.778	3.6364
d. The specification is not sufficiently confirmed by the user	3.065	3.361	3.8182
e. Involvement of project management by management is not sufficient	4.065	3.861	4.5909
f. Business terms are not shared	5.13	5.167	4.3636

Items (a. ~ f.) in Figures 10 to 12 to be introduced below are linked to the items (a. ~ f.) in Table 2. Also, the Y axes show importance ranking.

4.3.1 Project Experts

The figure 10 shows distribution ranking of Project Expert. The Expert recognized Item 1 "The purpose of systemization is not clear" As most important. And the average score of Item 6 "Industry terms are not shared" shows that many experts recognize it is not the most important item.

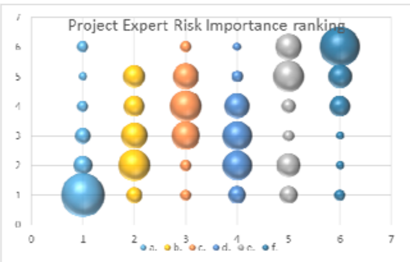

Figure 10 Project Experts Risk Importance Ranking

4.3.2 Foreign Students

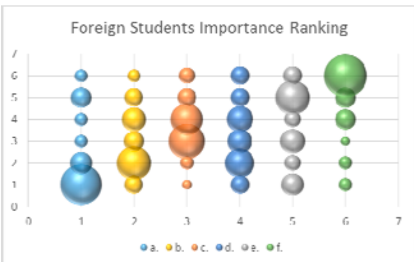

Figure 11 Foreign Students' Risk Importance Ranking

Figure 11 shows the distribution of foreign students and it seems to be very close results same as Figure 10.

4.3.3 Japanese Students

Figure 12 shows the distribution of Japanese students.

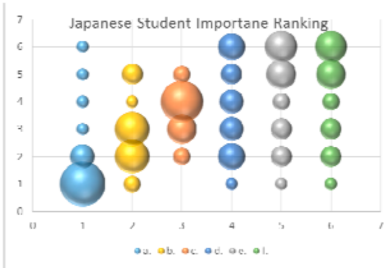

Figure 12 Japanese Students' Rank Importance Ranking

It seems to be very close regarding the results of Item 1 and Items 6. Regarding Item 1, 2 and 3, many of the respondents make the ranking as 1, 2, 3. For item 4, the answers are dispersed.

5. Data Analysis

In this chapter, we consider the data results of the questionnaire survey conducted for the experts about the software development projects and the Graduate Students including foreign students.

5.1 Correlation of each Risk Event Driver

We first prepared the correlation table of 24 items of Risk Event Driver by each target and confirmed how strong a correlation between each item perceived as Risk or between each item perceived as Issue is. We also confirmed the strength of an inverse correlation, where someone perceived an item as Risk while perceiving another item as Issue.

Table 3 Correlation and Inverse Correlation

	1. Foreign Students (Before)		2. Foreign Students (After)		3. Japanese Students		4. Project Experts	
	Item	Co-efficient	Item	Co-efficient	Item	Co-efficient	Item	Co-efficient
Correlation (1)	4-21	0.5103	7-6	0.6126	19-8	0.7014	5-4	0.8659
Correlation (2)	17-15	0.4990	13-4	0.5962	18-17	0.6798	12-11	0.8631
Correlation (3)	17-6	0.4728	9-8	0.5056	13-8	0.6564	6-5	0.8497
Inverse Corrlation (1)	12-2	-0.4370	21-4	-0.5005	21-18	-0.4609	23-3	-0.1271
Inverse Corrlation (2)	21-2	-0.4031	20-1	-0.4897	9-5	-0.4426	22-3	-0.1061
Inverse Corrlation (3)	16-2	-0.3021	23-9	-0.4435	2-1	-0.4314	18-3	-0.0945

Table 3 shows the results of top 3 combinations by each target group in the order of strength of a correlation and inverse correlation, chosen from the correlation table.

5.1.1 Foreign Students

Looking at the foreign students group before taking a risk education class, as common items of a correlation, it is highly probable that those who perceived "17. Involvement of executives in the project operations is not enough." as Risk (or Issue) answered that "15. Completeness of business requirements cannot be verified." is also Risk (or Issue).

Similarly, it is also highly probable that those who perceived "17. Involvement of executives in the project operations is not enough." as Risk (or Issue) answered that "6. The availability is not sufficiently studied." is also Risk (or Issue). With regards to an inversion correlation, this table shows it is highly probable that those who answered that "2. Investigation / confirmation of the current function is insufficient." is Risk (or Issue) answered that "12. Specification change management is not done.", "21. Higher order adjustment / decision agencies are not functioning." and "16. The consistency of design and actual work has not been verified." are conversely Issue (or Risk). It seems that education had some positive effects since a correlation before education is not similar to one after education and numerical values shows that correlations became higher after education.

5.1.2 Japanese Students

The results of Japanese students in the correlation table shows that "8. Constraint conditions for operation are not clear." tends to have high correlations as a factor in common with "13. The specification is not sufficiently confirmed by the users." and "19. The executives do not clearly indicate the intension / purpose of package installation." With regards to correlations, it shows the results tend to have higher correlations than those of the foreign students group.

5.1.3 Project Experts

The correlation table of project experts shows that "5. Consideration of performance is not sufficient." has high correlations with "4. Consideration on package selection is not enough." and "6. The availability is not sufficiently studied."

With regards to an inversion correlation, it shows that "3. The current system and its document are not consistent." serves as a factor of inversion correlations in common with "22. There is not enough communication," "23. Industry terms are not shared." and "18. Involvement of executives in the scope determination is not sufficient."

Correlations and inversion correlations higher than those of the students group are also acknowledged. This means that they have a higher tendency to have common perception about the identification of Risk/Issue for each item.

5.2 t-Test

We confirmed if there is any difference between each target group about perception to each item of Risk Event Driver by t-test using R. T-test enables to examine whether the difference of an average of two groups is within the range of an accidental error.

Table 4 Result of t-test

Group of t-test	Risk Event Driver	P-value
(1) Foreign Students (Before) vs. Foreign Students (After)	3.08 / 2.96	**0.04844**
(2) Foreign Students (After) vs. Japanese Students	2.96 / 2.71	**0.00795**
(3) Japanese Students vs. Project Experts	2.70 / 2.31	**0.00092**

Since the p-value of each t-test result of (1) before and after education to foreign graduate students, (2) foreign graduate students and Japanese graduate students and (3) Japanese graduate students and PM experts is smaller than 5%(0.05), each null hypothesis is rejected, which means "the difference is significant." The level of the difference of values is (1) 0.04844 > (2) 0.00785 > (3) 0.00092. While the difference of (1) before and after education to foreign graduate students is significant but little, that of (3) Japanese graduate students and PM experts is remarkably large.

5.3 Kendall's rank correlation coefficient

Next, we ranked 6 items chosen from "Risk Event Driver" and obtained rank correlations based on answered results in order to grasp the strength of the association between each group's data by number.

We first obtained the average of ranks set for each Risk Event Driver by group. The list is shown in the Table 5.

Table 5 List of average of 6 Risk Event Driver

Risk Event Driver	Foreign Students (B)	Foreign Students (A)	Japanese Students	Project Experts
a. The purpose of systemization is not clear.	2.722	2.306	1.8182	1.739
b. Investigation / confirmation of the current function is insufficient	3.194	3.111	2.7727	2.978
c. Specification change management is not done	3.333	3.778	3.6364	3.826
d. The specification is not sufficiently confirmed by the user	3.694	3.361	3.8182	3.065
e. Involvement of project management by management is not sufficient	3.694	3.861	4.5909	4.065
f. Business terms are not shared	4.361	5.167	4.3636	5.13

Figure 13, 14 and 15 show variances with the x-axis and y-axis as combination of each group.

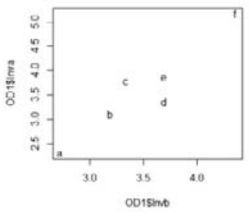

Figure 13 Kendall's rank correlation tau

(1) Foreign students before education vs. Foreign students after education

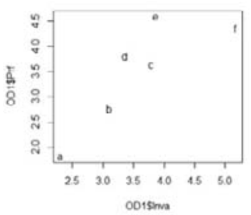

Figure 14 Kendall's rank correlation tau

(2) Foreign students after education vs. Japanese students

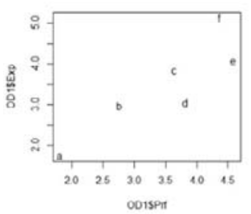

Figure 15. Kendall's rank correlation tau

(3) Japanese students vs. Project Experts

According to the variances in graphs, it is clear that each group perceives "a. The purpose of systemization is not clear" as the most important item and chooses "b. Investigation / confirmation of the current function is insufficient" as the second one. All groups also perceive "f. Business terms are not shared" as the least important one.

Table 6 shows p-values obtained from Kendall's rank correlation tau by R.

Table 6 Kendall's rank correlation tau
Correlation and coefficient and p-value

Group of t-test	Correlation Coefficient	P-value
(1) Foreign Students (Before) vs. Foreign Students (After)	0.8280787	**0.02172**
(2) Foreign Students (After) vs. Japanese Students	0.7333333	**0.05556**
(3) Japanese Students vs. Project Experts	0.7333333	**0.05556**

(1) Since a correlation coefficient before and after education to foreign graduate students is 0.828, close to 1, there is a tendency that an item recognized as an important one before education is also recognized as important one after education. Its p-value is 0.02172, smaller than 5% (0.05), resulting in the rejection of the null hypothesis, which means "the difference is significant."

The value of correlation coefficients of both (2) foreign graduate students and Japanese students and (3) Japanese graduate students and PM experts is 0.73333, relatively close to 1, which means that the importance perception of each group has a strong correlation. Since both p-values are 0.05556 over 5% (0.05), null hypotheses are not rejected, which means "the difference is significant."

6. Conclusion

In conclusion, investigation to confirm risk and issue perception using questionnaires provided unexpected results that project experts more strongly perceive Risk Event Driver as Issue. Two reasons can be expected for this. One is different interpretation of the definition of Risk. As mentioned in 2.3 before, there is a reference (Smith and Merritt 2002) defining "Issue" as "Events such as risk, except what certainly occurs", which means all events including risk. Since this definition means "Risk is included in Issue", Issue can be regarded as all events including Risk except what certainly occurs in a question to choose Risk or Issue.

The other is, albeit a general consideration, that people tend to perceive Risk as Issue when more knowledge or experience they acquire, more certainly they think risk events occur.

Data analysis enabled us to confirm changes in perception of Risk or Issue common in items more associated with functions or presence/absence of significant differences, which cannot be obtained from statistical results.

We reconfirmed importance to share the definition of Risk, Issue and their associated terms in risk management education at companies or graduate schools in the future. Based on the assumption, understanding of the following issues and basic recognition leading to practice are also considered to be a key factor contributing to success in a project.

(1) Able to identify Risk potential to occur in the future
(2) Able to calculate its impact and occurrence probability
(3) Able to form a response plan to practice

Finally, let us introduce consideration about the practical indicators of how education on project risk management leads to success in a project as a future challenge of this research since we think it is more necessary to know if responses to Risk are useful for practice than just to understand it.

Acknowledgements

Gratitude has been expressed to the project experts and the graduate students who answered in the questionnaire.

Also thanks for your support to the stakeholders of this research group of the Society of Project Management.

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Appendix A.

Questionnaires Regarding Risk / Issue Perception

ID _______________

Name ____________________________________

Nationality _________________________________

Age (Please mark ✔ your applicable age range) a.20~29 b.30~39 c.40~49 d.50~ e.60~ Years old

S/W project experience (Please mark ✔ your applicable range) a.0 b.1~2 c.3~5 d.5~9 e.10 ~ Years

1. Below is a table showing events that are considered to be a negative factor at the planning stage of software development project.
   Please respond with your perception whether each item is "risk" or "issue".
   The answer is 5 Likert, please fill in the number on the following scale into the answer column under the list.

Absolutely Issue	Rather Issue	Neither Issue nor Risk	Rather Risk	Absolutely Risk
1.	2.	3.	4.	5.

Classification	No.	Factor	Answer
Main Process	1	The purpose of systemization is not clear.	
	2	Investigation / confirmation of the current function is insufficient	
	3	The current system and its document are not consistent	
	4	Consideration on package selection is not enough	
	5	Consideration of Performance is not sufficient	
	6	The availability is not sufficiently studied	
	7	The investigation requirements are not sufficient	
	8	Constraint conditions for operation are not clear	
	9	Stakeholders who should acquire requirements are not covered	
	10	The requirement compilation by the system department is not sufficient	
Support / Management Process	11	Document updates are not managed	
	12	Specification change management is not done	
	13	The specification is not sufficiently confirmed by the user	
	14	The priority of the request is ambiguous	
	15	Completeness of business requirements cannot be verified	
	16	The consistency of design and actual work has not been verified	
Organizational process	17	Involvement of project management by management is not sufficient	
	18	Involvement in scope determination by management is not sufficient	
	18	The management does not clearly indicate the intention / purpose of package	
	20	Power relationship between stakeholders is unbalanced	
	21	Higher order adjustment / decision agencies are not functioning	
	22	There is not enough communication	
	23	Business terms are not shared	
	24	Business knowledge is short	

2. Please number the following six events in order of importance as risk or issue.
   (1 · · Most important, 6 · · Not the most important)

Events	Order of Importance (1~6)
a. The purpose of systemization is not clear.	
b. Investigation / confirmation of the current function is insufficient	
c. Specification change management is not done	
d. The specification is not sufficiently confirmed by the user	
e. Involvement of project management by management is not sufficient	
f. Business terms are not shared	

Source: (IPA 2013) .

A Study of Risk Assessment for Supply Chain Model in Industry 4.0

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Nowadays, the industrial revolution has transitioned to the Fourth Industrial Revolution (Industry 4.0). This revolution includes cyber-physical systems (CPSs), the Internet of Things (IoT), and cloud computing. It will connect people so that they can cooperate with each other in real time to improve decision making and make work procedures in each section of worker more convenient. Generally, a supply chain is a network of manufacturers and service providers that work together to move goods from the raw material stage through to the end user. To integrate the supply chain in order to adapt it to Industry 4.0, the chain will be a flexible system, meaning that some work procedures will be automated to quickly respond to customer demand in real time by connecting people on the Internet. Therefore, Industry 4.0 will increase manufacturing productivity, but the number of risks will also increase because the Internet is used. In this paper, we aimed to assess the risks of a supply chain model in Industry 4.0. Specifically, the risk factors of the model were specifically and comprehensively extracted with the risk breakdown structure (RBS) method. This will contribute to utilizing Industry 4.0 more safely and securely.

Keywords and phrases: Risk Assessment, Supply Chain, Industry 4.0, Risk Breakdown Structure

1. Introduction

In recent years, Industry 4.0, led by the German government, has been attracting attention in industry. The purpose of Industry 4.0 is to control the entire value chain through the product life cycle and establish a new business model. This will enable low cost, energy-saving production. Similar efforts are beginning in Japan as the movement toward smart factories using the Internet of Things (IoT) is accelerating in various parts of the world (LANch BOX online Magazine, 2016).

While these are important concepts for manufacturing, some issues are raised, especially security issues. Security threats have been reported from many companies, and it is said that it is difficult to promote Industry 4.0 broadly without a solution to this. In particular, in Industry 4.0, innovation in manufacturing is aimed at connecting factory automation system, such as connecting a new information system to a closed system in a plant. However, information systems use the Internet, for which there is the threat of cyber attacks. As a result, companies with control systems used for production in manufacturing industries, such as for critical infrastructures, are strongly concerned about security and are currently unable to implement solutions with Industry 4.0. Thus, ensuring security is indispensable for realizing Industry 4.0 (The Finance, 2016).

Furthermore, the threat of security threats also manifests itself in the value chain, which is a characteristic of Industry 4.0. Specifically, when an FA device such as a programmable logic controller (PLC), which is an important part in the formation of the value chain, is attacked, there is a possibility that production will be stopped or production information will be stolen. As a matter of fact, an incident has already occurred in which critical facilities went out of service due to cyber attacks. For example, in 2010, Iran’s nuclear facility was attacked by the malware “Stuxnet,” and the centrifugal separator was destroyed (Newswitch, 2015).

Therefore, Industry 4.0, which is also drawing attention in Japan, measures against risk management in the value chain, such as supply chain management, particularly, whether its security aspects are sufficient. In particular, it is assumed that such value chain formation will become indispensable not only in the same industry but also between different industries.

In this paper, on the basis of the progress of Industry 4.0 in the future, we will describe risk assessment for the supply chain model as a specific subject, contributing to safely and securely forming value chains in Industry 4.0.

2. Overview of supply chain model in Industry 4.0

2.1 Overview of Industry 4.0

As shown in Table 1, Industry 4.0 is also called the "Fourth Industrial Revolution." From the Programmable Logic Controller (PLC; factory automation utilizing ICT) used in conventional closed-system factories, smart technology utilizing IoT in factories, which is an Internet of Things (IoT), makes low cost and energy saving production possible. That is, Industry 4.0 aims to innovate manufacturing by connecting newly closed systems within a factory to IoT information systems and others.

Table 1 Position of Industry 4.0 (Nikkei business Online, 2014)

	Feature	Major Products
1st revolution 1784~	Hydraulic power, beginning of factory-based machine industry applying steam engine	World's first loom machine (UK)
2nd revolution 1870~	Beginning of mass production era with development of electricity and distribution networks	Meat processing factories achieving mass production with electricity (USA)
3rd revolution 1969~	Practical application of factory automation utilizing electronic technology and IT	First program logic controller (PLC) (US)
4th revolution present	Innovation of IT technology and networking of goods become possible	

In a report by PwC (http://www.pwc.com/jp) in 2014 titled "Industry 4.0 – Opportunities and Challenges of the Industrial Internet, (survey results from 235 German companies) (PwC, 2014), the driving force of Industry 4.0 is said to be the value chain. As shown in Fig. 1, the framework of Industry 4.0 consists of digitalization of the value chain, digitalization of products, and a new business model.

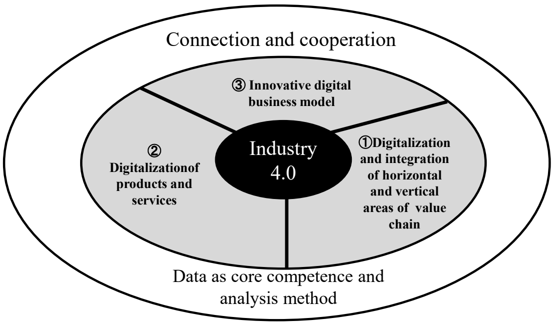

Figure 1 Industry 4.0 framework

2.2 Digitization of value chain

As shown in Fig. 2, the digitalization of the value chain shown in Fig. 1 will be completed at more than 80% of companies (235 German companies) in five years.

As shown in the figure, the horizontal and vertical value chains are almost evenly advanced. As shown in Figure 3, digitalization of the horizontal value chain ranges from suppliers, their companies, to customers, and this process integrates all divisions (purchasing, manufacturing, logistics, planning) and preventive management to be realized. In the vertical value chain, we ensure a consistent flow of information and data from sales to product development, manufacturing, and logistics. It is said that there is a possibility that the quality and flexibility of information systems will increase and that the cost will be lowered due to the optimum connection of manufacturing systems, prevention of system failures, and improvement of analysis capability.

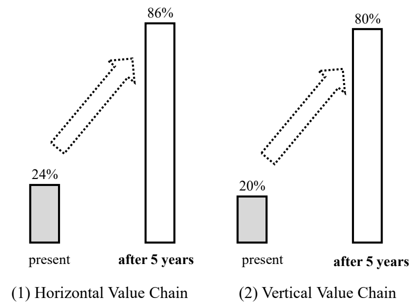

Figure 2 Digitalization of value chain

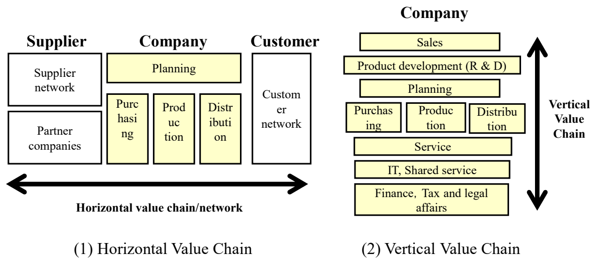

Figure 3 Horizontal and vertical value chains

2.3 Supply chain model in Industry 4.0

As described above, in Industry 4.0, it can be assumed that all conventional supply chain models are networked via the Internet. Figure 4 shows the conventional supply chain model. As shown in Fig. 4 (a), the base of the model has a network for each site, and between supply chains, it commonly is connected with in an extranet form via a gateway.

In comparison, in the supply chain model in Industry 4.0, the connection is an intranet one that ties together each site as one network. Furthermore, as shown in Fig. 5, at the manufacturing base, which is one of the elements of the supply chain, it is assumed that it is possible for each other to communicate up to a sensor/device with respect to communication by a dedicated server.

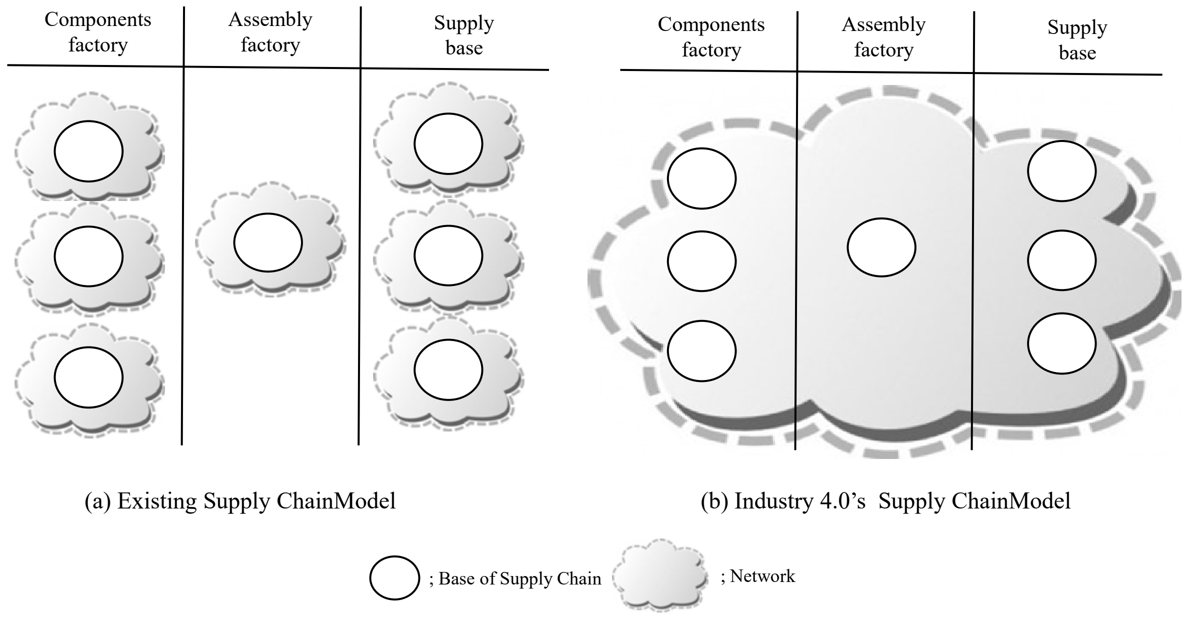

Figure 4 Supply chain model in Industry 4.0

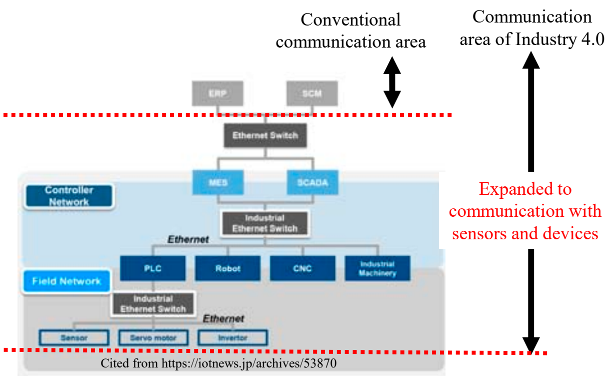

Figure 5 Supply chain model within manufacturing base in Industry 4.0

2.4 Security measures for Industry 4.0

Incidentally, Industry 4.1J is listed as a security measure in the current Industry 4.0 (VEC, 2015). Current problems with Industry 4.0 from using the Internet to connect control systems in a plant to the cloud include the threat of cyber attack, large capacity data not being transmittable in real time, and problems such as the inability to introduce secure communication OPC UA [OPC Unified Architecture, OPC (Object Linking and Embedding)] to all legacy systems.

In comparison, Industry 4.1J proposes a solution that connects control systems with private clouds and optical cables. By linking these systems to a private cloud server in 13 major countries, it will be possible to securely link the control systems of factories around the world. Furthermore, it is said that remote service from equipment and machine vendors can be securely implemented, and demonstration experiments are underway at NTT Communications, etc. (VEC, 2015). The current Industry 4.0 shows that a control system is connected with IP-VPN. As described above, security measures from a system viewpoint are mainly considered in the current Industry 4.0. In comparison, as shown in Figs. 4 (b) and 5, stakeholders and networks that are related to the supply chain are unified, assuming the supply chain model in Industry 4.0 in addition to security from a system viewpoint like Industry 4.1J. It is necessary to consider cost and how logistics change. Since it is assumed that the chain an become a network that extends not only within the enterprise but also between companies and even between countries, risk assessment assuming such a form is necessary, but so far, such consideration has not been made sufficiently.

3. Risk assessment of supply chain model in Industry 4.0

Here, the risk assessment of the supply chain model in Industry 4.0 is described. Specifically, in Industry 4.0, as shown in Figure 5, there is an exhaustive examination on what kind of risk is assumed / analyzed and an explanation of concrete measures to cope with them based on a case where an environment capable of communicating up to the sensors and devices in the site was established.

3.1 Extracting risk factors of supply chain model in Industry 4.0

Generally, extracting risk factors is most important among risk management, and it is difficult to select risk factors before service utilization. The flow from extracting risk factors to creating risk countermeasures is called "risk assessment." To extract risk factors, the risk breakdown structure (RBS) method, which is a typical method of risk management in project management, is used (Manick, 2011).

Figure 6 shows extraction results. In the first hierarchy of RBS, we classified risks from the perspective of humans, goods, money, information (ICT) as the management elements of general companies. For a human hierarchy, assuming a supply chain model in Industry 4.0, it is necessary to consider multiple stakeholders, not only within the same company but also across multiple companies. Furthermore, in Industry 4.0, it is assumed that the hierarchy spans multiple domestic companies as well as the same domestic companies. From the above, here, as the second hierarchy, we tried to segment and refine risk factors from a multi-stakeholder and multi-country perspective.

For the hierarchy of things, since we are targeting the supply chain model this time, we decided to classify risks from the viewpoint of logistics. From the perspective of logistics, it seems that realistic logistics and a logistics assumption based on cyber (IT) are supposed to be necessary, but this is also an initial study, focusing on cyber (IT) from the viewpoint of simplification. We decided to extract risk factors. Next, in Industry 4.0, as shown in Fig. 5, we supposed to be within a base, such as a factory. In other words, communication with sensors and devices in a factory became possible, and it was decided to consider risk factors taking into consideration that these span across multiple factories. Specifically, the network in the factory is defined as factory automation (FA), and in Industry 4.0, when this FA crosses a plurality of bases (Multi FA), as shown in Fig. 5, the sensors in the FA or when the communication is expanded to the device (Expansion FA).

For the hierarchy of money, as well as the tier of goods, we extracted the risk factors with a focus on cyber (IT). In the information (IT) hierarchy as well, we extracted risk factors similarly to the goods hierarchy. As a result, as shown in Fig. 6, 22 risk factors were extracted. Table 2 provides details on these factors.

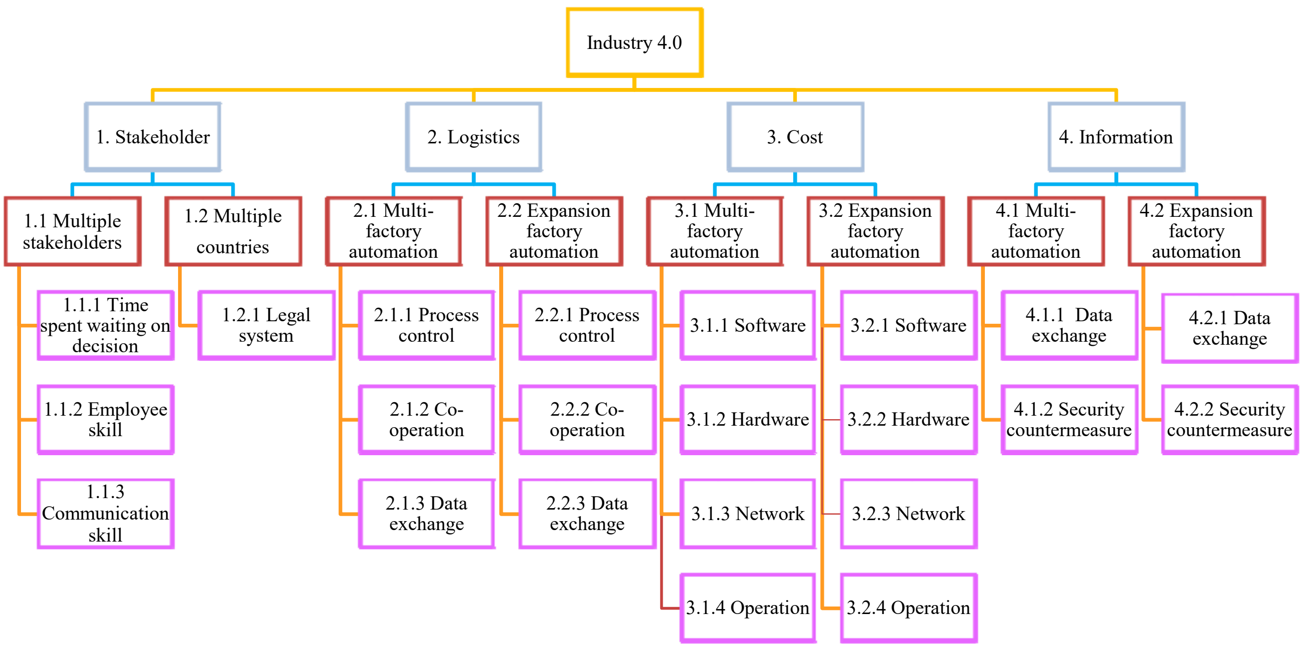

Figure 6 Results of extracting risk factors in supply chain model in Industry 4.0

Table 2 Details of risk factor

No	High Level	Middle Level	Low Level (Risk Factor)	Details on Risk Factor
1	1. Stakeholders	1.1 Multiple stakeholders	1.1.1 Time spent waiting on decision	Due to Industry 4.0, decision-making time will be issue because there are multiple stakeholders
2			1.1.2 Employee skill	Difference in ability of employees arising from multiple offices will be issue
3			1.1.3 Communication skill	Communication among multiple offices will be issue
4		1.2 Multiple countries	1.2.1 Legal system	When spanning multiple countries, difference in legal systems [EU's GDPR (*) etc.] enacted in each country will be issue
5	2. Logistics	2.1 Multi-factory automation	2.1.1 Process control	As target is communication with devices and sensors, standardization and connection with existing facilities are issues
6			2.1.2 Co-operation	As target is communication with devices and sensors, access control, such as authentication, is issue
7			2.1.3 Data exchange	Regulatory considerations on customer data etc. concerning privacy protection based on legal system [EU GDPR (*) etc.] enacted in each country are issues
8		2.2 Expansion factory automation	2.2.1 Process control	As target is communication with devices and sensors, standardization and connection with existing facilities are issues
9			2.2.2 Co-operation	As target is communication with devices and sensors, access control, such as authentication, is issue
10			2.2.3 Data exchange	Regulatory considerations on customer data etc. concerning privacy protection based on legal system [EU GDPR (*) etc.] enacted in each country are issues
11	3. Cost	3.1 Multi-factory automation	3.1.1 Software	As target is communication with devices and sensors, new communication software (drivers etc.) will be necessary, and appropriate expenses are issues
12			3.1.2 Hardware	As target is communication with devices and sensors, new hardware, such as gateways, will be necessary, and appropriate expenses are issues
13			3.1.3 Network	As target is communication with devices and sensors, implementation of new protocols and connection with existing network costs are issues
14			3.1.4 Operation	As target is communication with devices and sensors, network management of architecture is issue
15		3.2 Expansion factory automation	3.2.1 Software	As target is communication with devices and sensors, new communication software (drivers etc.) will be necessary, and appropriate expenses are issues
16			3.2.2 Hardware	As target is communication with devices and sensors, new hardware, such as gateways, will be necessary, and appropriate expenses are issues
17			3.2.3 Network	As target is communication with devices and sensors, implementation of costs of new protocols and connection with existing network is issue
18			3.2.4 Operation	As target is communication with devices and sensors, network management of architecture is issue
19	4. Information	4.1 Multi-factory automation	4.1.1 Data exchange	Regulatory considerations on customer data etc. concerning privacy protection based on the legal system (EU GDPR (*) etc.) enacted in each country are issues
20			4.1.2 Security countermeasures	As target is communication with devices and sensors, security measures are issues
21		4.2 Multi-factory automation	4.2.1 Data exchange	Regulatory considerations on customer data etc. concerning privacy protection based on legal system [EU GDPR (*) etc.] enacted in each country are issues
22			4.2.2 Security countermeasures	As target is communication with devices and sensors, security measures are issues

*; GDPR (General Data Protection Regulation)

3.2. Risk analysis of supply chain model in Industry 4.0

Figure 6 and Table 2 show the results of risk analysis for the risk factors of the supply chain model in Industry 4.0. As for the risk analysis method, a method using a decision tree and one using a risk matrix are representative. The former is based on a quantitative viewpoint, and the latter is based on a qualitative viewpoint (K. Awati, 2009).

In this paper, we use a risk matrix method based on a qualitative point of view, especially in the supply chain model in Industry 4.0 for smart grids since we deal with issues of security in particular. As shown in Figure 7, the risk matrix method classifies risk into four categories, Risk Avoidance, Risk Mitigation, Risk Transference, and Risk Acceptance, depending on the frequency of occurrence and the degree of influence, and it formulates countermeasures. Table 3 shows the results of risk analysis based on the risk matrix.

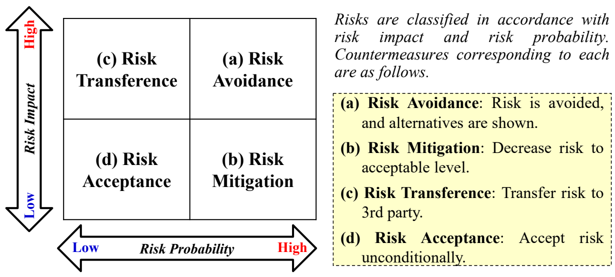

Figure 7 Risk matrix method

3.3 Consideration

As shown in Table 3, the risks associated with the supply chain model in Industry 4.0 are primarily technical countermeasures, which are an urgent issue. The feature of the industry 4.0 is that a sensor and a device newly constitute an object for communication as mentioned above. For this reason, the actual proof experiment is conducted in Industry4.1J. In this experiment, the issue about networks, such as deployment of OPC UA (Object linking and embedding Process Control Unified Architecture) and

Table 3 Risk analysis result

No	Level 3: Risk Factors	Risk Impact	Risk Probability	Classification of Risk Matrix	Proposed Countermeasures	
					Main Countermeasure Contents	Classification of Countermeasure
1	1.1.1 Time spent waiting on decision	High	Low	Risk transference	Establish decision making flow across multiple companies	Operational aspects
2	1.1.2 Employee skill	High	Low	Risk transference	Establish standardized labor skill guidelines etc. across multiple companies	Operational aspects
3	1.1.3 Communication skill	High	Low	Risk transference	Establish communication method spanning multiple companies	Operational aspects
4	1.2.1 Legal system	High	High	Risk avoidance	Establish data portfolio on supply chain	Technical aspects
5	2.1.1 Process control	High	Low	Risk transference	Establish communication protocol for sensors/devices and establish connection method with existing network	Technical aspects
6	2.1.2 Co-operation	High	Low	Risk transference	Strengthen access control such as authentication	Technical aspects
7	2.1.3 Data exchange	High	High	Risk avoidance	Establish data portfolio on supply chain	Technical aspects
8	2.2.1 Process control	High	Low	Risk transference	Establish communication protocol for sensors/devices and establish connection method with existing network	Technical aspects
9	2.2.2 Co-operation	High	Low	Risk transference	Strengthen access control such as authentication	Technical aspects
10	2.2.3 Data exchange	High	High	Risk avoidance	Establish data portfolio on supply chain	Technical aspects
11	3.1.1 Software	High	Low	Risk transference	Develop sensor and device drivers for communication	Technical aspects
12	3.1.2 Hardware	High	Low	Risk transference	Develop gateway device for sensors/devices	Technical aspects
13	3.1.3 Network	High	Low	Risk transference	Establish communication protocol for sensors/devices and establish connection method with existing network	Technical aspects
14	3.1.4 Operation	High	Low	Risk transference	Strengthen access control such as authentication	Technical aspects
15	3.2.1 Software	High	Low	Risk transference	Develop sensor and device drivers for communication	Technical aspects
16	3.2.2 Hardware	High	Low	Risk transference	Develop gateway device for sensors/devices	Technical aspects
17	3.2.3 Network	High	Low	Risk transference	Establish communication protocol for sensors/devices and establish connection method with existing network	Technical aspects
18	3.2.4 Operation	High	Low	Risk transference	Strengthen access control such as authentication	Technical aspects
19	4.1.1 Data exchange	High	High	Risk avoidance	Establish data portfolio on supply chain	Technical aspects
20	4.1.2 Security countermeasures	High	High	Risk avoidance	Implementation of security functions for sensor devices	Technical aspects
21	4.2.1 Data exchange	High	High	Risk avoidance	Establish data portfolio on supply chain	Technical aspects
22	4.2.2 Security countermeasures	High	High	Risk avoidance	Implement security functions for sensor devices	Technical aspects

connectivity with the existing network, became clear. Moreover, such connection costs and operation costs are also undecided. Therefore, these are also risk factors.

As other risk factors are spread across several countries, as seen in the General Data Protection Regulation (GDPR) by the EU and the “A Consumer Privacy Bill of Rights” in the United States, discussions on personal data are held. It is necessary to keep in mind that this is actively done. Specifically, from the fact that the utilization of personal data in Europe and the United States plays an important role in the creation of new industries, data management in the supply chain model seems to be particularly important. That is, a portfolio of data considering a new balance between customer protection and industry creation is an important technical problem.

As described above, in the supply chain model in Industry 4.0 assumed at present, as the main risk factors, network connectivity, especially confirmation of standardization and interoperability, equipment cost, and the operation cost required for these, is undecided. In other words, since Industry 4.0 is a new infrastructure that is clarified and technical risks are the main issues.

4. Conclusion and future work

In this paper, we assessed the risks of the supply chain model of Industry 4.0. In particular, in Industry 4.0, unlike the conventional supply chain model, sensors and devices communicate with the Internet so a basic examination on risk assessment was done in consideration of these factors.

In Industry 4.0, the threat of cyber attack manifesting itself in closed environments within a conventional base (inside a factory, etc.) because sensors and devices now use the Internet in the formation of value chains in the supply chain model. Thus, in the supply chain model in Industry 4.0, the threat of cyber risk increases because the network expands. As a countermeasure against this, an extranet connection (extended version of closed network), such as Industry 4.1J is being considered, but the cost in this case is generally assumed to be high, and in terms of the connection (introduction) cost, the operation cost could be a risk.

Future work involves further refinement of countermeasures against the extracted risk factors and quantitative evaluation such as cost effectiveness.

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Process Improvement Methodology for Geographically-Distributed Development

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In software development, it is increasing to develop one software or solution by geographically-distributed development teams. But each development team's capability to allocate resources corresponding to project requirements is changed by depending on project period. Project manager is required to consider work assignment so that productivity of the whole project can be optimized. However, existing working process and decision making process of work assignment are depending on the past results of each team, and it sometimes is not optimized for each project condition. In this paper, I will consider development process with proof of concept for each team which was added the repetitive development method based on waterfall model in a distributed software development with Japan, China, Vietnam and India. With this proof of concept process for each team, productivity and capability of each team can be measured by standardized KPI, and it became possible to optimize to assign workload to geographically-distributed development teams.

Keywords and phrases: Distributed Software Development, Project Team, Communication with oversea, IT Project in Japan, IT Development process

1. Introduction

The project which I am working is software development for retailer's store management system. And this software will be delivered to global market. In this project, core team was in Japan and project manager was also in Japan. In addition, Japan team was in charge of every specification of the software, implementation of application platform and decision of development procedure which is align with corporate standard. Regarding development team such as detail design, coding and unit test was planned to use geographically distributed teams.

The software development process was planned to be waterfall model. So, at the end of function design phase, team should start detail design. In this project candidates of geographically distributed teams were from three locations such as China, India and Vietnam. Japan team as project manager was required to plan combination of offshore sites so that project cost, risk, period can be minimized.

To evaluate capability of geographically distributed teams and find out reasonable development team structure, I made proof of concept phase in advance of detail design phase, and by using such process I was able to complete this project's software development successfully. In this paper, I report out process of development and result of this project.

2. Background

2.1 Development process

The development process of this project was waterfall model which is standard process for large volume development. At the moment, there was another option to choose agile model as development process. Dave West and Tom Grant, Ph.D. (2010) reported that agile model development was adopted in 35 % of development projects in the research of the third quarter of fiscal year 2009. In this project, I chose waterfall model since the following reasons.

- ✓ Development size (total amount of application) was large.
- ✓ Project member's experience in Japan was almost waterfall model development.
- ✓ Tis project would like to challenge to develop application with geographically-distributed teams, so that I could build up most optimized teams from worldwide development site. So, I would like to minimize risk of project.
- ✓ High level design was almost fixed and it was assumed that rate of change of specification was low.

The definition of each development phase is shown in Figure 1. Function design phase was in charge of Japan team, and from detail design phase to unit test phase was in charge of geographically distributed teams. And in integration test phase, work was collaborated by Japan team and geographically distributed teams.

Japan team defined proof of concept in advance of detail design phase and planned to proceed in parallel with function design phase so that whole project period was not extended due to additional work.

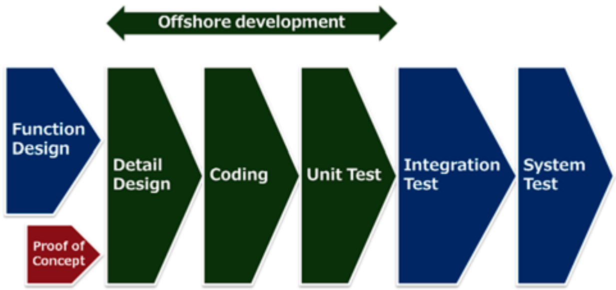

Figure 1 development process of this project

2.2 Software architecture

Regarding software architecture, Japan team developed application framework as shown in figure 2. The software which was developed in this project consisted of screen application, batch application and report application.

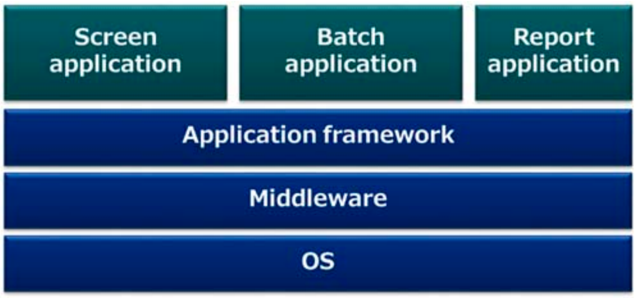

Figure 2 Application architecture

Development tools and guidelines were also developed and provided by Japan team

2.3 The issues of this project

In this project, three geographically distributed teams proposed to join this project. Project manager was required to consider each team's capabilities and reasonable assignment of works. On the other hand, it was required for Japan team's effort to evaluate each team, but Japan team's resources were limited.

To start up geographically distributed teams, I was required to transfer knowledge, explain development process, set up development environment and so on. Japan team was expected large amount of effort for starting up geographically distributed teams.

In this project, every document was created in English, and every communication was planned in English. In spite of that, some of team member in Japan were not good at communication in English. For utilizing Japan team's resources, it would be better that geographically distributed teams had capability to communicate in Japanese.

Regarding application framework, Japan team developed it in advance of detail design phase. So, to perform proof of concept in parallel with function design phase, it was required for Japan team to provide development tools or framework modules in advance. Because of it, there were risks that framework's or its guideline's quality was low and there were still defects in framework.

3. Study and knowledge on geographically distributed development

At the time of this project, most of development project were mainly Japanese team or using only Chinese offshore team which have resources who can communicate in Japanese. In addition, when project team consist of geographically distributed teams, differences of time zone are affected for project member's communication and it causes decreasing productivity of development. Regarding a geographically distributed development team, Miguel Jiménez, Mario Piattini and Aurora Vizcaíno (2008) organized the study and knowledge. And to visualize gaps of time-zone, there was knowledge of "Time-zone bubble chart" in accordance with Johanna Rothman (2012).

4. Geographically distributed development with proof of concept phase

4.1 Project planning

Based on the points and knowledge described earlier, I made project plans with consideration of the following points.

- ✓ At the end of Function design phase, the proof of concept phase was started.
- ✓ In the proof of concept phase, my team started up geographically distributed teams one by one.
- ✓ The proof of concept phase was started from the team which have less experience to collaborate with Japan team in the past project.
- ✓ Before starting proof of concept phase, small trial development was performed by Japan team.
- ✓ All of process and ways of evaluation of proof of concept phase were unified.

At the first, Japan team defined some indicators to summarized capabilities of each team. The indicators which I used is shown below.

a) Number of assignable resources
b) Experience of resources
c) Average cost of developer
d) Language capability for English
e) Language capability for Japanese
f) Result of previous project

In this project, software development was able to be categorized into three types of application, such as screen application type, report application type and batch processing application type. So, in “a) Number of assignable resources” and “b) Experience of resources” were confirmed for each type of application. In batch application development, a developer was needed to use original development tools which was original tools of the company, and developer’s experience was the key factor. Regarding “c) Average cost of developer”, this indicator was reflected the assignable resources. So it was not the same as general labor cost.

All of document such as design document, guidelines and development tools were in English. So, language capability of English was mandatory. And additionally, geographically distributed teams were required to communicate with Japan team which provides high level design to develop. In such situation, capability of Japanese was additional point which was nice to have, since some of Japan team member could not communicate in English and it took time to translate.

As the result of evaluation which was shown in Table 1, I decided that this proof of concept was started from Vietnamese team since they had the least experience to work with Japan team member, but the other conditions were seemed competitive as compared with India and China.

Table 1 Comparison of geographically distributed teams

Indicator	Vietnam	India	China
Number of assignable resources (screen)	Limited	Good	Good
Number of assignable resources (report)	Good	Good	Limited
Number of assignable resources (batch)	Limited	Limited	Good
Experience of resources (screen)	Good	Good	Good
Experience of resources (report)	Good	Good	Limited
Experience of resources (batch)	No experience	No experience	Good
Average cost of developer	Low	High (expensive)	Middle
Language capability for English	Middle	High (Good)	Low
Language capability for Japanese	Middle	Low	High (Good)
Result of previous project	Low	Middle	High (Well examined)

4.2 Schedule for proof of concept

I created to perform the proof of concept phase schedule as described in Figure 3. I planned proof of concept phase as three steps. The first step was startup preparation which was for ramping up team members. The second step was actual development for particular application. The final step was evaluation which Japan team and geographically distributed teams summarize the result of development.

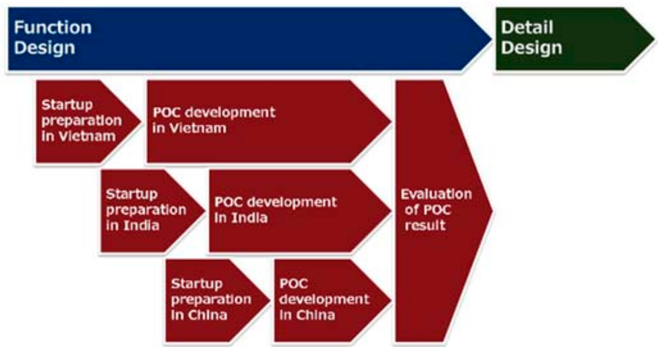

Figure 3 Schedule for proof of concept

4.3 Startup preparation

In the startup preparation, Japan team members explained about the process and how to develop applications. This team’s explanation was focused on the following points.

1. Schedule of proof of concept phase
2. Objectives
3. Success criteria and KPIs
4. Prerequisites
5. Scope of work
6. Team structure
7. Process flow of works
8. Definition of inputs and outputs in each task
9. High level design of software
10. Progress management rules
11. Issue management rules
12. Communication plan and rules
13. Configuration management rules

In these explanations, I tried to make clear the ground rule of proof of concept phase, and explained all of process, tasks and deliverables for developer in detail.

To get dispassionate result from proof of concept phase, all of information of this step for each geographically distributed team was carefully unified.

Regarding "1. Schedule of proof of concept phase", Japan team provided high level schedule and expected productivity of each task. geographically distributed teams planned detail workload and schedule by using that information. In "2. Objectives", I explained what I want to achieve in this phase and also this project. In "3. Success criteria and KPIs", I explained the KPIs which Japan team defined. Sample criterias which was used in this project were described in Table 2.

Table 2 Sample criteria of this project

No.	Criteria
1	An agreed schedule for each of task was kept.
2	Progress management was performed properly.
3	Reporting to Japan team, Q&A and consultations were timely and properly performed.
4	Quality of deliverables were met the quality indexes.
5	Development standards and project rules were compliant.
6	Communication with Japan team were performed properly and smoothly.
7	Potential process improvement / productivity improvement could be found.
8	Total cost effectiveness was reasonable.
9	Any risk factors were found out.

In "4. Prerequisites", I explained and provided information which was required to develop application such as PC, software and network environment. In "5. Scope of work", I explained the target screens, reports and batch applications which were developed in each team. In "6. Team structure", I provided information of project team structure and contact window of Japan team. In "7. Process flow of works", I explained detail process of software development from detail design to unite test, and figure out the touch point with Japan team as shown in Figure 4.

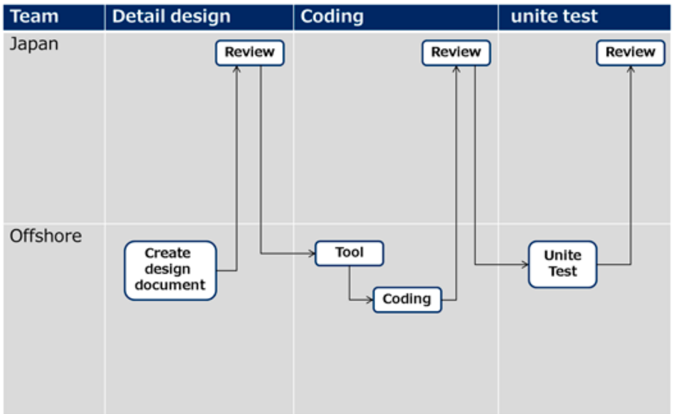

Figure 4 Process flow of works

In "8. Definition of inputs and outputs in each task", I defined and explained all of deliverables which each team should be received or develop. The inputs, for example, were development guideline for detail design, naming convention, coding rules, document templates, and samples. In "9. High level design of software", I explained architecture of the software, technical features, image of physical environment, and so on. In this section, I informed team member regarding function design in detail. From "10. Progress management rules" to "13. Configuration management rules", I explained all of project common rules which was defined by Japan team. This explanation was including how to use tools which were to maintain progress and deliverables or report issues.

4.4 POC development

In this step, Japan team was required to review deliverables from geographically distributed teams and answer queries from geographically distributed teams. In this project, the gap of time-zone between geographically distributed teams and Japan team were not so large. But, to provide prompt feedbacks and answers for all geographically distributed teams, I created the time-zone bubble chart as shown Figure 5, and planned working hours of Japan team members. When I created time-zone bubble chart, I put the business hour of each team so that I was able to understand the gap of time-zone easily.

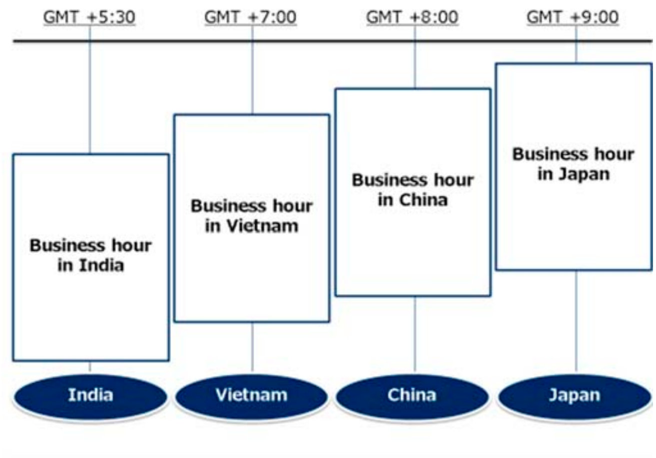

Figure 5 Time-zone bubble chart

4.5 Evaluation of result

In this step, Japan team summarized the result of POC development from the point of criteria and KPIs which were defined at the preparation step. And from this result, project manager was needed to decide assignment of development for geographically distributed teams.

5. Performance indicator

5.1 Result of proof of concept

At the end of proof of concept phase, I could get all of result of KPIs and criteria from each team. As the result, I could find out that even if a team did not have enough experience to work with Japan team, productivity could be achieved. And I could verify the actual productivity of each offshore team and capability to manage development. I could confirmed that if project manager decides geographically distributed teams based on their experience only, the decision might be different from this project and I could think that was not actually optimized for the project. The result of proof of concept phase was credible information for project manager. Project manager could make reasonable decision with that.

5.2 Feedback of this project

From the result of this project, I could find out some issues of process of proof of concept. I would like to report these issues as feedback and requirements for improvement.

1. Cultural gap of development process and resource allocation was found. In this development process, I had assumption that roles of developer were the same in each geographically distributed team. But actually, there were gaps regarding roles of developer. In this project, I had unified development process and guidelines, so one of teams was required to change their usual style and adapt to this project's style. I thought that this factor was caused reducing productivity for that team. To improve this point, I think that development process should be more flexible to be customized by each geographically distributed team.
2. Japan team's workload to support geographically distributed teams was larger than estimated. This project was the first trial to proceed proof of concept with geographically distributed teams, I could not estimate the Japan team's workload accurately. I expected this issue can be improved if project manager and team member experience more project and stores knowledge and results.

6. Conclusion

In this paper, I reported this project's development process improvement by using proof of concept phase with geographically distributed development. In section 2, this project background, features and issues were described. In section 3, the overview of study knowledge was reported. In section 4, this project's development process was described. I also reported the process I proceeded in detail and how I could make it with geographically distributed teams. As the result of this project, I found that some point should be revised or improved more. I am thinking that it needs to gather more counter-measure and more experience to resolve these problems.

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Localized Household Project Management: A Technology for Sustainable Municipal Development?

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This empirical study deals with justification of the household asset building activities (referred to as the household projects) as the technology for sustainable municipal development. Transformation of household resources into the source of local socio-economic development through habitualization of reasonable credit and consumer behavior practices is one of the most urgent, however insufficiently studied, issues for Russian cities and towns. The fundamentals of the project management theory, pragmatic institutional economics, reasoned action approach and the concept of sustainability are addressed as the key elements of the integrative theoretical framework. Qualitative research relying on the interviews with the community leaders of small depressed Russian monotown Gukovo (South Russia) had been focused on exploring how the local households can implement their asset building activities to improve their living conditions and rationalize their credit behavior. The research findings suggest the town administration's role as the parent organization in establishing a project office to help in interactions between the local people endeavoring to improve their housing conditions with other prospective interested parties, including local contractors, financial organizations and bureaucracy agencies. The main research finding is that localized household projects can contribute to the municipal development and to the sustainable development goals achievement.

Keywords and phrases: Schools of the Project Management, Local Socio-Economic Development Policy, Russia, Institutionalization of Household Projects

1. Introduction

In recent years, there is much interest among the researchers and practitioners in sustainable development concept, as well as in the project management theory applicability to regional and municipal governance. Increasingly unstable consumer financial behavior can result in inadequate and unstable assets and lead to asset poverty. Transformation of household resources into the source of local socio-economic development through habitualization of reasonable credit and consumer behavior practices is one of the most urgent, however insufficiently studied, issues for Russian cities and towns. However there is lack of theoretical and empirical literature which would emphasize the role of household asset building in context of sustainable development goals and treat the household asset building activities through the lens of project management theory.

The rationale for the research is provided by the fact that local authority and other local communities could be interested in household assets building (viewed as the localized household projects) if these assets and their further usage are consistent with goals and objectives related to local economic development, including officially stated ones. Given this understanding, portfolio of the households' localized credit projects might be viewed as an element of a municipal strategy for sustainable local development, with the role of municipal authority as the provider of financial and non-financial support for these projects.

The research site has been a small depressed monoindustrial town Gukovo located at the South of Russia, with a population of approximately 66 thousand people which was previously successfully developed with coal mining enterprises as the dominant enterprises. Nowadays the Russian government created a Priority Socio-Economic Development Area here (According to The Russian Government Resolution of January 28, 2016 № 45 "On creation of a Priority Development Area in Gukovo"), since socio-economic situation in the town is extremely bad, and urgent need exists to develop assets (in particular, to improve living conditions) for the people who live in the town.

2. Background

The concept of sustainable development originates from a synthesis of economic, social and ecological agendas (WCED, 1987), and nowadays grows in popularity in Russia, being broadly addressed by the Government officials' discourse on the Russian municipal development, as well as by public discussions around application of project management in municipal strategy planning. The background for these discussions is the need of ensuring sustainable local socio-economic development – as the declared priority stated by the Federal law of 2014 "On the strategic planning in the Russian Federation". The law emphasizes the importance of ensuring sustainable local development of constituting entities of the Russian Federation. This issue is of increasing relevance against the backdrop of the current socio-economic crisis, which aggravates the problem of lack of sustainability of consumer and credit behavior of the Russian households (see for more details Shafirov, 2014a; 2014b; 2014c; 2014d; 2015; Shafirov and Oganesyan, 2013). Given the federal, regional and municipal budgetary limitations, need for diversified sources for the local socio-economic development is evident, and one potential solution is activation of the household housing asset building activities partly financed by the purpose loans, based on the proactive networking of stakeholders concerned and intervention of local government in striving out all the potential policy and administrative support.

Experts' analysis of existing Russian city strategies (mostly written before 2014) (see Zhikharevich, 2015) highlights priority of the interests of various groups of citizens to serve as the basis for the process of strategy elaboration as one of the features of a "good" developmental strategy. Within a "proper" city strategy interested parties' interactions are viewed as a prerequisite for public-private partnership, with the organizing and coordinating role of the municipal authority emphasized. This is in line with the foreign practice in local economic development: according to Swinburn et al. (2006), local economic development success requires tailored approaches to local conditions, including, as one of its guiding principles, a range of short, medium and long-term projects to catalyze partnerships and build stakeholder confidence (p. 7).

It is worth noting that there is a range of institutions and measures the Russian Government implements to develop the project management approach in the federal, regional and municipal governance (see Table 1). All activities of these institutions are broadly highlighted by the federal and regional mass media and internet media. However, an important challenge we face today is whether the project management can provide a sufficiently adequate framework for local economic development.

Table 1 Public institutions and documents to promote project management approach in national, regional and municipal governance by the Russian officials

Public institution/document	**Date of establishment/issue**
National Standards of RF on the requirements on project portfolio management	2011 – approved by the Russian Government
Analytical Center under the Government of the Russian Federation, related departments of the Ministry of Economic Development and Agency of Strategic Initiatives	since 2012 – supporting the tendency to implement project management principles in the federal and municipal governance; since 2014 – conducts a contest "The Project Olymp" among the state-owned agencies and government institutions, regional and municipal administrations
Council on the Project Management Implementation in the Federal and Regional Government under the Ministry of Economic Development of the Russia	2013 – established
Methodical recommendations on project governance in the executive authorities	2013 – issued; a Decree on the approval of the Recommendations is issues in 2014 by the Ministry of Economic Development of Russia
Single-Industry Towns Development Foundation	2014 – established by the federal government; project offices have been created in various municipalities to manage the projects financed with the government support; primary concern is to seek ways and elaborate solutions to re-industrialize the economy and to revitalize social environment in monotowns; actively communicates with the residents of monotowns (including ordinary citizens) through the largest Russian web net "Vkontakte" (https://vk.com/dialog319)

Center for the Project Management of RANEPA	2016 – established to educate specialists on project governance
Department of the Project Activity under the apparatus of the Russian Government	2016 – established to provide support for the project environment to be build in the state authorities of different levels, to provide a link between the project governance and strategic planning, as well as to awake the initiative of the population – to form the feedback on the suggestions of the projects required from the people
Moscow School of Management Skolkovo	2016 – chief magistrates of the monotowns, deputies, governors and the commercial residents of the monotowns residents start to train in project management to be prepared to launch the new project for creating the new working places

3. Theoretical framework

Project management is applicable to a wide range of areas, including education and training (Bisschoff et al., 2004; Levi, 2009), institutions of public administration (Hedvicakova, 2013; Liviu and Liviu, 2012), public-community participation (Chakrabarti et al., 2009), public-private partnership (Henjewele et al., 2013), socio-economic issues (see for example FAO, 2001), including household and community level projects to improve livelihoods of the poor and contribute to sustainable development (e.g., Müller and Bock, 2010), social entrepreneurship promotion (Cruz et al., 2011), creation of opportunities for economic growth, fighting stagnant poverty and inequality (Khandker, 2009). However there is a research gap in investigating theory and practice of household asset building as the household project, and as one of the elements of sustainable local socio-economic development.

Within this paper, the focus is on the household asset building as the prerequisite for household long-term financial sustainability, as well as for sustainable local socio-economic development. Along with the concept of Sustainable Development (Du Pisani, 2007), literature on community studies (Jason and Glenwick, 2016; Lagae, 2012) and participatory development with the focus on its critique to provide practically useful approach (Aust, 2014), three theoretical pillars are addressed by the author as a part of integrated theoretical framework, as Fugure 1 shows:

- The elements of the project management theory, with the emphasis on the 2010 research on Perspectives on Projects – Nine Schools of Project Management (Turner et al., 2010); three selected schools of the Behaviour, Decision and Governance Schools have been selected, and literature on projects as social constructs (organisations, processes) are used (Gareis, 2005; Zwikael and Smyrk, 2012; Small and Walker, 2012; Turner and Müller, 2003; Müller et al., 2015);
- Literature on pragmatist foundations of the Original institutional economics (Gruchy, 1947; Mirowski, 1987; Garreta, 2007; Stanfield, 1999);
- Studies on the reasoned action approach (Fishbein and Ajzen, 2010; Ajzen, 2006; Francis et al., 2004a; 2004b; Ajzen and Klobas, 2013), including those showing the reasoned action model's relevance both for quantitative and qualitative studies (Zoellner et al., 2012).

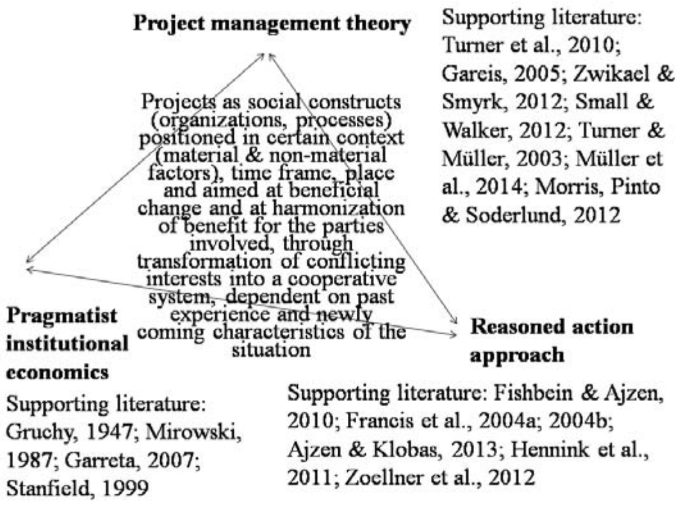

Figure 1 The overlapping research approach*
* Source: author's research

As the elements of the author's theoretical framework, the following points are suggested.

1. Household project – a temporary organization owned by the household, established on the initiative of household or project stakeholder/stakeholders interested in the

whole project delivery or interested in the part of activities of households within the project.

2. Household localized project – household project of which output and/or outcome are consistent with the local economic development goals
3. Household credit project – household project that is partly or fully financed by borrowed finance granted to the household.
4. Portfolio of households' localized projects (credit projects, in particular) – a group of household projects for residential construction or renovation, which use common resources, taken broadly as the measures of financial and non-financial support that could be provided by the local authorities viewed as the parent organization for the portfolio, and purpose loans as one of the financial resources for the project included in the portfolio.
5. Household credit project delivered within the portfolio – household project managed within the portfolio of household projects which financial resources are borrowings/loans granted to the household members by banking and/or non-banking institutions.
6. Household project output – the beneficial change in the household wealth, a new household asset that delivered by the project.
7. Household project outcome – the beneficial change in the set of household capabilities by the new capabilities obtained in the result of the project delivery, which when operated gives household benefits which pay for the resources consumed for the project implementation.

4. Research propositions

For the purposes of this research paper, the author's propositions are formulated as follows:

a. Over-indebtedness and unstable credit behavior have a negative impact on achievement of sustainable development goals declared by the municipal strategies of socio-economic development in Russian municipalities.
b. Institutionalization of reasonable credit and consumption practices among the local households can positively affect the goals officially declared as the goals related to sustainable regional and local socio-economic development.
c. Municipal authorities can contribute to the local socio-economic development, promoting and replicating sustainable credit and consumption practices among the local households.
d. Being implemented as the financial source for municipal development, target programs for sustainable credit can serve as the factor for increasing perceived performance of the local authority in the eyes of its people.

5. Methodology

For the current research, qualitative methodology (Richards and Morse, 2013; Maxwell, 2013; Bickman and Rog, 2008) had been applied to identify various perspectives related to common practices of local households, underlying beliefs and rules, as well as the expected role of local authority to change them. As the main strategy, inductive thematic analysis (Guest et al., 2012; 2013) is addressed in the research, with the textual data served as a proxy for experience.

The research site, as it is mentioned above, is a small depressed mono-town Gukovo, located in the Rostov region (South of Russia). The current study has relied on:

a) document analysis of Strategy of Socio-Economic Development of Gukovo Town till 2020 issued by the local administration, to support the proposition about the local authorities' interest in household housing assets building activities if these assets and their further exploitation are consistent with goals and objectives related to local economic development (LED), including officially stated ones, and
b) in-depth and semi-structured interviews with the 23 community leaders of the town to provide justification of the portfolio of the household localized credit housing projects as a key element of local socio-economic development policy. Community leaders are considered in this study as the key informants who are well familiar with the social and economic challenges the local households face with, and as the "opinion leaders" for the people who live in the town, that is, whom the

local households usually contact to obtain advice and information.

6. Research findings

During the data analysis, the research propositions have been strongly supported.

First of all, the interviews with the community leaders have revealed an urgent need for housing improvements and remedying over-indebtedness for the local people, as Figure 2 shows.

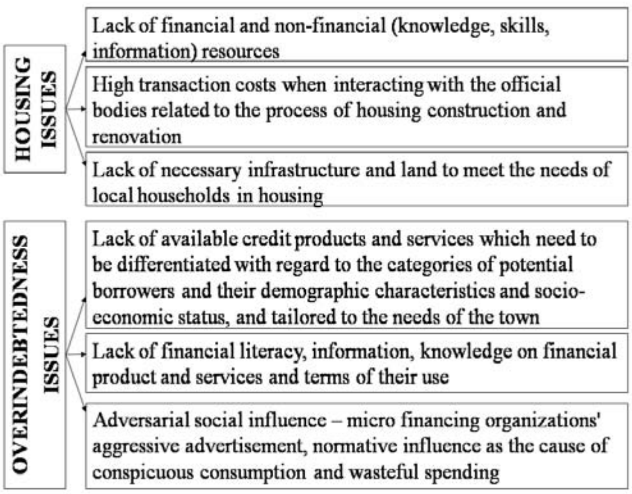

Figure 2 Housing conditions and over-indebtedness as important concerns for the Gukovo households: related themes emerged from the narratives provided by the interviewees*
* Source: author's research

Along with the importance of housing improvements (i.e., residential construction and renovation), other assets were emphasized by the interviewees as necessary for the well-being of the local households, such as better education and business start-ups. Based on the detailed analysis of the text of the strategic document, "Strategy of Gukovo till 2020", expected outcomes and outputs of these asset building activities by the households were matched with the officially stated objectives related to local economic development, as Figure 3 shows.

Figure 3 Correspondence between the LED goals stated by Gukovo Official Development Strategy and relevant expected outputs and outcomes of local household projects*
* Source: author's research

With household asset building activities being a pivotal catalyst, and borrowed money seen as one the sources to localized household projects, the evidence is provided for identification of the expected measures of targeted assistance from the town administration, if its representatives are assigned to support the housing projects for the people who live in Gukovo. Prospective role of local administration's representatives is seen as involving the following functions:

1. To facilitate coordination between the members of the local households (or their groups) and other parties involved (creditors, suppliers and contractors, bureaucracy agencies, including facilitating access to the objects of engineering infrastructure).
2. To provide informational support for the parties involved.
3. To control the fulfillment of the credit obligations by the households.
4. To implement monitoring of completion and efficiency of housing projects.
5. To promote and make efforts to replicate best practices of the use of credit resources for housing construction and renovation by the borrowing households to generate future incomes, ensure cost savings – i.e., to

promote rationalization of borrowing and consumer behavior and prevent wasteful spending.

Importance of target credit programs as the additional financial source for financing localized household projects has been proven as the factor for increased perceived performance of the local authority. The research findings are shown in Table 2.

Table 2. Target credit programs for financing localized household projects as the factor for increased perceived performance of the local authority

Target program for localized household project support	**Target indicator for assessment of the local authority's activity which may be influenced by the target credit program**	**Rationale**
Household project for insulation of dwelling. Household project for connecting the dwelling to the gas pipe. All types of household projects indicated below.	1. The number of small and medium-sized business enterprises (SMEs). 2. The share of SMEs employees in the average number of employees of all enterprises and organizations. 3. The share of tax and non-tax revenues of the local budget in the total volume of own revenues of the municipal budget.	Increase in consumer demand for goods, works and services offered by small and medium-sized local enterprises.
Credit for advance fees for the general repair of the common property assets in the apartment block.	Specific value of consumption of energy resources (electric and thermal energy, water, natural gas) in apartment buildings	Reduce in consumption of energy resources as a result of improvement of the energy efficiency of housing.
Household project for residential construction and renovation.	1. The share of the land plots that are subject to land taxation in the total area of the urban (municipal) district. 2. The total area of dwellings, an average of one resident, including housing units completed in a year. 3. The area of land for the purpose of construction. 4. Proportion of the population who owns dwelling and improves housing conditions in the reporting year (among in the total number of people who needs a shelter).	Increase in the number of residents of the territory who receives financial resources.
Household project for the private farm building or/and upgrading. Household project for gardening agriculture.	The share of the land plots that are subject to land taxation in the total area of the urban (municipal) district.	Increase in the number of residents of the territory who receives financial resources.

7. Practical implications and further research

Referring to the challenges for the Russian households which were addressed in the background section of the current paper, it can be outlined that the research findings can serve as a trigger to initiate implementation of the pilot housing projects in Russian depressed monotowns (Gukovo, in particular). Introduction of the proposed model of interactions between prospective stakeholders of housing projects, including loan providers, local suppliers and contractors, local employers, construction companies and neighboring households can positively affect living conditions, stimulate financial rehabilitation of the local households. If properly replicated, successful practices of housing projects may therefore promote regional and municipal sustainable development. Increase in housing affordability and growing rationalization of the credit resources usage as the positive outcomes of the localized credit household projects can provide a strong rationale to view household asset building interventions as the element of municipal policy aimed at local socio-economic development, helping to reduce the load on the municipal, regional and federal budgets. Since there is, as a rule, deficiency in highly qualified human resources in the Russian municipalities located in depressed areas, it seems relevant to treat project management methods and techniques as the means to overcome dependency on "human factor" as well.

It is strongly recommended, within the framework used in this study, that:

1) pilot projects in Russian depressed monotowns are initiated, with the preliminary quantitative and qualitative field studies to identify the needs and prospects for financial rehabilitation of the local households;
2) other regional and municipal studies are implemented on the perspectives of household localized projects feasibility in context of interactions between the prospective stakeholders of these projects, including loan providers, local suppliers and contractors, local employers, construction companies and neighboring households.

It is important, from this perspective, to understand that the main idea of such interactions should be building of true public relations and public responsibility as mutually responsible social partnership – overcoming perception of vision of people just as "human resources", which might be a crucial factor to prevent social explosions.

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Building a Migration Organization and Communication Management in Large Scale Overseas SaaS Project

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The organization planning process of human resources management in the project is a process to build up the organization taking into consideration of requirements and constraints of necessary human resources, after grasping internal and external environment of the project and understanding status of stakeholders. Since the project that I have participated as a migration promotion team member was to migrate a large and mission-critical system, it was necessary to carry out migration tasks in a wide range of areas, users 'system operation check and management decision "to Go" or " no GO" involving a large number of stakeholders including overseas SaaS vendors in a limited outage period.Among the restrictions mentioned above, we have formed a migration organization, which was the most important task in drawing up migration plans, by making full use of human resource and communication management techniques.Based on this experience, I am going to introduce what kind of planning and control practiced while carrying out organization management in "Overseas SaaS" and "Large Scale" migration with some case examples.

Keywords and phrases:SaaS, Migration Organization , Migration Plan, Project Human Resource Management, Communication Management

1. Introduction

In recent years, system renovation of a large-scale core system accompanying the trend of system cloudization to overseas SaaS is an unusual case.

In particular,the client operating the large-scale core system in creating the migration plan will present rapid migration requirements with less business impact than the mission-critical characteristics of the system. However, migration tasks involving a large number of stakeholders, including overseas SaaS vendors, involve a lot of communication channels due to task dependency and relevance, and the time course of communication does not match the migration requirement.

In this paper, based on the experience that I have gained as a client migration promotion team in the project which shifted from the large-scale core system to the overseas SaaS, I introduce the communication management which reduced the risk of the migration task in the overseas SaaS renewal project.

2. Project overview

An image of the system renewal project that I have participated is shown in Figure 1. Large scale mission critical systems are replaced with overseas SaaS systems. (Some will replace the infrastructure system)

Currently there are more than 200 impacted systems which have IF to core system, and at the time of system switching, they switch to a system that replaces the new system at that timing and a refurbishment system that includes new requirements. It is a large-scale project requiring six years as a project period.

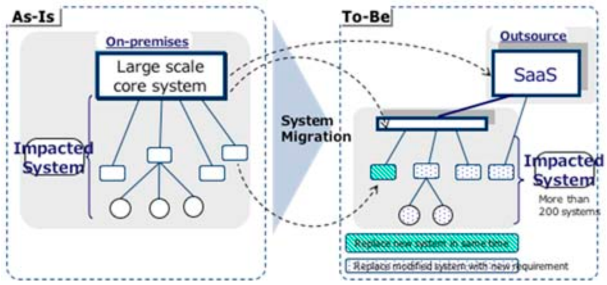


Figure 1 Migration Image Picture

3. Overview of system migration requirements

Requirements for system migration are to be completed within only 13 hours from beginning of the migration task to the end of them in order to minimize the business impact.

As migration tasks that must be completed within 13 hours, there are system migration tasks including the release of the new system from the outage of the current system, operation verification of the system after the migration tasks, management

Go/No go decision, incident handling and announcement system users and customers with business impact.

At migration period, checkpoints are defined, and the task status of each checkpoint is checked and approved by the program manager, and in # 4, it is necessary to judge the GO / no Go of the new system from the operating situation. (See Figure 2)

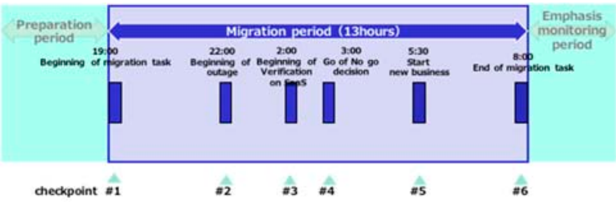


Figure 2 time schedule at the migration

Particularly, the time constraint is strictly between # 3 and # 4, and the time schedule is as follows.

1) # 3 After confirming start of operation - start / end of each team operation check
2:00 - 2:15
2) Operation confirmation end ~ Each team checkpoint judgment / sending
2:15-2:30
3) Acceptance of judgment result - Completion of information aggregation
2:30-2:45
4) Judgment of # 4 Go ~ Completion of team awareness of judgment result
2:45 - 3:00

With the above requirement, while consolidating a wide range of work situation with system personnel of more than 200 systems, operation management team, SaaS vendor, the operation management department outside the program, the system maintenance department, the client executive, public relations etc. It is necessary to link the information properly.

4. Construction of migration organization

Human resources management project team formation is a process of constructing organizational structure while considering requirements and constraints of necessary personnel, based on the internal and external environment (the position within the company, external suppliers, etc.) in which the project is located, and we organize and recognize the technical role of stakeholders.

In this case, we organized the requirements based on the project organization and built a migration organization. There were three points in establishing the organization.

4-1 Migration Center

In order to achieve the migration requirement shown in section 3, we have constructed a migration organization centered on "migration center" from the viewpoint of communication efficiency.

Although there were a lot of systems, by grouping them, 18 teams of "migration center" are formed to report by the group, instead 200 systems reporting command centers individually. Also, center chiefs assigned to each migration centers.

The grouping was based on a group of systems with a lot of migration task dependency. In addition, although system development team are different from the business management team and the SaaS vendor, in the migration organization each migration centers had system personnel /business management personnel/ SME (SaaS vendor) to communicate frequently. That's why I gathered members of different specialists who handle the same function in one migration center. (See Figure 3)

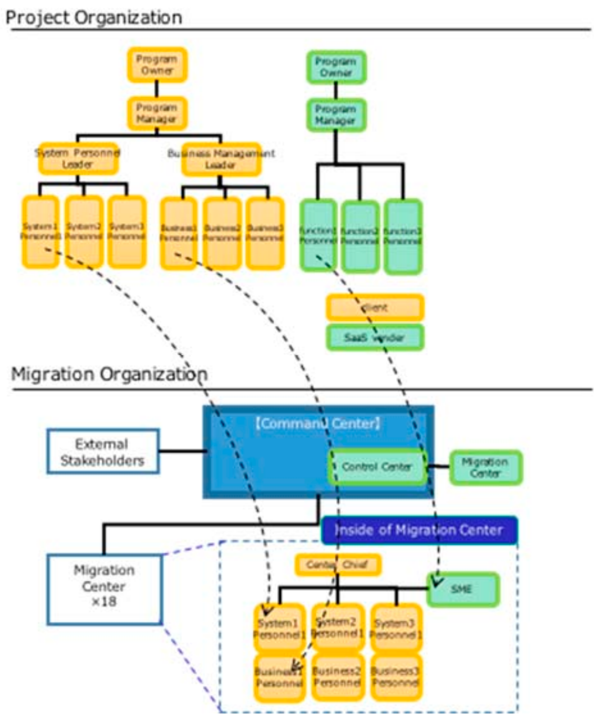


Figure 3 Shift image of Migration organization

By setting up a migration system centered on the migration center, we can see that the number of communication channels has been drastically reduced compared to the team structure of each system.

Channels =n*(n-1)/ 2

Calculation formula of communication channel

1) System unit team organization

200*(200-1)/2=20000

2) Migration Center organization

12*(12-1)/2*18 + 19*(19−1)/2=1400

*Each migration center channel * 18 + each migration center and command center channel

An experience of communication management on above 2) Migration center organization channels will be explained in the next section.

4-2 SaaS vender

The SaaS vendor was a virtual team. There were more than 10 teams which were different cities in the world. In the communication plan within the SaaS vendor, it was out of the management target on the client side, but at the communication point with the client team, 2 points were taken into consideration when establishing the migration organization.

1)control center

Since SaaS vendor work progress and troubleshooting situation are the core tasks of the entire project migration work, we placed a control center so that information can be aggregated in one place. In addition, consideration was made to increase the efficiency of information linking by placing a SaaS control center inside the command center.

2)SME

Although SaaS vendor migration work was done at SaaS migration center, incidents were assumed to occur in the migration task within the client migration center and operation verification of the client impacted system and SaaS linkage.

Since it is necessary to respond promptly and it is indispensable to get support of specialist of SaaS function, SME of SaaS vender is assigned to each migration centers.

To enhance the ability to achieve as migration center, SME members gathered physically in the same place as where all members are located. (Collocation)

4-3 command center

We placed a command center to consolidate information necessary for decision making of projects sent from each migration center.

In addition to the aggregation of information at the command center, the command center is responsible for disseminating information to stakeholders outside the project (client upper executives, user department managers, public relations, etc.) and maintains consistency of information in external communication.

5. Communication management

PMBOK Guide defines communication management as "a process of defining information needs required by project stakeholders and defining how to approach communication".

We introduce case examples of "defining information needs" in 5-1 managed information, " defining how to approach communication " in 5-2 communication method / tool selection.

5-1 Management target information

There are three types of information that the command center should manage in the migration system, "migration task progress information", "incident information" and "check point report information". The timing when information is required and the information which stakeholders need are different.

5-1-1 Migration task progress information

Shared information: Management target migration task completion information

1)Information Flow: migration center → command center

2)Management method: Excel file

3)Transmission method: E-mail

4)Transmission timing: completion of the management target migration task

5)Points: The purpose of the command center is to grasp whether the main migration task is progressed smoothly or not. It’s decided that it is unnecessary for command center to manage all migration tasks considering the system scale. We conducted communication management on migration tasks related to GO judgment, which is the biggest checkpoint at the time of migration.

5-1-2 Incident information

Shared information: Information on events, it’s causes, and handling situation when unexpected events occur at the time of migration task or operation verification

1)Information flow:

[Event, cause, response status report]
migration center - SaaS vendor - migration center - command center
[Incident notification]
Command center - migration center, users etc.
2)Management method: incident management tool
3)Transmission method: incident management tool Workflow, mail, telephone, ad hoc face-to-face report
4)Transmission timing: when incident is detected
5)Point: It is judged that it is unnecessary to grasp all incidences from the viewpoint of other task priority. Incident evaluated in four levels according to magnitude of business impacts and only first 2 levels incidents are to be managed. There are also cases where SaaS vendor's fix cannot be provided in time, so we decide WorkAround and include it in the incident information to notify the user.

Although the tool was used as a management method, since it is necessary to make judgment in a timely manner, it allows to report incident face-to-face first and input its information after no to disturb migration activity.

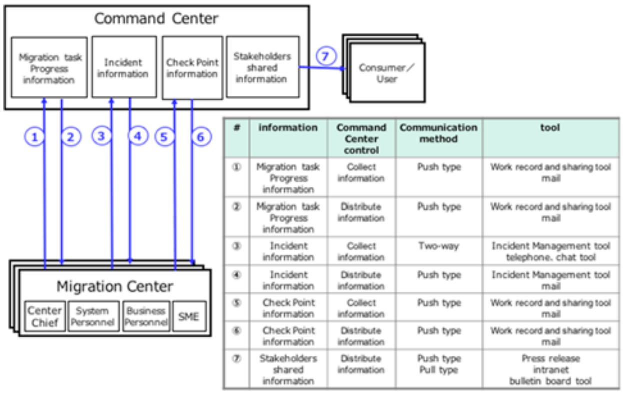
5-1-3 Checkpoint information

Shared information: Check point passing judgment input information
1)Information flow:
[Check list information aggregation]
members - center chief - command center
[distribution of judgment result]
command center - migration center - members
2)Management method: Excel file, work record information sharing tool, meeting (checkpoint MTG)
3)Transmission method: Notification function of work record information sharing tool
4)Transmission timing: 15 minutes before checkpoint
5)Points: As a report summary, we have defined format for organization / environment / data / work / administration management. It allows only OK/NG to be entered, which enables quick and easy reporting. In checkpoint MTG, we focused on “NG” matters so that we could shorten the meeting to share that information.

5-2 Communication method / tool selection

We utilized various tools to smoothly share our generation/collection/distribution/storage/retrieve migration information in more than 1000 members of migration organization. It is essential to select the tool to be used according to the application and to make effective use of it.

The following three communication methods were chosen, and the optimum tool was selected according to each method.
1)Two-way communication
Telephone, instant message, face to face
2)Push type communication
Report, e-mail, press release
3)Pull type communication
Intranet site, bulletin board
The selection result is shown in Figure 4 below



#	information	Command Center control	Communication method	tool
①	Migration task Progress information	Collect information	Push type	Work record and sharing tool mail
②	Migration task Progress information	Distribute information	Push type	Work record and sharing tool mail
③	Incident information	Collect information	Two-way	Incident Management tool telephone, chat tool
④	Incident information	Distribute information	Push type	Incident Management tool mail
⑤	Check Point information	Collect information	Push type	Work record and sharing tool mail
⑥	Check Point information	Distribute information	Push type	Work record and sharing tool mail
⑦	Stakeholders shared information	Distribute information	Push type Pull type	Press release intranet bulletin board tool

Figure 4 Communication tool

6. Implementation result

The summary in this paper is as follows.
Requirement:
Because time is limited, prompt and accurate communication is required
Problem:
The project organization becomes complicated and had too communication channel to execute migration tasks.
Strategy:
Make Migration Centers to reduce communication channel. Select appropriate tool and organize information for migration organization
Effect:
Completion of migration tasks within 13 hours

The certainty of the strategy was verified by three rehearsals, and each migration rehearsal was used to find out the improvement of the migration structure and communication management. The purpose of migration rehearsal and improvement points and as follows.

6-1 Purpose of rehearsal

The purpose of rehearsal is as follows.

·Validation of the migration center structure
·Trial of communication within migration center
·Validate communication tool
·Communication trial with user management department
·Simulation with the same members as the actual migration
·Hand over to operation maintenance member

6-2 Improvements

The improvements of rehearsal is as follows.
·The organization in the migration center was not aged and communication in the migration center was not functioning
·For migration center chief, it was difficult to manage and judge about some systems which the chief unknown
·Between SaaS vendor and migration center communication required more time
·Between the person who detected the incident and the SaaS vendor communicated in communication management tool, but the correspondence result was sent only detecting incident person and there were no announcement effectively in the migration center.
·It was difficult to grasp the progress of the whole and the situation of one migration center as seen from the other migration center
· If multiple incidents happen at the same time, it can not be timely listed in the incident management tool
·In case of incident happen business member couldn’t understand the incident information which the system personnel wrote in incident management tool.
· Evaluation criteria of each migration center was not fixed at decision making.
·It was not possible to deal with tasks that focused on decision making timing at the command center in a short time, and the operation of the decision-making meeting could not be performed smoothly.
· It was impossible to properly carry out the sharing of the incident information to the business person and the confirmation of the business impact at the occurrence of the incident.
·Migration center member were unable to grasp the overall migration situation and the judgment of the incident across the migration center was delayed.
· There were multiple reporting methods for each command center and SaaS vendor from each migration center, so that they were lost in selection

6-3 Corresponding

Through three rehearsals, I improved the problem and refined the migration organization and communication plan.

The points of sophistication are the following two.

1)Teaming in migration center

Although we created the migration center for implementing the migration task, we decided on a new framework called "migration center" on the initiative of the project but lacked consideration on the team building, and in the first rehearsal, "communication in the migration center was not functioning". In the TuckMan model, team formation was expressed in the forming period / storming period / norming period / performing period / adjourning period, we could imagine "forming period = first rehearsal" "storming period = second rehearsal" "norming period = third rehearsal "performing period = real migration". The migration center had also gradually matured in such a way. The role and responsibilities of the transition center length were partly unclear in the formative period and there was a part unclear, and as a leader of the team building, the head of the transition center smoothly advanced the team building and solved the problem.

2)Correspondence of command center when multiple problems occur simultaneously

Although communication management could proceed with no problems including tool selection, functional problems in the command center occurred when there was a failure from 18 migration centers at the same time. Specifically, it was to transmit information with priority given to decision makers. About this problem, PMO in the command center was set in the command center as opposed to 18 migration center. Also, as necessary, a troubleshooting room was created in the command center and responded. The PMO in the command center organizes the information of the migration center, communicates it to the troubleshooting office in conscious of the priority, plays the role of the mitigation agent, clarifies the priority in the troubleshooting room, and makes it easy for the program manager to judge the information went.

During 3 migration rehearsals, we have reviewed the tool and improved the information sharing flow and migration organization. The result is introduced in this document.
(It is still in the state before the actual migration while writing this paper)

System migration of large-scale systems to overseas SaaS has been frequently undertaken recently, and for many project personnel, establishment of a migration organization at the time of system migration and communication management are important issues. I hope this article will help readers involved in similar projects from now on.

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Case Studies of Scope Management for Regional Shared Accounting System Implementation

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In recent years, the globalization of corporate activities is accelerating, and the development and optimization of IT systems at the global level is an important factor for maintaining and improving the competitiveness of companies. NTT DATA group to which the authors belong currently focuses on the integration of accounting systems at the regional level in order to realize optimization of IT systems among the group company. Generally, when we implement common business application to multiple countries, we have to consider the differences in local legal regulations and business practices for common system introductions. It might be need so much effort to standardize business processes among multiple countries. We have been implementing the project of the APAC accounting sharing system, which is the first project of the NTT DATA Group's global business application. Thus I will describe how can we organize the requirements from user company and has been implemented in the system, and how to solve the problem efficiently in this cases. In addition, I would like to share points that are important in anticipation of the future introduction of global shared business applications.

Key Words & Phrases : Global Project, Corporate IT, Shared Business Application System, Offshore Development, Scope Management

1. Introduction

The main business of NTT DATA Group has been dominant for Japan domestic market, but recently it has been trying to advance into the global market by focusing on M & A.

From this background, the needs for internal IT systems to support the global business of group companies is increasing, and how to prepare global optimized IT systems will become increasingly important in future IT which is becoming very important for strategy.

The internal IT department of NTT DATA to which the authors belong is NTT DATA's global IT team starting in April 2012 and establishing a Global Business Supporting Services-IT team. (Shimomori, T. et al., 2013) It has been organized that crosses overseas regions to aim for global optimization. In addition, as the first step in the global project, we have integrated global e-mail addresses and built a global knowledge management platform. (Ohira, M. et al., 2014)

The main activity area of these global IT was the IT infrastructure field, but we have started the integration of business applications. Particularly, there is also a movement to unify accounting standards globally. NTT DATA group aimed to realize an optimized IT system by implementing the common accounting system in each region.

Generally, business applications depend on the business process of each country or company, so it takes a lot of effort to standardize both business process and IT system. It is also difficult to consolidate all the requirements of each country and to implement them all in one accounting system.

In this article, we would like to introduce the outline of scope management, especially the approach of requirement arrangement and consolidation, the Key of success factor and the future challenge, etc, as an example of implementation of shared accounting system in APAC (Asia Pacific) region.

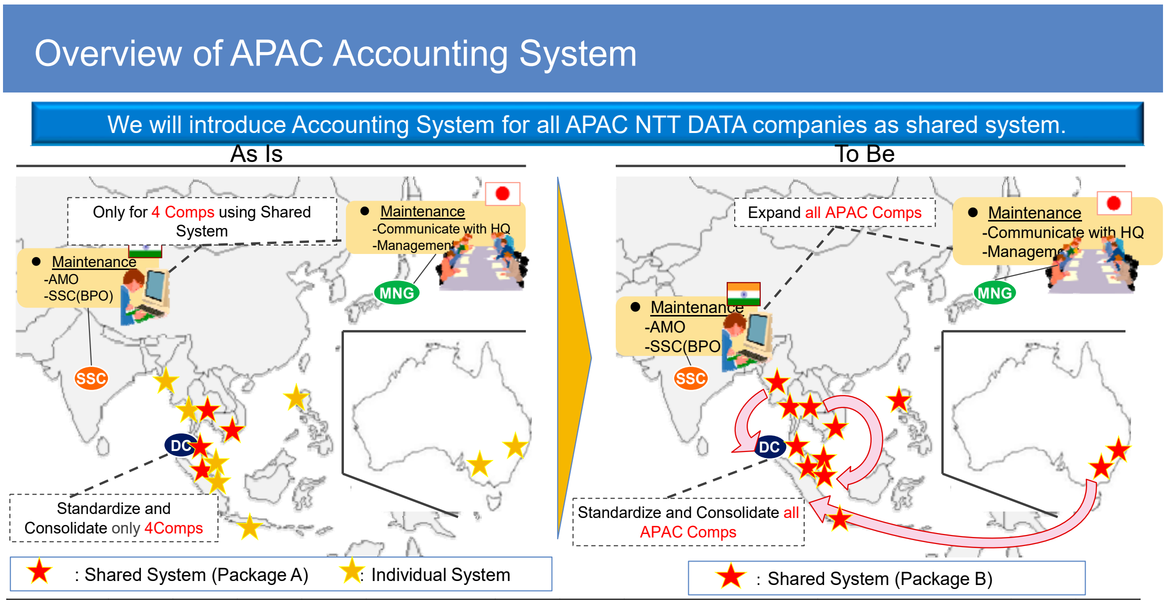
We would like to explain the project overall on chapter 2, and then explain a case of concrete implementation method of APAC shared accounting system and the evaluation after chapter 3.

2. Overview of APAC accounting system

2.1 Project overview

(1) In the APAC region of NTT DATA group from the beginning, there was a problem that the governance based on the business process and the accounting system was not integrated.

(2) There was a problem that accounting process and approval process had risks such as unfair accounting due to inappropriate approval due to



No	1	2	3	4	5		6	7	8			9			10	11
Company	A	B	C	D	E		F	G	H			I			J	K
					E-1	E-2			H-1	H-2	H-2	I-1	I-2	I-3		
Phase	Step1	Step1	Step2	Step2	Step2	Step2	Step3	Step3	Step4	Step4	Step4	Step4	Step4	Step4	Step5	Step5
Location	Singapore	Indonesia	Vietnam	Malaysia	Thailand	Thailand	Myanmar	Melbourne	Singapore	India	Japan	Singapore	UK	NZ	Singapore	Philippines

Figure 1 Project overview

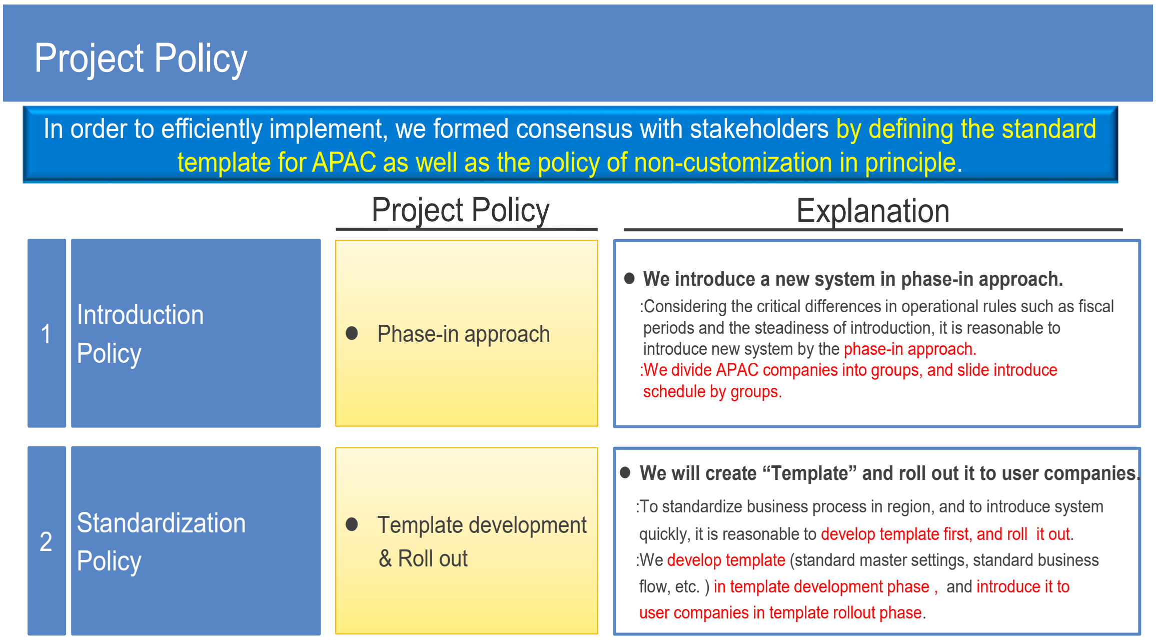


Figure 2 Project policy

there is no accounting system standardized for some APAC companies.

(3) In addition, each APAC company has its own accounting system which is the unique hardware and customized program, and due to duplication of such investment there was a problem regarding cost optimization among the APAC region.

In order to solve the above problem, we established the APAC common accounting system introduction project led by Japanese headquarters and aimed to construct globally optimized accounting system. (Figure 1)

The expected effect is as follows.

I. Strengthen governance in business operations and IT systems

II. Standardization of business process in accounting field

III. Optimal IT investment through integration of accounting system

Previously, only 4 companies are used the common accounting system in the APAC region, but through this project, all of the APAC companies were the target of scope of the shared accounting system.

2.2 Project policy and features

At the beginning of this project, we have decided the following two project policy. (Figure 2)

<Policy>

(1) APAC companies are divided into several groups, and accounting systems are gradually implemented

(2) Define the standard template (business process) and adopt it to all companies

As each country has different legal regulation, it is necessary to carefully conduct Fit and Gap analysis in standard business processes when introducing accounting systems. By setting standard templates of the APAC region, it is aimed at standardization of business operation which are currently operated individually by each companies.

Simultaneously, these also necessary to lead minimization of risk and optimization of cost. In addition, it is important to properly manage the scope that should be standardized as APAC and the template considering the parts to be implemented locally individually. The feature of the project are two point as following.

<Point>

(1) Local regulations and business processes of multiple countries in the APAC region.

(2) Policy in cases the individual company requirement.

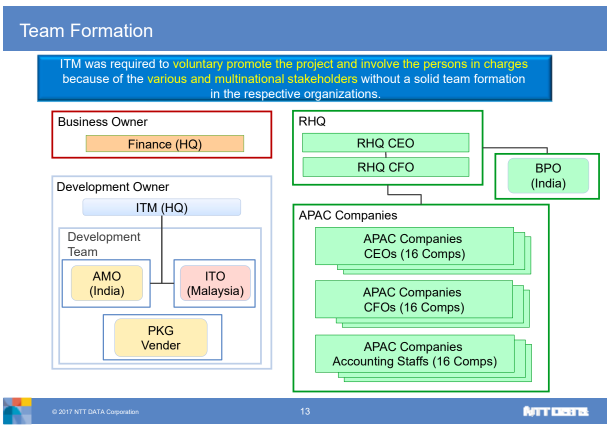


Figure 3 Team formation

It is important to understand the diversity of requirements of each APAC company (business by each company, accounting standards by country) and leveling them.

We thought it is difficult to implement a common system to all APAC companies at same timing, it would be necessary to leveling and scope arrangement step by step. Also, it is a project led by the headquarters with many stakeholders (Figure 3), the decision consensus process also becomes important.

Therefore, in order to introduce the system to these problems efficiently, we divided the phase of implementation, introduced the system step by step. A company which the business scale is small and implementation risk is low has selected the first phase company, then this development model was being template, also implementation know-how should be reflected to next phase.

Also there need to be arranged the scope of requirements that comes from country level or each company level for introducing the shared accounting system. To the reason mentioned above, we established the method to manage the requirements properly and applied it in this project as following. We determined the method should be “Innovative, Diversity, and Stepwise scope management (*)”

(*This is “Innovative Requirement Collection Matrix method”, so we named the method as “Inno-RCM” method)

From the next section, we describe the contents of the method of stepwise requirements definition (Chapter 3) and project management (Chapter 4) as examples of projects applying the above methodology.

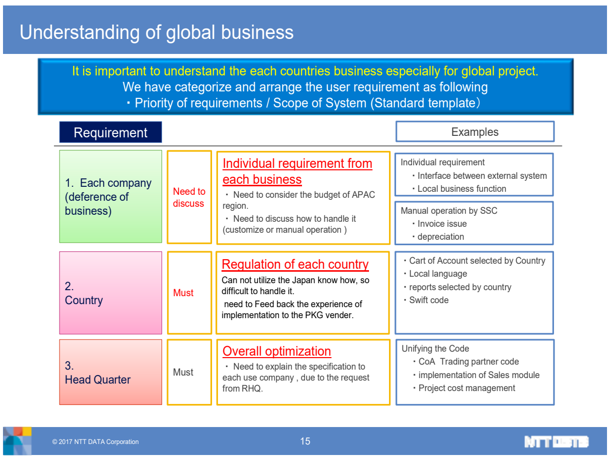


Figure 4 Process of classifying the requirement

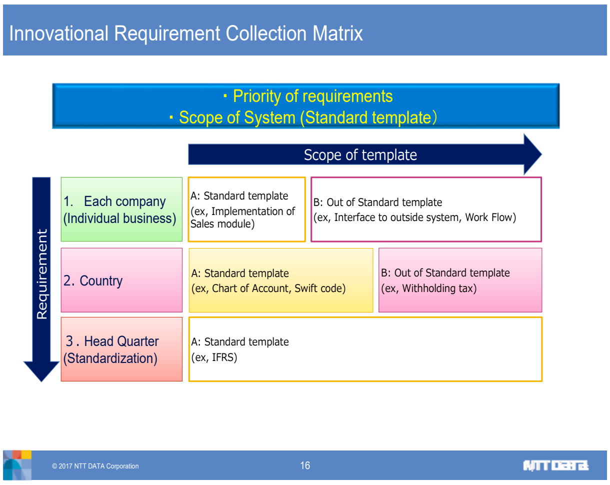


Figure 5 Requirement collection matrix

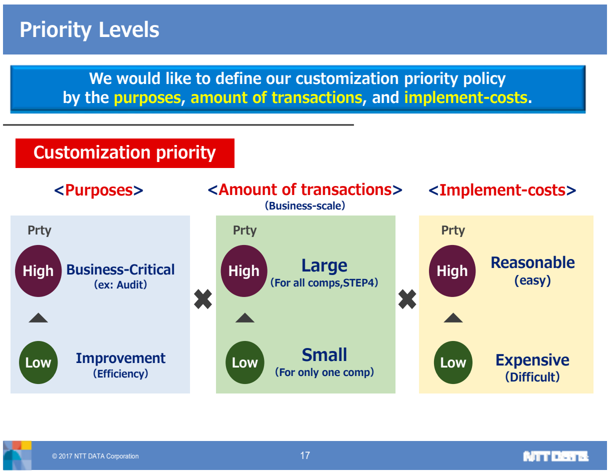


Figure 6 Policy of prioritize

#	Category	Function	Priority
1	Report	・Invoice, Tax Invoice, Debit Note, Credit Note	1
2	Report	・Cheque	3
3	Report	・Online payment data	2
4	Report (VC)	・Taxable Transaction detail※Individual Request	4
5	PKG	・Changing number of digit "Description"	2
		・ ・ ・	

Figure 7 Classification of priority group

3. Application examples of method

3.1 Case study for Vietnam (Case of scope organization, visualization)

When introducing accounting system, it is necessary to consider the regulations and business processes of each country and company, but if you try to include all requirements in the system, the accounting system will become too large.

As mentioned about the policy in the previous chapter, in order to achieve overall optimization, we proceeded to introduce it according to the policy based on utilize of standard template as much as possible.

We have adopted the Inno-RCM method to the project, so we would like to describe an example of Cart of Account setting for managing the requirement.

<Features>

There are country regulations for chart of account and reports in Vietnam, since there are many gap with accounting systems.

<Issue>

There are dilemma it is necessary to comply with the legal system of Vietnam although NTT DATA headquarter requirement which is the unification of chart of account in APAC region is also important.

<Arrangement>

The concrete arrangement process is as follows.

(1) Fit & Gap of standard templates for individual requirements.

(2) Classification of operational measures within the system or outside the system

At first, we checked the requirement using Inno-RCM method, examined whether the requirement is truly necessary or not Figure 4 and then, we arranged whether the requirement can be handled with the standard template or not Figure 5.

According to the Vietnam national regulation, the structure of the number of code is determined, there is a rule of outputting the account title name in Vietnamese. As a result of classification, it was arranged as follows.

<1> Setting of account code

This requirement was classified as a national requirement and categorized a standard template, so we planned it was scope of systemize (2. A in Figure 5).

<2> Output of Vietnamese name

This requirement was classified as a national requirement and categorized an outside the standard template, so we planned it was out of scope of systemize (2.B in Figure 5).

As a result, we decided to deviate from the unifying the account code in the APAC region, which is the head office requirement. However, we suggested a compromise proposal that creating mapping between common chart of account of APAC region and Vietnamese with some relevance, it has satisfied the headquarter requirements.

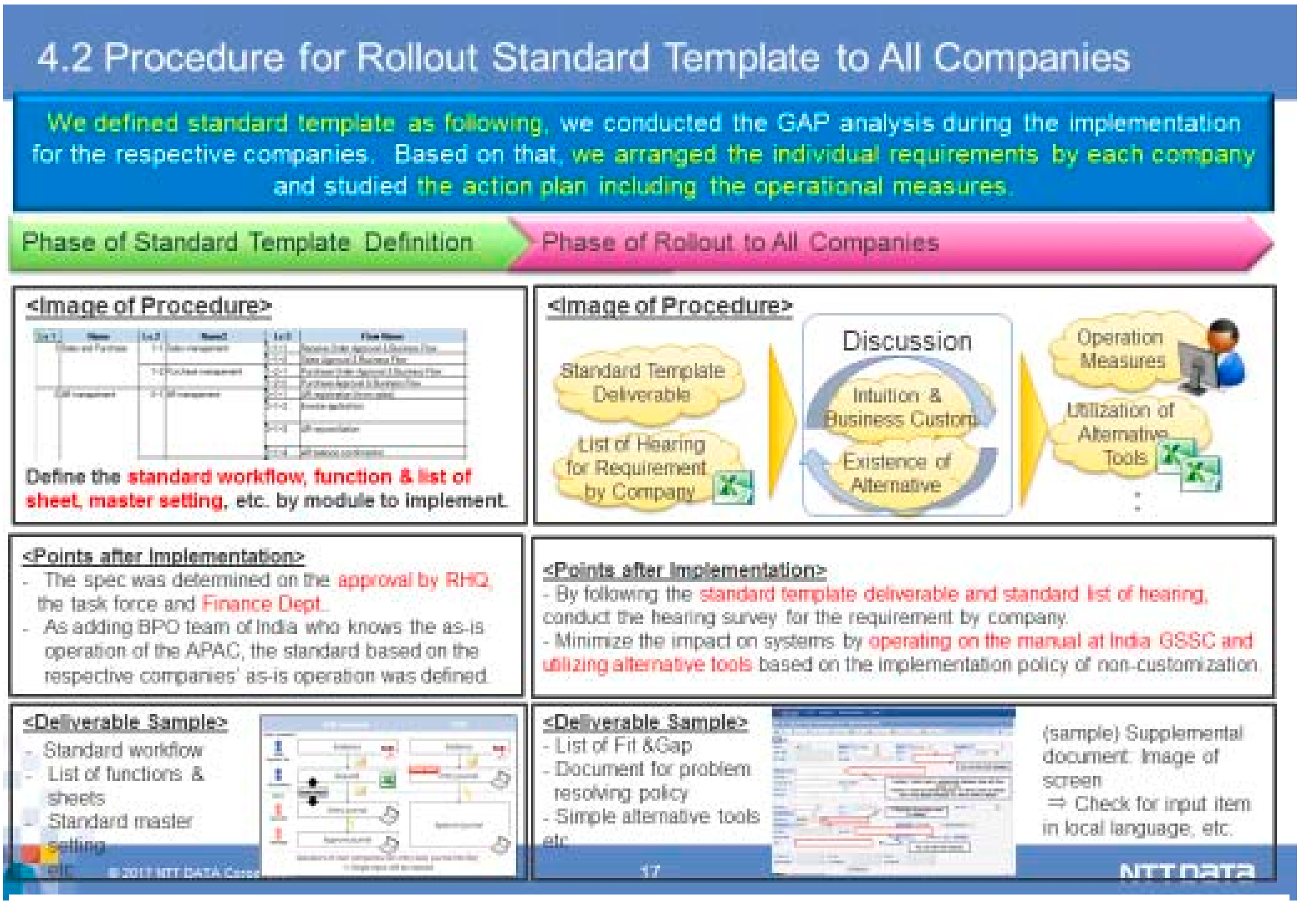


Figure 8 Procedure for rollout standard template to all companies

Table 1 Arrangement of issue

Improve	Issue	How to do
Phase1 -> 2 (Development phase)	-Luck of user understanding -Luck of system function	Measure of improving of user comprehension -set of the practice before UAT -extension of UAT terms -using actual data for UAT
Phase2 -> 3 (Operation phase)	-much operation out of system -late of response time for query	Measure of improving of operation and function -additional document for Audit -User support -Customize

3.2 Example of Invoice creation (prioritization)

In order to provide common functions for accounting system, it is required to promote project with a certain top down method. However, it is difficult to accept all the requirements for adding common functions related to multiple countries and multiple companies.

We managed by arranging the guidelines for determining the priority for the additional request from the user in this project. In this section, we would like to introduce the contents of the case of common invoice creation.

<Features>

Additional requests such as local reports occur frequently after system go-live. Reports such as invoices are indispensable for business purposes, and

it cannot be utilize the standard template functions.
<Issue>

APAC companies needs report which is common, general-purpose function especially invoice. When we extract the requirements, it is necessary to consider the differences in business practices of each company and prioritize the correspondence.

<Arrangement>

(1) Arrangement of additional functions and items
(2) Prioritize according to point of Inno-RCM method, and aspect of work volume and cost.
(3) Agreement with user about measure

For example, functions for submitting to external business partners like invoice, it is important to arrange and include the mandatory item into the system, and confirm that to each company. At that time, we have to decrease misunderstanding between user and us by interviewing at the user's point of view using prototypes, rather than explaining to the user with detail document such as design documents.

As for (2), we have decided the order of priority based on the requirement, and this is arranged by Inno-RCM method which is defined previous chapter. (Figure 6)

For each additional development function, we have assigned priority group by applying the target company, frequency, importance, cost, etc. (Figure 7)

4. Application of method (time and risk management)

This project has been proceeded for adopting scope management and implementation according to the following procedure.

<Procedure>

(1) Agreement with agreement and understanding with stakeholders
(2) Organizing and visualizing the scope
(3) Prioritization

Regarding (1), as we mentioned by the authors paper, we have carried out consensus building process and understanding with stakeholders. (Ohira, M. et al., 2016)

In the previous chapter, (2) described the process of arranging and visualizing scope, and (3) prioritizing process. We would like to describe the characteristic of implementation items in the phased introduction of this project. We divided the introduction phase into several phases, and situation is that the first and second phases has been completed.

<Phase Introduction>

· Reflect know-how to the next phase
· Check of actualization risk regularly

As shown in Figure 8, in the phase 1 (initial construction phase), business hearing was conducted for each company and a standard template was constructed based on them. We have been trying to reduce risk and costs by deploying them to companies in the subsequent phase.

In addition, as shown in Table 1, we divided the issues in the development phase and the operation phase, and resolved them by effective measures.

We clarified the timing of risk regularly before starting of each phase, and examined not only improvement of functional aspects but also operational aspects. Particularly, regarding to the introduction of a companies which business scale are bigger than previous phase, we predicted un-matching with the standard template due to increasing of operational load, so we were able to reduce risk by dealing in advance.

5. Evaluation of the effect

-Evaluatoin on the capter 3.1: (Scope managmenet by efficientry and logically)

By applying this method, we thought requirements could be properly classified. It can be said that it was effective especially for companies with special requirements like Vietnam.

-Evaluation on the capter 3.2: (Prioritize and user agreement)

Although there were demands for additional development due to user complains after operation, we were able to prioritise these requirement and implemented minimum number of additional functions by applying this method.

Based on such arrangement policy, it could be say that efficient and effective system introduction could be done by concentrating only on the requirements that truly needs to be addressed. To promote global projects, it is important to understand diversity and to arrange requiremnets logically and logically, and get consensus with user company with an appropriate process.

We were able to convince each user and stakeholders, and got concensus by providing the method (Inno-RCM method) and showing the way of thought. We evaluate that the method also could be adopt the implimentation of remaining APAC companies as a standaerd scope management method.

6. Conclusion

In this paper, we introduced the example of the introcuction of APAC Regional Common Accounting System, which was the first step of global IT activities in NTT DATA's business application field. and we describe how to manage the requirements scope of each countries.

This paper is related to "scope management" in the field of PMBOK, and this case study is assumed to be available for other similar global projects. We aim to expand global business in the future, so the importance of global optimized business applications is supposed to become important for the Group's IT strategy and other global companies.

We recognize that we should improve the following points in order to introduce it for furure large business scare company more efficiently and than before.

(1) Implementation of efficient operation.
(2) Improvive quality both in operation and function.
(3) Unification of future accounting standards

We would like to continually strengthen and develop the knowledge and experience of the global project.

Acknowledgements

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Visualizing Organizational Skill for Managing IT Projects

-Capability Maturity Model Targeting to Prevent Serious Problem Projects-

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Once after serious problem project (SPP), which caused enormous influences to a software developing company (SDC), the SDC practices countermeasures not to re-produce the same tragedy. However, within several years, the same tragedy happen and the same history repeats. Moreover, most of SDCs have histories to have been survived by just supplying resources to meet with demands from system development projects without taking project risks. The managements of such SDCs seems to give up stepping up to be higher project contractors, since they cannot understand how to enhance capability of project management. One of the causes of repeating such histories might be that individual goal of organizational capability maturity for managing IT projects are not visible for individual SDC. This paper tries to visualize organizational skill for managing IT projects. Specifically, we present a new organizational capability maturity model, based on our survey. After presenting suggestions for individual SDC to step up and prevent SPP sustainably, we discusses necessity to further develop and apply the model for software industry.

Key Words & Phrases: Capability Maturity Model, Organizational Project Management, Tacit Knowledge, Best Practices, Software Industry Development, Serious Problem Project

1. Introduction

In the software industry, most of software developing companies (SDCs), whose number is said to be more than 20 thousands in Japan, have been suffering the following problems.
(Problem No.1) Serious problem projects (SPPs) occur again and again.

Even major prime contractors, which represent Japanese software industry, have been threatened often by SPPs, which brought enormous losses to their businesses. History of such incidents have been repeated as follows.
Step1) An outbreak of SPPs.
Step2) The management empowers a PMO (Project Management Office) organization and requests the PMO to carry out its orders reactively.
Step3) After successfully decreasing the number of SPPs, the management reduces resources allocated to the PMO.
Step4) As the resources decrease, the power of project risk checks and inspections degrades. The project risk check is likely to become a mere formality, because the power of the PMO are weaker than before.
As SPPs are apt to reoccur due to the situation described above, the status will return to step 2). When this happens, the management is apt to be changed due to loss caused by the SPPs. The new management may establish a new inspection regime and reporting style for the project risk check, rejecting the system established by the former management. Thereafter the cycle shown in Figure1 repeats itself.

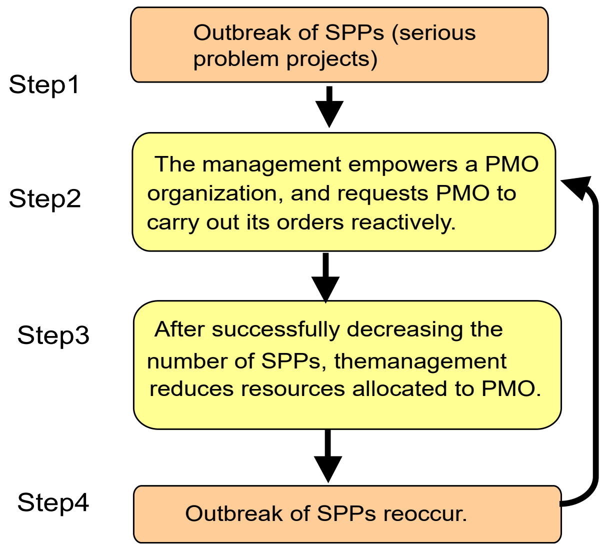


Figure 1 History of Repeating Outbreak of SPPs

(Problem No.2) Business declining due to lacking project management.

Most of the other SDCs, whose company scale are middle to small, do not aim to be major prime contractors, which take responsibility for project goals of software development. The reason is that the managements of such SDCs fear for business losses caused by project cost overruns, since Nikkei BP often said decision by the managements of SDCs to withdraw from contracting business for software development after project cost overruns in actual. One of the causes might be that it is not visible for the managements how to set a goal and how to achieve the goal for individual SDC, to improve organizational project management skill enough to be a prime contractor. Therefore, the SDCs sink in business without taking project management risk (only taking role of regulating amount of engineer resources to receive/feed, who are required for IT system development. e.g. just supplying software engineers to IT projects in the major contractors). Thus, more than 90% of the SDCs, including some companies listed in Tokyo Stock Exchange No.1, is said to give up to step up to upper level contractors with higher business value. However, if the SDCs continue their existing business without any change, their business may be contact fraud, since governmental regulation became to be strengthened by Worker Dispatch Law.

While those SDCs facing the problems mentioned above, there are best practices where the problems are solved by another SDCs. For example, the following cases are specified by our survey.

- Best practice case by stopping dispatch business.

There is a SDC whose company scale are smaller than the major prime contractors. However, the SDC made a commitment in its management charter that it never rely upon dispatch business by supplying engineers but actual contract by taking project management risk, and have been practicing the commitment actually.

- Best practice case of preventing SPPs.

There is another SDC which successfully have been preventing SPPs by practicing organizational improvement based on lessons learned from the past SPP cases.

It is necessary for the software industry to lead individual SDC to take project management responsibility and control and prevent SPPs ideally in the last stage. For the purpose, it is necessary to clarify hierarchy of organizational skill of individual SDC for managing IT projects. In this paper, after we show data which indicate relationship between organizational responsibilities and problem projects, we review current methods for organizational skill like CMMI (Chrissis et al., 2003). In the review, after we show that they cannot sufficiently identify the organizational skill to take project management responsibility and control SPPs, we show necessity to develop a new method to clarify hierarchy of organizational skill of individual SDC for managing IT projects.

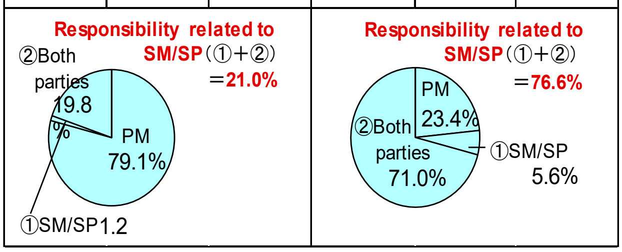
Thereafter, we propose a new organizational maturity model which visualize next target skill level to be accomplished so that individual SDC can recognize its current skill level and enhance the level step by step in the hierarchy of organizational skill for managing IT projects, by clarifying necessary organizational skill for each level in the hierarchy based on actual situation of the industry and our experience. Lastly, we discuss expected effects by our proposal.

2. Relationship between Problem Projects and Organization

There have been a research on relationship between projects and their organization by analyzing who are responsible for each of actual 193 cases problem projects (107 SPPs and 86 projects with less problem, which were summarized by members of IT project experts in a working group named "Project *Mieruka*" organized by Information- technology Promotion Agency, Japan (IPA)). In this research, the criteria of SPP is defined as either caused the delay of the customer service starting plan, resulting in enormous problems broadcasted by the news media, or caused a financial loss more than one hundred million yen) (Ohtaka and Fukazawa, 2011).

In the research, it is clarified that the ratio of cases where only project managers should be responsible decrease and, on the contrary, the ratio of cases where senior managers and salespersons should take responsibility increase in SPP compared with problem projects other than SPP, based on an assumption that responsibility of a project manager is defined in PMBOK (PMI, 2016) (Figure 2).

Break down of responsibility for 86 cases other than SPP			Break down of responsibility for 107 SPP cases		
PM	SM/SP	Both parties	PM	SM/SP	Both parties
68 cases	1 case	17 cases	25 cases	6 cases	76 cases



(note) PM; Project manager, SM; senior manager, SP; sales person

Figure 2 Break Down of Responsibility for Problem Projects

When we focus on 86 cases other than SPP in the figure, senior managers and salespersons were responsible for 21%. On the other hand, as far as the SPP cases are concerned, the senior managers and the salespersons were related to more than 76% of the SPP cases.

It is suggested that not only the project manages but also whole organization in which the senior managers and the salespersons are involved should practice project management for avoiding problem projects.

3. Surveying Current Methods

1) CMMI (Capability Maturity Model Integration)

CMMI proposes an organizational capability maturity model of SDCs focusing on engineering process. However, although it specifies five levels of the capability maturity based on sufficient process for software engineer, less process is involved in it as far as project management is concerned. For example, the CMMI just requires documents for software development plan, although the documents are not required to be produced and maintained based on process of project management (like scope, cost, time or any other management process in the PMBOK). In actual, we often observe that software products, which are developed in SDC organization with the certification of the CMMI level five, are released too late or with full of bugs. This is thought to indicate that project management of the organization is poor.

Therefore, it is difficult to undertake the CMMI as a method to identify capability maturity of project management for SDC organization.

2) OPM3 (PMI, 2013a)

Project Management Institute (PMI) shows a standard to identify capability maturity of project management in general organization by classifying targets of organizational management to “Project”, “Program” (PMI, 2008a) and “Portfolio” (PMI, 2008b) by OPM3 (Organizational Project Management Maturity Model). Four levels are defined (Standardization (S), Measurement (M), Control (C), and Continuous Improvement (I)) to identify organizational capability maturity regarding project management as illustrated in Figure 3.

Although the OPM3 may be a common standard for all industries or services including construction, medicine or any other firms, it is very hard for SDCs in the software industry to map the idea to their actual field. Thus, even if the idea of the maturity model is understood, at least Japanese software vendors or users could not apply the idea to step up their level of project management to the higher one in the industry. Actually, there have been no report proving that higher level organization in the OPM3 could decrease SPP much more than the lower level organization in the software industry.

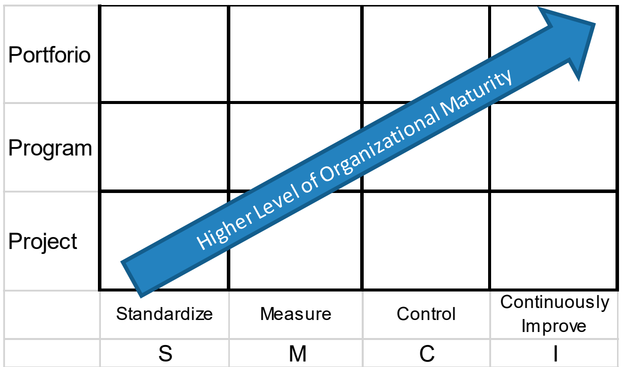


Figure 3 Organizational Project Management Maturity Levels in OPM3 (PMI)

Therefore, we need a new capability maturity model which can contribute to solve the problems to step up or to prevent SPPs, by closely investigating actual software industry.

4. Surveying Actual Software industry

Among software related enterprise firm, there are small business companies whose scale is too small to organize a software development project. Major business of such companies is consulting or dispatching business of engineers with special technology including information security If we exclude such small-scale companies, SDCs can be categorized as follows.

CAT1: SDCs which sink in dispatching business by supplying engineers, although their scale and engineering resources are sufficient enough to organize a software development projects. Such SDCs who gave up project contract business fill major part of the whole SDCs.

CAT2: SDCs which try to step up to be project contractors with decreasing dispatching business.

CAT3: SDCs which have achieved the stepping up. Most of major prime contractors are included in this category. As explained by Figure1, they suffer from periodical SPPs and repeating the same history.

CAT4: SDCs which try to prevent repeating the same

history of the SPPs.
CAT5: SDCs which have sustainably achieved preventing SPPs.

5. Identifying Organizational Skill and Proposal

Based on the categorization, there come up a question why each SDC in different category practices different business content. This may be caused not only by skill of project manager, but also organizational skill of project management (or governance) in individual SDC, as far as we surveyed. Based on this organizational skill (hereafter, we call capability maturity), individual SDC may be classified to either level in the following capability maturity hierarchy.
SDC LEVEL1: companies corresponding to CAT1.

The SDCs are sinking in dispatch business for just taking role of regulating amount of software engineer resources who are required for IT system development projects which are mostly managed not by project managers in their companies but by project managers in major prime vendor contractors of CAT3. Even if the SDCs practice project contract business, the business scale is far smaller than the whole business of the companies. The management of the SDCs give up to take project risk and make rightful project contract basically.
SDC LEVEL2: companies corresponding to CAT2.

The SDCs are trying to enhance skill of project managers in their own companies and increase project contract business by replacing legacy dispatching business to step up to be project contractors.
SDC LEVEL3: companies corresponding to CAT3.

Most sales of the SDCs are achieved by project contract business. However, the followings are often observed.
- Project checklist:
Although the SDCs "standardize" methodology to check projects, the amount of check list is too large to use it for the management to avoid outbreak of SPPs. It is also not easy for field project managers to check all items in the list without extra load.
- QA (Quality assurance team including role of PMO):
Although the QA "standardize" to practice "measure" and "control" specified in OPM3, the QA members are not necessarily relied upon by field projects. Even if some QA members are highly skilled and fully relied upon by field projects, they are just temporally involved in the OA team and will be in a meanwhile moved to business units for managing field projects, when the business units lack resources of project managers due to increase of software development orders.
- SPPs:
Outbreak of SPPs is observed periodically. After the outbreak, the management takes countermeasures for strengthening QA activities to reduce and prevent the SPPs, by recalling the highly skilled project managers to the QA team as its members. However, for a mean after decreasing the SPPs and increasing the orders, the QA activities are to be weakened, the same historical events are re-produced (e.g. SPPs occur again).
SDC LEVEL4: companies corresponding to CAT4.

The SDCs are trying to step up to be contractors with sustainable countermeasures to prevent outbreaks of SPPs, by "continuously improving" the followings.
- Project checklist:
The SDCs have much more compact methodologies, which both the managements and field project managers can use them without extra load.
- QA (or PMO):
The managements of the SDCs continuously assign members, who are highly skilled and fully relied upon by field projects, to QA teams, even when the business units lack resources of project managers due to increase of software development orders.
- SPPs:
Outbreak of SPPs become to be observed less frequently than LEVEL3.
SDC LEVEL5: companies corresponding to CAT5.

The SDCs have achieved preventing SPPs sustainably, while practicing"continuous improvements" without termination.

Although CMMI is a capability maturity model for software firm, it is based only on engineering viewpoint. On the contrary, we propose, on management viewpoint in projects and organizations, a new model for software firm. The model, hereafter CM3 (Capability Maturity Model for Management), has a hierarchical structure from LEVE1 to LEVEL5 mentioned above. Although the model is based on OPM3, it makes software firm much easier understand OPM3 and introduce it to individual type of SDC (e.g. vendor or user). The CM3 is specified as follows by adding necessary content to OPM3 and also eliminating unnecessary content from OPM3 for individual type of SDC.
[Maturity model for vendor]
Although "Portfolio" may be necessary axis for IT

system or software owner (user), it is not necessarily proper maturity axis for software developing contract vendor. Thus, the new model for vendor can be described as Figure 4 by elimination the “Portfolio”.

Higher Maturity Level

	(Portfolio: not necessarily essential axis for vendor maturity)				
Program					
Project					
CM3 levels	**LEVEL1**	**LEVEL2**	**LEVEL3**	**LEVEL4**	**LEVEL5**
	Sinking in dispatch business	Increasing project contract business	Mostly project contract business	Trying to sustainably prevent outbreaks of SPPs	Achieved preventing SPPs sustainably
Corresponding OPM3 levels			S , M , C	I	I

Figure 4 New Maturity Model for Vendor

[Maturity model for user]

“Portfolio” may be necessary axis for user (owner). However, since the user do not practice dispatch business even if they employee software engineers, LEVE1 and LEVEL2 are eliminated from the model. Thus, the new model for user can be described as Figure 5.

Higher Maturity Level

Portforio				
Program				
Project				
CM3 levels	(note)	**LEVEL3**	**LEVEL4**	**LEVEL5**
		Develop software by itself or vendor contract	Trying to sustainably prevent outbreaks of SPPs	Achieved preventing SPPs sustainably
Correspond ing OPM3 levels		S , M , C	I	I
	(note) LEVEL1 and 2 are only for vendor			

Figure 5 New Maturity Model for User

6. Suggestion for Stepping Up to Higher Level

The followings are recommended for those who have will to step up individual SDC level, as far as we have experienced.

[SDC LEVEL1 to LEVEL2]

In order for the SDC to become from LEVEL1 (a human bank of engineers) to project contract enterprise, there must be project managers for managing software development project. Thus the SDC needs to specify proper method to develop project managers among employees in the SDC. However, the PMBOK has insufficient method to develop project managers for software development, since it lacks software specific knowledge. In spite of recent software extension of the PMBOK (PMI, 2013b), it is also difficult to say it is sufficient, since the software extension involves less tacit knowledge of experienced project managers, with which they actually have been preventing IT project failures in actual projects. Thus we recommend to use project management method specified in books named “*Mieruka* (Visualization) of IT Project” (IPA, 2008a)(IPA, 2007)(IPA, 2008b)(IPA, 2006), which have been published by IPA (Information-technology Promotion Agency, Japan). The method involves variety of practical tools such as bird-eye-view diagrams, check sheet, summary of problem projects, quantitative management tools and integration management tool. These tools are developed by visualizing tacit knowledge of expertized project managers in major prime contractors such as NTT Data, Hitachi, NEC, NS Solutions or TIS.

[SDC LEVEL2 to LEVEL3]

The SDC increases project contracts comparing to dispatching business every year by developing skill of project managers (enlarging manageable project scale and complexity) as well as increasing amount of project managers. The SDC should start trying to “Standardize” and “Measure” project management to meet the company style. The SDC should also start practicing “Control” projects by organizing QA or PMO and by evaluating skill of project managers and engineers quantitatively.

[SDC LEVEL3 to LEVEL4]

The SDC may practice countermeasures including the following organizational actions for continuous improvement to sustainably prevent SPPs.

-QA (or PMO): The SDC organizes QA team under the top management by assigning QA members among expertized senior project managers. The members should have much higher skill than ordinary project managers and have been highly trusted by field projects. After problems of SPPs are resolved, the top management keeps the members staying in the QA team, even when business units lack project manager resources due to increase in orders.

-Project checklist: The SDC simplifies the checklist so that both loads of the management and field projects may be acceptable level, by reducing large checklist to check items which are mandatory for SPP prevention. For example, one way to practice the reduction is to link individual check item to each case of problem project like *Mieruka* method (IPA, 2006-2008b), and eliminate check items which have no link to cases of SPPs.

-Tacit knowledge: The SDC visualize tacit knowledge which project managers have been got in their experience of SPPs, before their retirement. It is also advisable to learn how to visualize tacit knowledge by participating in research activity to practice it by non-profit based organization such as IT *Mieruka* Institute (ITMI, 2017).

[SDC LEVEL4 to LEVEL5]

The SDC establishes its own mechanism to prevent SPPs sustainably. For example, it has quantitative evaluation inventory of skill to prevent SPP in every stakeholders (e.g. not only project managers or engineers but also senior managers or sales person). A methodology to prevent SPPs sustainably may be operated by quantitative management to check correlation between stakeholder skill and risk of SPP, using the inventory. Also QA team has strong leadership for avoiding SPPs so that it may influence the management decisions. After keeping such continuous improvement, the SDC has been not suffered from any SPP for more than 10 years.

7. Expected Effects

When we forecast several tens of years ahead, the following management losses are expected, if the current SDC levels in the software industry are not changed any more. On the contrary, the software industry is expected to be developed with less management losses in the future, if it try to improve SDC levels based on our proposal.

1) The management losses due to SPP

First, the cost overrun of SPP brings magnificent loss of the management. Although the actions to step up migration level, which are suggested as specific examples of how SDC should be in the previous section, require some investment, cumulative SPP loss caused by repeating the same SPP history may be expected to exceed the investment plus reduce profit loss (total investment) as illustrated in Figure 6.

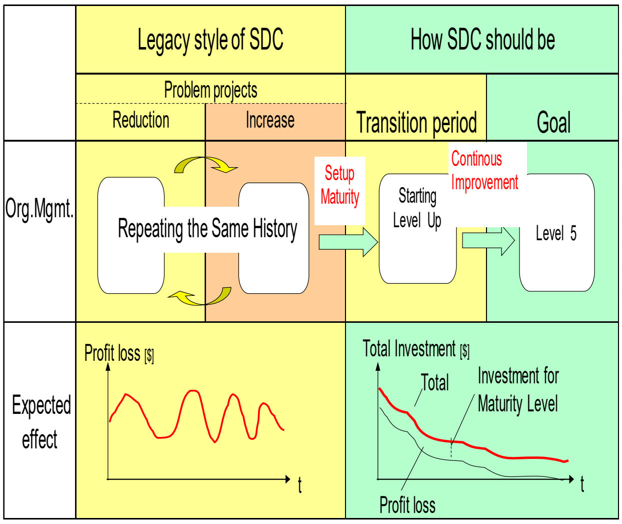


Figure 6 Expected difference (long-term profit)

Other than profit loss, the management suffers from opportunity loss due to SPPs, since much resources, who should have increased sales by other project contract, are consumed for shooting troubles of SPPs.

Moreover, the management also suffer from the loss of valuable human resources due to repeating the same SPP history, since it is often observed that some project managers or software engineers quit their jobs and move to another industry other than software, after shooting SPPs.

2) The management losses due to sinking in dispatching business

In the near future, the SDCs may lose such business, and replaced by other companies which develop software by project contracts whether they are done on shore or off shore.

If such SDCs are replaced only by off shore companies, software engineer resources in domestic market reduce, which may cause hollowing out of the software industry.

8. Conclusions

New capability model for managing projects (CM3) is proposed for individual company in the software industry to make business progress by taking project contract responsibility and with the aim of preventing projects from serious problems sustainably. We also discussed expected business effect by using the proposal model for individual company to recognize current maturity level and step up incrementally to improved levels.

Most of existing software vendors, whose number is said to be 20 thousands in Japan, are classified to only two groups in reality. One is major contractors (LEVEL3) and the other dispatch business company (LEVEL1). Such structure of the software industry have been continued without any change for tens of years. Based on discussion of the previous section, it is hardly a wise option for the software industry to keep the existing structure also in the future. In order for the software industry to proceed to how it should be, we believe that it is necessary for the software industry to incrementally change its structure from the two groups to 5 groups corresponding to 5 levels (LEVEL1 to LEVEL5) as illustrated in Figure 7. Therefore, we continue developing the proposed organizational maturity model in research activities of IT *Mieruka* Institute, by aggregating much more best practices and call for participants to introduce the results.

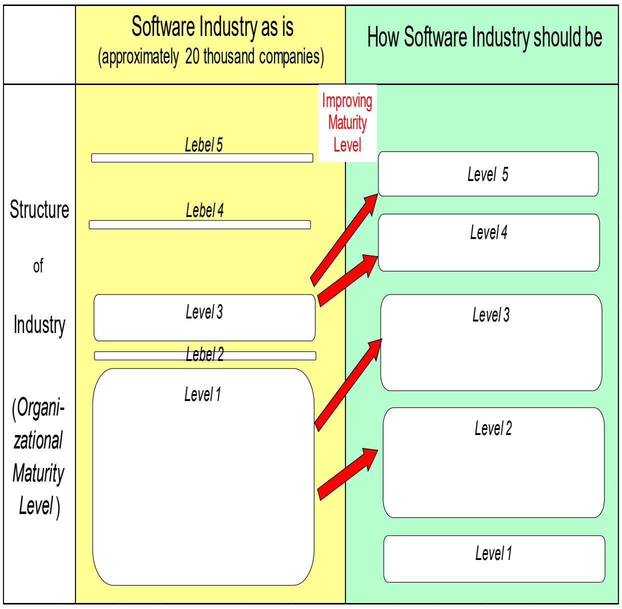


Figure 7 How Software Industry Should Be

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A Study of Efficient Team Management Configuration for CSIRT Deployment

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In recent years, 98.9% of enterprises are taking information security measures. However, security incidents such as information leakage from the inside are still increasing. Generally, an enterprise always needs to prevent a security incident. However, security incidents are also increasing rapidly in the information and communication technology (ICT) environment where technological innovations are carried out, such as Internet of Things (IoT) and financial technology (FinTech). Therefore, it is extremely difficult to completely avoid security incidents. In addition, expert skill is needed for the detection and recovery of security incidents. At present, the deployment of computer security incident response team (CSIRTs) is progressing to resolve these factors. Although CSIRTs have been introduced mainly by enterprises that have important infrastructure, the deployment of CSIRTs in Japanese enterprises is insufficient compared with enterprises in Europe and the United States. Problems such as high cost structures and CSIRT management are major issues, with team management lacking sufficient research. In this paper, to deploy CSIRT services, we focus on the current CSIRT management. Specifically, we propose an efficient team management configuration for CSIRT services. This will contribute to the deployment of CSIRT and enable safe and secure ICT infrastructures.

Keywords and phrases: CSIRT, Security Incidents, High Cost Structure, Team Management

1. Introduction

In recent years, the Internet penetration rate of Japan is 83.5%. In addition, innovative technologies such as Internet of Things (IoT) and financial technology (FinTech) are progressing rapidly. Although the convenience of information and communication technology (ICT) has remarkably improved, the number of information security incidents is also increasing. The importance of information security is increasing, with 98.9% of enterprises in Japan implementing their own security measures (MIC, 2017). Furthermore, the interest of information security in the management of an enterprise is also increasing. A 2013 information security investment plan report revealed that the number of investment plans was increasing, and it can be said that information security measures in enterprises are spreading (NPA, 2016), (NPA, 2015).

Although the management of most enterprises recognizes security risks, the departments in charge are left to deal with them (JNSA, 2017). For this reason, there is not enough sharing recognition of security measure promotion between management and those in charge (IPA, 2017a). Furthermore, a questionnaire on investment plans of information security measures revealed that it is difficult for small and medium-sized enterprises (SMEs) to implement security measures (NPA, 2016).

In regard to security incidents, illegal access attempts utilizing vulnerabilities in systems and the number of virus damage reports are increasing. For example, in 2015, the pension management system's server was illegally accessed from the outside by means of social engineering and unauthorized access. As a result, personal information of about 1.25 million pension subscribers, which included their names and annuities, was leaked (Japan Pension Service, 2015). Further security problems include information leakage caused by enterprise insiders such as employees of cooperating enterprises and employees. For example, in 2014, Benesse's customer information databases, which contained personal information of about 20.7 million customers, were leaked. This cost the enterprise about 26 billion yen (Benesse Corporation, 2014a), (Benesse Corporation, 2014b) and resulted in the number of members decreasing, in which sales then declined. It is very difficult to completely avoid security incidents.

In contrast to the above, the establishment of a computer security incident response team (CSIRT) is said to be effective. CSIRT is a generic term for security teams that deal with computer security incidents within an enterprise. Currently, CSIRTs are widely used in large enterprises, but are not as popular in SMEs.

In this paper, Section 2 describes the status and issues of CSIRTs including the issues of promoting CSIRTs to SMEs. Section 3 outlines a proposal to promote the spread of CSIRTs to SMEs, specifically, proposing efficient team management configuration for CSIRT that contributes to the popularization of SMEs. Section 4 presents the evaluation of the suggested efficient team management configuration. Section 5 discusses our conclusions and future tasks. With the above, we aim to promote the spread of CSIRTs to SMEs and contribute to safe and secure ICT infrastructures.

2. Overview of CSIRT and issues of CSIRT deployment

2.1 Overview of CSIRT

CSIRT is a collective term for teams specializing in handling computer security incidents within an enterprise. CSIRT functions include analyzing incident related information, vulnerability information, and attack information and preparing response policies and procedures. Depending on the enterprise, the function of the CSIRT is implemented simultaneously with other related work within the enterprise. The main functions of a CSIRT inside an enterprise include providing a single point of contact for receiving reports of incidents that occur within the enterprise and responding to incidents that occur and providing necessary technical know-how.

A CSIRT also functions outside the enterprise, coordinating communication with external incident response teams, collecting information on cases and trends of security incidents, and acquiring new incident handling methods and techniques from outside sources and deploying them within the enterprise (Wara, 2015).

There are three major advantages in establishing a CSIRT. The first is that information on information security (incidents) can be to centrally manage. This makes it possible to share security information, achieve centralized management, and speed up development of an instruction system related to security correspondence (direct reach). The second is a CSIRT can become a unified point of contact for incident response in the enterprise. By doing this, it is possible to provide a reliable point of contact and achieve unified management of information to and from the outside. The third is that by building a relationship of trust with external organizations through the CSIRT, it is possible to share incident-related information and enable coordination in incident response. This makes it possible to improve the amount of information necessary for incident response and to respond flexibly to unexpected incidents (Otto, 2016).

A CSIRT is a team of "systematic accident response" for grasping damage situations and the early restoration of accident damage, and is used as an effective means for further cooperation with external accident response teams (JPCERT/CC, 2015a).

Numerous CSIRT activities for incident response are roughly divided into three “services.” “Reactive service” focuses on activities for corresponding to an incident occurring. “Proactive service” focuses on activities for gathering information before incidents occur, carrying out measures to prevent occurrences of incidents, and taking countermeasures to minimize damage at the time of occurrence in advance. “Security quality management service” focuses on grasping the situation of the enterprise through activities such as risk analysis and education and carrying out activities to improve the security level. Table 1 shows examples of the activities in each service (JPCERT/CC, 2003).

Table 1 Example of service classification of CSIRT

Service name	Main activities
Reactive service	-Alerts and warnings -Incident handling -Vulnerability handling -Artifact handling
Proactive service	-Announcement -Technology trend survey -Security audit or review -Intrusion detection service -Providing security related information
Security quality management service	-Risk analysis -Awareness raising -Education/Training -Evaluate or certify the product

2.2 Issues of CSIRT deployment

2.2.1 Penetration rate of current CSIRT

In 2016, the number of enterprises that installed CSIRTs increased, reaching about 10.3% of the total: 2.5 times higher than that in 2015. However, it can be said that it is still low in regard to security incident response. In addition, only 25.3% of enterprises utilized an information sharing system similar to CSIRT (JUAS, 2017).

In a survey comparing incident response situations of enterprises in different countries, only 22.6% of enterprises in Japan established CSIRTs compared to those in the United States (55.6%) and Europe (32.9%) (IPA, 2017a).

Furthermore, the penetration rate for SMEs is low, as most of the members of the Nippon CSIRT Association (NCA) are large enterprises. "In-house facilities" is listed as a necessary countermeasure in

SMEs, but it is lower than other items, especially as because the scale of the enterprise is smaller, the ratio is lower (IPA, 2017b).

However, the problem of information security measures in Japan is due to low budget (IPA, 2017a). For this reason, it is difficult to introduce it to enterprises, especially SMEs. Also, when establishing a CSIRT, teams are reorganized taking numerous factors into account (Roderick, 2015). Therefore, the function of a CSIRT changes in accordance with team management configuration. Along with this, it is necessary to secure personnel.

To encourage the establishment of CSIRTs, it is necessary to clarify team management configuration. In addition, it can be said that there is a need to present an idea a team management configuration for SMEs and encourage setting up CSIRTs. One reason is that the number of large enterprises in Japan is about 11,000, while that of SMEs is 3.809 million. (The Small and Medium Enterprise Agency, 2016). Another reason is that in current cyber-attacks, there are cases where weak servers are used as proxy servers to hide attackers. Proxy servers used also include servers of SMEs (IPA, 2017b).

For the above reasons, it is necessary to improve the security of SMEs and to urge the installation of CSIRTs to contribute to the construction of higher security measures by CSIRT operation.

2.2.2 CSIRT deployment's issues

In general, as a cause of the low penetration rate, the main factors for spreading CSIRTs are the high cost problems and the complexity of the process when building a team management configuration dedicated to security (Jezreel, 2016), (Marthie, 2010). Regarding the former, since the cost structure of CSIRTs is diverse, including system, operation, and facility costs, it is generally said to be high, and various investigations have been made so far. (Kikuchi, 2011), (Kenmoku, 2012), (Tanimoto, 2014). On the other hand, regarding the latter a study on the complexity of the team management configuration is not sufficient. Therefore, in this paper, we examine issues concerning the team management configuration.

3. Proposal of efficient team management configuration to promote the spread of CSIRTs

3.1 Team management configuration of general CSIRTs

There are various forms of CSIRT, but five representative forms shown in JPCERT/CC are shown below (JPCERT/CC, 2015b).

(1) Security team

This is a team management configuration that does not require a full-time person in charge. A response team is formed of IT department staff, system administrators, network administrators, etc. in response to incidents.

(2) Distributed CSIRT

Under the responsibility of one person responsible for overseeing and coordinating the CSIRT, the person in charge of the departments involved at the time an incident occurs functions as a member of CSIRT. At that time, some members specialize only in CSIRT work, and the leader converses with external organizations etc.

(3) Centralized CSIRT

This is a team management configuration that defines the CSIRT as an officially independent department and is responsible for handling incidents. Also, because it has full responsibility for security response, it is often required to report to management.

(4) Integrated (distributed/centralized) CSIRT

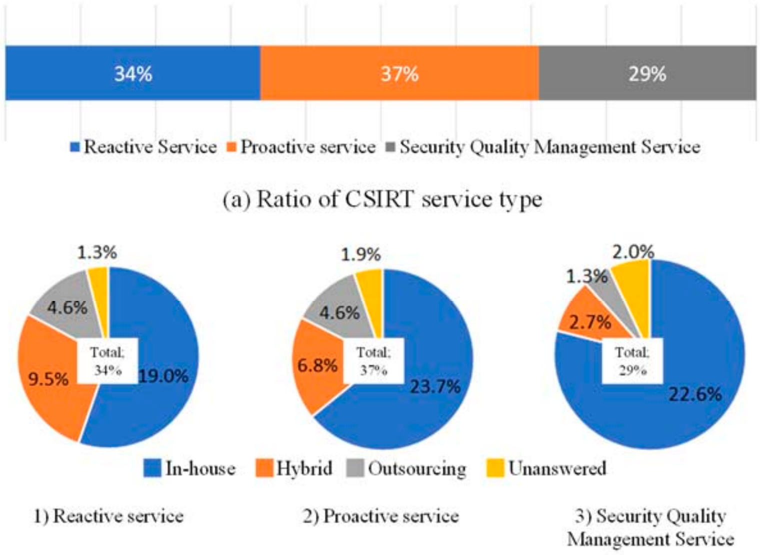
This is a team management configuration of CSIRT that combines distributed and centralized CSIRT. When an incident occurs, members of the CSIRT nominated by each division are added to respond to the situation. It can be said that it is appropriate for an enterprise that needs incident response.

(5) Adjustable CSIRT

This is a relatively large enterprise's a team management configuration of CSIRT, for example, when the parent enterprise oversees group enterprises. The adjustment of information is the main task. There are not many practical tasks for handling incidents.

3.2 Survey results of the current team management configuration for CSIRT

On the basis of the CSIRT questionnaire survey conducted by JPCERT/CC for NCA members, we classified the implementation of each service as "In-house", "Hybrid," and "Outsourcing." Furthermore, among the services of existing CSIRTs, we investigated the most frequently performed service (Figure 1).



(a) Ratio of CSIRT service type

(b) Ratio of service implementation entity

Figure 1 Questionnaire result for CSIRT introduction enterprises

From this result, it can be said that CSIRT services are often made in-house. This is supported by the fact that in the survey, 0% of outsourcing enterprises were outsourcing CSIRT services, and 80% of enterprises answered that they used only regular employees (JPCERT/CC, 2016).

In addition, out of the three services, "proactive service" was the most frequently performed service in preventing incidents. According to the same questionnaire, the number of CSIRT members was 9% for less than 5 people, 27% for 5 to 10 people, 17% for 10 to 20 people, and 39% for unanswered. If 39% of unanswered answers are omitted, more than half of the enterprises are fewer than 20, of which 5 to 10 are the most (JPCERT/CC, 2016).

The above is a general team management configuration including large enterprises. However, to spread CSIRTs to SMEs, it is necessary to propose a team management configuration for SMEs.

3.3 Proposal of efficient team management configuration with CSIRT for SMEs

There are two main issues in introducing CSIRTs for SMEs. One is that it is difficult to spend more on security measures than large enterprises. Therefore, it is difficult to build a full-time team like a centralized CSRIT. The other is that it is difficult to secure talented people who can become CSIRT members. Therefore, it is difficult to do all the work in-house like in large enterprises.

For the team management configurations described in Subsection 3.1, the proposals that consider the issues of SMEs as described above are shown in Figure 2.

	Team management of CSIRT	Business system in SMEs
(1)	Security team	Concurrently
(2)	Distributed CSIRT	
(3)	Centralized CSIRT	Full-time (※Including concurrently in integrated type)
(4)	※Integrated (distributed / concentrated) CSIRT	
(5)	Adjustable CSIRT	Not applicable (Because of only large company)

(a) General team management configuration

	Proposal of Team management for SMEs
(Draft 1)	Concurrent team management configuration
(Draft 2)	Full-time team management configuration
(Idea 1)	Outsourced team management configuration
(Idea 2)	Hybrid team management configuration 1 (Concurrent+ Full-time)
(Idea 3)	Hybrid team management configuration 2 (Concurrent + Outsource)
(Idea 4)	Hybrid team management configuration 3 (Full-time+ Outsource)
(Idea 5)	Hybrid team management configuration 4 (Concurrent + Full-time + Outsource)

(b) Proposals of team management configuration

Figure 2 Relation between current CSIRT team management configuration and proposals of team management configuration for SMEs

The efficient team management configuration models of the CSIRT for SMEs listed in Figure 2 is shown in Figure 3 and their outlines are shown below. As a precondition, as shown in Subsection 3.2, the number of CSIRT members is assumed to be 5 to 10, which was the largest number in the survey results. Similarly, it was assumed that emphasis was placed on the "proactive service" of CSIRT.

(Draft 1) Concurrent team management configuration

This form works on the basis of each department. When an incident occurs, this form enables each department to function as a member of the CSIRT.

(Draft 2) Full-time team management configuration

This form consists of employees dedicated to CSIRT.

(Idea 1) Outsourced team management configuration

This form outsources the CSIRT service.

(Idea 2) Hybrid team management configuration 1 (Concurrent + Full-time)

This form has CSIRT dedicated staff performs CSIRT operations. When there is a resource shortage or cooperation is necessary, additional post members are added.

(Idea 3) Hybrid team management configuration 2 (Concurrent + Outsource)

This form outsources the function of CSIRT with concurrent members assisting, thereby facilitating service.

(Idea 4) Hybrid team management configuration 3 (Full-time + Outsource)

This form has dedicated members that provide CSIRT services, but can outsource when resources are insufficient.

(Idea 5) Hybrid team management configuration 4 (Concurrent + Full-time + Outsource)

This form has dedicated members and additional post members that provide CSIRT services. In the case where resources are insufficient, outsourcing is carried out.

4. Evaluation of proposed team management configuration of CSIRT for SMEs

4.1 Evaluation of proposed team management configuration to promote CSIRT dissemination

In this section, we evaluate the team management configurations proposed in Subsection 3.3 qualitatively. The results are shown in Table 2. From these results, it was shown that the hybrid tissue form 4 is the most suitable.

4.2 Consideration

Hybrid team management configuration 4 seems to be the most suitable for SMEs because the original work can be done while doing CSIRT services. Also, the need to disclose information to outsourced partners is relatively small compared to other proposals. However, outsourcing is an external factor that is difficult for the enterprise alone to control. Therefore, measures to cope with the risk of disclosing internal information and cooperation between members and outsourced partners are necessary.

H. Fayol states that the number of spans of control is 4 to 6 from the rule of thumb of "industry and general management" (Fayol, 1985). In addition, Nonaka cites an example of Egypt at "Business management" and introduces that the organization member is up to ten people (Nonaka, 1983).

For the above reasons, the number of responsible managers per person is 10 or less, which is consistent with the assumed number of members.

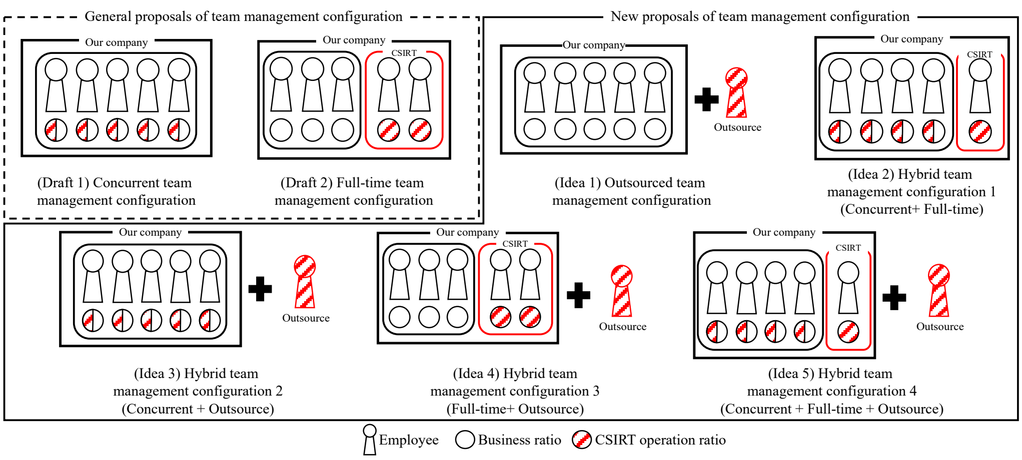
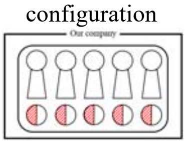
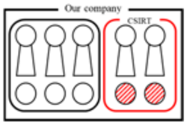
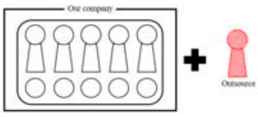
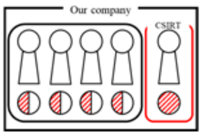
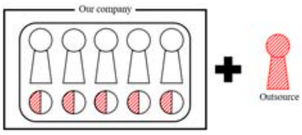
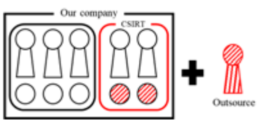
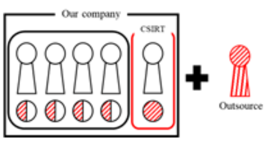


Figure 3 Team management configuration models for SMEs

Table 2 Evaluation of proposed team management configurations

	Team management configurations	Merit	Demerit	Evaluation
Exiting Methods	Draft 1 Concurrent team management configuration 	-Costs can be kept low -Collaboration with the member's department is easy	-Hard to cooperate with external organizations -Resources may be limited -Difficult to secure the function of service to prevent incidents	(Bad) Difficult to secure the function of the service to prevent incidents, and the merit of constructing CSIRT is small.
	Draft 2 Full-time team management configuration 	-Focus on the work of CSIRT -Function as a liaison with external organizations	-Labor costs are expensive -Necessary to secure talent who possess knowledge and expertise	(Bad) SMEs have few employees. It is difficult to hire people with new knowledge.
Proposed Methods	Idea 1 Outsourced team management configuration 	-Low costs -Few problems with people and know-how	-Risk generation in disclosing internal information	(Bad) Difficult to conduct a service to prevent incidents when outsourced.
	Idea 2 Hybrid team management configuration 1 	-Securing centralized functions -Function as a liaison with external organizations -Easy to get in touch with the departments to which the member belongs -Easy to secure resources	-Placing a full-time person in charge is expensive -Resources are limited compared to full-time staff	(Average) It is easy to cover all services. It is good at handling incidents and is suitable for the prevention of damage expansion. However, it is difficult to secure dedicated staff at SMSs enterprises.
	Idea 3 Hybrid team management configuration 2 	-Fewer maintenance costs -Fewer problems with people and know-how -Easy to get in touch with the departments to which the member belongs -Easy to secure resources	-A new risk arises that internal information must be disclosed -Functions can be difficult when cooperating with external organizations	(Average) It has the lowest cost among all team management configurations that can cover the whole service. However, it is difficult to conduct a service to prevent incidents. Therefore, measures for cooperation inside and outside the enterprise are necessary.
	Idea 4 Hybrid team management configuration 3 	-Function as a liaison with external organizations -Few problems with people and know-how	-A new risk arises that internal information must be disclosed -Personnel expenses are required due to the large number of full-time people	(Bad) It is easy to cover all services. However, expenses will increase more than with only dedicated members. Furthermore, the risk of disclosing internal information can occur.
	Idea 5 Hybrid team management configuration 4 	-Function as a liaison with external organizations -Few problems with people and know-how -Easy to get in touch with the department to which the member belongs -Easy to secure resources	-Necessary to take measures for cooperation -Leadership skills are required -A new risk arises that internal information must be disclosed	(Good) It is easy to cover all services. Since there are fewer specialized staff in charge, there are fewer problems. The need to disclose information to outsourced partners is relatively low. It is necessary to take measures to avoid the risk of disclosing internal information

5. Conclusion

In this paper, we proposed a team management configuration for promoting CSIRT to SMEs. As a result, although it is a qualitative evaluation, it was revealed that the hybrid team management configuration 4 was the most suitable. The reason is that the hybrid team management organization 4 can perform the original work while performing the CSIRT service. As a result, it will be easier to cover all services, because less specialized staff in charge can reduce the burden of problems such as securing personnel.

In the future, we will calculate the degree of simultaneous parallel proportion and clarify the scale where CSIRT should be established.

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Project Management Method of Constriction for Large-Scale Submarine Telecommunication Cable System

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In order to fulfil the continuously increasing demands of international traffic capacity, several submarine telecommunication systems across the oceans have been installed recently, and more systems are planned to be constructed in a coming years. As the system becomes more sophisticated with the evolution of technologies compared with the past, demand for shorter construction lead-time and lower cost are getting stronger while the system must still be maintained at the highest quality. So project management becomes more important than ever. Especially, during the construction of large-scale international systems, there are many aspects to be considered, not only the technical matters but also the commercial maters taking into account geographical issues, environmental impact and permission from the governments etc., for the system to meet the requirements and on-time delivery. NEC is one of the submarine cable suppliers in the world who can successfully deliver on a full-turnkey basis, which provides services including but not limited to the system design, manufacturing, permission acquisition, marine survey, cable installation, commissioning testing etc. This paper describes the latest trend of the submarine cable systems, and aims to share the major project risks in the construction of large-scale international submarine cable systems based on NEC's latest experience and how we manage project implementation, mitigate risks and lead the project to a success.

Keywords and phrases: Submarine Cable System, International, Consortium, Risk Assessment. Risk Mitigation

1. Introduction

The number of large-scale submarine cable systems continue to expand as an international communication backbone all over the world. In recent years, sophisticated submarine cable systems which connect multiple countries have become a trend in order to provide a flexible and cost-effective network.

The construction of large-scale submarine cable systems will cost several hundreds of million dollars and will typically take more than 2 years to construct. Any failure or accident in one of the processes may lead to a huge impact to the QCD of the entire project, therefore project management is essential to implement the system while minimizing any failure or accidents throughout the project.

Recently, NEC has successfully installed on a full turn-key basis, a large-scale submarine cable systems which links multiple countries facing the Indian Ocean. Through this experience, I will assess the implementation risk which needed to be considered on large-scale systems

2. Submarine Cable System Trend

A submarine cable system mainly consists of optical submarine cable (equipped with the optical fiber and copper), optical submarine repeaters (equipped with optical amplifiers to boost the optical signal) and the terminal station equipment which comprises from the Submarine Line Terminal Equipment (SLTE), Power Feeding Equipment (PFE) and Network Management System (NMS). Figure 1 and Figure 2 show the typical example of the submarine cable system and cable landing station configuration.

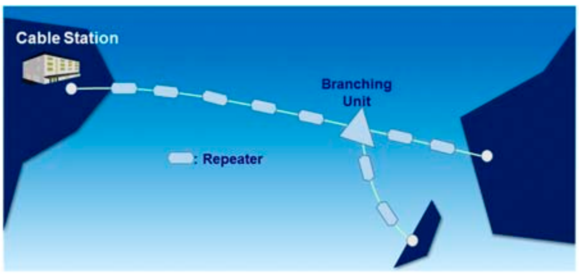

Figure 1 Submarine Cable System

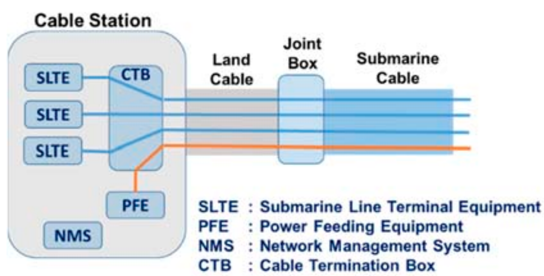

Figure 2 Cable Landing Station Configuration

In recent years, Branching Units (BU), which can divide the route to two destinations, are used in submarine cable systems. Since several of these BUs can be deployed in one system, the cable route resembles a fishbone, and therefore such network is called a "Fishbone Network". This configuration enables to connect multiple countries in one submarine cable system. Figure 3 shows an example configuration of "Fishbone Network".

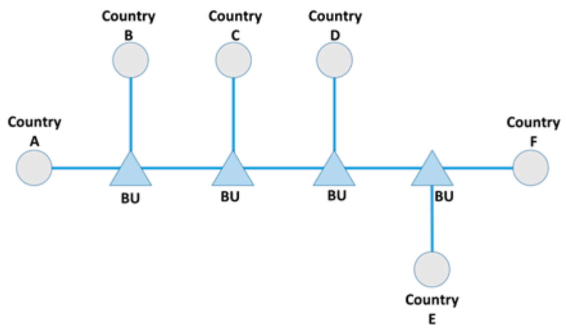

Figure 3 Fishbone Network

A "Fishbone Network" is more flexible than previous cable designs since it can provide direct connectivity to multiple points in a cable system. This contributes not only providing the connection flexibilities and minimizing transmission delay between cable landing parties who are connected to the system, but also contributes to the mitigation of construction investment by sharing the construction cost among them. Since direct connection to multiple points are made available, it also reduce the OPEX by eliminating the interconnections among the parties. It has becomes, therefore, the mainstream of recent submarine cable systems.

Another technology utilized to enable multiple connection is the Optical Add-Drop Multiplexer (OADM) function which is equipped inside the BU (Inoue, 2010). The OADM function realizes multiple point connection by sharing the fiber capacity at an optical wavelength level. Because of this, the system configuration becomes very sophisticated but the design and optical wavelength management becomes complicated. In addition to this, since multiple points are connected, the network needs to be designed to enhance the network survivability in case any cable failure is encountered during the system operations. From these points, the "Fishbone" submarine cable system design is more complex than the traditional point-to-point cable system.

In addition, it is very important to carefully plan the construction and implementation since any small delay or construction incidents may affect the entire project implementation planning.

3. Construction Activity and Process

The construction process of a large-scale submarine cable system is very complex, and consists of quite a large area to be covered. To simplify for this paper, those are classified into three stages, as;

(1) Contract & Design,

(2) Manufacturing, and

(3) Installation.

Figure 4 shows the said simplified process.

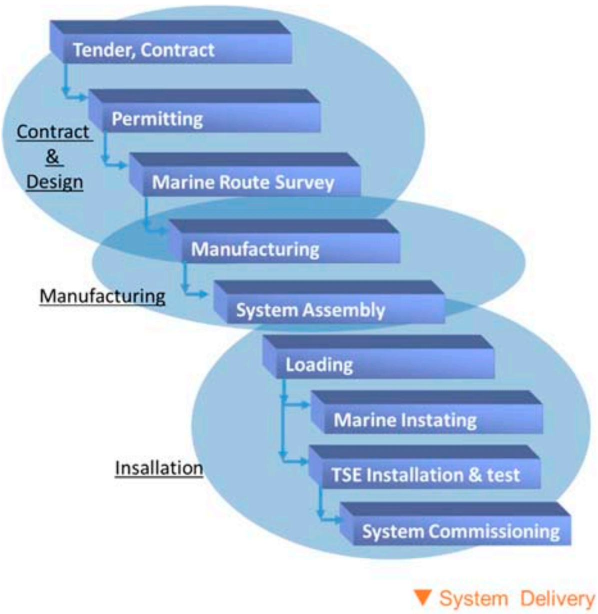

Figure 4 Submarine Cable Construction Processes

3.1 Contract and Design

The supplier would design the submarine cable system to fulfill the system owner's requirements of the system, such as connectivity, capacity, performance level, lead time, etc. After the evaluation of the tenderers and negotiation, the contract is signed between the system owners (the Purchasers) and the Supplier. It is common practice to enter into a contract for one submarine cable system with multiple owners (where the Purchasers form a consortium) for large-scale submarine cable systems. Occasionally, some suppliers will also form a consortium with another to reduce the construction period.

The Supplier starts designing the system and equipment in detail after the contract comes into force. In parallel, the marine cable route is designed on a Desk

Top Study (DTS) basis as the first stage. Once the DTS route is agreed, the marine route survey is conducted to obtain the actual geographical seabed condition, water depth, environmental requirement and so on.

After completion of the marine cable route survey, the marine installation plan is developed. At the same time, the system design is reviewed once again based on the marine route survey results (i.e. cable route and length, cable protection types and location of repeaters and branching units) to optimize the system.

A study of the process for obtaining permits needed for cable laying, which is to be obtained from the relevant governmental authorities, is also conducted at the first stage of the project implementation.

3.2 Manufacturing

The Supplier starts procurement of components and manufacturing of submarine cable, submarine repeater and terminal station equipment individually after finalizing the system and equipment design.

It is important to determine and manage the manufacturing sequence taking into account the cable loading plan and marine installation sequence. This is because large-scale submarine cables may have thousands of kilometers in length, and those must be stored in a cable tank at the factory in a proper sequence (Yoneyama, 2013).

The submarine cables and repeaters are assembled as blocks and stored in tanks at the factory in accordance with the cable loading plan to the cable laying vessels. After these are assembled, the assembled system is tested in accordance with a block specification. Figure 5 shows an image of assembled system and cable tanking at a cable factory.

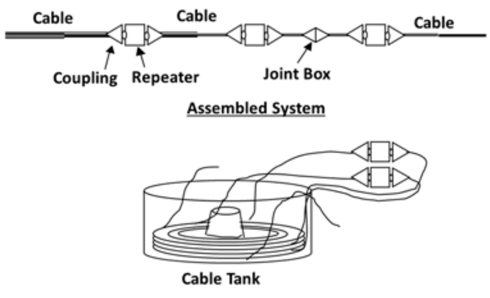

Figure 5 Cable Tanking at Cable Factory

3.3 Installation

The assembled system (submarine cables and repeaters) are loaded on to the cable installation vessels, and then they will ship out to lay those assembled systems to the seabed, and bury them where required.

In the meantime, land cable and terminal station equipment are installed at the cable landing site. Those installation must be synchronized with the marine installation, since these equipment are also used for testing the marine installation.

After the completion of installation and testing of all assembled systems, land cable, and terminal station equipment, all of these components are connected as a single whole system, and finally an end-to-end system commissioning test is conducted. In the system commissioning test, various tests are performed in order to confirm for the performance of the system to meet the requirement and specification. In addition, reference data needed for future maintenance purposes are obtained. During this period, operation and maintenance training to the Purchaser is also provided.

After all the test data is reviewed and evaluated, the system becomes ready for service (RFS) and will be handed over to the Purchaser.

4. Assessment of Project Risk

As stated in Section 3, many of the processes are overlapping and linked with each other. Since one risk occurrence in a certain process may impact other processes, risk management is most important. In this section, concerned major risks and how to manage these risks are discussed.

4.1 Schedule Risk

One of the most concerned risk is the delay of the project. Since most, if not all, submarine cable system construction is linked directly to the national economic strategy of the country or business plan of the Purchaser, on-time delivery is always of utmost importance from the Purchasers point of view. Usually, delay of a project delivery will carry liquidated damages up to 10% to 15% of the project construction cost. In case of large-scale submarine cable systems, the construction cost becomes hundreds of million dollars, and therefore the liquidated damages could also become several tens of million dollars. In order to mitigate such liquidated damage risk, the schedule must be controlled properly from the supplier point of view as well.

At the beginning of the construction stage of the submarine cable system contract, all the planned tasks are scheduled in the Plan of Work (POW). The POW is periodically and continuously reviewed and modified throughout the project implementation and we will assess the critical path from time to time according to the progress of each work. The most important assessment is to mitigate the risk which is beyond the control by the both the Purchasers and the Supplier. In a submarine cable construction project, there are mainly three risks to be considered for such uncontrollable issues. First is the permits, the second is weather, and the last one is damage to the cable by 3rd parties' activities during the construction.

4.1.1 Permit Acquisition Risk

Since a submarine cable system will occupy the sea bed at the country where a cable lands, permits must be obtained from the relevant governmental authorities. At the country where the cable lands, permit acquisition cannot be avoided. In each country where the cable lands, a cooperative organization among the Purchasers and the Supplier is made available, which is always efficient to obtain the permits in timely manner. If the cable system should pass across territorial waters or an EEZ of a 3rd country, permits from such 3rd country are also required, which we call "transit permits". For such transit permits, the responsibility of permit applicant to such 3rd countries is always a topic of debate between the Purchasers and the Supplier. Therefore we recommend that such responsibility must be determined at the contract stage.

From an economical point of view, the shortest cable route between landings are preferred. However, even though it could end up to be more costly, cable re-routing is strongly recommended to avoid passage of 3rd country waters if there is a possibility of difficulty obtaining transit permits. Figure 6 shows an example of re-routing to avoid 3rd country transit. At the DTS stage, it is very important to study the permits, whether there exists uncertain issues in such related countries.

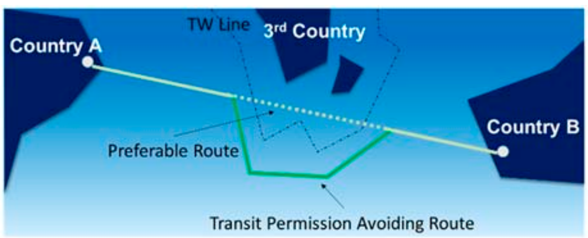

Figure 6 Transit Permit Avoidance Route

Apart from the transit permit, it is also important to understand the requirement from the relevant governmental authorities. Especially, environmental requirements must be carefully reviewed, since they require a special survey for assessment of the impact to the environment, and a special treatment may be required consequently. In such case, the environmental assessment could take a long time and may have an impact to not only the permit application, but also the method of installation procedure and the delivery schedule.

4.1.2 Weather Risk

The second risk to be considered is weather condition at the area where the cable is being installed.

Depending on the installation area, a work period for a marine operation such as marine route survey and/or cable installation work, is sometimes limited due to rough sea condition. One example is the monsoon well-known in the Indian Ocean and East China Sea. During that period, cable landing operations or shore end cable installation operations may not be performed. As an example, probability of workable weather day in Indian Ocean is shown in Figure 7. Since the season or period when we can do the marine operation differs from area to area, the consideration of weather become more critical for a large-scale submarine cable system. If the marine operation is suspended in one of the segments in the cable system, it will have a huge impact to the other segments. For example, for a large-scale submarine cable system, say a 10,000km system, even if only 1km of laying is suspended due to seasonal weather condition while the remaining 9,999km installation is completed, the whole system will not be ready, and in the worst case, the remaining 1km installation could end up being conducted a half year later or even more since we only have to wait for the seasonal weather being good for resuming the operation. To avoid such worst case scenario, the marine operation sequence must take into consideration the weather conditions. If there is a weather risk in a certain marine sequence, it is important to make contingency plans, such as splitting the work using another vessel to avoid installing the cable during a bad weather period. Once the risk occurs and work is suspended due to a seasonal weather reason, it is very difficult to catch up the schedule because a seasonal weather recovery is uncontrollable and usually takes a few months to recover the weather to be workable widow. Therefore, an early decision is requested when a contingency plan is to be executed, even if such contingency plan could end up to be more costly.

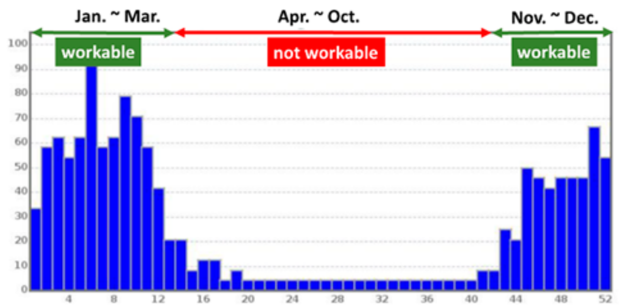

Figure 7 Weather window probability (%) of workable day in Indian Ocean (Wave High <1.0m, Wind : <15knots)

4.1.3 Cable Damage by 3rd Parties' Activities

Once the submarine cable system is installed and laid on the seabed, it is then exposed to risk of cable damage by 3rd parties' activities. One of the most concerned risks are fishing activities, such as bottom trawling. Once a cable is damaged, it needs to be repaired, which could sometimes take few months if no repair ship is available or requires cable repair permits from relevant authorities, which could also have a huge impact to the entire schedule.

In order to protect the cable system from such activities, the cable route must be designed to avoid heavy fishing areas as much as possible. However, it is also difficult to keep the route completely away from fishing areas since these activities are usually in shallow water nearby a landing site. A submarine cable laid in shallow water is therefore, buried under the seabed by a few meters. A burial operation is usually done by a plough machine equipped on a cable laying vessel. However, during the installation by cable laying vessels, sometimes a portion of the submarine cable may not be buried for some reasons, even though a burial operation was planned. In such case, a post-burial operation is performed by using a different vessel after the submarine cable has been laid. In such case, the risk of submarine cable damage by 3rd parties becomes higher, because the submarine cable is exposed on the surface of the seabed until post-burial operations have been completed. Therefore it is important to manage the schedule to shorten such risky period by dispatching a post-burial vessel just after the submarine cable has been laid. If such period is expected to be long, it is recommended to dispatch guard-boats to monitor the 3rd parties' marine activities along the cable route.

Besides the above, a submarine cable should be installed during periods with less fishing activities to minimize the cable damage risk.

4.2 Technical Risk

4.2.1 System Handling under Incomplete System

The submarine cable system uses unique technologies, which are well-known for long distance transmission (over 10,000km in length), ultra-large capacity (more than 12 Tb/s per fiber pair), high water pressure (withstand up to 8,000m water depth), high voltage application (up to 15KV) and so on.

Although the risk caused by each unique technology is not discussed in this paper, we would like draw your attention to one of the concerned technologies which need to be carefully handled during installation work, which is the high voltage application.

In case of large-scale submarine cable systems, very high voltage is applied to the system in order to energies the submarine repeaters. Because of this high voltage, improper handling may cause unexpected damages to components and equipment. Therefore, a proper power handling procedure must be established well in advance. Such procedures are usually made for a cable system which has been fully completed, but also for a system under a certain cable fault condition after system handed over.

During the installation, it is essential to recognize that there are phases when the system is incomplete since the system is not fully connected. Especially, in large-scale cable systems, the system is temporally divided in to several segments during the marine installation work. Even under such incomplete configuration during the installation operation, the system still needs to be powered in order to confirm the system's normality. If the said incomplete configuration is planned at the design stage, the powering is safely performed in accordance with the prepared procedure. However, if the marine installation program changes urgently because of permit delays, severe weather conditions, unexpected cable faults or for whatever unforeseeable reasons, an unplanned incomplete configuration may occur. Under such unplanned configuration, the system powering carries a risk because it may result in an improper handling and therefore cause damage to the components and the equipment. In order to eliminate such risk, we establish a special task team who has responsibility for developing and evaluating the powering procedure in any foreseeable configuration.

There may be other measures to mitigate such risks, but an assessment on how an operator handles the incomplete configuration is important. This importance does not only apply for the submarine cable project, but also other similar projects.

4.2.2 System Integration

Large-scale submarine cable projects often need to be implemented by a consortium of system suppliers, so that they can manufacture and install the system in parallel to meet the required completion date of the system (Yoneyama, 2010). In most of the recent projects where a cable is co-built among multiple suppliers, the scope of work for each supplier is divided by construction area (segment). In such case, the system integration become the one of the critical on the project schedule since the actual system integration is performed at the last stage after each individual supplier completed installation of its segment. In such case, it is important to deeply study the integration parts and define the interface between the segments and integrated performance at the design stage well before manufacturing. It is most preferable to perform integration tests on an interface basis and an equipment basis before full system integration, and all technical issue shall be resolved beforehand. Although each supplier should not affect the project implementation schedule of the other supplier until completion of commissioning test on each segment, the progress sharing is useful to coordinate with each other. The example of a scope split and integration is shown in Figure 8.

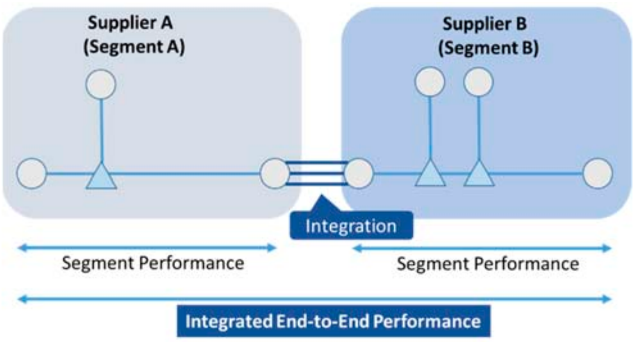

Figure 8 Scope Split and System Integration

4.3 Commercial Risk

Apart from the technical risks when implementing large-scale submarine cables, there are also risks associated with Commercial matters. Just to mention a few of the many such risks, it is always important to make sure that the legal risks, Creditworthiness and financial risks, suppliers' liability is always addressed.

4.3.1 Legal Risk

One should make sure that all terms and conditions are addressed and covered in a contract. There is always a time when the Purchasers and the supplier enters into a dispute where the terms and conditions do not define a way to resolve the matter. Typically, if such case should arise, the Purchasers and supplier will discuss amicably to resolve the issue, Worst case, the contract will require the parties to resolve the matter through arbitration, but this is always a costly and lengthy procedure which does not benefit neither parties. Also, the governing law should not be neglected as each jurisdiction could have unique legislation which are out of the norm. It is suggested that contracts should be based on either New York State law or laws of England and Wales, which are commonly understood and used internationally.

4.3.2 Financial Risk

As discussed above, since the cost to construct a submarine cable system is huge, the payment creditability (or creditworthiness) of each Purchaser must be carefully reviewed before entering into a Contract. In case the creditworthiness is determined to be low, some form of payment assurance (such as a Parental Guarantee, a bank guarantee and/or purchase of payment insurance) needs to be obtained. If such payment assurance cannot be obtained and such purchaser has difficulties raising the necessary funds, it is worth to consider establishing some sort of finance scheme including a loan structure. In case of a Consortium project, it is also useful to make a deposit system among the Purchasers' consortium to pool the construction funds. In this case, a bank account statement showing the deposited balance amount is effective. The terms of payment and the treatment of delay of payment and/or payment default needs to be defined clearly in the Contract.

4.3.3 Liability for the Consortium of Suppliers

If more than one supplier is involved, it is common that the responsibilities of the suppliers is Joint and Several. Under this condition, if one of the suppliers fail to perform its contractual obligation, a liability, the other supplier(s) will be required to take full responsibility in place. In such a case, the risk of project delay may be realized and it may also affect the profit and loss for each supplier. To hedge such risk, the Suppliers' Consortium partner must be a reliable and qualified party. A Consortium Agreement must be agreed among the suppliers and executed together with the Contract. In the Consortium Agreement, a share of supply should be defined without any ambiguity. Additionally, all integration risk is reviewed and listed. If there are any foreseeable technical issues, it is better to change and modify the share of supplier accordingly. And, to define and agree upon the liability for liquidated damage and other damages is also an important aspect. In order to mitigate such risk completely, it is preferable that the liability is defined based on the share of supply and that there are no cross connection of liability for each supplier among the consortium party.

4.4 Profit and Loss Management

At the beginning of any project, the cost breakdown for each of the work is estimated, and built up to get a picture of the overall cost. Then each estimated cost is reviewed from an aspect of both "possibility" and "need", measures for cost optimization is taken in to account, and then a cost target is determined. It is important that the gaps between the cost estimate and cost target is recognized so that detail measures to minimize such gaps can be taken. One of the efficient measures is "schedule control" for the work to be performed sequentially in any stand-by situation. Since the project schedule is quite long, any stand-by to mobilize any facility or resource could result in a large cost, which needs be avoided.

Through the project, the actual cost and progress in every work is continuously monitored and is fed back in to the cost management tools, thereby enabling the entire project cost to be reviewed and managed.

5. Verification

We have successfully implemented the Project which is one of the biggest submarine cable system in the world recently. During the implementation of this Project, all the risks described above were fully considered into the planning and well managed through the project implementation period, however, it was encountered unexpected risks which were uncontrollable. A few months of delay of the cable installation vessel arrival is one of the examples. It was due to the delay of other different project in which the cable installation vessel had been appointed in advance of our Project. In order to absorb the encountered delay, we decided to exercise the contingency plan, which is to split her cable installation wok into two segments and to operate two vessels at the same time in parallel as shown in Figure 9. Although this contingency plan might be more costly than our original plan, the entire project schedule was maintained as planned, which was the most preferable from both the Purchasers' and the supplier's point of view as described in Part 4.1 above.

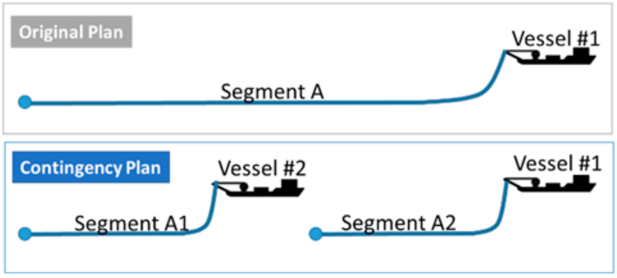

Figure 9 Work Split for Contingency

6. Conclusion

Major concerned risks which may lead to huge impacts to the QCD of a submarine cable construction project is introduced in this paper. In an actual cable system, however, we assess risks which can be broken down to more than 150, which would cover purchasers' ability, profitability, contract conditions, technical requirement, technical applicability, environmental condition, schedule applicability, resources, compliances and so on. Risk management has become more and more complicated because many process and concerned risks are mixed and interlinked with each other. Therefore the importance is to find the risks in advance at the beginning stages of the project, and address these risks in the system design and project schedule as preventive actions. The preparation of contingency planning in advance and the decision making in a timely manner are also key for the successful project.

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The Method for Visualizing Variance of Software Development Project in Real Time

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In a software development project, software size, progress and productivity will differ from the project plan for various reasons. However, the real situation of the software development cannot easily be seen. It is difficult to grasp the precise changing status of the project quantitatively. If the grasped progress and cost are not accurate, the actions to solve the problems would be late and the control of the project might fail. The cause analysis has to be done by hearing to the members about the problems. Success of the action depends on the PM's experience. EVM can be adapted to software development project. However, it is difficult to collect the precise and detailed WBS related data because it takes much effort to collect them. In this paper, to solve these problems, it proposes the method to make the changing situation visible quantitatively in real time. This method makes the variance visible in real time by the unit of person, product, and task. It is achieved by systematically collecting the data such as man-hour and progress which is related to detailed WBS. It helps PM to control the project smoothly by finding problems early, analyzing the causes of the problem, and forecasting the cost using EVM.

Keywords and phrases: Progress, Cost, Productivity, WBS, EVM

1. Introduction

In a software development project, software size, progress and productivity often vary from the first plan according to many factors. However, it is difficult to grasp the software size and progress precisely because the outcome of software development consist of documents or source codes, and the development works include various invisible works such as research and review. If recognized software size, progress and actual costs are not accurate or management granularity is rough, following problems might occur.

If project manager cannot find the increase of the software size, the actions such as coordinating specification and increasing personnel might be late. If granularity of the management is rough, cause analysis of the problem will take much time. When project manager cannot know the schedule delay and accurate actual cost quantitatively, the effort estimation would not be accurate and the number of additional personnel might not be enough.

As for the method to manage the progress and cost, Lipke (2009), Maeda (2004) and Yonehana (2003) propose the method to adapt EVM (Earned Vale Management) to software development and how to count the progress rate and cost. However, it takes a lot of effort to grasp the progress and cost precisely by the unit of detailed WBS level. It is difficult to grasp the quantitative information precisely. In this paper, the method for visualizing the changing status of the project regarding the progress and cost in real time is proposed. Both of accuracy and low operating cost had been realized by systemizing the whole process for collecting data, counting progress ratio and visualizing the variance of the project.

2. Problem of progress management and cost management for software development

2.1 Problem for cost plan by the unit of WBS and collecting actual data

Regarding making cost plan and collecting data, there are some problems as follows.

2.1.1 Problem of making cost plan and collecting data by the unit of WBS

To grasp the change of the project, it is necessary to make the project plan as base-line and to prepare collecting actual data. In fact, WBS, project plan and data collection process are made by project managers according to their own experiences in each project. This is not an efficient way because the base-line and summarized data vary according to project and it is difficult to know where the cause of the problem exists in the plan or in the actual project. And, the project data and the knowledge is not accumulated and it is difficult to re-using the knowledge of previous project.

2.1.2 Problem of granularity of the unit for progress & cost management

As for the granularity of progress management, and cost management, it is common to grasp progress by the unit of subsystem or functions and to grasp total cost. In this case, finding the problem and the analyzing the cause of the problem might be late and the problem might be getting bigger gradually. However if we try to collect the data for the unit of detailed WBS, it takes a lot of effort. The same problem was pointed out by Maeda (2004) and Yonehana (2003). Some simple ways for collecting data and counting progress are proposed. However, the way to collect accurate detailed data with low operating cost had not been established.

2.2 The problem of monitoring progress

There are some ways to monitor progress in software development project such as follows. Each way has some problems.

2.2.1 Reporting the progress from members

The accuracy of the report for each person's task is not so high because it depends on each person's subjective view. Sometimes the reported progress might include too optimistic judgement.

2.2.2 Counting progress according to the rule related to the main point of WBS

There are some ways to count-up progress rate at the main point of the WBS according to a simple rule like "Fixed ratio method" and "Weighted ratio method". However, it is difficult to monitor the progress in the mid-term of the WBS if the period of WBS is long.

2.2.3 Counting progress by the amount of outcome

It is the way to count progress by the number of design documents or source codes. However, the productivity varies by the type of documents or the complexity of each business function. Regarding source code, the estimation of lines of code tends to include the estimation error because it depends on person's experience and the progress is affected by the quality.

3. Visualizing the variance in real time

3.1 Outline of the method to visualize variance

As one of the solution to these problems Higashi (2003) proposes how to collect the progress and cost by the unit of work-package. In this method, the progress is counted by collecting the progress rate which is reported by members. This way has some problems described at 2.2. This method is used to grasp the whole status and cost of the project roughly, but it is not suitable to find out the problems exist in each process, functions and people.

To solve the above problems, following process was developed. At first, the way to make the cost plan and the way to count progress are standardized. Then, monitoring process for the progress and cost by the unit of detailed WBS like work-package level has been developed. The method to monitoring cost by detailed WBS was developed by referring to the way proposed by Higashi (2003) and Watanabe (2009). The method to count progress was developed by referring to the one proposed by Maeda (2004) and Yonehana (2003), and combining several method by considering the characteristics of each phase. Finally, to visualize the variance of the project precisely with low operating cost, whole process from cost planning process to monitoring and visualizing process had been systemized .

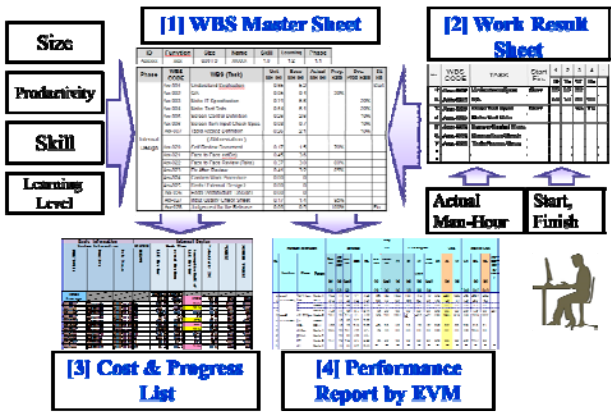

Figure 1 Outline of visualizing method for variance

Figure 1 shows the outline of the visualizing method for project variance. The main idea of this method is standardizing and systemizing the process of cost planning, collecting data to realize both of accuracy and low cost. Main documents in Figure 1 are explained at the following section.

3.2 About the documents for the visualization of variance and the usage of them

3.2.1 "WBS Master sheet"

"WBS Master sheet" in Figure 2 is used to make cost plan, collect actual cost and count progress. In this document, standard WBS is defined at the work-package level in advance. The objective of this document is to improve the accuracy of planning and collecting actual data. It also aims at accumulating and re-using project data.

"WBS Master sheet" is prepared by the unit of functions such as screen or report of the system. To make the sheets efficiently, project template sheet is prepared in advance. To make project template sheet, standard template sheet is provided.

ID	FUNCTION	SIZE	NAME	SKILL	Learning	Phase
Axxxxxxx	xxxx	800 FS	XXXXX	1.0	1.2	1.1

PHASE	CODE	TASK	UNIT MH (H)	BASE MH (H)	Actual MH (H)	Prog. Rate	Doc. Prog Rate	Stt Fin
Internal Design	Axx-001	Understand Secification	0.65	5.2				Start
	Axx-002	Q/A	0.05	0.4		30%		
	Axx-003	Make IT Specification	0.71	5.6			20%	
	Axx-004	Make Test Data	0.64	5.1			20%	
	Axx-005	Screen Control Definition	0.26	2.6			10%	
	Axx-006	Screen Item Input Check Spec.	0.08	0.7			10%	
	Axx-007	Table Access Definition	0.26	2.1			10%	
		(Abbreviation)						
	Axx-020	Self Review Document	0.17	1.5		70%		
	Axx-021	Face to Face getDo)	0.45	3.6				
	Axx-022	Face to Face Review (Take)	0.37	3.0		80%		
	Axx-023	Fix After Review	0.41	[illegible]		85%		
	Axx-024	[illegible]		[illegible]				
	Axx-025							
	Axx-026							
	Axx-027	Input Quality Check Sheet	0.17	1.4		95%		
	Axx-028	Judgement for the Release	0.06	0.5		100%		Fin

Counting Rate for Progress

Figure 2 WBS Master Sheet

In the standard template sheet, standard WBS is defined. The unit man-hour corresponding to WBS is filled in each cell. Unit man-hour is standard time to execute the WBS per unit software size. It is used to calculate "Base man-hour" of each WBS. "Base man-hour" is calculated by the following calculation formula.

Base man-hour = Unit man-hour x software size x productivity factor

Standard unit man-hour is derived from past project data. In the actual project, the unit man-hour is customized according to the productivity of the project.

If the productivity as precondition from internal design phase to Integration test phase of the standard template is 150 (h / ks) and the productivity of the project is 180 (h / ks), unit man-hour of the project is calculated as following calculation formula.

Unit man-hour of the project = unit man-hour of standard template x 180 / 150

"WBS Master sheets" for each function are made from the project template sheet. Software size of the function and skill level of assigned person are put in the header of the sheet.

Productivity is different according to the person's skill. Base unit man-hour is calculated using the productivity factor depends on the person's skill level. Productivity coefficient regarding skill is set to the header of the sheet to reflect the skill to the productivity. For example, productivity coefficient 1.1 means that it takes 1.1 times longer than standard skill person to do the work.

Thus, the process of making cost plan and the process for preparing the collecting actual data was established. When it is necessary to change the project plan to adapt to software size change or productivity change, project manager is able to re-make the schedule easily by using "WBS Master sheet".

3.2.2 "Work Result Sheet"

No.	WBS CODE	TASK	Start Fin.	1	2	3	4	·
				M	Tu	W	Th	
1	Axx-001	Understand Spec.	Start	5.5	6.5	2.0		
2	Axx-002	QA		2.5	1.5	0.4	0.5	
3	Axx-003	Make Test Spec.	Start			6.6	7.5	
4	Axx-004	Make Test Data						
5	Axx-006	Screen Control Spec.						
6	Axx-005	Screen Item Check						
7	Axx-005	Table Access Spec.						
-								
-								

Figure 3 Work Result Sheet

"WBS Master sheet" is used to collect the actual data. Figure 3 shows "Work Result Sheet" for collecting cost of WBS. It is recorded by project members every day. The items consist of phase, WBS code, actual hours for each WBS and work status. WBS and WBS code is copied from the "WBS Master sheet". The member inputs the actual time for each WBS every day. As a work status, "start" or "end" is input for the specific WBS. Input data are copied to "WBS Master Sheet" and progress rate is counted. The reports for visualizing variance are made from "WBS Master Sheet" using the collected data. It is important to collect data every day for getting information of variance in real time. It takes few minutes to input data a day. To ensure the everyday input, check tool is executed and the mail for informing input status is sent to the members.

3.2.3 Systemization of counting progress rate

As for the method for counting progress rate, several methods exist. "Fixed ratio method" is to count up 30% when the task started, and to count up 100% when finished. "Weighted ratio method" is to weight each WBS. "Criteria achievement method" is to count progress using several criteria. In this visualization method, several methods are combined according to each phase's characteristics.

In "WBS Master Sheet", parameters for counting progress rate is defined. To calculate the progress rate in each phase, weighted ratio method is adopted. For example, in the internal design phase, when the task for "understanding specification" and "QA (Question and Answer) " finished, progress rate is counted as 30%. When self- review finished, progress rate is counted as 70%. When "phase completion judgement" is finished, the progress rate is counted as 100%. "Criteria achievement method" is also adopted. For example, "Review" WBS is regarded as completion when pointed out item had been fixed.

In document making process, "Weighted ratio method" is adapted. Fixed progress ratios are allocated to making documents tasks according to document types. For example, 10 % is allocated to "screen item definition", 10% is allocated to "table access definition" and 20% is allocated to "test specification document".

In program development phase, as duration tends to long, number of method is used to grasp progress along with weighted ration method.

In test phase, number of test items and executed test items are used to count progress. Progress rate is defined in the WBS master sheet according to the above rules. Thus, from the man-hour and work status data collected by "Work Result Sheet", progress rate is calculated automatically without the repot of progress rate from members. By summarizing the collected data in "WBS Master Sheet", several documents to visualize the variance of progress and cost are made systematically every day.

3.2.4 Systemization of collecting actual data and visualization

The process to visualize variance of the project is summarized as follows.

Actual data is input to "Work Result Sheet" by members every day and is exported to "WBS Master Sheet". Man-hours and progress are summarized and documents to visualize the variance of the project are made automatically. All of the process is executed systematically.

Concrete usages of the visualizing method will be explained in the following project case.

4. Case study of visualizing method for variance in real time

Case study regarding visualizing method for the variance of progress and cost is explained. The project profile is as follows.

4.1 Project profile

- System function : contract examination
- System architecture : Web system
- Number of screens : 27 screens
-Number of members : 29 people (Maximum)
-Software size: Function Scale : 30 KFS
LOC : 950 KS
-Schedule : Figure 4 shows the first schedule from the external design phase to integration test

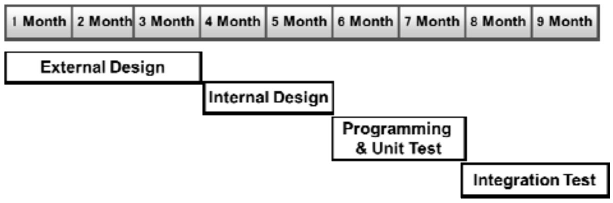

Figure 4 The first schedule from external design to integration test

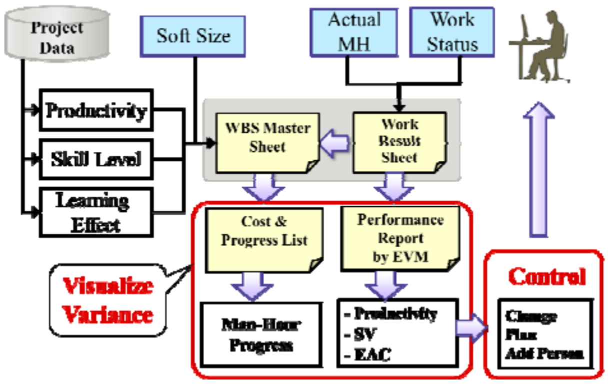

Figure 5 Management Process using visualizing method for the variance of the project

Figure 5 shows the management process using visualizing method for the variance of the project. How to utilize this method is explained below with a case study.

4.2 Making cost plan

At this project, some WBS of standard template was tailored to fit to this project. Average productivity was derived from the former projects that have similar architecture with this project. And modified some unit man-hour partially. Thus, the project template of WBS master had been made. By setting the necessary information such as software size of each function, productivity and assigned person's skill factor to the project template of “WBS Master Sheet”, base man-hours of each WBS of all 27 functions are calculated. Using this base man-hour, the detailed schedule had been made easily.

4.3 Visualization of variance

In execution phase of the project, each member input the WBS based man-hour and task status every day. This actual data is exported to the WBS master sheet. As the information of software size change is important, visualizing method for software size change which was proposed by Oshima (2016) was used.

Team leader and member were able to watch the variance of man-hour and progress rate every day. Project manager and team leader were able to find problems at an early stage and take actions to solve the problem by analyzing the cause of the problem.

4.4 “Cost and progress list”

Using the data collected into “WBS Master Sheet”, several reports to visualize the variance of progress and cost are made. Figure 6 shows the example of “Cost and Progress List”. This list shows summarized actual cost, consumed cost ratio and progress. If the difference of plan and actual data has exceeded predefined threshold, the background collar is changed. By utilizing this document, project manager is able to find problems easily and execute focusing management.

For example, when project manager realized the delay of a function by watching “WBS Master Sheet”, he were able to find that the man-hour for “understanding specification” increased than the base man-hour, and the man-hour for QA had increased.

Basic Information				Internal Design					
System Information			PERSON	Work Time					
FUNCTION ID	Function	Work Status	PERSON	BASE Man Hour	Actual Man Hour	Consumption RATE of BASE Man Hour	Productivity (SS)	PROGRESS	DOCUMENT PROGRESS
Total				2361.4	3274.3				
Average				94.5	131.0	139%	0.0	90%	92%
ABCAA03	ScreanA	PT Finish	A	140.2	268.9	192%	17.8	100%	100%
ABCAA04	ScreenB	PT Finish	B	230.7	339.0	147%	12.4	100%	100%
ABCAA05	ScreenC	PT Finish	C	102.1	121.2	119%	11.5	96%	85%
ABCAA06	ScreenD	PT Finish	D	47.0	0.3	1%	0.1	20%	0%
ABCAB03	ScreenE	PT Finish	E	124.1	155.3	125%	12.6	90%	100%
ABCAB05	ScreenF	PT Finish	F	129.6	214.1	165%	12.8	86%	88%
ABCAB07	ScreenG	SS Doing	G	125.6	180.9	144%	14.5	79%	80%
ABCAB08	ScreenH	PT Finish	H	151.4	153.6	101%	8.6	90%	100%
ABCAB09	ScreenI	PT Finish	I	230.2	162.8	71%	8.9	85%	68%
ABCAB12	ScreenJ	PT Finish	J	61.9	60.2	97%	5.8	100%	100%
ABCAC00	ScreenK	PT Finish	K	67.2	118.2	176%	11.6	89%	95%

Figure 6 Cost and progress list

It had turned out that the cause of this problem was that the quality of external design documents was not good. To solve this problem, project manager were able to take actions to improve the quality of design documents and prevented the expansion of the problem.

In another case, the man-hour for “error fixing” increased. It was found that the person’s skill and experience was not enough. The team leader decided to strengthen review of the particular member.

Project manager and team leader were able to find the problems early and take actions by focusing on individuals and specific WBS. This method for visualizing variance of the project made it possible to take timely actions to prevent the expansion of problems.

4.5 Management process adapting EVM and case study

Using the data in “WBS Master Sheet”, EVM (Earned Value Management) can be applied for management. By regarding base man-hour as PV (Planed Value), regarding base man-hour x progress

Function Information				Schedule						Today 7/22		EV & Progress				Cost		Index of Cost			
No.	Function	Phase	Person	Base MH (H) (1)	Avg Time /Day (H) (2)	Dura-tion (Day) (3)	Start	Fin.	Prog. Rate (%) (4)	Elapsed Day (Day) (5)	PV (H) (6)	EV (H) (7)	SV (7)-(6) (H) (8)	Differ of Day (Day) (9)	SPI	AC (H)	CV (H)	CPI (10)	EAC (H) (11)	VAC (H) (12)	Pro-duct-ivity (H/100FS)
5	ScreenA	SS/PT Spec.	Member A	140.2	11	12.7	7/4	7/23	85%	13.0	130.2	119.1	-11.0	-1.0	0.92	228.1	109.0	0.52	268.4	128.2	
6	(ALAA03Scrn00)	DBA	DBA A	31.2	11	2.8	7/22	7/24	50%	1.0	10.4	15.6	5.2	0.5	1.50	12.5	-3.1	1.25	25.0	-6.2	
7		PG	Member A	71.2	11	6.5	7/24	8/4	0%	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.00	71.2	0.0	
8		PT	Member A	75.9	11	6.9	8/5	8/14	0%	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.00	75.9	0.0	29.1
9	ScreenB	SS / PT Spec.	Member B	230.7	10	11.5	7/7	7/22	90%	12.0	230.7	207.7	-23.1	-1.2	0.90	299.6	91.9	0.69	332.9	102.2	
10	(ALAA04Scrn00)	SS	Member C		10	0.0	7/7	7/22	—	—	—	—	—	—	—	—	—	—	—	—	—
11		DBA	DBA_A	19.5	10	2.0	7/18	7/25	40%	3.0	9.8	7.8	-2.0	-0.2	0.80	8.6	0.8	0.90	21.6	2.1	
12		PG Main	Member C	106.6	10	10.7	7/23	8/5	0%	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.00	106.6	0.0	
13		PG Sub	Member D		10	0.0	7/23	8/5	—	—	—	—	—	—	—	—	—	—	—	—	—
14		PT	Member B	147.7	10	14.8	8/5	8/20	0%	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.00	147.7	0.0	
15		PT	Member D		10	0.0	8/5	8/20	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7 Performance report by EVM

rate as EV (Earned Value) and regarding actual man-hour as AC (Actual Cost), EVM can be adapted to visualize the variance of progress and cost totally. Figure 7 shows the Performance report by EVM.

Main management indicator is as follows.

(1) Base Man-Hour (H) : Necessary hour for the task
(2) Average Working time (H) : Average Working a day
(3) Duration (day) : = (1) / (2)
(4) Progress Rate (%) : calculated by "WBS Master Sheet"
(5) Elapsed day (day) : Days from start to finish of the WBS
(6) PV (H) : Planed Value = Base Man-Hour
(7) EV (H) : Earned Value = Base Man-Hour x Progress rate
(8) SV (H) : Schedule Variance = EV - PV
(9) Difference of Days (Day) = SV / Working hour
(10) CPI : Cost Performance Index
(11) EAC (H) : Estimate At Completion = AC + (BAC - EV) / CPI
(12) VAC (H) : Variance at Completion = EAC - BAC

By utilizing the above indicators, the variance of progress and cost can be grasped as intuitively understandable number every day. For example, schedule delay can be seen by difference of duration days. As EAC (Estimate At Completion) is updated every day, it helps to share the project status by cost information quantitatively among stakeholders.

In this project, according to the progress of the design phases, software size increased because of the additional requirements. From the "Cost and Progress List", it became obvious that the variance of the progress and cost had been increasing. This situation had been shared among stakeholders with prediction of the total cost quantitatively. Thus, project manager was able to negotiate about the specification and increase of the budget with stakeholders effectively. Project manager changed the project plan by adding personnel to meet the schedule. After having changed the project plan, project manager was able to confirm the effect of the action by using the visualizing variance method. This visualizing method for project variance helped project manager to monitor the detailed situation in real time and to control the project effectively.

5. Conclusion

In this paper, it proposed the method to visualize the variance of software development project in real time by the unit of detailed WBS. Through the project case study, it had been proved that this method helps project manager to find the problem early, analyze the cause of the problem and estimate the cost at completion successively.

In the organization where the author belonged, this method is adapted to several projects that developed new systems using waterfall development process. By adapting this method as standard process, project data are accumulated and reused. Accumulated data and "WBS Master Sheet" can be used for the effort estimation and project schedule planning.

Recently, the purpose of utilizing ICT spread from the efficiency improvement of existing work to creating new business model. Consequently, it will be more difficult to fix the requirement and specification in early phase. The variance between the plan and actual result tends to increase. The proposed method would help the project managers to take proactive actions when the project tends to change often.

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Project Management Method for Short-term Large-scale and Complex IT Development of Information System for Financial Regulation with Deadline of Compliance

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This paper discusses the effectiveness of the project management method that the author practiced as a project manager in short-term, large-scale and complex IT development of information system for financial regulation with multiple strict deadlines of compliance. This would be a risk management system for global systemically important financial institutions (G-SIFIs) and this project was required to deal with two regulations at the same time, one was for Japanese domestic regulation which must be complied no later than 6 months and the other was for international one which must follow within one year plus. Since the huge project was divided into multiple sub-projects that exceeded 600 man-month for each and more than 10 teams which would be managed and delivered in parallel, the author created and applied such project management methods as (1) an appropriate phased approach, (2) standardization and automation of project management as well as development method, and (3) strategy and plans for improvement of productivity and quality. In this paper, the author describes the methods and its effectiveness through the actual project.

Keywords and phrases: Complex, IT, Risk, Productivity, Quality, Standardization, Automation, Financial Regulation, G-SIFIs

1. Introduction

In this paper, we focus on project management in the development of information system to deal with multiple financial regulations, which are increasing in recent years. As a feature of those projects, short-term, large-scale and complex projects are required to deal with compliance deadlines of multiple regulations. Since these projects is increasing, this paper proposes the approach to deal with the risks and issues that these projects have.

Suzuki(2014) and Mizuho Securities Basel 3 Study Group.(2012) explain the reason of that background as below. Since the global financial crisis of 2007 to 2008, the regulation of the financial industry has been strengthened and strict global rules have been set by the government and the financial authorities to prevent the recurrence of the global financial crisis, and global financial institutions are required to comply with them. These financial regulations which have reporting deadlines are increasing, deadline of compliance especially strict for global systemically important financial institutions (G-SIFIs), such as international banks that operate internationally need to collect and process data existing in branches all over the world and to report to financial authorities, so manual actions are face a limit, so it is urged to automation by system.

Against these situations, Tanba (2016) pay attention for the solution called RegTech (Reg : regulation, Tech : technology) that utilizes new IT to deal with the complex and advanced regulations. According to Gulamhuseinwala and Silverberg (2016), the issue to deal with financial regulatory, RegTech is effective. Many short-term and large-scale system development projects that are conscious of the report deadlines of various financial regulations are often advanced in parallel from the above situation, the project is becoming complexed, these projects have high risks, appropriate project management have been important.

In this paper, solutions to deal with project risks of these short-team large-scale and complexed system development projects as described above, and show the results of applying to actual projects and their effects.

2. Risks in financial regulatory compliance projects

In this section, describe the risks of short-term large-scale and complex system development projects of international banks.

2.1 Risks in handling multiple financial regulations

International banks that operate internationally are required to respond to multiple financial regulations at the same time, and the compliance deadlines of regulations may be different from each other.

To deal with these projects, it is necessary to advance concurrently multiple system development projects as subprojects, and program management corresponding to the following risks is required.

- If dependencies of deliverables arise between projects that are being developed in parallel, the risk that the progress and quality of one project will affect the progress and quality of the other project
- If organizing a resource plan covering multiple projects is required, for example there are skilled person's resource constraint, the risk that the change in resource plan of one project will affect the resource plan of the other project
- Risks that it is difficult to confirm the progress and issues across projects because the project management method and management policy are not consistent in each project

2.2 Risks in short-term and large-scale development

To realize the short-term development of a large-scale system such as an international banking system that gathers data from branches all over the world and reports to international financial authorities, it is necessary to shorten the development period by applying solutions such as Crashing and Fast Tracking. In that case, the following risks are assumed to occur.

- Since there are multiple dependencies of work between teams, the risk of delays of tasks in dependence at the same time due to the delay of work that becomes a critical path
- Risk of schedule delay due to productivity and quality degradation by increasing development staff in a short period of time
  (Risks that may be caused by Crashing)
- To shorten the schedule, if the subsequent phase is started without waiting for the completion of the previous phase, there is a risk that the rework of the subsequent phase due to following the modification of the previous phase occurs and the resource will increase
  (Risks that may be caused by Fast Tracking)

3. Approach for the project risks

In this section, the approach for the project risks in section2 are shown in the following three points.

- Application of phased approach
- Standardization and automation of project management and development methods
- Strategy and plan for productivity and quality improvement

3.1 Application of Phased approach

Applying the phased approach has preventive effect to deal with the risks as shown in section 2, also it has effective on to deal with actualized risks. When multiple projects run in parallel, various progress obstruction factors occur as described above. Therefore, at the phase of project planning, it is important to make the requirement list which has a baseline of the project requirements as shown in Table 1, and these requirements should be agreed with stakeholders as a baseline of the projects, and also it is important to be reflected which requirements are mandatory for regulatory compliance. In order to decide the priority of requirements, as shown in Table 2, it is effective to describe the judgmental factors for deciding the priorities, such as corresponding man-hours, ROI(return on investment), manual correspondence availability, alternate proposal etc., and it is contribute to the improvement of understanding of stakeholders and the fostering of satisfaction.

If the risk becomes apparent and the project progress is affected during the project, it is important to take the phased approach with stakeholder agreement according to the above priority, so that the project does not affect the compliance with the deadline, and phased approach that responds to risks by changing the baseline is effective.

Table 1 Requirements Baseline

ID	Requirements and Details		Priority Level	Mandatory Flag	Phase	etc.
01	AAA	AAA	1	Y	Ph1	
02	BBB	BBB	2	Y	Ph1	
03	CCC	CCC	3	N	Ph2	

Table 2 Requirements Priority Level Decision Factor

ID	Requirements	Man-month	ROI	Alternatives	etc.
01	AAA	5	1000	Y	
02	BBB	10	1000	N	
03	CCC	50	50000	Y	

3.2 Standardization and automation of project management and development methods

When multiple projects run in parallel, or when multiple teams are developing in parallel at the same time as large-scale projects, there is inevitable risks that productivity and quality vary. To deal with the above risks, as shown in Table 3, it is important to consider solution of standardization and automation that can be applied in the entire life cycle of the project, and eliminating dependency on individual skills has effective in improvement productivity and quality. In addition, standardization and automation should consider applying both project management method and development method.

Table 3 Standardization and Automation apply area

	Project Phase	Project management area	System development area
Standardization	Requirements Definition	Consider solution of standardization and automation for Project management area to be applied in each phase in consideration of the scale and complexity of the project	Consider solution of standardization and automation for System development area to be applied in each phase in consideration of the scale and complexity of the project
	Design		
	Development		
	Testing		
	Migration		
Automation	Requirements Definition		
	Design		
	Development		
	Testing		
	Migration		

If there are multiple projects or teams with dependencies, thorough standardization of project management materials will manage these projects with the same management indicator in every project and every phase, it is possible to compare the management index with cross project or cross team, and it is considered effective for identifying the true problem of the project.

The proposal of the approach for standardization of project management is shown in Table 4 below.

Also, for various management indices, a rule should be set as to which index value should be applied according to the size of the project, and it should be possible to adjust the appropriate management level by making it possible to adjust the management load according to the project scale.

Table 4 Approach of project management Standardization

	Project Phase	Project management
Standardization Approach	Common	✓ Standardization of progress report material (Both qualitative report and quantitative report) ✓ Unified format of WBS and other management materials ✓ Encoding of judgment criteria for importance and priority when managing risks or issues
	Requirements Definition	✓ Appropriate phased approach (3.1) ✓ Standardization of requirements baseline document (Table 1)
	Design	✓ Standardization of project management documents as below ➢ design documents review records ➢ development review records ➢ system defect management table
	Development	
	Testing	
	Migration	

That rules on project management and standardization rules should be always documented, and it is important to share with project members is completed until one month before the start of each phase, and the degree of comprehension of the project members is confirmed before the start of each phase.

The automation of project management has effective in reducing management workload and improve management accuracy.

Especially in the case of short-term projects, the management workload increases due to shortening of the collection frequency of management index values, and the case of large-scale projects, the management workload increases due to enormous number of objects in the management target, there is also concern occur mistakes of the collect works.

Therefore, it is effective to reduce the management workload and improve the accuracy of management by automating the collection of management index values to the preparation of various report materials as much as possible.

However, in considering whether or not it is necessary to apply management automation approach, it should be considered the trade-off between the cost of automation and the cost reduced by automation.

The proposal of the approach for automation of project management is shown in Table 5 below.

Table 5 Approach of project management Automation

	Project Phase	Project management
Automation Approach	Common	✓ Automatic extraction of progress count from WBS ✓ Automatic extraction of progress count from issue or risk management table
	Requirements Definition	Same as common
	Design Development Testing Migration	✓ Automatic extraction of quality evaluation index value from project management documents as below ➢ design documents review records ➢ development review records ➢ system defect management table ➢ system defect of management table

In the case of short-term, large-scale and complex projects, there is inevitable risks that productivity and quality vary. Therefore, to thoroughly standardization and automation of development methods in all development phases is a precaution against the above risk I think that it is effective. However as in common with automation of the project management, in considering whether or not it is necessary to apply management automation approach, it should be considered the trade-off between the cost of automation and the cost reduced by automation.

The proposal of the approach for standardization and automation of development method is shown in Table 6 and Table 7 below.

3.3 Strategy and plan for productivity and quality improvement

It is important to implement strategies and plans for improving productivity and quality centered on the standardization and automation described in the previous section at the time of project planning and especially to agree with the stakeholders the following perspectives.

Table 6 Approach of System Development Standardization

	Project Phase	System development
Standardization Approach	Common	✓ Make the checklist to check compliance of standard rule
	Requirements Definition Design Development Testing Migration	✓ Make the development standard documents as below ➢ requirements documentation standard ➢ design documentation standard ➢ design standard ➢ data standard ➢ coding standard ➢ testing standard ➢ migration standard

Table 7 Approach of System Development Automation

	Project Phase	System development
Automation Approach	Common	✓ Application of development framework or software
	Requirements Definition	Same as common
	Design	Same as common
	Development Testing	✓ Automatic generation of development and testing deliverables as below ➢ code from design document ➢ test data from test specifications ➢ test evidence from application log
	Migration	✓ Automated migration manual

- ➢ Application area of standardization and automation for project management and development method respectively
- ➢ Cost resources required (including software assets etc.)
- ➢ Framework to promote the strategies and plans formulated

3.4 Solutions the author applied to actual projects

Figure 1 shows the standardization and automation algorithm of project management applied by the author to actual projects. Quantitative evaluation of project management indicators and automatic generation of reports were realized by the four processes shown in the Figure 1 below.

By developing all standardized templates, automatic report creation tool, report templates, etc. applied in this algorithm on Excel basis, we realized by the resource less than 1 man-month within the project cost range. This algorithm eliminates the need for manual collection and evaluation tasks, we could get the quantitative reports accurately and promptly.

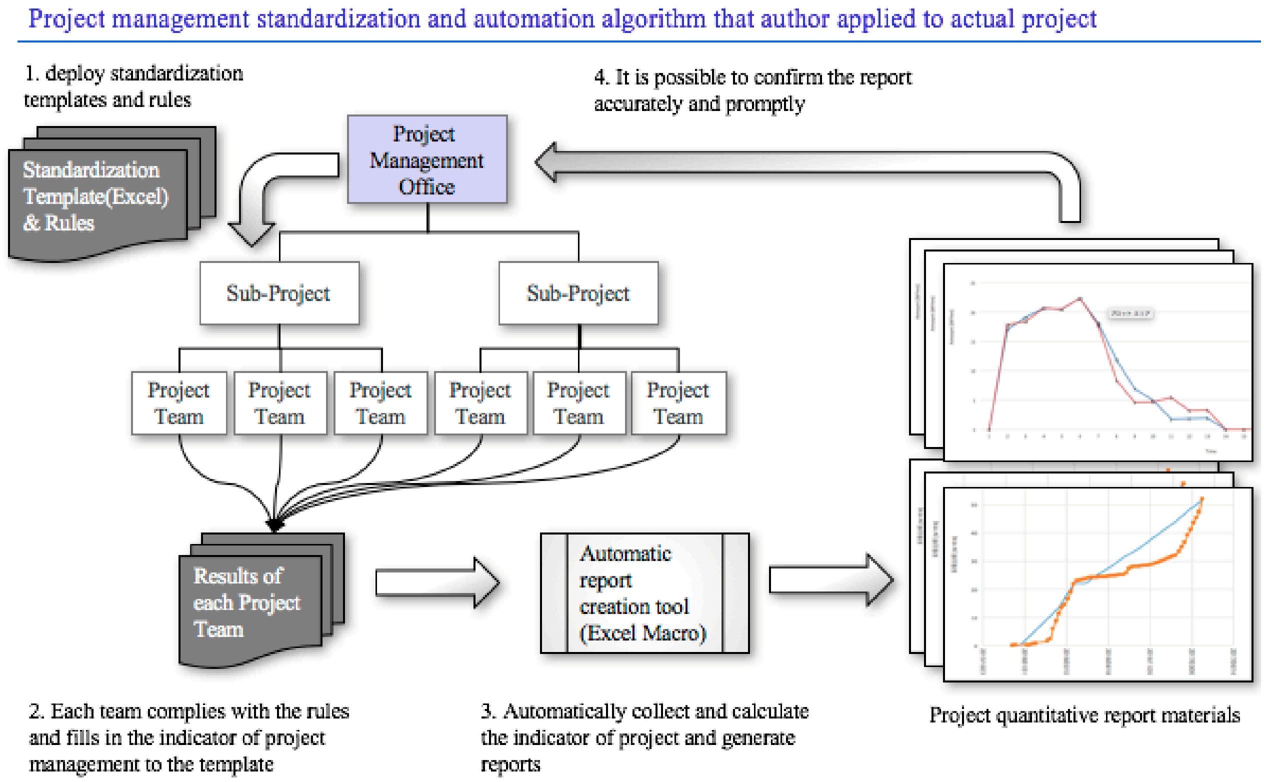

Figure 1 Project Management Algorithm

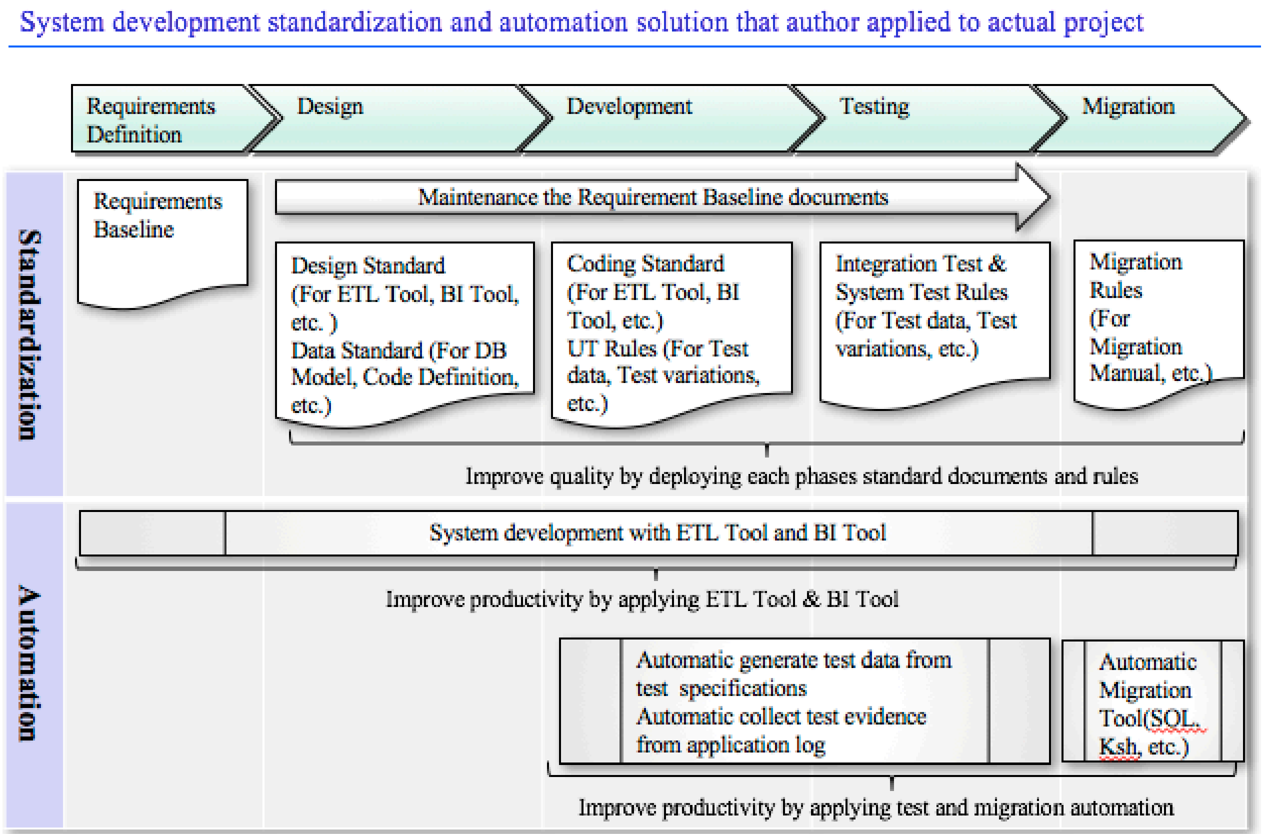

Figure 2 System Development Solution

Figure 2 shows the standardization and automation solution of system development applied by the author to actual projects. To improving quality and productivity, we applied these solutions.

4. Effectiveness through the actual project

In this section, the effect of applying the proposed method in this paper to the information system development project corresponding to actual financial regulation as project manager.

4.1 Project overview

The table 8 below overview of the project that the author drove as a project manager.

Table 8 Project Overview

Client	One of the global systemically important financial institutions (G-SIFIs)
User Division	Risk management division
Target System	Global risk management system
Target Laws and Regulations	Banking Act Basel Regulations
Project milestone	For Banking Act which must be complied no later than 6 months For Basel Regulations which must be complied no later than 12 months
FTE	Average 80 Max 100
Man-month	Multiple sub-projects that exceeded 600 man-month for each and more than 10 teams which would be managed and delivered in parallel
Organization	Owner Project Manager: Author Sub Project Manager: Average 3 members Project management office: Average 3 members Architect: Average 3 members Sub Team: Average 10 teams
Project Goals and Challenges	✓ Renewal of risk data model ✓ Application of Big data & BI solution ✓ Capture the data of group company in all over the world and achieve daily processing ✓ Full automation of user existing manual work

4.2 Effects on risks of projects to deal with multiple financial regulations

To deal with this risk, applied Phasing approach shown in 3.1, proposed the phased of the requirements that dependency between projects should not occur and it was possible to reduce the risk by agreeing with stakeholders.

Moreover, applied standardization of the project management shown in 3.2,3.4, it becomes possible to share the progress and issues of both projects, and when problems occur in the progress and quality of deliverables with dependency, it made it possible to share information in a timely, and made it possible to take approaches judge and solve priority of the issues across projects.

If the risk becomes obvious and the influence is inevitable, changed the requirement baseline with the agreement of stakeholders also by applying the Phasing approach shown in 3.1.

And to deal with issues of cross-projects, constructed project management office across projects by collaboration with stakeholders, it made it possible to reduce the impact on individual project progress.

4.3 Effect on risks of short-term and large-scale projects

Because of the target project required development for over 600 man-months in less than 6 months, to deal with above risks, as the approach of productivity and quality improvement in the activity of 3.3, to achieve a balance between shorten the period and maintain quality, scratch development judged that the risk is high, so proposed to introduce ETL tools and BI tools for clients. And, efficiently created the development standard materials by utilizing the assets of past projects, made it possible to standardization of ETL tool and BI tool.

We also applied project management standardization and automation algorithm and system development standardization and automation solution shown in 3.4.

With the above approach, it was possible to achieve development completion at more than twice the recommended development period of the same development scale and to prevent productivity and quality deterioration due to an increase in development members.

5. Conclusions

The project management method shown in this paper was applied to actual short-term, large-scale and complex projects, and the effect was recognized.

Regarding the application of the Phasing approach, it was possible to get the agreement with stakeholders of the baseline of the requirements at the time of project planning and thoroughly control the baseline while controlling the expectations of the stakeholders throughout the life cycle of the project.

It was also important to apply standardization and automation of project management and development methods in the entire life cycle of the project, to formulate strategies and plans for productivity and quality improvement based on standardization and automation.

By the above approaches, realized shortening more than twice the development period normally recommended, and it was possible to maintain quality and contributed to the smooth progress of the project.

With this approach, regulatory reports of multiple financial regulations could be achieved according to the deadline without problems, these projects provided highly satisfaction to stakeholders.

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Lubricate the Team Management with Non-Linear Progress Schedule

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To control priority and restriction condition in parallel running projects which are also including urgent interrupt missions and troublesome routine works, we suggest a new type of schedule control structure. Many manufacturing companies carry out plural projects in parallel. However, standard management tools are rectilinear, just emphasizing cost and delivery time, and they can't describe restricting conditions among activities in parallel programs. Another reason is that Japanese companies have been required to deal with the scheme of work life innovation which is advocated by the government recently. In direct words, that means reducing working hours. Therefore, the more subtle and effective approach is required to lubricate the team management. Here we report the first step of our challenge to explore specific optimization for our team and project management focusing on the priority management in design and development team.

Keywords and phrases: Schedule Optimization, Work Life Innovation, Team Management, Priority.

1. Introduction

There are various management systems and methods in the manufacturing industry. Aoki et al. (2012) consider the management rules, and Shibata and Sato (2015) consider the platform of project management tools. However, we still didn't find a solution for that when any schedule delay occurs in the project, how we should deal with that. Especially for our type of production, which is described in clause 2.1, a delay would fall into chain of delays in related processes. From a view point of delivery date management section, delays regarding engineering documents which provided by upstream process in the project occur frequently. On the other hand, design teams are always busy with duties. We wondered why the type of delay occurred so often and how we can control that. We thought that the standard schedule tools could not fit to handle the condition of design and development phase, and the delays may mean differences of timing. Therefore, we need a new style of schedule simulation tool to visualize and understanding the complicated condition hidden behind the schedules, and synchronize the timing gaps. Then organize the conflict sequence instead of hard time management and follow-up many times, so that shift the team schedule management from reactive to proactive. In this article, describe the simulation model for optimizing team schedule management in production project. First, organize a basic team model. Second, install synchronizer in boundary of each team model. Third, expand the network for project. That is why a project is consists aggregate of team models, and to optimize a team model, it isn't enough organize the one model but it need to synchronize the timing with related models in project. So that we should consider the synchronize control between each boundary of team and the schedule according to the three steps above. This article, mainly describe the first step, a basic team management model.

2. Feature of continuous build to order production

2.1 Feature of continuous build to order production

Regarding manufacturing companies in heavy industry firm, even build to order production, orders will come and continuous irregularly, therefore these companies need to conduct the production like as mass production to meet the continuous tight delivery dates. Therefore, hereunder we call this type of production as continuous build to order production which has features both hospitality of build to order production and reducing production cost of mass production. Comparing with mass production, it is difficult to estimate the accurate engineering hours and control the schedule according to a plan for continuous build to order production which includes customer original specification or connecting part between the delivery products and other equipment in the construction site. A project is supported by many suppliers and partner companies, and they also have the same features mentioned above in common. Therefore, the project structure which consists of main contractor, supplier, engineering teams in each company, and others relevant subcontractors have similar structure like as multiple nested model. A model of delay chain reaction among design works, procurement and manufacturing is easily expanded from prime contractor to suppliers, and the models construct a network. Therefore, we considered that finding the optimize solution for a basic model, and the solution may expand to our project management overall. Figure1 shows an image of the nest structure of team management in project.

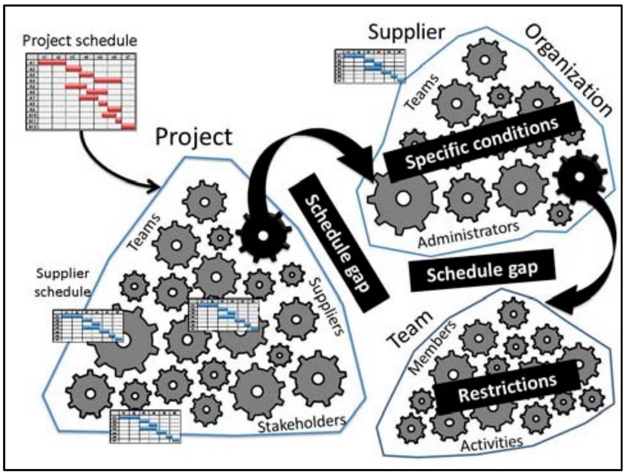

Figure 1 Nest structure of team management

2.2 Difficulty of estimating work hours and activities

In this type of production, especially for design and development department, it is too complex to understand the present actual situation such as required resources, amount of works, priority for parallel schedules and activities, and the progress. This is because the engineers should deal with many interruptions works, for example, change requirement from customer, adjusting the connection part, retry for running test, call from construction site, follow up by other department, and a variety of urgent requests. Even senior managers can't grasp each member's current condition which holding duties, progress, and when it will be finished. This problem directly affect to the manufacturing phase, because the schedule which includes manufacturing, procurement and construction is often changed by the reason of design works delay. Referring to some supplier's schedules, production schedule is normally described focused on manufacturing process, and for about design phase, the schedule line indicated with simple line such as only design work or just omitted. From the view point of manufacturing or procurement section, the deliverables from design department will provide indefinite priority order and timing. Then we should examine how we can expedite the output of design work to meet the production and project schedule, or how we can help the design deliverables management between design department and manufacturing or also our suppliers. We consider that the linear production schedule isn't enough to explain these complex conditions and need any complement to synchronize the gap of schedule in each organization.

2.3 Expediting work

A project is supported by various coordinators and administrators. In practical effort, we have introduced expediting process, so that to conduct more effective procurement management. Expediting means follow up the production progress of each supplier to meet the contract schedule and check their production regarding their stated quality management process. These expediters work according to the production schedule. Expediters check and follow up the supplier production process and progress. When the schedule is changed or the required documents are delayed, expediters also affected to take actions following the changes. Expediters aim to help smooth the procurement from project suppliers like a lubricating oil in gears, but they can't know the exact date when providing engineering documents and the status whether providing soon, postponed or not. Also, if there is pile of orders at the same time in a supplier, they can't handle that and need to know about the priority order of delivery and the exact delivery date without any margin time. Regarding the delivery schedule control, most of the delivery dates both of which requested by buyer and answered by supplier have margin time, and these margins are necessary to adjust the production and the transportation schedule. However, when the project schedule is having differences form the first plan and the order queue is stacked in the supplier, the delivery schedule will make no sense and they should just dedicate to conduct the stacked order.

2.4 Orchestrate differences and make a common view

A lot of differences have been made between planned schedule and actual performance in production projects according to the progress. Then, to carry out some complexity project managing method, many administrators will attend the project. These staffs usually operate database system to input the project performance and progress data, to modify changes on the previous data, to adjust the difference of schedule, and to negotiate with stakeholders. This process is necessary for project management but it seems to become vicious circle of overhead cost increase. Also, the schedule planning process requires experienced administrators for drawing the line between delivery date and the start point in the schedule, and adjusting the delay by their experienced knowledge. In fact, most of administrators deal with modifying schedule changes and input work result, so that means a reactive approach. When the project schedule stack up, it is impossible to identify the work priority order for project and production administrators and difficult to decide the order sequence without agreement by production stakeholders. That is obstructive to the progress of decision making. To proactive control activity order sequence and simulate the effect and risk when applying a new sequence order, we would like to use simulator which calculating the priority order. If the calculator can't make the best optimized priority, administrators can have a common view, and reduce the pressure to state strategy and take proactive action.

3. Differences and gaps in each schedule

3.1 Differences in production type

Although making an excellent schedule at the start of the project, the project usually can't progress according to it. In case of multiple projects carry out continuous, a delay caused in a project will transmit other projects easily. We are studying the difference of schedule type in production type and production phase. First, there is deference between the build to order production and mass production, but most of scheduling tool and production management method is designed for mass production or construction projects which have standard process. For mass production, each part of manufacturing work hours can estimate by similar record or past experiences. Regarding procurement, manufacturer of mass production can provide working hours and delivery schedule with small error. On the other hand, build to order production can't easily estimate work hours because the same work package will not repeat the next project, then the past data can't reuse directory, and there are many changes and additional works as requested in the planned schedule.

3.2 Differences between production phase

Second, we focused differences between design phase and manufacturing phase. As mentioned in clause 2, the design work of continuous build to order production is too complex to estimate the amount time providing deliverables and control the activity order. The design department seems always busy and full of tasks to do as soon as possible. Seen from other departments, deliverables from design department including drawings, specifications, and instructions for other department frequently get delayed as if they don't follow any schedules. However, design department usually have strong organized structure, and junior engineers follow the senior engineers and their line manager, also their reporting and approval line is well organized regarding technical development work. On the other hand, in terms of planning schedule and controlling the deadline they will lose interest and just concentrate on the duty of design works. The standard administrative work for schedule and performance management seems like humdrum and tough for busy team managers and members, and it isn't so effective to control their complex conditions. However, recent environment is under pressure to strict control deliverables deadline and work hours. Time and cost management is essential for project management, on the other hand, design engineers are different from the manufacturing machines in factory, if strictly manage the time schedule, their work performance can't be necessarily improved and their motivation may go down. We thought that not only just request to hurry for engineers according to the production schedule, but should organize the priority order and structure of work packages to reject the restriction condition which preventing their work progress and adjust the timing between the output of design team and the production schedule.

3.3 Differences between a project and suppliers

Third, we focused the gaps between a project schedule and each engineering team or supplier schedule. In power production firm, a project is supported by many suppliers. However, the production schedule from stand point of a project doesn't care about specific condition of project suppliers. Of course, main project schedule is the most important road map to lead the project overall but there is also distortion problem in progress between main project and each supplier project. Project schedule leads one flow but most of supplier schedules usually leads parallel and continue flow because suppliers are company and they have specific conditions. Even if suppliers join a very important project seeing from the project side, the production is just one of their continuous daily works. Therefore, we can say that it is difficult to control a project overall with only project standard schedule such as Gantt chart, because the project schedule is a target banner and can't explain the complex condition behind each team and suppliers. When a lot of change and chain of delay will occur, the reactive schedule management can't forecast and follow the changes.

3.4 Differences between standard theory and the real

To make the standard linear schedule such as Gantt chart, it is required the certain estimated activity hours and number of process though the project overall. Therefore, we can't make the type of schedule if we don't know about how many number of process in the project and how long time is required for each activity. However, sometimes we can't estimate the work package and time accurately regarding the build to order production, research and development works, in the urgent situation, and completely new project. Therefore, we would like to try introducing the scheduler which growing up according to the progress without accurate plan at the start time. In addition to this, if there are too much changes and additional works in the first defined schedule, we can't apply the all changes in the linear schedule, finally, engineering teams likely to stop following the schedule and just do duties in front of them.

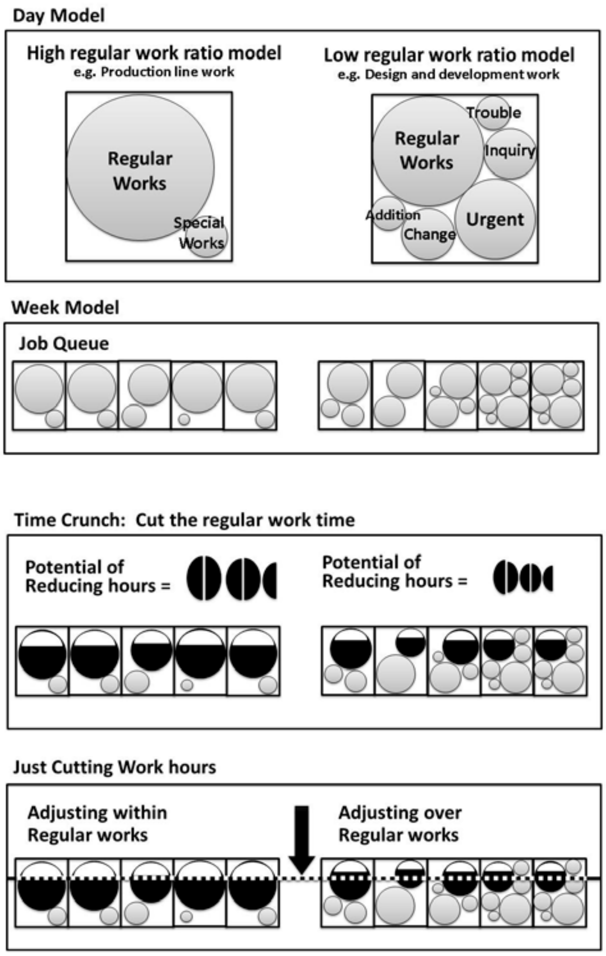

Figure 2 work hour variation and time reducing

4. Work life innovation

4.1 Deal with work life innovation

Currently we are introducing and enhancing to all departments in our organization 'work life innovation' which is the movement recommended by Japanese government for private companies. In direct words, the movement requires to reduce the working hours. Other relevant companies also have been introducing 'work life innovation', so that we should consider and reorganize work hours and schedule. Therefore it is impossible to depend on urgent response from stakeholders and partner companies as has happened in the past, and should not request such response in the future. A model of team management described in clause 6.2 is useful to organize activities and the priority order. We should understand the current condition dynamically and adjust the activity balance according to priority order. At first, practicing in a small team model, then grow the model to network in related department and partner companies.

4.2 Reorganize the job queue before time crunch

Time crunch is the same problem both of project management and the work life innovation. In work place, common problem is that effort of administrative section will become just cutting work hour innovation. The same issue can be said about project management especially for the design and development team management. We should not just cut the work hours, because as mentioned in clause 2.2, a daily duty of design team consists of regular works and many irregular works which including urgent interruption. In any case, simply cutting work time doesn't equal to increased efficiency. Figure 2 shows the model of duties variation on a day and a week level, and the potential of reducing time in regular work hours, and then cut the time on a threshold line. Regarding the model about the low regular ratio model, just cutting time is impossible without reorganizing and putting off the other duties. So that handle this situation, the team managers should have tools which to prioritize the duties order and to organize the balance of responsible activities in the team, and adjust work packages with the cooperate teams. In addition to this, schedule synthesizer is required, so that adjust the timing between postponed works and next process works which waiting the previous work as finished.

5. Synchronize the schedule gaps

5.1 Delivery date management for design department

The works such as design department generally don't have strict activity order control different from manufacturing line. Regarding manufacturing line, when an order is putted into the line, and the order will flow according to the process. However, design and development works can carry out any activities without strict order control depending on each person. For example, triggers of starting activities are applied by getting follow-up by other section and instruction by their manager. Time is limited but there are many duties to do as soon as possible, and interruptions are often occurred. Therefore, engineers need to postpone other activities to handle the conflict situation, but it is impossible even the team manager to predict the best priority order with considering a strategy in parallel running projects overall at the time. In addition to the situation, if the working times are cut simply by a project schedule crunch, engineering team can't achieve that easily, then they put of the other activities temporarily without proper priority order. We consider that the ordinary delivery management method which follow-up according to the planned delivery date in each production schedule will sometimes give negative influences for priority control from the view of strategic program management. If we have a simulator to calculate priority of job queue dynamically, we can understand the proper job order and share it in different processes, for example, between design works and manufacturing process. This is a function of boundary control working as feedback circuit. In addition to the order simulation, the boundary should have features which synchronize the delivery timing between previous process and post process. Then the function will work as synchronizer in continuous build to order production. Figure 3 shows a circuit model with the schedule synchronizer.

5.2 Installing the schedule synchronizer

There are various conditions for each standpoint in a project, and that can't be explained with one flame of schedule. For example, from the view point of a project, the project can't understand the detail of works a line in the main schedule. When a deliverable delayed, project administrators just request to hurry and shift behind the progress line on the schedule. On the other hand, from the view point of suppliers or engineering teams, a project works is just one of continuous production. If any incident will occur in a project, the delay affects the other layer of activities, and may cause the chain of delays. Therefore, there are various administrators and expediters in projects to adjust the gap about the view point of project schedule. Project or production management is spending much time and manpower to handle schedule arrangement and negotiation, also input and modify the changed record into a database system. For this reason, we considered that try to install a synchronizer in each organization schedule. Schedule administrators want to know just real delivery date from previous process, and the process team should inform the certain date but sometimes there are information errors different from the actual condition. Therefore, the sink side of schedule should correct information for the output job order rather than the date because the date may be changed. If there are large differences between the project schedule and the job queue of previous process team, feedback the gap for both of schedule and request to organize the job priority order.

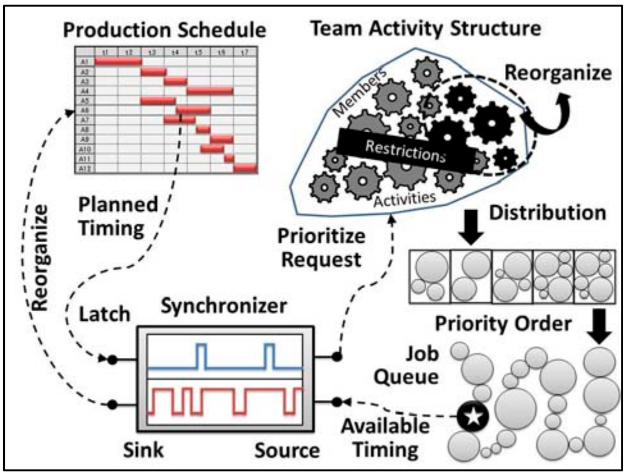

Figure 3 Synchronizer in the gap of timing

5.3 Orchestrate the supplier schedules

A project especially for production in heavy industry is supported by many suppliers and teams. Each supplier and team has the original schedules, and behind the schedules there are some complicated circumstances. We can't understand the hidden condition like a black box, but Input-output control can be seen by documents correspondences on each phase of production such as purchase orders, design drawings and quality requirements. These documents are keys for the next step of process, and important record of the project. Therefore, it is necessary to provide documents timely and smoothly for going forward the project without any loss but it is difficult to provide documents timely in various reasons. Accordingly, production administrators mainly follow the document correspondence. However, if documents preparation is in a hold state with restriction condition, we can't get it even requesting number of times. If it comes to this situation, taking other action or plan is better rather than just waiting and wasting the project time. So, we want to know a current condition of the previous process at least the job queue and priority order rather than the stated delivery date including some errors. Although project administrators are waiting deliverables at the point of main schedule, usually they can't get it without any follow-up action. Also, if the project requests to hurry about the deliverable, suppliers or engineering team can't reply that due to their job queue order. Therefore, to control the project activity order more proactive, project sink side should adjust the activity order according to the job queue of source side without just waiting and accepting delays, or negotiate with the source side to control the job queue order in advance.

6. Modeling the current condition dynamically

6.1 Sequence control for team management

Each team and company in a project has complicated circumstances behind the main schedule and the condition can't be controlled by strict time and performance management especially for the upstream process in projects such as design and development teams. We consider comparing team members and duties to a gear system. Gears can rotate smoothly and effectively when they are assembled appropriately, but the driving efficiency drops due to unsuitable combination and sequence control. In this article, learning from a combination of gears, we considered the method to conduct proactive team duty management especially for design and development work. To rotate gears effectively in the system, grasp respective gears combination state and reorganize them the most effective formation, and remove the restriction condition from gears. A model of combination system and each gear can indicate the relationship between a team and engineers, a project and activities or deliverables. The important point is that remove blockages, wasted waiting time and restriction conditions which prevent each gear from rotating without increasing the number of gears or boosting the speed putting on overload the gears. Then calculate the priority of activities to do at the same time range. And more, reorganize the activity structure considering the feedback from other boundary, so that adjust the proper schedule with the post processes.

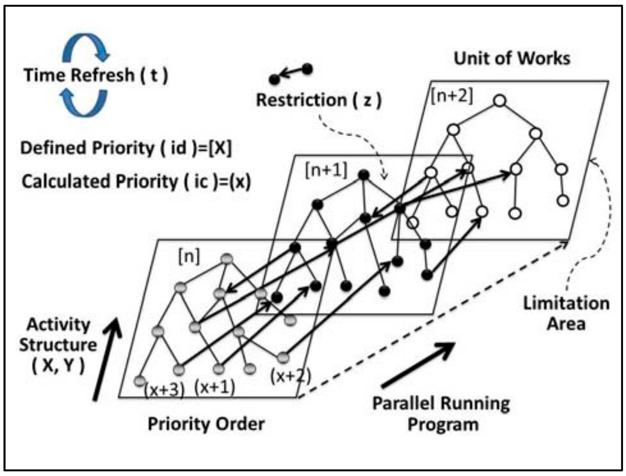

Figure 4 Basic team models

6.2 Basic team models

First, organize basic team models which understanding the current condition dynamically with restrictions and calculate the priority order in a small unit. Operating the ordinary schedule tools, we should try new approach to explain the details of complex conditions for bring out the new understanding for handling team management proactive. We designed a model of priority control tree to explain the activities in a unit of engineering works, and restrictions between parallel running units. Then calculate the priority order of activities considering with restriction condition and master priority defined for each unit. Figure 4 shows an example of a basic team model to organize activity structure and the priority. Small circles indicate activities, mainly activities mean deliverables. Layer of tree structures mean parallel running activity units or projects. Connected lines over each circle indicate restriction conditions. Using this model, calculate priority order of activities to do considering the restrictions among parallel running programs in engineering daily works. The concept of this model is that figure out the dynamic current condition and priority order without time management.

At first, make the activity structure with information which previously known at present and just focus on the order of activities for identify the restriction condition.

1) Waiting the required input
2) Waiting the previous activity is finished
3) Conflict of orders or job queue
4) Stagnation with having troubles
5) Reconsider the work allocation

When any interruption occurring or the condition changed, then modify the structure and status dynamically. The tree structure will grow up according to the time. In case changing plan very often, it causes commotion for the team member and stakeholders. However, conditions are changed often in the real world especially for human works such as research and development, and it doesn't progress on the line defined at the first. Therefore, schedule controllers are needed to follow the unstable condition dynamically to catch the risk before it will grow up too complex structure or cause a chain of problems.

6.3 Function of boundary

Second, after organizing the team model, define and install the boundary function which works for adjusting the timing between the previous process and the post process as timing synchronizer. The other feature is feedback circuit which to calculate and reorganize the activity priority order with accepting any prioritize request from the other schedule unit. This boundary function is important because a project consists of various teams and relations. Therefore, it isn't enough to improve and optimize only own team management but it is required to adjust timing among related process, and connect the feedback circuit to reorganize the priority and delivery timing according to the relations. Then expand the network in the project to orchestrate the project management overall. In case of conduct an improvement either project management or a team management, we need to consider about both and the connection of related process and adjust the timing. At first a team model, and organize the relation and timing between the others team model, then expand the network to project overall.

6.4 Expand networks

After installing synchronizer of input-output timing, the next step is that making connection with related team models and expanding the synchronized network. The team model mentioned in the clause 6.2 can apply for supplier's condition in the similar way. Engineering documents need to flow smoothly through the project stakeholders as medium of the network. Also, these documents can indicate production progress. Therefore, it is one of method orchestrating the procurement schedule to visualize and explain the documents providing network and the restriction condition of the delivery order. The documents input-output network consists of activity units, supplier's production schedule, and main project schedule. Change orders are one of reason for causing a delay of chain. This network image can use to simulating the risk what the level of influence will cause for the post processes if a change of specification would issue at an inconvenient timing.

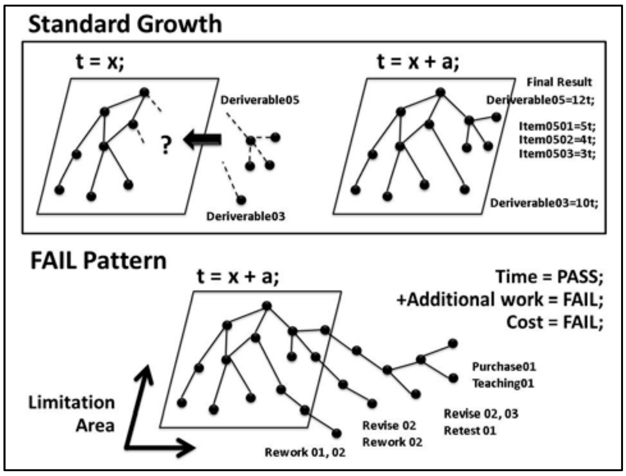

Figure 5 Risk predictions with growth pattern

6.5 Predict the risk from growth pattern

Sometimes, we found the chain of delay in production schedule. Once a schedule gap occurred in a point, the initial event will grow up the domino effect which would cause heavy impact to the project schedule and cost overrun. This risk would occur at the any place of projects which includes production of internal factory, supplier's factory, design department and the others section. However, it is difficult to predict the sign of risk for the view of daily work result management according to linear schedule. Because the view point of standard schedules such as Gantt chart and matrix type performance input system are linearly, and the line progress continuously and slightly according to data accumulation. Then, we normally can't identify the changes whether the change is normal situation or not. Yokota et al. (2013) consider that determining level of risk depends on the personal experience in the mind, and Uchida and Yamamoto (2014) mentioned that the knowledge of risk prediction usually can't be shared and recorded even in the organization. So that to support the risk prediction, we considered a method using the model of tree mentioned in clause 6.2.

In this phase, time and cost are applied as additional parameters. Time is applied as length of line, and cost is applied in activity circles. Using the model and focus on the difference and growth pattern, then evaluate the activity unit from the size, shape, and growth pattern. Furthermore, to evaluate the structure with limit gauge, register the all activities in development process such as revision and redoing in addition to the final result which defined in the plan. Second, recording the model data and network structure, then analyze the data transition of the structure to find the model and condition which is likely to cause the domino effect of delays or cost overrun. Figure 5 shows the image of risk prediction which using the structure evaluation. When a failure pattern occurs, record the pattern for searching if any similar pattern will occur in the future. When finding the similar pattern, reorganize the structure or keep strict watch on the part to deal with the risk.

7. Conclusion

We would like to try expressing the invisible and hidden information such as the difference between a planned schedule and real situation to synchronize the gaps between respective organizations which have complex and specific conditions in the background of schedule. To sum up, the simulating step is that control engineering team duties with just focus on the priority order control without hard time management because the time is indefinite and sometimes including false information. The next attempt is to synchronize the schedule gaps between the previous process and the post process. This phase includes feedback sequence which simulating the activity order and organizing the priority. Third, make a basic model grow and expand the network. This simulation finally aims to automate the coordinate and administrative works, because the schedule management is troublesome and the busy team managers can’t handle it, so that there are many overhead works to coordinate gaps of each boundary in the project. To reduce and orchestrate the situation, we would like to continue research for the hidden gaps until it will become our practical know-how.

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Project Finance through the Application of Islamic Securitization

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Project finance is a form of financing a capital-intensive project on non-recourse or limited recourse basis through a special project vehicle (SPV). via this method the bankruptcy risk will remote from the corporate and lender relay on project cash flow. Finance the project through the asset backed securitization can be one of the best methods to fund the financial resource in order to run the capital-intensive projects. The Islamic Financial System incorporates an asset based structure, excluding Riba or Usury with risk packages distributed and concentrated relatively uniformly among participants but Non-Islamic Financial System incorporates a credit based structure, with risk packages distributed and concentrated non-uniformly among participants. Project Finance through the Application of Islamic Securitization is a kind of non-recourse project finance that has positive aspect of non-recourse project finance and bridge on its weaknesses and limitations via eliminate the possible failure risk and preserve the investor's rights. This paper with qualitative approach tries to recognize a new debt finance instrument in order to finance the capital-intensive projects which based on Islamic foundation. It means investor relay on tangible assets for lending rather than credit paper and awarded for its incorporation in a real economic activity rather than acquire the interest.

Keywords and phrases: project finance; Islamic finance; sukuk.

1. Introduction

The concept of project finance is widely used in business in both developed and developing countries. The term 'project financing' is used to refer to a wide range of financing structures; however, these structures have one feature in common – financing is not primarily dependent on the credit support of the sponsors, special project vehicle (SPV), or the value of the physical assets involved. In project financing those providing the senior debt place a substantial degree of reliance on the performance of the project itself. In this paper the concept of project finance will be discussed firstly and then securitization as a financial instrument that can be used for finance the capital intensive project will be defined at a glance and the most important section – Islamic finance or issuance the sukuk- as a kind of asset-backed securitization will be discussed. it will backed by a case study-PETRONAS Global Sukuk .

2. Project finance

2.1 Definition of project finance

In the field of project finance, various definitions of project finance are cited. According to a definition provided by Nevitt and Fabozzi (2000), project finance refers to:

A financing of a particular economic unit in which a lender is satisfied to look initially to the cash flows and earnings of that economic unit as the source of funds from which a loan will be repaid and to the assets of the economic unit as collateral for the loan.

The economic unit in the definition typically refers to a legally and economically independent project company. The definition emphasizes that repayment of loan is primarily dependent on cash flow generated by the economic unit. Esty (2004) defines project finance as follows:

Project finance involves the creation of a legally and economically independent project company financed with non-recourse debt (and equity from one or more corporate sponsors) for the purpose of financing a single purpose, capital asset usually with a limited life.

The definition highlights two important features of project finance. First, a project is a set of legally and economically independent assets. Second, non-recourse debt means that the lenders only have recourse to cash flows and assets of the project. Esty et al. (1999) point out that although there may be periods when lenders have recourse to the sponsors' cash flows and assets, often during construction, project debt must become non-recourse to the sponsors at some point during the project's life. Merna and Owen (1998) define 'project finance' as follows:

Financing of a stand-alone project in which the lender looks primarily to the revenue stream created by the project for repayment, at least once operations have commenced, and to the assets of the project as collateral for the loan. The lender has no or limited recourse to the project sponsors. There is no single agreed definition for project finance as yet. It is no surprise that the market has not standardized these definitions because the field of finance is extremely dynamic and constantly changing. For the purpose of this guide, the concept of project finance is defined as follows:

Financing of a stand-alone project (or bundle of projects) is structured by using a group of agreements and contracts between lenders, project sponsors and other interested parties that create a form of economic unit; lenders and investors will look primarily to the economic unit to generate cash flow as the sole source of repayment of principal and interest and collateral. The lender has no or limited recourse to the Project sponsors (Chu 2007) .

The ultimate goal in project financing is to arrange borrowing for a project, which will benefit the sponsor (SPV), whilst not affecting its credit standing or balance sheet. All the above definitions emphasize that, in project finance, lenders to the project initially look at the cash flows of a project as the source for repayment of the loan and economic unit or SPV as one of the key features of project financing.

2.2 Requirements for successful projects

Requirements for successful projects are summarized as follows:

- Enforceable contractual arrangements
- Robust financial structures
- Detailed cash flow modeling
- Effective risk management
- Sensible risk apportionment
- Effective monitoring
- Stakeholder coordination

2.3 The key characteristics of project finance

Although project finance is used to refer to a wide range of possible financing structures that have been used in different industries for many years, the authors suggest that they all have five common features, which distinguish project finance from other financing methods:

- SPV
- contractual agreements of various third parties
- non-/limited recourse
- off-balance sheet financing
- robust income stream".

3. Securitization

Securitization is the method utilized by participants of structured finance to create the pools of assets that are used in the creation of the end product financial instruments. There are several main types of structured finance instruments.

- Asset-backed securities (ABS) are bonds or notes based on pools of assets, or collateralized by the cash flows from a specified pool of underlying assets.
- Mortgage-backed securities (MBS) are asset-backed securities the cash flows of which are backed by the principal and interest payments of a set of mortgage loans. .
- Collateralized debt obligations (CDOs) consolidate a group of fixed income assets such as high-yield debt or asset-backed securities into a pool.
- Credit derivatives are contracts to transfer the risk of the total return on a credit asset falling below an agreed level, without transfer of the underlying asset.

4. Islamic finance -sukuk

In fact, not only does Islam not negatively impact growth, but Islamic banking could complement conventional banks and thereby help diversify systemic risk. In conventional banks, when a bank gives out a loan, the borrower bears all risks, except in the case of bankruptcy. In Islamic banking, both bank and entrepreneur share the rewards and failure. In many developing countries risk sharing might allow entrepreneurs with little savings to undertake projects they could not contemplate in an environment where all the risk lies on them. In conventional banking, the creditworthiness of the borrower is the main determinant of the lending decision, and banks are interested in the interest and principal on the loan.

In Islamic banking, because profits and losses are shared, banks will receive a return only if a project is successful. Therefore, Islamic banks are more prone to finance sound projects, even if the entrepreneur has no credit.

Islamic finance offers an alternative financial paradigm. It is unique in that religious doctrines are avowed in the commercial and financial behaviors, transactions and sectors. The presumption that finance and economics are independent of religious considerations is challenged to the extent that an Islamic financial industry is thriving.

Core principles of Islamic finance

- Sharing (profit/loss and risk)

A distinctive feature of Islamic finance is its concern with development and social goals. Profit and loss sharing, or partnership finance, with its focus on cash-poor but promising entrepreneurs is believed to hold more economic potential than conventional, collateral-based lending, which favors established businesses. As profit cannot be assured, an Islamic financial institution must assume at least part of the risk of a given transaction. There can be no guarantee of a fixed return. Equally, depositors with Islamic institutions may not invest on a basis of guaranteed return. However, taking security is permitted in order to guard against negligence, willful wrongdoing or breach of contract by parties to the contract.

- No unfair gain

The charging of interest is strictly prohibited; any return should be linked to the profits of enterprise. The concept of Riba extends beyond that of interest to include the idea of unfair gain or exploitation.

- No speculation

Transactions relying on chance or speculation, rather than the effort of the parties, to produce a return are considered void under Rhariah . Any contracts involving speculation are not permissible (haram) and are often considered as gambling. Shariah, however, does not prohibit ordinary commercial speculation or risk taking. Transactions involving the use of swaps and options, for example, will need to be considered carefully to check whether the commerce substance of the transaction complies with this principle .

- No uncertainty

The existence of uncertainty in a contract is prohibited as it requires the occurrence of an event that may not occur. When entering into a contractual relationship, there must be full disclosure by all parties involved – a transaction 'tainted' with uncertainty will not be allowed. This suggests that detailed risk assessments should be performed by both parties to a transaction before entering into an agreement. Any transaction where the subject matter and the price are not fixed in advance will be viewed with suspicion under shariah.

- No investments that are not in the public interest

Investments must be Shariah compliant. Transactions involving certain products such as pork, alcohol, armaments, conventional finance products and gambling are prohibited.
Typically, institutions work from a blacklist of prohibited investments developed by the Shariah board.

- No hoarding of money

Trade and enterprise, which can generate real wealth for the benefit of the community as a whole, are encouraged between partners sharing profits and losses; therefore, money should be treated as a means of exchange and should not be treated as a commodity that is accumulated. For example, making money out of money in the form of interest is deemed unacceptable.

- Deception

Gharar is the term used to define an exchange in which there is an element of deception through ignorance of the goods or project or relevant price, or a false description of the goods or project. All such transactions are prohibited under Shariah.
Gharar includes such exchanges as the selling of goods that the seller is not in a position to deliver or the making of a contract which is conditional on unknown or uncertain events.

5. Case study

Leasing or Ijara Sukuk -The Case of Malaysia: Petronas
PETRONAS is the national oil and gas company of Malaysia and is wholly owned by the Government of Malaysia. PETRONAS was incorporated in 1974 under the Malaysian Companies Act, 1965 and derives its powers from the Petroleum Development Act of 1974, which vests in PETRONAS the "entire ownership in, and the exclusive rights, powers, liberties and privileges of exploring, exploiting, winning and obtaining petroleum whether onshore or offshore of Malaysia." At January 1, 2009, Malaysia had reserves estimated at 5.52 billion barrels of crude oil (including condensates) and 87.97 trillion standard cubic feet of natural gas.

PETRONAS, together with its subsidiaries and associated companies, is a fully integrated oil and gas company engaged in a broad spectrum of upstream and downstream oil and gas operations and petrochemical operations. PETRONAS' upstream operations include the exploration, development and production of crude oil and natural gas in Malaysia and overseas.

Securitization for finance the project

The US$1,500,000,000 Trust Certificates due 2014 is issued by PETRONAS Global Sukuk Ltd. (the "Issuer") and is constituted by a declaration of trust dated on August 12, 2009 . made by the Issuer, the Issuer in its capacity as trustee, Petroliam Nasional Berhad (PETRONAS) and The Bank of New York Mellon, London Branch (the Delegate). Pursuant to the Declaration of Trust, the Issuer is declared that it will hold certain assets (the Trust Assets), primarily consisting of the Trustee's right to the Sukuk, the Trustee's rights, title, interest and benefit, present and future, in, to and under the Transaction Documents ,all monies which may now be, or hereafter from time to time are, standing to the credit of the Transaction Account and all proceeds of the foregoing, upon trust absolutely for the holders of the Certificates pro rata according to the principal amount of the Certificates held by each Certificateholder in accordance with the Declaration of Trust and the terms and conditions of the Certificates . The Certificates is rank pari passu among themselves. The Certificates constitute limited recourse obligations of the Issuer. On February 12, 2010, and thereafter on each February 12 and August 12 in each year up to and including the Periodic Distribution Date falling on August 12, 2014 (or if such a day is not a Business Day , the Issuer will pay a Periodic Distribution Amount from proceeds received from and in respect of the Trust Assets to Certificateholders which is calculated on the basis of 4.25% per annum of the outstanding principal amount of the Certificates as at the end of the Periodic Distribution Period on a 30/360 day basis. The Certificates will not be redeemable in whole or in part prior to August 12, 2014 except upon the occurrence of a Total Loss, a Dissolution Event or a Tax Event, each as further described herein. Certificate holders should note that, through a combination of the Lease Agreement, the Purchase Undertaking and the Servicing Agency Agreement the ability of the Issuer to pay the amounts due in respect of the Certificates will ultimately be dependent on PETRONAS.

The Certificates is rated A- by Standard & Poor's Rating Services, a division of The McGraw-Hill Companies, Inc., and A1 by Moody's Investor Services, Inc. These credit ratings are not a recommendation to purchase, hold or sell the Certificates and may be subject to suspension, change or withdrawal at any time by the assigning rating agencies. PETRONAS Global Sukuk Ltd. is received approval in-principle for (a) the listing and admission to trading of the Certificates on the Labuan International Financial Exchange and (b) the listing of the Certificates on Bursa Malaysia n Financial Exchange Securities Berhad under an exempt regime pursuant to which the Certificates will be listed but not quoted for trading. PETRONAS Global Sukuk Ltd. and PETRONAS have also applied to list the Certificates on the Official List of the Luxembourg Stock Exchange and for their admission to trading on the Euro MTF market of the Luxembourg Stock Exchange and such application is pending.

6. Result

- Project finance is a form of financing a capital-intensive project on non-recourse or limited recourse basis through a special project vehicle (SPV). via this method the bankruptcy risk will remote from the corporate and lender relay on project cash flow.

- The Islamic Financial System incorporates an asset based structure, excluding Riba or Usury with risk packages distributed and concentrated relatively uniformly among participants but Non-Islamic Financial System incorporates a credit based structure, with risk packages distributed and concentrated non-uniformly among participants

- The Islamic Financial System revolves around Investor-Entrepreneur relationships – Equity Based Risk but Non-Islamic Financial System mainly revolves around Debtor-Creditor relationships –Credit Based Risk

- The Islamic system risk management issues revolve around Structuring risk mitigation processes through the enhancement and incorporation of risk sharing & participation features before the operation. Risk mitigation processes are not separated from the original Banking operations leading to a more stable and less volatile dynamics but in the non-Islamic Financial System risk management issues revolve around Structuring risk mitigation processes to off-load or disseminate packages of risk concentrations after the operations. Risk mitigation processes are basically separated from the operations

- Risk Management in Islamic Financial System is a complex, multi-dimensional process that must incorporate the following features:
  - Have a Holistic approach
  - Have a Multi-disciplinary approach
  - Have a Quantitative and Qualitative approach
  - Have a Centralized and Decentralized Management approach
  - Have a particular focus on the Accounting (AAOIFI) and Risk issues (IFSB , etc…) related to Islamic Banking operations (ROR , Equity, Fiduciary and Shariah Compliance Risks)

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International Project Management Co-operation in the Postal Sector: the example of Deutsche Post/DHL and South African Post (SAPO)

Amin Saidoun

This paper addresses international collaboration in project management and the impact areas it has on the community. The paper focuses on a practical example of collaboration between two postal operators while addressing the philosophical project management approach behind this endeavour. The project Deutsche Post/DHL and South African Post (SAPO) work together to prepare the turn-around of the latter one and better serve the community. There are only few publications related to international project management collaboration in the postal sector and their various impact areas. As with many case studies, this one provides a flexible format to address the peculiarities of international project management collaboration, the philosophical project management approach, building of a successful realisation of a turnaround in Germany and trying to implement lessons learned in South Africa to achieve project management success. Furthermore, the case study format offers a trans-disciplinary approach to a vast subject and facilitates the transition from an academic /model-driven approach to the day-to-day practical challenges of the project manager's profession. Here, the author can rely on his own experience in the field through a combination of research and story telling. The paper highlights the importance of the contextual setting and the behavioural competences in a competitive environment which remains strongly regulated by a postal legal framework. In that context the preservation of the universal service obligation in part of the project. The article is based on single-sited interpretative qualitative field experience in which an international team of professionals interacts to achieve a common objective: winning a strategic management partnership contract. From the results of the fieldwork and its various impact areas, the paper comes up with recommendations to be considered before and during project start, in order to manage and accomplish project management success.

Keywords and phrases: Templates, Format, Margin, Fonts and Font Sizes, Project Portfolio Management, Programme Management, Project Management, Project Governance

1. Introduction

Since the early nineties, the postal market in under profound transformation in Europe and in Germany in particular. This transformation process is driven by the philosophical and strategic approach of governments that liberalise postal markets, give more independence to public postal operators (PPOs) that strive for financial independence and have to become profitable [1]. At the same time, these operators must fulfil the public mission of assuring the universal service obligation, which is legally monitored by both the Universal Postal union (UPU), the European Directives and national regulatory authorities. This transformation project (which is in reality a programme made of a multitude of projects) is impacting many stakeholders on a national basis. However both liberalisation and globalisation are pushing operators to go international and to seek opportunities to co-operate in various forms on the one hand side.

On the other hand, PPOs are entering progressively in new markets to remain profitable and full fill their commitments deriving from their membership with the UPU. This approach forms part of PPO's mission and corporate social responsibility.

This article will highlight in particular:

- what philosophical approaches taken in the project management collaboration between two very different postal operators
- what are the contextual challenges that project managers of public postal operators (PPOs) need to address
- what are the main impact areas of the international co-operation between a German multinational and a South African historical operator
- what are the lessons learned arising from the preparation of an international co-operation project between two postal operators

2. Philosophical approach to project management in general and in the DHL-SAPO project

We need philosophy because we do not know. A project per definition is unique, innovative and restricted on a time line. So even if we can build on lessons learned from past experience having worked in similar projects in the same sector we will always encounter aspects we did not know before. Therefore there is no way around philosophy in project management.

Philosophy underlie our fears and the extraordinary potential of human beings to be inspired and create pictures and impressions of the unknown. Our philosophies help us dress up the unknown in ways, which comfort us in its presence

Success is a puzzle whose pieces has everyone to find and put together themselves. Project management success however can be secured through processes, tools, and techniques although this is still to narrow philosophy. By looking at international collaboration in megaprojects, not only optimism bias, but also strategic misrepresentation are main factors (or 'which is not' elements) that need to be considered in projects. Examples from the postal sector include the countless aid and support for projects which are initiated and executed by the Universal Postal Union in form of technical assistance. Indeed, aid for development which is a basic philosophy from which derive projects of technical assistance is one of the pillars of an UN body like the Universal Postal Union, of which the German and the South African Operators are long standing members.

Project management philosophy in general but in particular in the postal sector emphasizes on sharing the problems with all stakeholders of the "postal family" and team members. This way different brains come out with different responses and any of the response(s) can become the best solution(s). Deutsche Post managed to change from a lossmaking state-owned company to become one of the most dynamic logistics company in the world. Sharing this project management experience can to some extent save other postal operators from re-inventing the wheel. Documentation sharing and a knowledge-sharing platform make a strong basis for keeping all on the same wheel. This approach was taken to submit a bid for a strategic management partnership with the South African postal operator SAPO in 1999.

3. Environmental challenges and contextual competences

3.1 Germany: from state-owned national post office to one of the biggest logistics companies in the world

According to newly voted German Postal Law in the early 1990s, Deutsche Spot undertook a profound transformation process. The objective was to achieve progressive privatisation, to become profitable, to improve its overall quality of service and to diversify towards a logistics global player. The services offered cover the mail area, in the parcel and logistics area and in financial services through its subsidiary Postbank. The transformation project includes among others the set-up of a new country wide postal infrastructure (new but less sorting centres, parcel centres and postal outlets), a new postal code system increasing the number of digits from 4 to 5 to satisfy mail and parcel distribution for 17 million new people joining Germany after reunification of the country between 1990 and 1996, the review of the whole mail and parcel distribution system, the launch of a quality initiative and the re-launch of the whole Deutsche Post product portfolio (see Fig. 1)4. Figures and tables

Number figures and tables serially as separate lists (e.g., Figure 1, Figure 2, etc.; Table 1, Table 2, etc.). Numbers and headings are placed below the figures and above the tables. Leave a space between the number and the heading; do not use symbols, such as colons or commas (e.g., "Table 1 (Heading)"; and not "Table 1 : (Heading)" or "Table 1 . (Heading)"). When figures and tables do not fit within one column, align them to the center of the page, between the two columns.

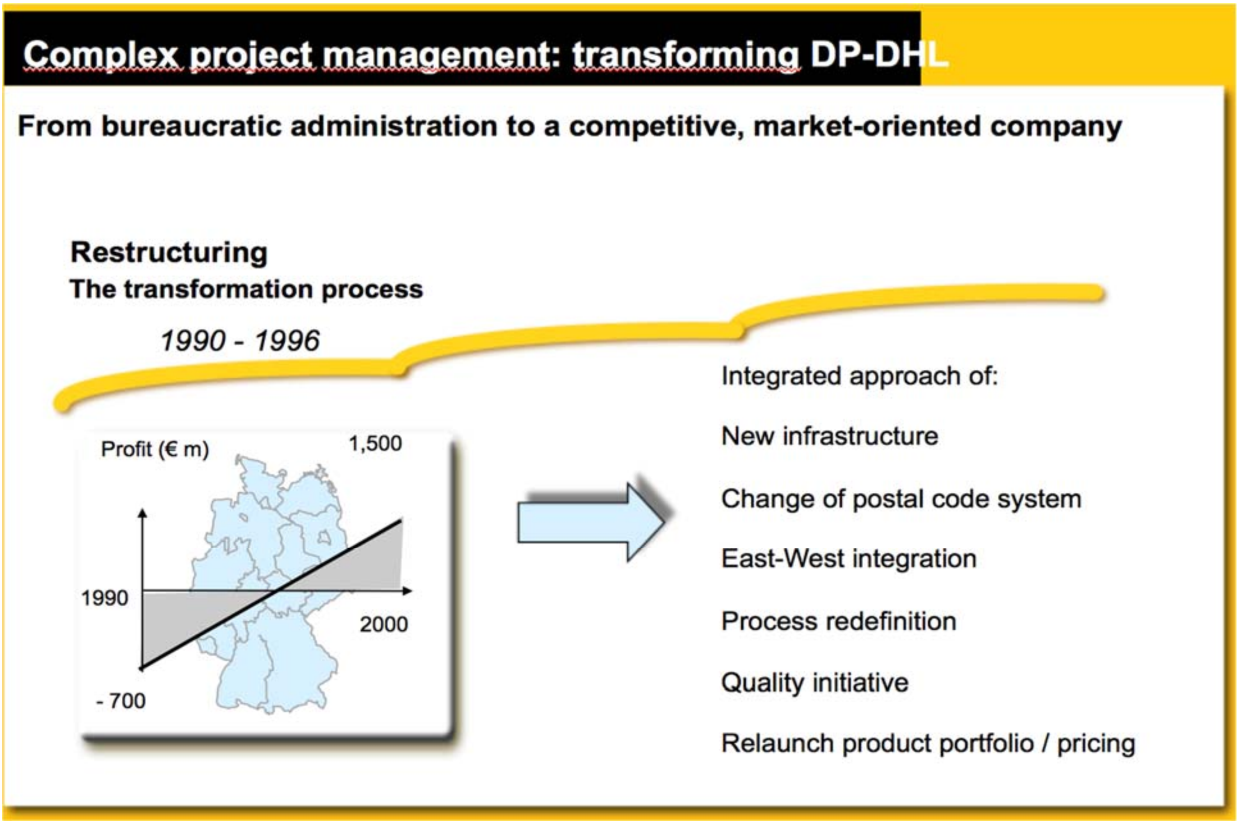

Figure 1 The phase of DP-DHL transformation process, Source: Deutsche Post (1998)

The transformation also meant creating projects to build new platforms for value added services such as hybrid mail, warehousing, online banking, in-house and direct mail services.

Coping with increased competition, new customer requirements and new markets meant to go international via incumbent and new entrant strategies deriving from the overall corporate strategy. A proper project management was set-up to implement these strategies. In this context, Deutsche Post identified a call for a strategic management partnership published by the South African Ministry at the end of Nelson Mandela Presidency in 1998. The objective of the Ministry was to seek for an international strategic partner from the postal sector to manage the turnaround of the South African post with the mandate of the South African Postal Act [8]. This act stipulates that the mission of the South African Post is to leverage its established postal infrastructure to link government, business and consumers with each other locally and abroad.

3.2 South Africa Post: the post Apartheid era is starting with many challenges and new projects

In 1998, South African Post (SAPO) is making heavy losses, has poor quality of service, inclusion is not really working, automation is poor and the need to reorganise the management and the postal network is urgent. The population in growing fast and long queues in postal outlets and loss of mail is putting the reliability of the postal operator at stake. This also includes the need to reform the financial services offered by SAPO.

A strategic partner able to achieve the turnaround with technical support and financial investment is needed by South Africa and complies with the overall Deutsche Post/DHL strategy. This last point was essential in the communication to DP/DHL top management in order to receive political, financial and HR support.

Knowing that South Africa is a strategic hub with huge opportunities to make business while serving the community, SAPO is calling in 1998 for a strategic management partnership and invites the major postal operators around the world (Royal Mail from UK, La Poste from France, New Zealand Post, Australia Post, Deutsche Post/DHL, etc..) to submit an extensive proposal within a period of 6 months.

For all operators it is critical that project management takes into consideration that:

- Affordable and reliable postal and parcel services must be achieved
- Independent regulatory oversight must improve
- Affordable and reliable universal service must be provided for letters
- Accurate and comparable information about any net cost of the universal service is essential
- Competition will be developed although slowly for the letter post as some operators risk to behave in an anti-competitive way (monopolist attitude)
- The number of letters will decline due to e-substition so value added services need to partly offset this decline in the longer run
- Employment by unversal services providers will inevitably decline, primarily as a result of email-substiution and automation. Organisational adaptation must me managed

4. Case Study: Incubating the turnaround of SAPO with DHL modernisation concepts

Forming an inclusive project team

After having formed a project team which is a consortium of Deutsche Post and South African companies, it was critical to show that already in the pre-project phase Deutsche Post/DHL would practice inclusion and employs South African employees. The reason for this was that the South African government launched the concept of black economic empowerment consisting of employment preference. South African employees were integrated right from the beginning in a balanced project structure where steering committee and project team members were equally staffed in number of experts from Germany and South Africa (Fig. 2).

Further impacts of the international project management collaboration are described in the next part of this paper.

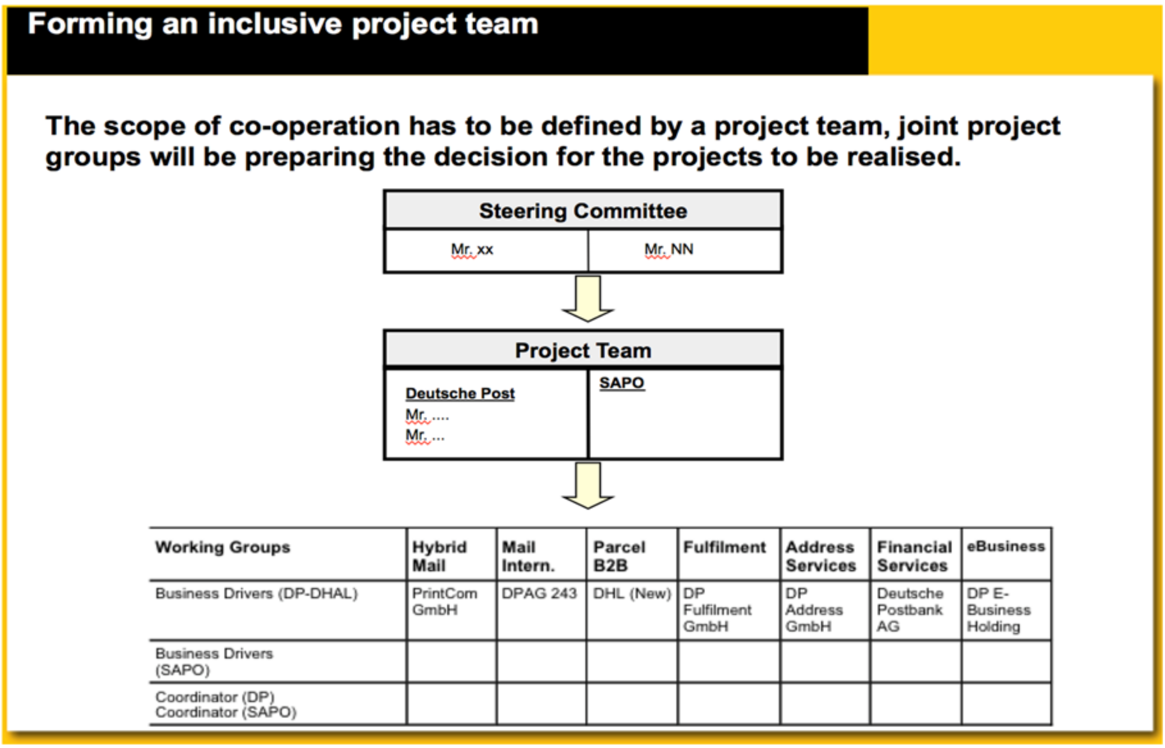

Figure 2 Inclusion in pre-project phase: Source: Deutsche Post Consult International GmbH

5. The main project management impact areas of international collaboration

5.1 Building trust in the project team, a fundamental project manager competence

Right from the teambuilding phase, the creation of trust between team members was essential to work under both time pressure and high quality expectations. This was a challenge as coloured African team members from Soweto (one of the biggest townships in the world), the Boers (descendants of the Dutch-speaking settlers), the descendants from the English speaking settlers and Germans team members from Deutsche Post had to work together for the first time in their life. This was even more difficult as during Apartheid regime built on legal and racial segregation, some of the team members were not allowed nor willing to work together on an eye-to-eye level for centuries. Reliability through the work assigned and transparency with clear working and reporting processes were key to establish trust among the team members and partly to get rid of hidden agendas.

Deutsche Post went through a profound integration process of thousands of employees educated and trained in the former GDR during 40 years. This meant developing training, mentoring in HR concepts that allowed the progressive integration of these employees in Deutsche Post, covering a reunified country with more that 17 millions new inhabitants. Part of these concepts were shared with SAPO and adapted to the local context for the benefit of the South African stakeholder. Cultural intelligence as the intersection of knowledge, behaviour and mindfulness would have been useful in the trust building phase:

· knowledge, for instance in the area of communication and more precisely the language used. South Africa is a melting pot of many tribes (Zulu, Khossa, Boers, English descendants) and languages

· Mindfulness, cultural "metacognition" (thinking about thinking): Reflection one's own role and the role of the other, as well as empathy are essential in interpersonal relations for the project manager and his team members

· behaviour, such as "project management style": The so-called "Western" and often in business schools taught management style is not particularly helpful in such an diversely composed project team. However, a relationship-oriented and partially authoritarian management style characterizes many typical South-African project management leadership structures. Knowing this helped to keep momentum in the consolidation of the work for the proposal submission to SAPO

5.2 Technological impact

The site visits both in Germany and South Africa to observe the work in sorting centres in Gauteng,KwaZulu- Natal and West Cape helped to create concepts for a new postal infrastructure in South Africa.

Reducing the number of sorting and parcel centres but increasing automation in production, reviewing the distribution of mail and parcel routes, the modernisation of postal outlets for mail, parcel and financial services, were some of the technological impact areas and lessons leaned from the German transformation process that were translated to the international the project management collaboration

5.3 Social dialogue

For the project management success it was critical that trade unions on both sides (Verdi for Deutsche Post/DHL and the Congress of South African Unions COSATU) were involved in the PM collaboration. Exchange of opinions to get the support of the postal work force was an important part of the stakeholder management strategy in the project.

5.4 Cost benefits analysis

The cost benefits analysis was performed is a systematic manner by analysing the various products segments in order to determine the potential gains for both parties on a longer run and to justify the financing of future investments made by DP/DHL in the SAPO infrastructure (Fig. 2). The main segments concerned were, mail, parcel, international mail and parcel, fulfilment, financial services and e-business.

5.5 Organisational impact

The suggestion to create different divisions/business units by separating the three areas mail parcel and financial services was well received by the South African Post

There were many other impact areas in the international project management collaboration. Risk analysis, risk management and project governance in a pre-election context can be mentioned (Thabo Mbeki in 1998 was preparing the take over of the ruling from Nelson Mandela whose term was ending in the same year).

The constructive collaboration between different people and the quality of the bid submitted led to a successful selection of Deutsche Post/DHL to the shortlist of selected future strategic management partner for SAPO.

Furthermore, the way project management was applied was well received by most of the involved stakeholders.

However, after 6 months of co-operation, the final project outcome was not achieved as the South African government decided to retain the proposal submitted by the consortium between New Zealand Post and Royal mail, one of the other competitors for the bid

In such a situation, a project manager should remind the team that success does not always mean winning. Success can also mean taking the steps that are right for the team. And there is no doubt that looking back with some self-criticism to the performed international project management collaboration, the steps taken by the team were definitely right to achieve the best possible outcome.

Despite of the fact that the final outcome of the project deceiving for all project members of Deutsche Post/DHL consortium, the project management was a success. Within a short period of time, people who never met before coming from very different backgrounds worked intensively to submit a high quality offer for a strategic management partnership with all the complexity this brings with it. The other positive side effect of this collaboration was as intensive training on the job of the team members having accomplished a lot in a short period of time.

6. Summary/conclusion:

Philosophies in project management are essential as for every project the Socrates paradox "we know that we do know" applies. This is even more true when it comes to international cooperation in project management between two very different postal operators whose mission is to serve the community. The practice of philosophy is a process benefiting the whole of society. It helps to build bridges between peoples and cultures. Philosophy encourages respect for cultural diversity, exchanging opinions and sharing the benefits of science, which are the conditions for genuine debate in project management.

The main takeaways from the presented international project management collaboration case are the following:

Firstly it was important to align the project goal in the overall corporate and division strategy for Deutsche Post/DHL to prepare for adequate internal stakeholder management.

Second, never underestimate the politics of a political project as international project management collaboration in the postal sector is before and after everything a political project, with strong political content and processes.

Third, it is necessary to reassure in a political project that the benefit for the project is not only economic but that it benefits the community at large. This is the basis of postal economics [14]. This means in particular benefits for stakeholder like private consumers, the staff representatives, the trade unions and small and medium sized companies that can speed up the employment creation thanks to the presence of a national wide postal logistics and financial services network.

Fourth, it is critical to master the human factors of behaviours and empathy that can be derived from adequate application of cultural intelligence.

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An Effective Way to Use the Process Metrics and the Product Metrics for the Software Quality Control

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NEC Corporation

Defects in delivered software can seriously impact a business, leading to declining customer trust and satisfaction, as well as increasing the cost involved in repairing the defect. In order to reduce the risk, we have developed an efficient and reliable quality control method that uses process metrics and product metrics to improve defect detection and correction. Process metrics are an aspect of the software development process that includes reviews, the number of test items, the number of defects detected, etc. Product metrics pertain to the product itself and include various aspects of the software code such as the number of lines, complexity, etc. Our approach involves setting a target value for the metrics and evaluating software quality by comparing the actual value to the target value before the product is shipped. However, it is difficult to find the relationship between the metrics and the quality of software, because it requires us to take into account so many different factors that may affect the quality. This makes it necessary to collect as much information and actual data as possible about the various factors comprising the metrics. In this paper we introduce an effective way to leverage the information generated by product and process metrics based on a detailed analysis of actual data collected by our organization.

Keywords and phrases: Process Metrics, Product Metrics, Source Code Complexity, Quality Control

1. Introduction

If a software defect shows up after a product has been shipped, the impact on the software provider can be extremely damaging and costly, leading to a loss of credibility and enormous expenditures not only to repair the defect, but to resolve problems caused by the defect. The software we develop is incorporated in corporate backbone systems and social infrastructure systems, which means that extremely high quality is required at all times. At the same time, people have come to expect more and more capabilities from their software, as evidenced by the rapid growth of Internet of Things (IoT) and artificial intelligence (AI). This in turn is pushing producers to ramp up software development and to release the attractive product into the market as rapidly as possible. Under such conditions, it is critical that sufficient resources are allocated to support the prevention and elimination of software defects and that limited resources are shifted to more advanced design tasks.

In waterfall development at our organization, the number of hours spent working on upstream phases - including definition of requisites and design - account for only 30% of all development phases. The main tasks in downstream phases are coding and testing as determined in the upstream phases. In other words, 70% of development time now has to be spent on downstream phases.

Thus far we have practiced quantitative quality control processes using process metrics applied to items such as the number of defects detected, review efforts, and the number of test items. Recently, however, we have begun to apply product metrics applied to more abstract features such as the scale and complexity of source code.

Current research into product metrics includes a report on the correlation between quality and source code complexity by Koketsu et al. (2010), Sato and Yamada (2017), an evaluation on the combination of product metrics with the coverage of unit tests given by Shimomura et al. (2013), and a study on measurement and management of source code complexity by Yamazaki et al. (2015).

This paper analyzes causal relationships between pre-shipment procedures and post-shipment quality. It focuses in particular on the relationship between product metrics and process metrics in order to determine whether or not it is possible to efficiently eliminate development backtracking forced by defects detected in downstream phases, as well as minimize the risk of defects surfacing after shipment.

2. Development Process and Quality Control

2.1 Development process

At our organization we apply the waterfall development model shown in Fig. 1. Design of external and internal functions is conducted in the basic design (BD), functional design (FD), and detailed design (DD) phases. Coding is conducted in the coding (CD) phase. Subsequently, unit test (UT), functional test (FT), and system test (ST) phases are performed. The BD-CD phases consist of the design (creation of draft design specifications and source codes) and review of the draft.

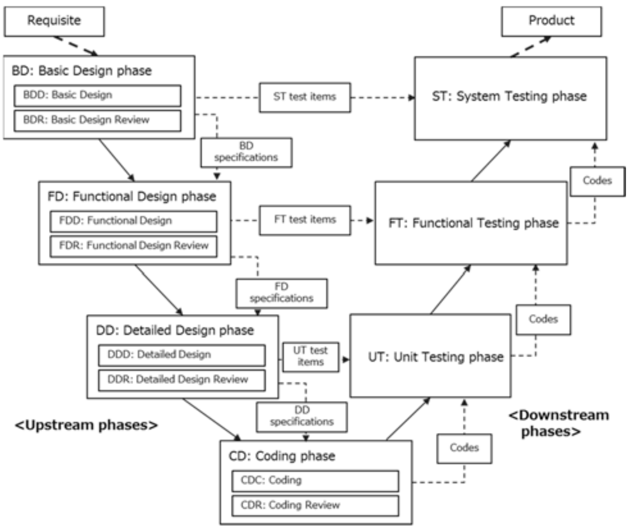

Fig. 1 Development process

2.2 Quality control

Our organization usually conducts quality control using process metrics. Process metrics is a measurement standard generally used in software development life cycles. The primary metrics include the number of defects detected, review efforts, and the number of test items in each development phase (see Table 1). The reference values of process metrics are mainly derived from development data of passed projects performed by the development team and checked against the values derived from the collected metrics to confirm that the phases are performed correctly during transition of phases and so on.

Recently, we have stepped our efforts to apply product metrics to quality control. The main product metrics used here include the number of lines and complexity of source code (see Table 2). We collect these product metrics during every phases from coding to the final testing stage. Using product metrics in addition to conventional quality control processes allows us to enhance the efficiency of all quality control processes.

The data we collect is stored on a standardized cloud platform called the Software Factory (See Fig. 2). Because we use the Software Factory to manage all data pertaining to all of our development projects, we can automatically totalize the metrics overnight and get the results the next morning. As a result, project leaders and quality control teams can immediately discuss and review the current status of development process and products, as well as analyze their weak points.

Table 1 Main process metrics

No	Metric	Meaning
1	Density of defects detected in each phase and after shipment	The number of defects detected during each BD-ST phase and after shipment / Development scale (KLOC)
2	Density of review efforts in each phase	The number of review efforts (labor and time) in each BD-CD phase / Development scale (KLOC)
3	Density of the number of testing items in each phase	The number of testing items in each UT-ST phase / Development scale (KLOC)
4	Density of the number of efforts in each phase	The number of efforts (labor and time) in each phase / Development scale (KLOC)

Table 2 Main product metrics of source codes

No	Metric	Meaning
1	Effective lines of codes (ELOC)	Value derived by subtracting the numbers of comment lines and blank lines from the total number of lines (totalized in each class) (LOC)
2	Rate of comments (%)	(Number of comment lines / Total number of lines) * 100)
3	Average value of cyclomatic numbers (CYCLO)	Class average value of numerals that represent path complexity by branch instructions
4	Branch condition average value (BRANCH)	Class average value of the number of conditional expressions of branch instructions
5	Maximum nesting average value (NEST)	Class average value of maximum nesting numbers in each method

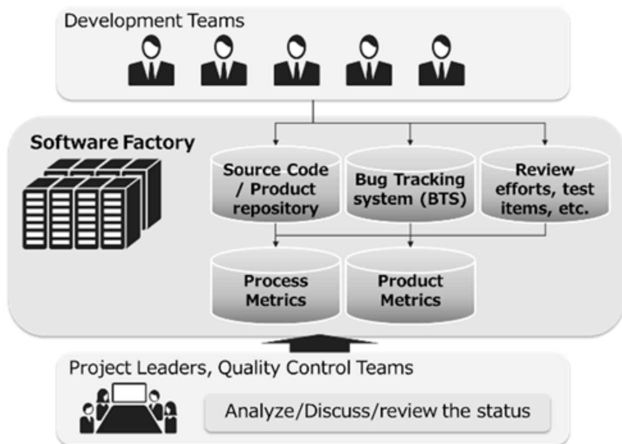

Fig. 2 Software Factory

3. Metrics and Data Subject to the Analysis

3.1 Metrics used in the analysis

For process metrics that can affect the quality of source codes, we narrowed the metrics of Table 1 down to the metrics related to the CD-UT phase. We selected the following three: the CD phase's coding efforts density (hereinafter referred to as CDCD), the CD phase's review efforts density (hereinafter referred to as CDRD), and the UT phase's testing item density (hereinafter referred to as UTD) (See Table 3). For product metrics, we selected the following four: the effective lines of source code (hereinafter referred to as ELOC), the average value of cyclomatic numbers (hereinafter referred to as CYCLO), the average value of the number of branch conditions (hereinafter referred to as BRANCH), and the average value of maximum nesting numbers (hereinafter referred to as NEST) (See Table 2). These process metrics are used to express efforts that ensure the quality of source code, while the product metrics are used to express source code scale and complexity.

As the metric that indicates the quality of source code, we used the densities of defects detected in the ST phase and after shipment (hereinafter referred to as DEFD) (See Table 3). This metric means the density of defects that could not be detected before UT. In many cases, our organization performs the CD and UT phases side by side. Moreover, in the FT phase, defects on the functional and requisite levels are often found. Thus, we decided that it would not be appropriate to include the defects detected in the UT and FT phases in the DEFD metric.

We did not select the skill-level of developers and difficulty of the product as the metrics although they seem to influence the quality of source code, because we decided it is difficult to control the value of those metrics during the development process. We should call them into account as the preconditions for the development.

In this paper, we use above metrics to effectively analyze whether or not we can efficiently eliminate backtracking of development procedures due to defects detected in downstream phases, as well as to minimize the risk of defects surfacing after shipment.

3.2 Data subject to the analysis

We used the data from 69 general-purpose software products that we developed from FY 2014 to FY 2016. We totalized and analyzed the data according

Table 3 Process metrics used in the analysis

No	Metric	Meaning
1	Density of the number of efforts in CD phase (CDCD)	The number of efforts (labor and time) in CD phase / Development scale (KLOC)
2	Density of review efforts in CD phase (CDRD)	The number of review efforts (labor and time) in CD phase / Development scale (KLOC)
3	Density of the number of testing items in UT phase (UTD)	The number of testing items in UT phase / Development scale (KLOC)
4	Density of defects detected in ST phase and after shipment (DEFD)	The number of defects detected in ST phase and after shipment / Development scale (KLOC)

to the product.

In our data, there are characteristics that almost all of products are coded using C/C++/C# language or Java language and each product has many variations in its development scale (from 0.1 KLOC to 700 KLOC) and in the difficulty of the product.

4. Analysis of Metrics That Affect Quality

4.1 Extraction of effective metrics (correlation analysis between metrics)

If one of the metrics discussed in 3.1 can be found to affect the DEFD, that metric is likely to prove useful in quality control. The first step we took in order to extract such a metric was to analyze the correlation between the metrics. A scatter diagram matrix is shown in Fig. 3, and a correlation coefficient matrix is shown in Table 4.

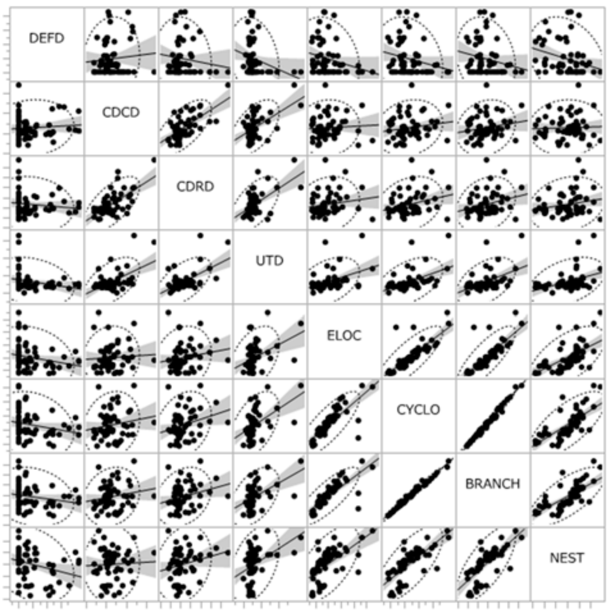

Fig. 3 Scatter diagram matrix between metrics

Table 4 Correlation coefficient matrix between metrics

	DEFD	CDCD	CDRD	UTD	ELOC	CYCLO	BRANCH	NEST
DEFD	1.00	0.09	−0.13	−0.26*	−0.23	−0.22	−0.19	−0.28*
CDCD	0.09	1.00	0.65****	0.55***	0.06	0.17	0.18	0.04
CDRD	−0.13	0.65****	1.00	0.58***	0.17	0.28*	0.27*	0.21
UTD	−0.26*	0.55****	0.58****	1.00	0.42***	0.49****	0.47****	0.42***
ELOC	−0.23	0.06	0.17	0.42***	1.00	0.81****	0.81****	0.60****
CYCLO	−0.22	0.17	0.28*	0.49****	0.81****	1.00	0.99****	0.71****
BRANCH	−0.19	0.18	0.27*	0.47****	0.81****	0.99****	1.00	0.71****
NEST	−0.28*	0.04	0.21	0.42***	0.60****	0.71****	0.71****	1.00

*: p<0.05, **: p<0.01, ***: p<0.001, ****: p<0.0001

None of the process metrics and product metrics in this analysis was found to show a correlation with the DEFD. However, in the scatter diagram, the DEFD was better dispersed in domains where each individual metric was relatively low. It would appear that the DEFD converged at low levels that surpassed a specified level. This trend was particularly noticeable with UTD.

Among the process metrics, only the UTD showed a positive correlation with the product metrics (ELOC, CYCLO, BRANCH and NEST, correlation coefficient: 0.42-0.49, p<0.001).

A positive correlation was also seen between the process metrics (CDCD, CDRD and UTD) (correlation coefficient: 0.55-0.65, p<0.0001). This is believed to be the result of the quality control we usually conduct in which the density of the number of review efforts and test items is sufficient as well as the target value derived from development data of passed projects. In addition, strongly or very strongly positive correlations were seen between the product metrics (ELOC, CYCLO, BRANCH and NEST, correlation coefficient: 0.60-0.99, p<0.0001).

4.2 Extraction of effective metrics (stratified analysis according to medians)

Next, we confirmed DEFD trends by stratifying the relationships between the metrics and the DEFD according to whether each individual metric was larger or smaller than the median of each metric. This is because the correlation analysis indicated that the DEFD exhibited different tendencies in the smaller and larger metric domains' results. The process metrics and DEFD mosaic diagrams are shown in Fig. 4, and the product metrics and DEFD mosaic diagrams are shown in Fig. 5.

The size of each cell in the mosaic diagrams represents the frequency (the number) of samples which are higher or lower than the medians of vertical and horizontal axes.

As seen in Fig. 4, there was not much difference in frequency between the larger and smaller DEFD when they were stratified by CDCD and CDRD, whereas a rather substantial difference was exhibited when they were stratified using UTD. In general, the DEFD tended to be lower when UTD was higher. When taking a look at Fig. 5, we can see slight differences in the frequency no matter whether ELOC, CYCLO, BRANCH, or NEST is used for stratification. In each case, DEFD tended to be lower when ELOC, CYCLO, BRANCH, or NEST was higher.

The number of samples in each cell is 10 or more, meeting the application criteria for the chi-squared test. As a result of the chi-squared tests, a significant difference (p<0.05) was recognized in the case of UTD (Fig. 4, bottom, p value=0.0114) and also in the case of NEST (Fig. 5, bottom right, p value=0.0400).

In case of stratification with product metrics such as ELOC, CYCLO and BRANCH (other than NEST) which express the complexity of source code, DEFD did not exhibit the significant tendency. These metrics are strongly related to the development scale of the functions or files as their calculation methods are shown in Table 2. It is normally found the case that the functions or files with large scale consists of simple sequence of many simple procedures even if the metrics are large value. These metrics did not express the complexity of source code correctly in this case. We think this is the reason why the significant difference was recognized only in the case of NEST.

These findings show a pattern where DEFD was higher when UTD was lower. It was also higher when NEST was lower. The former is an intuitively reasonable conclusion that increasing the density of UT testing items will decrease the number of defects detected. But it requires attention because increasing

UT testing items can lead to increased cost. The latter conclusion requires detailed analysis why the number of defects detected decreases when the average value of maximum nesting is increased.

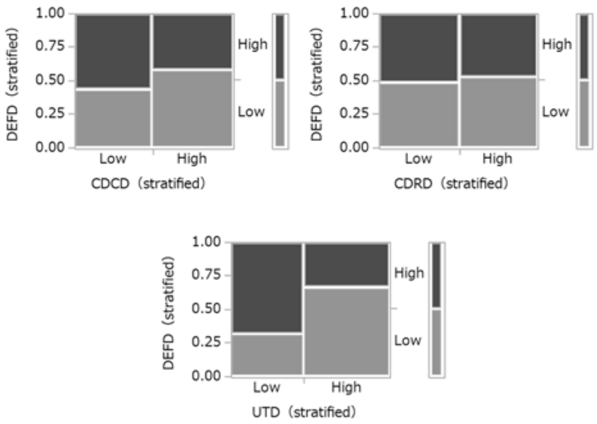

Fig. 4 Mosaic diagrams of process metrics and DEFD (top left: CDCD, top right: CDRD, bottom: UTD)

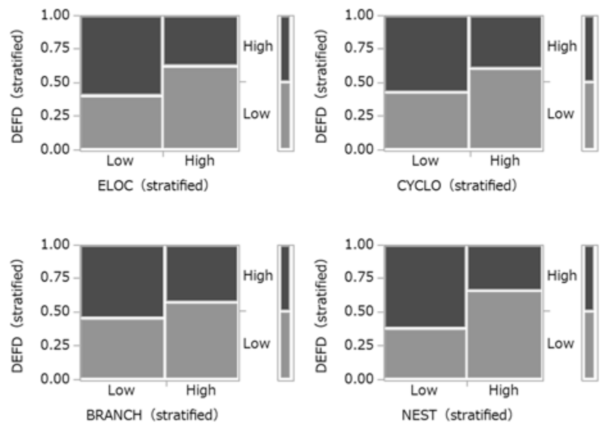

Fig. 5 Mosaic diagrams of product metrics and DEFD (top left: ELOC, top right: CYCLO, bottom left: BRANCH, bottom right: NEST)

4.3 Analysis of metrics combinations

Although the analysis in 4.2 shows that some differences were observed in the trends of DEFD when stratification was made using UTD and NEST, an effective usage method for the improvement of quality could not be found. So we subsequently performed analysis in combinations of the metrics - rather than a mere analysis of a single metric.

Table 5 shows the ratios of products with high DEFD in combinations of the metrics when they were stratified according to the median. From these metrics, we extracted distinctive combinations according to the following conditions.

1. When stratification is based on a specific metric, the ratio of products with high DEFD can be divided into 70% or more and 30% or less by stratifying them with some other metric.
2. There are a sufficient number of samples (N>=10).

As a result of the extraction, we obtained two distinctive combinations - a CDCD and UTD combination and a UTD and NEST combination. What makes these combinations distinctive are the following relationships: in cases where CDCD was low, DEFD was high when UTD was low and DEFD was low when UTD was high; and in cases where NEST was high, DEFD was high when UTD was low and DEFD was low when UTD was high. It is possible that these combinations can help improve quality.

We show the scatter diagram in which the UTD is plotted in the horizontal axis and the CDCD in the vertical axis as Fig. 6 to confirm the trends, Also we show the scatter diagram in which the NEST is plotted in the horizontal axis and the UTD in the vertical axis as Fig. 7. The horizontal and vertical axes of the diagrams are relative values when the median of each metrics is 1. The dotted line shows the median. The plotted "0" (Circle) shows products with lower DEFD than the median while the plotted "X" shows products with higher DEFD than the median.

When the diagram of Fig. 6 is examined with respect to the borders of the medians of UTD where the CDCD is low (Fig. 6, lower side), the general trend is different when the UTD is lower than the median than when it is higher than the median. In other words, products with high DEFD (marked "X" in the scatter diagram) are distributed in the domain where the UTD is low. Similarly, when the diagram of Fig. 7 is examined with respect to the borders of the medians of UTD where the NEST is high (Fig. 7, right side), products with high DEFD (marked "X" in the scatter diagram) are distributed in the domain where the UTD is low. But both the products with high DEFD and low DEFD are dispersed where the CDCD is high (Fig. 6, upper side) and where the NEST is low (Fig. 7, left side).

We can confirm another general trend that most products are located near the median of UTD in both Fig. 6 and Fig. 7. The median of UTD is approximately same as the target value of UTD at our organization. This seems the result of the quality control we usually conduct in which the density of UT test items derived from the development scale and the number of test items performed is sufficient.

Table 5 Matrix showing the ratios of high DEFD in the metrics stratification

		CDCD		CDRD		UTD		ELOC		CYCLO		BRANCH		NEST	
		High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
CDCD	High			45.8%	45.5%	44.0%	50.0%	42.9%	50.0%	42.9%	50.0%	45.5%	46.2%	35.0%	60.0%
	Low			63.6%	52.2%	✓10.0%	✓75.0%	46.2%	61.9%	46.2%	61.9%	50.0%	59.1%	50.0%	60.0%
CDRD	High					34.8%	83.3%	45.5%	61.5%	41.7%	72.7%	43.5%	66.7%	34.8%	83.3%
	Low					33.3%	59.1%	41.7%	54.5%	50.0%	50.0%	54.5%	47.8%	54.5%	47.8%
UTD	High							36.4%	30.8%	34.8%	33.3%	36.4%	30.8%	✓22.7%	53.8%
	Low							58.3%	72.7%	63.6%	69.6%	66.7%	68.2%	✓75.0%	63.6%
ELOC	High									48.4%	(0.0%)	50.0%	(0.0%)	41.4%	(60.0%)
	Low									(0.0%)	62.5%	(25.0%)	61.3%	40.0%	60.0%
CYCLO	High											45.5%	(0.0%)	40.0%	(75.0%)
	Low											(100.0%)	55.9%	50.0%	58.1%
BRANCH	High													41.4%	(80.0%)
	Low													40.0%	56.7%
NEST	High														
	Low														

✓: extracted combination (): N < 10
High: Greater than or equal to Median Low: Lower than Median

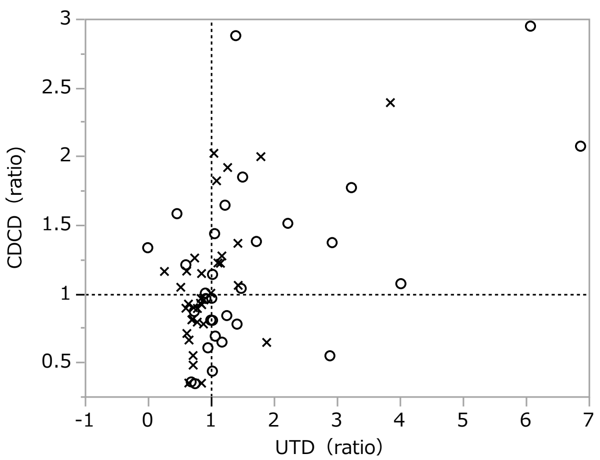

Fig. 6 Scatter diagram of UTD and CDCD

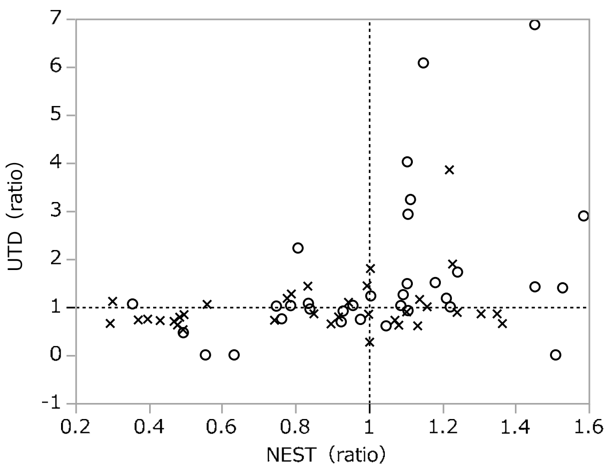

Fig. 7 Scatter diagram of NEST and UTD

5. Consideration

Although we could not find a simple correlation between the quality of source code and process metrics, product metrics in the analysis in 4.1, we were able to see different trends in DEFD when stratifying it according to median of UTD and NEST, by analyzing more details in 4.2. Moreover, we obtained two distinctive combinations - a CDCD and UTD combination and a UTD and NEST combination - in 4.3.

We conclude that increasing the UTD may prove effective in helping improve quality when the CDCD is low or NEST is high. There is no indication that this would be effective in domains where CDCD is high or NEST is low. Also, it is not effective to increase CDCD because we could not find different trends in DEFD when stratifying it according to CDCD in 4.2. Increasing NEST may effective but it is difficult because it requires the refactoring of source code structure and it is costly.

Based on these findings and conclusion, we implement large numbers of UT test items for CDCD and NEST. In particular, we determine whether additional test items are required or not according to following steps during coding (CD) phase.

1. Check-in the source code to the Software Factory (repository)
2. The average value of maximum nesting number (NEST) and totalized density of coding efforts (CDCD) and totalized density of UT test items prepared (UTD) are derived from the Software Factory
3. If the CDCD is low or NEST is high, check UTD and implement additional UT test items to the level of our organization.

With the additional step3, we can determine the number of test items by conditionality of CDCD and NEST and it is more effective than we determined it by only its density before.

6. Future Work

Further analysis is necessary in cases where NEST is low. There is a possibility that metrics other than complexities of source code (such as the skill of the programmer or discrepancies between designing and coding) may be related with the quality of source code. Should that be the case, we think that the current metrics are unable on their own to provide an adequate means for analysis of causal relationships involving quality.

In the future, it is necessary to identify these metrics to make it possible to accumulate more effective data.

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A Study of Project Failure Attribution Analysis based on Morphological Analysis

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Projects undertaken within organizations have failure rate of about 60 to 70 percent. Many failures are thought to be caused by incorrect understanding of information in documents due to polysemy (multiple meanings). When documents contain polysemous words, different readers may draw different conclusions. Because misunderstandings may arise due to the interpretation of polysemous words, polysemy is not desirable from the viewpoint of information sharing. In this study, actual software development project documents were analyzed using a morphological-analysis tool (KH Coder). The rate of polysemous words contained in the documents was calculated and compared with quality indicators (schedule performance index/cost performance index (SPI/CPI) of each project. The results did not show a correlation between the proportion of polysemy in a document and SPI and CPI of successful or failed projects. However, since the proportion of polysemy was easily derived by KH Coder, the relationship of these results and SPI and CPI was able to be visualized. Thereby, polysemy can be checked when reviewing software development projects. Thus, the context level in project documentation can be reduced, which can contribute to the improving the project success rate.

Keywords and phrases: Project Success Rate, Project Failure Attribute, Morphological Analysis, Schedule Performance Index, Cost Performance Index

1. Introduction

Projects undertaken within organizations have a failure rate of about 60 to 70 percent (Nishijima, 2004), and many of these failures are thought to be caused by human factors. One such factor is the problem of information sharing in project documents. This study assumes that project documentation is shared among project members (specifically, software development projects). In this case, if project documentation contains words that have two or more possible meanings (polysemy), readers may understand the documents differently during information sharing. For example, if someone is described as "a kind person," one reader may interpret this as "a kind person only to some people," but another reader may interpret it as "a kind person to everyone." Thus, polysemy increases the possibility that misunderstanding will arise due to people’s subjective understanding.

Polysemy tends to occur more in high-context languages, such as Japanese. Although Japanese speakers have no more trouble communicating face-to-face than anyone else, for a project to succeed, information must be shared correctly in documents to avoid misunderstanding (Yamaguchi, 2012). Generally, multiple members need to read the purpose of a project, and the project needs to achieve the purpose within a limited period. Here, it is assumed that not all project members know each other (e.g., some are new hires). In this case, the members do not know the skill level, knowledge and experience of each other. That is, even if the same information is given, different members may understand it differently.

Because Japanese has many polysemous words, people can easily read things in different ways depending on the context. For a project to succeed, a Japanese-speaking team needs to lessen expressions that depend on high context as much as possible. However, the relationship between polysemy and project failure has not been fully researched until now.

In this paper, the relationship between polysemy in Japanese and project failure is visualized. Specifically, the proportion of polysemous words in project documents and its relationship with project quality (Schedule Performance Index (SPI) and Cost Performance Index (CPI)) is visualized. This visualization enables the polysemy contained in project documents in software development to be easily checked and can contribute to improving the project success rate.

2. Related work

Project failure has been widely studied, often in software development. For example, J. Pinto et al. analyzed the failure factors of 97 actual projects and found that the process in project classification or life-cycle relates to project failure (Pinto., 1990).

J. Verner et al. analyzed the data of 70 failed software development projects. As a result, although there was no decisive failure factor, they showed clearly that there are 5-47 project failure factors in general. Furthermore, these failure factors include project development factors, management factors, etc. (Verner, 2008). K. Linberg et al. analyzed failures of software development projects in detail from a software developer's viewpoint. In this analysis, they concluded that there is a big gap between the way the software developers' team defined the success of the project and the general definition of project success (Linberg, 1999).

On the other hand, Takagi Y. summarized the success factors of a project from interviews with people who collected success examples in large-scale software developments after a project and compared them with the project failure factors (Takagi, 2003). T. Matsumura et al. analyzed communication between the user vendors in a requirement definition process of software development and described a practical method to prevent problems from being generated (Matsumura et al., 2011). Moreover, K. Konishi et al. analyzed the failure factors of an IT project which paid its attention to a representative's participation (Konishi, 2009).

Although all these papers are based on case studies, they did not sufficiently examine the relationship between failure factors and the context level of documents. Furthermore, they mainly used post-surveys such as questionnaires and interviews with stakeholders. In this paper, we focus on the context of the project document. Specifically, high-context (polysemous) words considered to be highly relevant to the project failure are extracted from the project documents. In this way, we propose a method to visualize the relationship between project documents' high-context language and project failure.

3. Current status and problems of software development

3.1 Current status of software development industry

The software development industry is the core of the information service industry and has changed along with the expansion of computer use, as shown in Table 1. Today, information technology (IT) is essential infrastructure that supports society and the economy, and its importance is getting bigger and bigger. In addition, the competitiveness of a company is greatly influenced by whether or not the company can effectively utilize information system. In particular, the value created by software is a source of competitiveness. From now on, the social mission and responsibility of the information service industry will become increasingly important (IT JOBGATE, 2017).

3.2 Major Issues in Software Development

Only about 30 percent software development projects succeed (Nikkei Computer, 2008). According to InnoPM (InnoPM, 2015), success/failure factor can be classified as follows.

(1) Project manager: project manager's own skills
(2) Members: allocation of members suitable for project
(3) Risk management: risk planning and execution.
(4) Development process: decision on switching of development process
(5) Information sharing: minimization of high-context language in documents

In this paper, we focus on (5) information sharing from the viewpoint of reducing project failure factors, especially minimizing high-context expressions in project documents.

Table 1 Changes in the information service industry

Era	Changes in the positioning of the information service industry
Late 1950s - late 1970s	Information-oriented era
Early 1980's - middle stage	Era of software development expansion
Mid to late 1980's	Era of rapid growth and systems integration
Early 1990's - middle stage	Era of conversion to decentralized systems
Mid to late 1990's	Era of networking and outsourcing
2000s	Era of the Internet
Around 2010 - now	Era of cloud computing and big data

3.3 Information sharing and context

Because Japanese contains many polysemous words and phrases, the content that the writer of a document wants to convey may not be transmitted well to the reader when sharing a document in a project. For a project to succeed, documents need to be written with as few high-context words and phrases as possible. Whereas context is easy to grasp in face-to-face conversation, it is more difficult to guess someone's true intention in documents written in high-context language.

4. Visualization of relationship between project failure and context in software development project

4.1 Context analysis method

Next, morphological analysis is used to clarify the relationship between polysemous expressions and project failure factors. Morphological analysis involves decomposing sentences into morphemes and determining parts of speech and contents using dictionaries. It is used for kana-kanji conversion, machine translation, etc. Originally invented by the linguist Norm Chomsky, it is now a computer-based natural language processing technology. Thus, if the sentence can be broken down into morphemes, the range of analysis of sentences widens, such as extracting nouns as keywords.

Many morphological analysis tools have been developed so far. In this paper, we decided to use KH Coder, in which analysis procedures are packaged and can be easily utilized (Higuchi, 2013), (Higuchi, 2016). KH Coder is software for statistically analyzing text type data and corresponds to a method called "measurement text analysis" or "text mining."

The procedure for concretely analyzing the context of a project document is as follows.

(1) Morphological analysis of project document by KH Coder; First, we measure the proportion of synonymous terms included in the project document by the part-of-speech extraction results obtained using KH Coder. An example of actual analysis results is shown in Figure 1.
(2) Calculation of frequencies of polysemous words from analysis results: We classify the polysemous words used in this paper as follows. Adjectives, adjective nouns, and adverbs were defined as high-context parts of speech. We calculate a polysemous word by using the results for extracting by parts-of-speech obtained in (1).
(3) We create a graph showing the proportion of polysemous words for each project document.
(4) We compare SPI and CPI with the graph of (3) to visualize the relationship between the proportion of polysemous words and project quality.

4.2 Analysis target project

For target projects in this paper, we cover six software development documents actually created in Chiba Institute of Technology's experiment course (second year undergraduate course) shown in Table 1. The software development method in this experiment is the waterfall model. Projects in Table 2 are classified as successes if they obtain SPI and CPI that are ± 0.15 the reference value 1 and failures otherwise.

	A	B	C	D	E	F	G	H	I	J	K
1	名詞		サ変名詞		形容動詞		固有名詞		組織名		人名
2	プロジェクト	105	作成	77	必要	20	エン	1	自社	7	江口
3	システム	77	ミーティング	46	未定	20			データ通信	2	伊藤
4	品質	69	計画	44	詳細	8			ドコモ	1	松村
5	メンバ	64	管理	40	適切	8			ヒューマン	1	岸
6	マネジメント	63	作業	38	明確	8					上間
7	リスク	53	対策	37	重要	5					鴻巣
8	情報	45	評価	31	可能	4					卓也
9	顧客	44	設定	26	主	4					遠山
10	全員	44	分析	26	早急	4					省吾
11	コスト	38	影響	23	不具合	4					愛里
12	チーム	36	契約	21	有効	4					加藤
13	ステーク	35	担当	20	人的	3					大地
14	ホルダー	35	共有	19	正常	3					谷本
15	基本	29	発生	19	的確	3					ジョン
16	目的	28	要求	18	様々	3					リード
17	ユーザ	23	テスト	17	スマート	2					定義
18	ユーザー	23	維持	17	安全	2					里菜
19	プロセス	21	機能	17	円滑	2					
20	外国	20	不足	17	自然	2					
21	コミュニケー	19	調達	16	正確	2					
22	内容	19	理解	16	不適切	2					
23	資料	18	開発	15	すみやか	1					
24	資源	17	検討	15	スピーディ	1					
25	予算	17	設計	15	スムーズ	1					
26	業務	15	予防	15	安定	1					
27	項目	14	コントロール	14	確実	1					

Figure 1 Analysis result example by KH Coder (in Japanese)

Table 2 Analysis target projects

No.	Project name	Project summary	SPI	CPI	Project feature
1	Goods introduction and point system	A system that allows users to browse digital map store information and service information in multiple languages	0.879	0.952	(Success) The objective was not satisfied, but the project was generally on schedule
2	Integrated Golf System	A system that manages and analyzes user information of golf members at point of service (POS) and issues advertisements and coupons	0.985	1.168	(Success) Cost was low, and Earned Value (EV) grew steadily
3	One-to-one individual travel plan providing system	A system that provides travel plans best suited to the needs of customers by collecting and analyzing customer information	1.000	1.043	(Success) Work progressed as planned, and the objective was satisfied
4	Purchased product analysis system for tourists visiting Japan	Purchased product analysis system that increases new customers on the basis on customer data of visitors to Japan	0.439	1.499	(Failure) Although it progressed smoothly at the beginning, progress stopped due to occurrence of trouble from the middle
5	Customer management system for overseas customers	A customer management system using a tablet capable of managing data for overseas customers	0.775	0.756	(Failure) The work time and the result were not proportional, and it progressed inefficiently
6	Point granting system for apparel store	A system with an application that has a point function or questionnaire posting function	0.763	1.155	(Failure) They could not regain the delay in the first half in the second half

SPI; Schedule Performance Index, CPI; Cost Performance Index

4.3 Polysemous word extraction results for each project

For each project in Table 2, the documents in the upstream process were analyzed: 1) customer setting document, 2) business analysis document, 3) basic planning document, and 4) system proposal document.

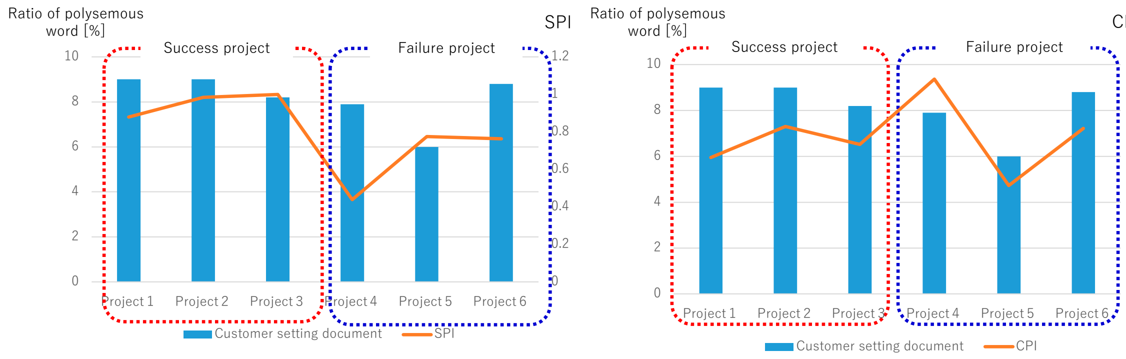
Next, polysemous words (adjectives, adjectival nouns, and adverbs) are extracted by KH Coder. Specifically, polysemous words are extracted for each project shown in Table 2. These results are shown from Figures 2 to 5 in accordance with the document classification in the upstream process.

In these figures, the horizontal axis is the project name, the vertical axis on the left is the percentage of polysemous words in the document, and the vertical axis on the right is the value of SPI or CPI.

(1) Customer setting document: Figure 2 shows the relationship between the polysemous word extraction results for the customer setting documents and the SPI and CPI.
(2) Work analysis document: Figure 3 shows the relationship between polysemous word extraction results for work analysis documents and the SPI and CPI.
(3) Master plan document: the relationship between the polysemy extraction results for master plan documents and SPI and CPI is shown in Figure 4.
(4) System proposal document: the relationship between the polysemy extraction results for system proposals document and SPI and CPI is shown in Figure 5.

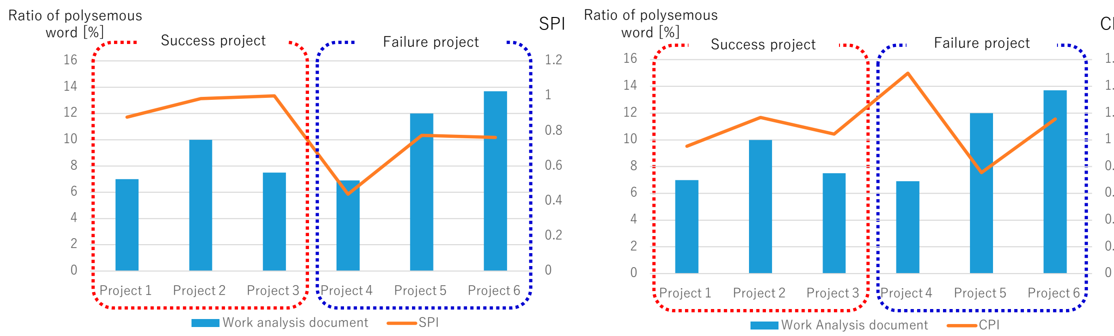
As shown in Figures 2 - 5, no noticeable difference was found between the successful project groups and the failed project groups. However, in the business analysis document in Figure 3, failed projects had large proportions of polysemous language.

Figure 6 summarizes these results by showing the relationship between all documents and SPI / CPI. From Figure 6, in successful projects, the proportion of polysemous words tended to decrease as the process progressed.



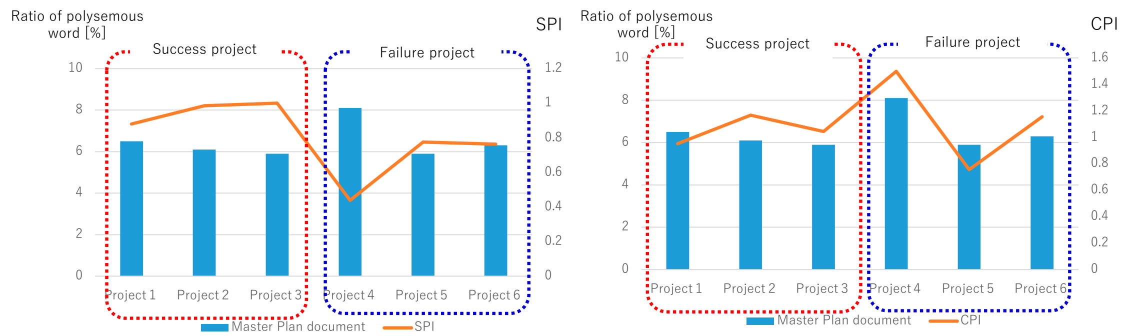
(a) Relation between customer setting document and SPI (b) Relation between customer setting document and CPI

Figure 2 Relationship between polysemous word extraction results and SPI and CPI for customer setting documents



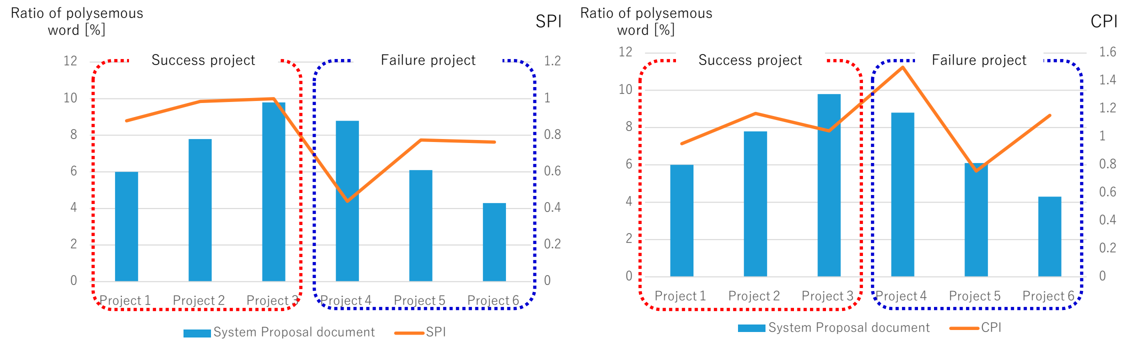
(a) Relation between work analysis document and SPI (b) Relation between work analysis document and CPI

Figure 3 Relationship between polysemous word extraction results and SPI, CPI for work analysis documents



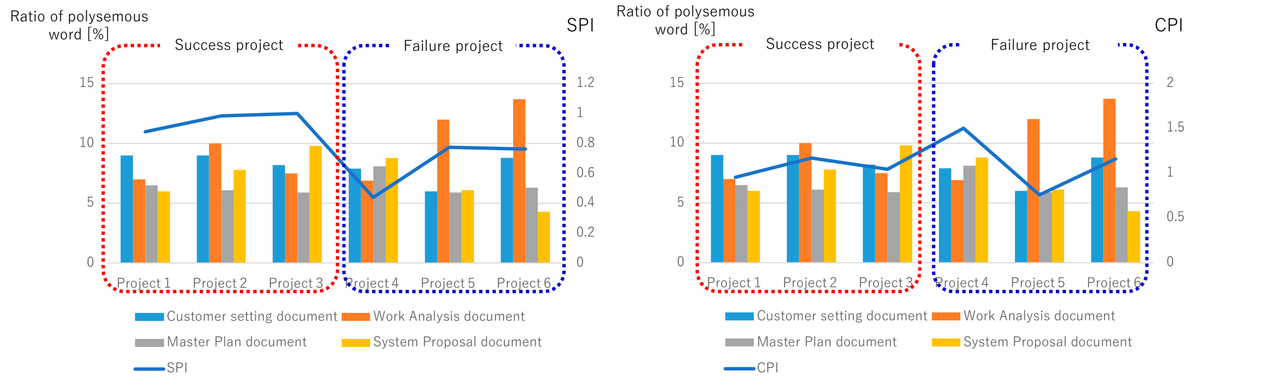
(a) Relation between master plan document and SPI (b) Relation between master plan document and CPI

Figure 4 Relationship between polysemy extraction results for master plan documents and SPI and CPI



(a) Relation between system proposal document and SPI (b) Relation between system proposal document and CPI

Figure 5 Relationship between polysemy extraction results for system proposal documents and SPI and CPI



(a) Relation between whole documents and SPI

(b) Relation between whole documents and CPI

Figure 6 Relationship between polysemous word extraction results and SPI and CPI in all documents of each project

As mentioned above, KH Coder can be used to easily check that the rate of the polysemy in project documentation. Furthermore, as shown in Figure 6, the context level (rate of a polysemy) in project documentation can be visualized easily. These visualizations can be practically used in the review in the development processes of a project or to resolve differences in understanding between members.

5. Conclusion and Future Work

In this paper, the relationship between a project failure/success factors and polysemous (multiple meanings) words in Japanese was visualized. Specifically, the relationship was visualized between the proportion of polysemy in documents of the upper process in software development projects and schedule performance index (SPI) and cost performance index (CPI) of successful and failed projects.

The results did not show a correlation between the proportion of polysemy in a document and SPI and CPI of successful or failed projects. However, since the proportion of polysemy was easily derived by KH Coder, the relationship of these results and SPI and CPI was able to be visualized. Thereby, polysemy can be checked when reviewing software development projects. Thus, the context level in project documentation can be reduced, which can contribute to the improving the project success rate.

For future work, the projects targeted in this survey were students' experiment project, so we plan to apply this method to the results of commercial projects and verify it from the viewpoint of practicality.

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Integrated Management in Municipal Backbone System Construction

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The change-over replacement to a new system for municipal mission-critical tasks, which is often carried out taking the opportunity of major law reforms, needs to be performed for multiple municipalities simultaneously. In such cases, considerably efficient system application is required due to tight constraints on the work periods as well as on the budgets and costs for the replacement. To operate such projects, integrated management in consideration of balance and integrity with the entire plan is important in addition to the management of individual projects for the respective bodies. In this integrated management, the following two characteristics should be noted.(1)Implementation of commonization and standardization of the scopes for respective bodies from the viewpoints of efficient response to law amendments and of cost restraints.(2)Optimization of processes and required resources in order not only to develop and implement the individual plans for respective bodies but also to achieve an overall balance. In consideration of these characteristics, we are exploiting Project Portfolio Management (PPM) to implement integrated management in the ongoing Number System Project.

Keywords and phrases: :Project Portfolio Management, Program Management, Accomplished Values

1. Introduction

Nowadays, in the projects of change-over replacement to a new system for municipal mission-critical tasks, failures to achieve original project goals increasingly cause confusion. Analysis shows that the confusion is induced by the following two major factors.
(1) Environmental changes surrounding municipalities. Frequent law amendments, severe fiscal circumstances, and operational innovations of municipalities.
(2) Sophistication and complication of projects. Insufficient management techniques, difficulty in estimation due to complicated required specifications, and difficulty to respond to scope changes.

In such a situation, it is "integrated management" that becomes a major factor leading to the success of multiple projects. Though it goes without saying that "integrated management" has universal importance common to all system construction projects, the municipal backbone system construction especially requires the response based on the recognition of its characteristics.

2. Characteristics of Municipal Backbone System Construction

Municipal backbone systems always respond to law amendments (development and operation). In the backbone system construction, listing of concrete requirements and preparation for development are often carried out in parallel with the examination of services to residents and operational methods in consideration of the administrative systems, in a limited period until the implementation date. Such tight constraints on the work period require efficient system construction and application to operations. In addition, major law reforms have been and are continually implemented recently according to the policy of the Japanese government. In municipalities and related organizations, systems employing specified linkage methods (which are nationally unified) are increasing, and their mechanisms are widely varied and complicated. Furthermore, sufficient consideration and provisions are required within municipalities for security environment and development of regulations and rules.

Therefore, under tight constraints on budgets and costs, such services are needed that satisfy concrete requirements on the details of the new administrative system and system implementation methods, and environmental improvement. A typical example of such services is the application of standardized and commonized package systems.

Because of these characteristics, the change-over replacement to a new system, which is often carried out, taking the opportunity of major law reforms, must be performed for multiple municipalities simultaneously. Therefore, multiple municipal backbone system construction projects need to be managed in an integrated manner, and the following are important for effective promotion of such management.

(1) Implementation of commonization and standardization of the scopes for respective bodies from the viewpoints of efficient response to law amendments and of cost restraints.
(2) Management which totally optimizes required resources and processes, based on the respective plans of bodies.

In this report, I consider what "Integrated Management in Municipal Backbone System Construction" should be, based on the points described above, using the Number System Project as a practice case.

This Project consists of the response to the concurrent implementation of the new nationwide administrative system and the service for installing packages (products of Hitachi Systems) for the purpose. The Project enters production phases in a step-by-step manner: Numbering start in October 2015; use start in January 2016; and linkage start in July 2017. We are striving to meet the needs of our customers in consideration of the information on the new administrative system and our products. Despite great many variable elements (including administrative systems, processes, and functions), we are carrying out the plans with flexibility. In this Project, we are managing the Project, considering not only individual project management for the respective bodies but also the balance and integrity with the entire plan.

I have been heading the Project as the senior manager to multiple project managers.

3. Integrated Management in Municipal Backbone System Construction

I think that the key to implementing the integrated management of the municipal backbone system construction as described in Section 2 is to utilize the techniques of Project Portfolio Management(PPM).

For integrated management, proper forms of organization for managing projects and control throughout the organizations are important. However, respective projects face practical challenges, for example, "diversification of projects (combinations of package systems), shorter periods, reduced costs, difficulty in estimation, unforeseeable risks, shortage of necessary human resources (business knowledge), and impossibility to form teams with required skill sets." The fact is that it is difficult to find out effective solutions.

Project Portfolio Management (PPM) is an excellent methodology to achieve objectives in such severe conditions (limited resources and periods).

3.1 Utilization of Project Portfolio Management (PPM)

"Project Management" aims at achieving QCD (Quality, Cost, and Delivery Time), and uses the achievements as indices.

"Program Management" placed in a level superior to projects is performed to attain targets planned strategically in terms of main factors of success and their indices. "Portfolio Management" placed at the top strategically sets up indices for missions, visions, and sets of values, deconstructs roles and responsibility ranges into multiple programs and projects, and performs optimized organizational management. The Program located in the intermediate layer is not just an aggregation of projects. This is a key point. The Program is not only supposed to achieve the objectives of multiple projects but also to have more control than individual management, thereby providing the maximum benefits to stakeholders, and creating added values.

As a Program Manager, I utilize this Project Portfolio Management to perform integrated management of multiple municipal backbone construction projects.

3.2 Program Management

As described above, Program Management refers to managing a program intensively in a harmonized manner to achieve the strategic objectives and the benefits (accomplished values) of the program. Program Management includes maintaining the integrity of multiple projects by optimizing or integrating costs, schedules, and activities to achieve program objectives. The projects in the program are related with one another to produce common accomplishments or integrated accomplishments. Program Management helps to determine an optimal method for managing the projects by focusing on the interrelationships among these projects.

Therefore, it is necessary to regard the system construction for the Number System for all the municipalities as a "program," and the system construction at the respective municipalities as a "project," to visualize and optimize the relationship between the project and the programs, and to perform "management so that the total of the accomplishments of the respective projects plus added value as a little something extra will lead to the accomplishments of the entire program" For this purpose, we have made the following definitions to apply Project Portfolio Management.

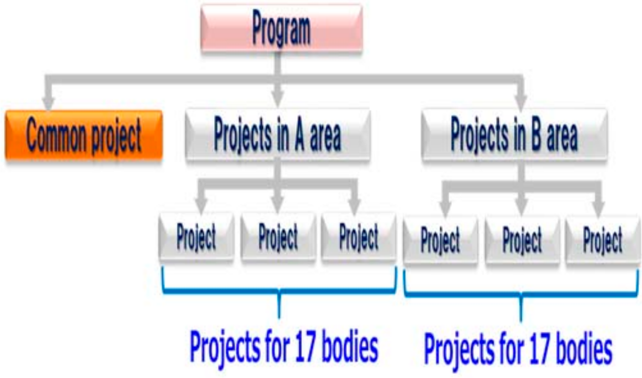

Figure 1 Program for system construction for the Number System

The first point is, regarding the strategic objectives and the benefits (accomplished values) of the program, to expand into the municipality business field, and to stabilize the business revenue bases, through the response to the Number System. We make efforts to realize these objectives. We also aim to contribute to the operations of the end users as a business partner and to improve and foster the skills of the project members.

The second point is, regarding the components of multiple projects and the interrelationship between the components, to define and relate processes, task descriptions (components), and human and environmental resources. We launch not only individual projects for the respective municipalities but also a common project for organizing information and creating development prototypes.

As the third point, in the comprehensive governance (control) activities for the projects, it is necessary to define the methods and the concrete items to be controlled, and the evaluation and feedback. We focus on the activities including reporting, monitoring, and control reviews.

3.3 Points to consider in Program Management

The practices of Program Management need strong leadership in a top-down fashion.

Additionally, for the success of the program management of the system construction for the Number System, it is important for both program side and project side to set up appropriate rules on how to share and utilize necessary information. It is a key point to balance the sharing and utilization between the program side and the project side. One of the measures to address these challenges is bottom-up communication, which conveys the information on the issues and risks in the projects from the projects up to the program. If the information on the reality of the projects performing development tasks on site is not appropriately passed on to the program side, program management will differ from reality just as third-party comments would.

The other measure is "top-down" communication, which conveys information regarding the system construction for the Number System thoroughly from the program to the projects. More specifically, it is necessary to provide information timely from the program side on the movements of the nation and legislation, package system implementation plans, changes in concrete requirements, development tasks, and other related changes, and thereby to maintain proper control so that the management of the respective projects will be performed systematically. The important thing is whether the concrete information truly required by the project side can be provided in a timely fashion or not.

To sum up, it is important to clarify communication rules and rules for handling the information to be shared (authorities and responsibilities).

4. Practices and Effects of Integrated Management

The project for installing the packages (products of Hitachi Systems) supporting the Number System is not as simple as "you only have to apply the packages to all the bodies" or "the packages prepared in accordance with clear agreements are to be applied in an established procedure."

The response in municipalities to the Number System covers a wide range from adjustment of respective administrative systems, preparation of system and office operations, improvement of infrastructure, to education and training for all the staff members (on administrative systems and office work). However, concrete administrative system information and agreements at the working level become clear in a step-by-step manner. Therefore, both municipal side and system side need to move forward according to the variations. In addition, the requirements, the business operation procedures, and the infrastructure may vary by municipality.

In Program Management, scope control and process control are performed with attention to these items.

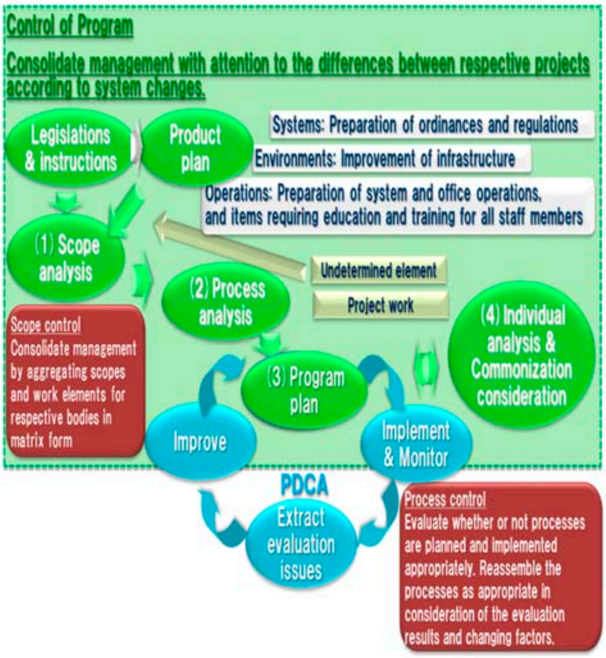

Figure 2 Integrated control of all scopes and processes of project

4.1 Scope control

In order to control all the scopes of the projects for multiple bodies in an integrated manner, we consolidate the management by aggregating the scopes and task elements for the respective bodies in a matrix form. The following four key points are in the scope control.

The first point is to pay attention to the aspects of things with a common measure and unique things (options and changes).

The second point is to use common worksheets prepared within the program for aggregation when collecting information from the respective projects.

The third point is to clarify the respective WBS relationships, and to use different colors for different levels of certainty when organizing and aggregating the information.

The fourth point is, regarding unclear things, to define the assumed task range and the task elements out of the range in detail.

In addition to implementing the above four points, the task elements should be reviewed and organized in terms of time, together with the input information required to fix the details (e.g. publishing of specifications from the national government): More specifically, you can ask such questions as "When the administration system will become clear?" and "By when what must we decide?" This will make the scope control more effective.

Furthermore, analyze the individual elements of the projects from the aggregated scopes of all the projects, and examine the elements which can be made common.

First, organize the types of operations and the characteristics of functions, and classify individual elements into groups. Next, determine to what extent the individual elements can be satisfied by common functions: "fully satisfied," "partially satisfied," or "unsatisfied." Finally, classify the elements into what is to be added to common functions and what is treated to be as an individual function.

Integration by increasing common elements within the scopes in this manner can compress the scopes of all the projects. In addition, this method, which can provide a lineup of common functions to end users, will raise the deliverables of all the projects up to a higher level.

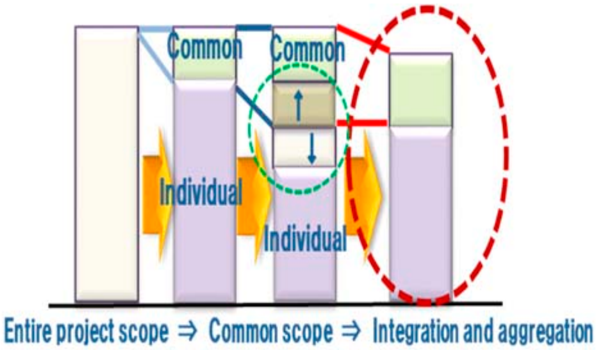

Figure 3 Integration and aggregation into common elements by organizing individual elements of projects

4.2 Process control

It is required to make use of scope control, and then to aggregate and organize "differences in processes caused by what are common and what are individual" and "processes applicable to unclear things." It is important to overlap task items for all the bodies, to assemble the quantity and quality (skills) of required resources, and to control the processes (task elements and their response procedures) and the resources concentrated in a certain period within the entire program. Ask questions: "What are concentrated tasks and required skills?" "When is the timing?" and "How high is the quantity of the tasks and skills?" Organizing the characteristics of the tasks along a temporal sequence, and analyzing the operational skills will clarify the important points in resource control and process control.

This procedure is the same as that of the compression of scopes as described in section 4.1.It is the proposition of integrated management to aggregate the elements of all the projects and to organize them into common elements and the others. The resources include not only "persons" but also "environments (working environments)." It is required to examine whether an environment is shared within the program or used for an individual project, in terms of integrated management.

Furthermore, it is very important to evaluate whether or not processes are planned and implemented appropriately in the course of promoting the project, and to reassemble the processes as appropriate in consideration of the evaluation results and changing factors. For example, it is necessary to collect and manage in advance the information on personnel (skills and loading), including the personnel of relevant departments and affiliated companies so that early measures can be taken if any resource becomes insufficient.

Irregular situations (abrupt changes) may result from external factors or changes in operating environment. The priority of municipalities and project constraints often change. We are required to accept and respond to such sudden changes. It is also important to prepare contingency plans for key processes. The following two points are critical in management.

The first point is to use the common materials prepared in the program to develop and consolidate the processes and process control documentation, and the development materials (development deliverables including procedures and acceptance certificates) of respective projects.

The second point is to create development prototypes, and to evaluate and organize the information to be provided to projects, as appropriate, in the "Common Project" launched within the program.

Especially, nationwide production change-over tasks are critical points in these projects: For example, change-over tasks will be performed for all the bodies from October 2 (Friday) to 4 (Sunday) in 2015 just before the legal implementation date on October 5 (numbering start) which is the first production date. Documented procedures have been prepared and verified in the "Common Project" within the program, and then been delivered to all the bodies in advance. The respective bodies have rehearsals, based on the procedures. Extracted issues are aggregated in the program and improvement is promoted. In the change-over tasks just before an implementation date, management tool(s) are used as mechanism(s) for concurrent progress management of multiple projects to visualize the progress of the respective task items for all the bodies. Failure is never allowed, in order to meet the task requirements for the Basic Resident Registry Network, which are defined by the Japanese government or the change-over task requirements within the system. In unforeseen situations, it is expected that coordination and/or consultation with related organizations may occur. We are striving to fully prepare for such situations through crisis management and risk management so that we can perform timely progress management and take early measures.

4.3 Evaluation on integrated management application

I evaluate that this integrated program management has enabled the preparation of such measures that allow the respective projects to achieve the maximum performance while assuring efficiency and quality. The respective projects can be implemented in harmony with each other, without being isolated or without involving issues. In addition, the project side can share the specificities of the respective bodies, which can be easily reflected to the measures and risk plans of the respective projects. As a result, the management levels of the respective projects are raised.

Many briefing sessions and study meetings are held on the Number System, a significant innovation that leads to a new administration system and social infrastructure. In addition to these internal and external meetings, the program management side has planned and implemented study meetings with our customers. These efforts aim to produce the strategic objectives and benefits (accomplished values) of the program.

Sharing of information in a wider area without being closed within a limited region or district is expected to generate new added value. In concrete terms, the new system brings about new challenges which cannot be solved only by the municipalities and the provider facing each other without interaction. To solve the issues, the provider and the municipalities need to share each other's information and to cooperate. Then a new sense of intimacy arises from the cool relationship between the provider and the municipalities who respectively work in the construction range, working conditions, and division of roles determined.

It is highly possible for the provider and the municipalities having different perspectives to make a new human connection. This new bond should be the basis for new added value. In addition, the implementation of internal study meetings (for education and training) helps our SEs broaden their perspective from a local vision to a national vision and deepen their knowledge, thereby fostering their management power, business power, comprehensive IT power, and power to create values.

This can be said to be another accomplishment in this program management since such human resource development could hardly be tackled in individual projects involving many restrictions.

5. Conclusion

Utilization of the techniques of Project Portfolio Management (PPM) requires review of forms of organization and preparation for systematization as a prerequisite. I think that proceeding with integrated management in a controlled and optimized organization (management system) while performing risk management by anticipating possible confusion of individual projects from higher viewpoints contributes greatly to the achievement of the project objectives.

Especially, the projects for municipal mission-critical tasks can be said to obtain remarkable effect from the utilization of Project Portfolio Management since integrated management is often required for the projects for multiple bodies.

Furthermore, in the practice of the current program management, I have aimed to achieve a target of creating added value, in addition to integrated program management in consideration of balance and integrity with an overall plan. Our organizational goals are "to expand into the municipality business field, and to stabilize the business revenue bases." How did we contribute to the goals? What kind of approach did we take? What kind of value did we create? I have set up a target and we had made specific efforts. As a result, I think that we contributed to the achievement of the organizational goals.

These days, the growth strategy of the Japanese government is accelerating, which is called "Reform toward the realization of Society 5.0 (intended to resolve social issues through the provision of services meeting the needs of individual persons by utilizing revolutionary technologies)." We need not only meet the needs of the municipality (administration) side, but also to contribute to creating a better society and resolving social issues.

The conventional approach is no longer appropriate where only municipality (administration) side examines administrative systems and approaches to IT by themselves, determines how to implement, and outsources to providers. Moreover, it is necessary to tackle challenges together with many parties concerned including private entities while sharing information in a wider area beyond regionality.

The skills required of us are the business power and management power combined with a wide field of vision and broad communication capabilities, and these continue to grow in importance. Furthermore, for the organizational power to integrate the human resources, sophisticated control is indispensable through the management of programs and a portfolio superior to projects.

Based on these points, it is important to continue operating integrated management utilizing Project Portfolio Management(PPM), to achieve objectives while creating added values and fostering skills, and to aim at a higher level of practice.

This report was prepared for an assignment of the Senior Project Management Training Course.

Project's Time Contingency Estimation Model Using CVaR

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The project management under uncertainty requires an appropriate measure of risk to control time, budget, and resources. In this paper, we focus on the time management issue and propose the CVaR to assess the risk of time overrun. The CVaR is known to have several good properties for risk management. One nice feature is that CVaR value can be decomposed into the individual activities in the project. We show that this allocated value is used to set up a control limit of activity's duration. Afterwards we introduced the assumption that duration overrun from the control limit can be cut by spending money proportional to the excess portion of time. This implies that by selecting the control limit correctly we can minimize the money for activity time control with a targeted risk overrun.

Keywords and phrases: Time Contingency, CVaR, Criticality Index, Mixed Integer Programming

1. Introduction

Every project is inherently exposed to the uncertainty. Hence, in the planning phase, the planner has to set aside management resources as "contingency reserve" to cope with the risks caused by uncertainties. Those management resources can be any type of source for the organization activity, though mostly it indicates cost and time and sometimes other resources can be part of it.

Several distinctive definitions of contingency reserve are found in literatures, implying that the planner can take a different approach for contingency planning according to his/her managing style. Generally saying, the central role of the contingency reserve is to buffer the impact of unexpected time/cost overrun. To determine the size of the contingency reserve, the planner inevitably faces the tradeoff between the buffer's capability and resource allocation efficiency. That is to say, the small amount of the contingency reserve may not be enough to absorb the shock, on the other hand, too much reserve may result in a redundant allocation of resources. We need the reasonable method to determine the contingency allocation incorporating such tradeoff.

The tradeoff problem is solved only if the tradeoff relation between the risk and the reserve is quantitatively specified. It requires that, at first, we should know risk profile. Secondly, the risk should be measured with objective criteria rather than subjective criteria. All these requirements suggest that we should rely on the quantitative approach such as probability theory and simulation techniques.

Compared with the time contingency, the cost contingency has been more popular topic in the research of contingency planning. A simple and widely-accepted practice, that can be regarded as a quantitative approach, is to assign a fixed percent of the targeted value of the project. There also exist more sophisticated approaches to evaluate the risk and the cost reserve. These include a Monte Carlo simulation (Barraza and Bueno [2007]), a probabilistic model (Touran [2003], and an artificial neural network method (Lhee et al. [2009]) and so forth. Barraza and Bueno [2007] Xie et al. [2012] define the cost contingency by value-at-risk (VaR). On the other hand, Uzzafer (2007, 2013) and Wiesemann (2012) use a risk measure that has a similar formula to conditional VaR (CVaR).

The number of studies on the time contingency with quantitative method are relatively limited. It can be explained by the fact that analysis of time overrun tend to be complex under the precedence relations in activities. Barraza (2011) employed a simulation technique to evaluate the contingency time as well as its allocation to each activity in the project.

In this study, we focus on the time contingency and estimate it with CVaR. We also propose a simple scheme that is derived from the definition of CVaR itself to allocate the contingency into activities. This also includes a heuristic method to set the control limit of activities' duration. Next, we introduced the time-cost tradeoff relation and compared our method to the simple control method. The numerical experiments showed that the former is significantly efficient than the latter. Finally, we consider the optimization problem that minimizes the expected overrun with a budget constraint, to find the best control limit. It can be shown that the optimization problem is formulated as a mixed integer programming problem. The computational experiment, the optimal control has slightly better result.

2. CVaR for time contingency

Given a project target duration (PTD), denoting by τ, we define CVaR as

$$CVaR(\tau) = E[T \mid T \geq \tau] \quad (2.1)$$

whereas project duration T follows the continuous distribution. This is also called an expected shortfall. By the definition, $CVaR(\tau)$ is the conditional expectation of the project makespan T given $T \geq \tau$. In the context of time management, it is the expectation of time overrun from PTD. Figure 1 illustrates the meaning of CVaR. In case of discrete distribution, a minor modification is required to define CVaR correctly. In later section, we calculated the time contingency by Monte Carlo simulation by using equation (2.1) for CVaR.

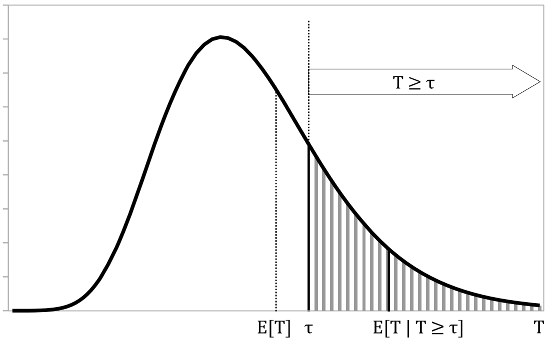

Figure 1: τ and $CVaR(\tau)$

The PTD can be determined by several ways. The project manager often expresses an allowance of the delay by percentile of the completion time distribution. If the completion time should be in the bottom 80% of the possible realization, the manager should set the PTD at 80th time percentile. In other case, PTD may be given exogenously, such as project's contract or agreement with the counterparty, regardless of the manager's view on the risk. Some authors make a slight distinction on the definition of CVaR between the case with a percentile and case with a fixed threshold. However, in this paper, we use a term CVaR with a wider meaning.

Compared to VaR, CVaR has several advantages (Rockafellar and Ulyasev, 2002). Such as, CVaR can consider the property of distribution beyond the given confidence level, it is convex with respect to τ, and it is sub additive. These characteristics make CVaR an effective tool for a risk control. In addition, if the activities durations are all independent, CVaR holds the decomposition relation as shown below.

$$\begin{aligned} CVaR(\tau) &= E[T \mid T \geq \tau] \\ &= \sum_{i=1}^{m} CI_i \ \ E[d_i \mid T \geq \tau, \delta_i = 1] \quad (2.2) \end{aligned}$$

where m represents number of activities, CI_i is a criticality index, defined as

$$CI_i = Prob\{\delta_i = 1\}$$

and δ_i is a random variable:

$$\delta_i = \begin{cases} 1, & \text{if activity i is on the critical path,} \\ 0, & \text{otherwise} \end{cases}$$

We also denote $E[d_i \mid T \geq \tau, \delta_i = 1]$ by $CED_i(\tau)$. It is the expectation of activity i's duration d_i conditional on observing that the project completion time exceeds PTD and activity i is on the critical path simultaneously. By this notation, (2.2) can be rewritten as follows.

$$CVaR(\tau) = \sum_{i=1}^{m} CI_i \, CEDi(\tau) \quad (2.3)$$

Equation (2.3) is interpreted as a decomposition relation of $CVaR(\tau)$ as the right-hand side is a sum of $CI_i CEDi(\tau)$ across all activities. It enables us to measure exactly how much each activity contributes to the size of the conditional expectation of the project completion time. Therefore, we can take advantage of the decomposition relation for time management by monitoring duration of individual activity and in section 3 we demonstrated the effectiveness of the control method exploited from this relation. It is often mentioned that CI is a good indicator to measure an activity's impact on the completion time. However, it is not sufficient to gauge a true effect for the time overrun. As shown in (2.3), the combination of CI and CED indicates the true contribution of activities.

To illustrate the CVaR and its decomposition, we conducted numerical experiments using the project network shown in Figure 2. A baseline setting of experiments is summarized as follows. The project consists of 10 nodes and 14 activities. Activities i's duration d_i (i=1,…,14) follows identical and independent lognormal distribution. The mean and the standard deviation of d_i, are 4 and 1.6, respectively.

The project's expected completion time ($\mathrm{E}[T]$) is estimated to 16.190 by Monte Carlo simulation.

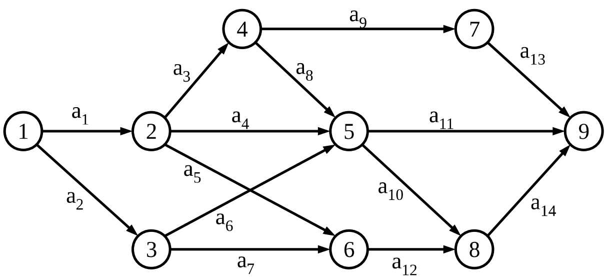

Figure 2: Hypothetical project network

$\mathrm{CI_i}$ $(i = 1, \ldots, 14)$ and $\mathrm{CEDi}(\tau)$ are calculated by numerical simulations and varying value of PTD (τ). The value of τ takes 0, 21.190, 23.190, and 25.190. The last three numbers are $\mathrm{E}[T] + 5$, $\mathrm{E}[T] + 7$, and $\mathrm{E}[T] + 9$ respectively. When $\tau = 0$, it corresponds to unconditional expectation, since $\mathrm{E}[\mathrm{T} \mid \mathrm{T} \geq 0] = \mathrm{E}[\mathrm{T}]$ for PTD. The results are shown in Table 1.

Table 1: $\mathrm{CEDi}(\tau)$ and $\mathrm{CI_i}$

activity	tau				CI
	0	21.190	23.190	25.190	
1	4.152	4.780	5.065	5.447	0.796
2	5.217	6.137	6.498	7.006	0.204
3	4.292	4.857	5.153	5.435	0.677
4	8.062	9.265	9.811	10.037	0.042
5	6.579	7.352	7.846	8.480	0.077
6	6.361	7.170	7.570	8.193	0.089
7	5.733	6.507	6.957	7.553	0.116
8	4.459	4.946	5.259	5.596	0.575
9	5.990	6.962	7.386	8.069	0.102
10	4.319	4.850	5.138	5.486	0.653
11	7.601	8.893	9.622	10.495	0.053
12	5.456	6.287	6.811	6.912	0.192
13	5.905	6.656	6.982	7.336	0.102
14	4.059	4.681	4.995	5.310	0.846

When the activities, such as No.1, 6, 14, have high CI, their CEDs are close to 4, the unconditional expectation of duration. On the other hand, the activity with small CI, such as No. 5, 6, and 11, exhibit the higher CEDs. Figure 3 exhibits the histograms and relative frequencies of activity 2 and 10. Relative frequency graphs can be interpreted as the sample distribution. Both activities show that the distribution conditioned with $\mathrm{T} \geq \tau$ has fatter tail than unconditional distribution. CEV $_i(\tau)$ is a mean of the

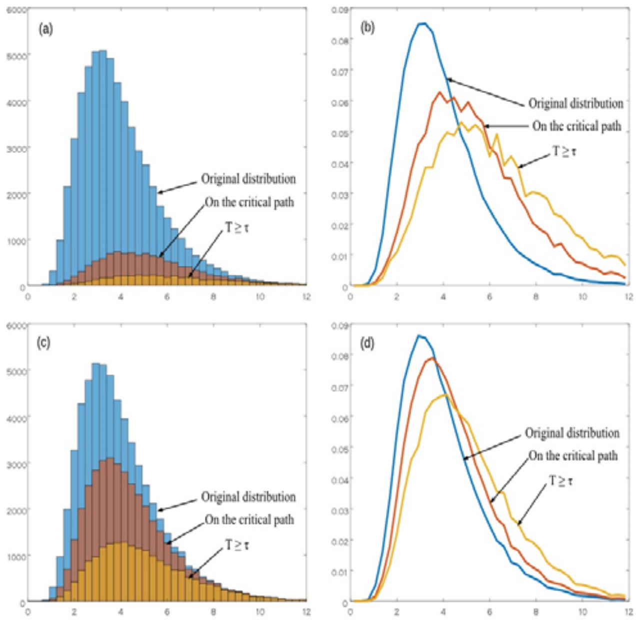

Figure 3: histogram (a) (c) and relative frequency (b) (d)

conditional distribution. The decomposed portion of CVaR is listed in Figure 4. If we evaluate activities by only CIs, the activity 14's contribution is about 20 times larger than 4's, but if we take into account the CEDs, the ratio decreases to 10. It implies that CI-only-evaluation may lead to underestimation of activity's contribution.

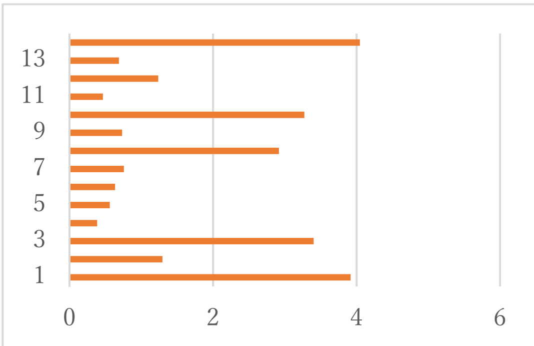

Figure 4: Decomposition of CVAR

3. Control limits

In this section, we will discuss a control method of activities duration using $\mathrm{CED_i}(\tau)$. Before stating the methodology, we introduce the assumption on the relation between cost and time reduction. In the classical CPM technique, the duration can be crashed to a certain amount of time by spending the cost that is proportional to the length of reduction. Here we follow the same manner. Specifically saying, we suppose that every activity has its upper control limit that the duration is not allowed to exceed. If the duration is expected to surpass the upper limit, the excess can be reduced to zero with proportional cost. As a result, we will obtain the lower expected time overrun, though we have to pay money corresponding to the reduced amount of time. Therefore, we need to decide appropriate control limit considering time-cost tradeoff.

The first method is simplest, we call it simple control. The upper limits are equivalent across all the activities. In the following computation, we employ the following relation:

$UL_i^1(a) = E[d_i] + a * sd(d_i)$

where $sd(d_i)$ denotes a standard deviation of d_i. Often the upper limit is naively set to the typical value such 90th percentile or 95th percentile. The simple control includes such a practice.

The second control is based on $CED_i(\tau)$. We decide the upper limit by the equation:

$UL_i^2(a) = CED_i(\tau) + a * sd(d_i)$

We call it CVaR control. This is also simple, and the only distinctive feature is use of CEDs for simple control instead of unconditional mean.

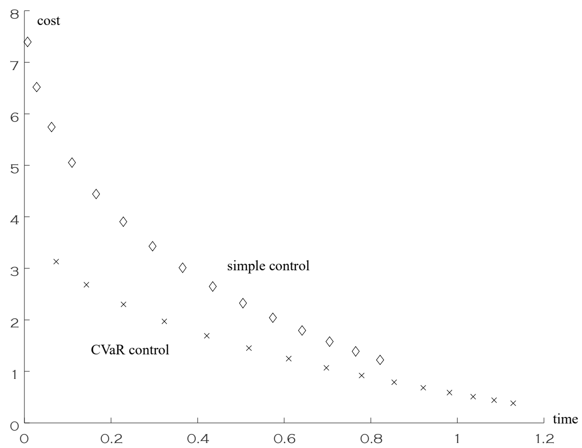

Figure 5: Comparison between two control

We compare the simple control and the CVaR control by Monte Carlo simulation. The setting of computational experiments are almost equivalent to the previous section. The main results are shown in Figure 5. The two curves are drawn on the time - cost plain. Horizontal axis means the expected cost for time reduction and the vertical axis represents the expected time overrun. In this experiment, τ is fixed at E[T]. Each point corresponds to a different value of a. Figure 5 suggests that CVaR control is more efficient than simple control.

The third method is known as optimal control because we optimize the control limits under a given budget constraint. This problem is written as follows.

$$\left|\begin{array}{ll} \min & \mathrm{E}[\max\{T_H - \tau, 0\}] \\ \mathrm{s.t.} & T_{e(i)} - T_{s(i)} \geq \tilde{d}_i, \;\; i = 1, \dots, m \\ & \tilde{d}_i = \min\{c_i, d_i\}, i = 1, \dots, m \\ & \sum_{i=1}^{m} \mathrm{E}\left[\max\{d_i - \tilde{d}_i, 0\}\right] \leq B \\ & c_i, T_i \geq 0, \;\; i = 1, \dots, m \end{array}\right.$$

It minimizes the expected time overrun from τ, with several types of constraints to find the optimal upper limits (Please refer to appendix for more details). The resulting MIP problem size depends on the number of scenarios (samples). In contrast to the case of a Monte Carlo simulation, the number of samples are limited to few hundreds. Hence, we should be careful to interpret the outcomes. The results with different τ are summarized in Table 2. In all cases, the optimal control shows smaller expected overrun. However, the difference of two expected overruns are quite marginal. This suggests that CVaR control generates the upper limits that are close to the optimal upper limits.

Table 2: Upper limits

activity	cvar cont.	optimal cont.
1	5.727	5.373
2	7.424	6.614
3	5.926	6.710
4	11.913	12.709
5	9.571	11.287
6	8.523	8.340
7	8.296	9.639
8	6.289	7.263
9	8.524	9.903
10	6.054	6.306
11	10.358	9.492
12	7.929	8.254
13	8.584	8.341
14	6.027	5.100
tau	21.050	
cost	1.250	
time	0.604	0.573

4. Conclusion

Under the uncertainty, the time management should be based on systemic approach that enables manager to assess the quantity of risk and to control the individual activity's duration while considering time--cost tradeoffs. In this paper, we proposed that CVaR is an appropriate risk measure for time overrun. Then time contingency can be derived as a difference between CVaR and PTD. Among many advantages of CVaR, one pragmatic merit is that the activity's contributions to total CVaR are strait-forwardly determined from the definition of CVaR. It is simply an expectation of the activity's duration conditioned with both activity's criticality and overrun of project duration. We call it CED.

We also proposed the effective method to control activity's duration to reduce the expected overrun. The proposed method, CVaR control method, provides each activity with the threshold (or control limit) of duration which is set at the $\mathrm{CED} + \alpha\,\mathrm{SD}$, where SD is a standard deviation of the activity's duration and alpha is a constant parameter. Changing alpha, the reduction rate is varied. Introducing the assumption that the duration can be shortened by spending the proportional cost to the reduction, we can analyze the cost-time tradeoff. We compared CVaR control method to the simple control method that provide the uniform threshold for all activities regardless of its criticality. As a result, the former is, on average, 40 percent more efficient than the latter, although the efficiency depends on the project network structure or parameters of duration's distribution.

Finally, we constructed an optimization model to determine the best thresholds to minimize the expected overrun within a given budget. Since the model contains the nonconvex constraints with stochastic parameters, it requires the special treatment. We converted the model into the stochastic linear programming problem with binary variables (stochastic MIP problem). The computational result shows that the control with optimization model can achieve the smaller expected overrun, although its margin to CVaR control is relatively small, implying that CVaR control method is quite close to the optimal control. Taking into the account of the computational burden for the control with optimization, the CVaR control should be a better choice for a pragmatic purpose.

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Appendix

In this appendix, we describe our formulation of stochastic mixed integer programming problem. The following is a list of notations:

m	number of activities
H	number of nodes in the project network
N	number of scenarios
τ	project's target duration
B	budget

T_H	Project's completion time
p_j	a probability that scenario j happens
$s(i)$	initial node of activity i
$e(i)$	end node of activity i
T_k	starting time (random variable) of node k, $k = 1, \dots, H$
T_{kj}	realized value of T_k at scenario j
d_i	activity i's duration (random variable)
d_{ij}	realized value of d_i at scenario j
c_i	control limit for activity i's duration
x_{ij}	$= \max\{d_{ij} - c_i, 0\}$

We consider to minimize the expected overrun under a budget constraint by controlling the control limits c_i (decision variables), the starting time T_k and completion time T_H (state variables). Conceptually, the problem can be written as follows.

$$\begin{array}{ll} \min & \mathrm{E}[\max\{T_H - \tau, 0\}] \\ \mathrm{s.t.} & T_{e(i)} - T_{s(i)} \ge \tilde{d}_i, \ \ i = 1, \dots, m \\ & \tilde{d}_i = \min\{c_i, d_i\}, i = 1, \dots, m \\ & \displaystyle\sum_{i=1}^{m} \mathrm{E}\big[\max\{d_i - \tilde{d}_i, 0\}\big] \le B \\ & c_i, T_i \ge 0, \ \ i = 1, \dots, m \end{array}$$

The objective function is the expectation of the excess of completion time $T_H$over target duration τ. The first constraint is derived from the precedence relation of the project network, while the second equation defines a reduced duration with c_i. The third inequality represents budget constraint. Since this problem contain raw random variables, it is not well-defined optimization problem with constraints. Here we assume that, for all i, duration d_i is a discrete random variable and that the joint distribution of $(d_1, d_2, \dots, d_n)$ is given. In other words, we know, for each *scenario* j, the realized value of $(d_1, d_2, \dots, d_n)$ and its probability p_j. Then the above problem is rewritten into the formulation using discrete scenarios:

$$\begin{array}{ll} \min & \displaystyle\sum_{j=1}^{N} p_j \, \mathrm{E}[\max\{T_H - \tau, 0\}] \\ \mathrm{s.t.} & T_{e(i)j} - T_{s(i)j} + x_{ij} \ge d_{ij}, \ \ i = 1, \dots, m \\ & x_{ij} = \max\{d_{ij} - c_i, 0\}, i = 1, \dots, m \\ & \displaystyle\sum_{i=1}^{m} \sum_{j=1}^{N} p_j \, x_{ij} \ \le B \\ & c_i, x_{ij}, T_{kj} \ge 0, \ \ i = 1, \dots, m; j = 1, \dots, N \end{array}$$

Here we introduced a new variable $x_{ij} \equiv \max\{d_{ij} - d_{ij}, 0\}$. Since problem (A2) is a nonconvex optimization problem, we incorporated binary variables z_{ij} resulting in the following formulation:

$$\begin{array}{ll} \min & \displaystyle\sum_{j=1}^{N} p_j \, y_j \\ \mathrm{s.t.} & T_{Hj} - y_j \ge, \tau \\ & T_{e(i)j} - T_{s(i)j} + x_{ij} \ge d_{ij}, \ \ i = 1, \dots, m; j = 1, \dots, N \\ & d_{ij} \le c_i + M z_{ij} \le d_{ij} + M, i = 1, \dots, m; j = 1, \dots, N \\ & x_{ij} - M z_{ij} \le 0, i = 1, \dots, m; j = 1, \dots, N \\ & c_i + x_{ij} + M z_{ij} \le d_{ij} + M, i = 1, \dots, m; j = 1, \dots, N \\ & c_i + x_{ij} \ge d_{ij}, i = 1, \dots, m; j = 1, \dots, N \\ & \displaystyle\sum_{i=1}^{m} \sum_{j=1}^{N} p_j \, x_{ij} \ \le B \\ & c_i, x_{ij}, T_{kj} \ge 0, \ \ i = 1, \dots, m; j = 1, \dots, N \end{array}$$

where M is a big positive constant. z_{ij} takes either 0 or 1. When it takes 1, it corresponds the condition $d_{ij} \ge c_i$ and $x_{ij} \ge 0$. On the other hand, if $z_{ij} = 0$, it implies the $d_{ij} < 0$ and $x_{ij} = 0$. As the objective function and all the constraints are linear equation or inequalities, the problem is a mixed integer linear programming problem. There exist several powerful solvers for MIP, we can solve problem (aa) of a modest size within a practical time.

How to Control a Surmise in Appropriate Project Management

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They say that the system development project falls into trouble because the communication does not work well. The author, through the experience which took part in a system development project of the major banking business company as a project manager from 2015 to 2017, considered there is an inappropriate surmise in one of the causes in communication trouble, and put some problems about that in order. It is said that Japanese hospitality or service is very good. This is also based on the surmise, guessing the feelings of others, which they try to exert a better than expected performance of the other person. On the other hand, communication is distorted, no longer is appropriate risk management, and the scope creeps. As a result, there are many projects which are not achieved by the effort and the schedule as planned first. In a word, the main cause of such a situation is an inappropriate surmise. When a surmise is used as love without reward, it is effective. But, in a business, it is important to get along with surmise appropriately. In this paper, I discuss how an inappropriate surmise is obstructing success of a project, and propose a way of surmise control which is important to appropriate project management.

Keywords and phrases: Surmise, Surmise Control, Communication

1. Introduction

They say that the system development project falls into trouble because the communication does not work well (Kimura, 2017; Krigsman, 2009; Ito, 2002).

The author, through the experience which took part in a system development project of the major banking business company as a project manager from 2015 to 2017, considered there is an inappropriate surmise in one of the causes in communication trouble, and put some problems about that in order. We think that a way of communication based on this problem is so important, and propose the way of communication to control a surmise.

In addition, a surmise is called "sontaku" in Japanese. There is more than one way of expression in English for a Japanese word as "sontaku". It means conjecture, surmise, reading between the lines, reading what someone is implying in Japanese. It's said that they don't have the word to say into which "sontaku" is paraphrased directly in English (Izutani and Furuya, 2017; ShareWis Press, 2017; Hikino, 2017). In this paper, we translated "sontaku" into "surmise". This matter is told just in case.

2. Inappropriate Surmise and the Problem

We considered that a problem on the communication of making the project difficult is in an inappropriate surmise.

Let us explain with some example. The chief director asked, "Can't you complete this project earlier?" The project manager answered, "(I guess he wants me to do it much earlier than now. It is quite severe, but I have to do. Well, I see.) Yes, I can do it."

Can a project be achieved appropriately by such communication method? No, it is impossible to achieve it. What happened to an impact analysis to the project quality or the project cost to estimate the schedule compression? The above communication between the chief director and the project manager includes an inappropriate surmise, and this kind of thing leads the projects to failure. A problem of an inappropriate surmise is specifically,

1. Unformed common recognition,
2. Ambiguous responsibility,

we considered the above two points are problems.

2.1 Unformed Common Recognition

Where was true meaning of the chief director's question? Even if the project quality and the project cost were disregarded, were there any management circumstances which can't help reducing a term of construction work? Or, through the current term of construction work was fine, did the chief director feel like considering what kind of condition and device are needed for term of construction work reduction? There are no means from which we learn about the chief director's true meaning only by this communication. The common recognition between the chief director and the project manager is not formed, it is a problem in the state with the misunderstanding in their recognition.

2.2 Ambiguous Responsibility

Also, the decision making which reduced a term of construction work is in charge of the chief director or the project manager? Later, the chief director who knew to cost much more money in this project, may regard a judgement of the project manager as a problem. On the other hand, when the project began to be delayed, the project manager may think that it is the cause that the chief director said the cost should be as scheduled as planned first and not to allow to increase it.

This is the chief director's responsibility. No, it is the responsibility of the project manager. This kind of situation is a he-said/she-said argument. We must avoid a barren controversy. Anyway, the above communication case makes where the responsibility lies is ambiguous, it is a problem.

Further, because it isn't a main point on this paper, about the toxic symptoms which happen when an inappropriate surmise was overdone, we put these into the study of the company scandals (Suzuki, 2017; Inoue, 2016; Yamaguchi, 2016).

3. Experiment

Figure 1 shows the Shannon and Weaver model of communication (Shannon and Weaver, 1949).

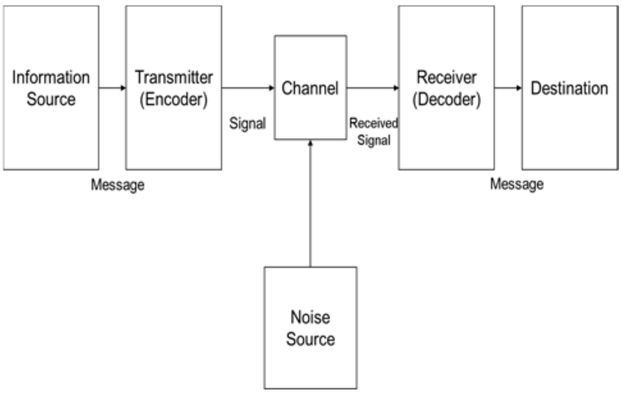

Figure 1 Shannon and Weaver Model of Communication

It is clear that there is a problem in the above communication with Encode and Decode for an occurrence point. Is the information a transmitter would like to tell encoded rightly? Or, is a recipient decoding a message encoded by a transmitter rightly? Can a recipient grasp the information a transmitter would like to tell?

At this point, a simple experiment was made to consider the way to handle these problems.

3.1 Contents of Experiment

<Precondition>

- A project manager receives a work request of due date A from a salesperson.
- The contents of the work request are something such as sending the result which agreed with a customer on the last month's operation achievement and details of operation by each component. In addition, each component owner are familiar with the last month's operation.
- The answer-format the salesperson usually uses is prepared for the last month's operation achievement and details of operation by each component. Half day is needed to arrange and mention the answer contents of each component.

<Experiment>

- The project manager requests to be conscious of the due date A to three component owners, to agree with the customer on the last month's operation achievement and details of operation and to inform of the contents.
- The due date A' (< due date A) is not established so that the project manager may be in time for the due date A.
- It is possible to grasp that one small touch is needed from a request to collect an answer of each component owner.

<Results>

- One person of three component owners answered to the project manager in the morning of the due date A. Investigated separately, the component owner said, "It is no problem about the morning's answer of the day for the due date even if it isn't the previous day's answer for the due date."
- As for one another component owner, the project manager received no answer in the morning of the due date, after the situation was confirmed from the project manager, he said, "Because no operation was in the last month, it is not needed to answer."
- The other component owner was reporting the agreement situation with the customer to the project manager every day, but he couldn't agree with his customer, and the due date was exceeded.
- The project manager informed the salesperson of the due date exceeding in advance, and answered the request contents after the due date.

3.2 Review of Experiment

Figure 2 shows the communication model of this experimental contents.

We reviewed this experiment, and put a problem and improvement points in order.

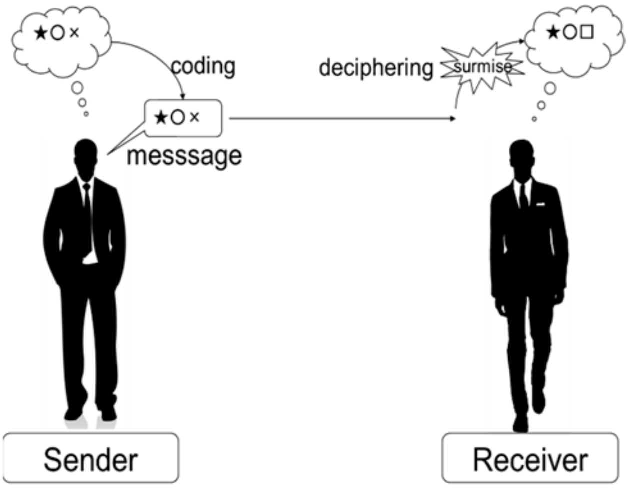

Figure 2 the Communication Model of the Experiment Contents

<Problems>

- The due date A' isn't established (the request side).
- It is not described about how to answer in case of no operation in the last month (the request side).
- It is not confirmed whether an answer on the due date A is no problem, and the need of the due date A' (the receiver side).
- It is not confirmed the need to answer in case of no operation in the last month (the receiver side).
- It is not described about the need to fill in the answer-format the salesperson usually uses (the request side).

By doing such a thing, the answer to the salesperson, the original requester, is not smoothly developed. An inappropriate surmise about the due date and the response details is obstructing some activities.

At first, a rough request on the request side, such as asking to be conscious of due date A and to response it, is mentioned as a problem. However, it's also a problem of no confirmation by the receiver though the receiver side can confirm it about this. The inappropriate surmise of the receiver shown in Figure 2 affected the decipherment of the message of the sender. An inappropriate surmise is like the noise in the model in Figure 1.

Second, it is mentioned as a problem that the request does not have the response details in case of no operation in the last month. However, it is also a problem of no answer by the receiver, even though there is no operation in the last month until the confirmation is received from the requester, the project manager.

We find there is a problem with a part of the transmitter's coding and the recipient's decipherment indicated on Figure 2.

When the contents of an inappropriate surmise are given specifically,

1. The point that the first component owner thought, "It is no problem about the morning's answer of the day for the due date even if it isn't the previous day's answer for the due date. The project manager can arrange the answer in the afternoon of the due date."
2. The point that the second component owner thought, "It is no need to respond the request, because of no operation in the last month."

we considered the above two points are inappropriate surmises.

Also, we can assume that there is one of the factors which generate these inappropriate surmises in the manner of the request of the project manager.

In addition, because it is a main point about an inappropriate surmise on this paper, we skip the problem about the delay of the consensus with the customer (confirmation of the situation, helping the customer agreement, etc.) (Berlitz Global Blog, 2015; Kuwako, 2015). However, it is not being investigated, there is a high possibility of the exceeding of the due date in order that an inappropriate surmise also exists in the part where the last component owner was reporting the agreement situation with the customer every day.

<Improvements>

Now then, how should have been done about the request and the response? We will control a surmise appropriately.

- Detail the request contents such as including the due date A' and the response detail in case of no operation in the last month (the request side).
- Confirm the same recognition with the requester from the receiver (the receiver side).

It is the request contents and the confirmation as improvement points, but moreover we will advance one step.

As for the request, how about sharing all the activities through the time axis including the final reply contents to the salesperson, and determining the action items by the person in charge? We are sure that the way should be planned that not only they shares the due date A' and the response detail in case of no operation in the last month, but also the project manager check and answer it after the component owners fill in the salesperson's format.

By improving such as the above, we can form the common recognition, and we make where the responsibility lies is clear.

Figure 3 shows the way of communication after improvement.

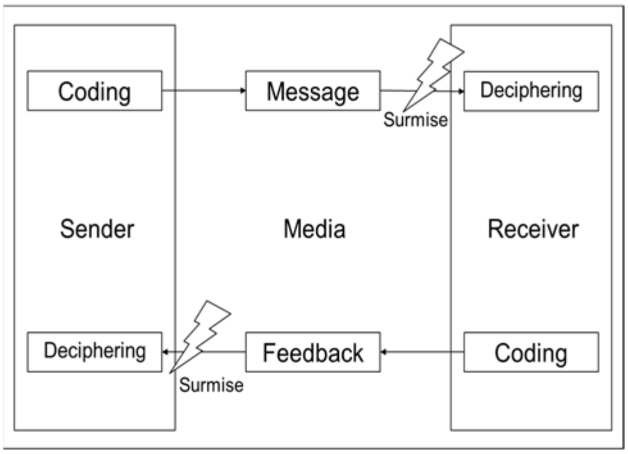

Figure 3 the Model of Communication after Improvement

4. Proposal

Based on the improvement points in the above experiment, we propose the practical way to control a surmise to get appropriate communication by excluding an inappropriate surmise.

4.1 Clarification of Directions

The directing clearly is the solution for making the common recognition, minimizing the room interpretation enters into. It is that the gap where I surmise inappropriately isn't given. However, "clear directions" are to tell the due date required and the state required, it is not to direct a small method by slightest effort.

In case of the experiment, it is the state that there is the last month's operation achievement and details of operation by each component in hand of the project manager until the due date A'. It is also important to add about fineness of operation achievement and details of operation according to an opponent's experience and knowledge, and it's regarded as the way which doesn't make cause an inappropriate surmise. However, it is insufficient only by the clarification of the directions and the supplement according to an opponent.

4.2 Confirmation of the Opponent's Intent

When we implement the project with many stakeholders, do the contents all the people tell probably become clear? No, such a thing can't occur in reality. In the first place, even if there is a very clear instruction, the own interpretation intervenes in the opponent's aim and purpose. In order to exclude an inappropriate surmise, it is necessary to confirm the own interpretation with the opponent.

Also, it is necessary to show the own hypotheses and to verify by the opponent's answer. In case of the above experiments, "Although the due date A has been set, but I have thought that there is not enough time for you to arrange the answers of each component to the salesperson if the response content of each component is not in your hand before the due date A. Is that right?", "Since it is a request to answer the operation achievement and the details of operation in the last month, even though there was no operation record, I have thought that I should answer the fact that there was no operation record last month. Is that correct?", such confirmations, these are exactly that.

4.3 Recapitulations of the Proposal

At present many complicated communication models are studied (Yamamoto, 2010; Ikeda, 2000; Sawaguchi), however the Shannon and Weaver model of communication indicated Figure 1 is a simple one and the one-way communication model by one channel. In real life, it is equivalent to broadcasting on radio or television. That is, when there is a mistake in encoding of the transmitter or decoding of the recipient, the contents that the sender wanted to tell are not conveyed, it is indicated.

Although the suggested improvement method seems to be very simple, we should not neglect the improvement of communication because the communication on the site of system development tends to be in the form of one-way communication in one channel like a radio or television broadcast.

The statements of the chief director and the project manager can not be handled like a one-way message like radio or television broadcasting. Since the chief director and the project manager are close by, we can confirm the contents of the statement. Also, the chief director and the project manager have to be careful to recognize that the communication tends to fall into a one-way communication like a radio or television broadcasting and to tell the outgoing contents without obscuring it.

The origins, experiences, beliefs, emotions, attitudes towards things, values, ideas, language skills, etc. of originators and recipients are usually different. We should not be overconfident that the sender's information is correctly Encoded and the recipient correctly decodes and receives the information the sender wanted to tell originally.

5. Conclusions

It is said that Japanese hospitality or service is very good. This is also based on the surmise, guessing the feelings of others, which they try to exert a better than expected performance of the other person.

On the other hand, communication is distorted, no longer is appropriate risk management, and the scope creeps. As a result, there are many projects which are not achieved by the effort and the schedule as planned first. In a word, the main cause of such a situation is an inappropriate surmise.

When a surmise is used as love without reward, it is effective. But, in a business, it is important to get along with surmise appropriately.

In this paper, we discussed how inappropriate surmise disturbs the success of the project, and classified the problem into two. Also, through some experiment, we proposed two practical ways to exclude inappropriate surmise by adjusting concrete problems and improvements in communication. Continued research is required because these can be important methods to control a surmise for proper project management. Especially, the measurement of effects and the verification are issues in the future.

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Challenges and Measures for Managing Agriculture ICT Project in Global Market

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In recent years, remarkably progressing ICT is being increasingly utilized for agriculture. While many farmers are small-scaled focusing high crop quality in Japan, many are large-scaled focusing high yield in other countries. North American and European major tomato paste manufacturers generally contract with many tomato farmers and the increase/decrease of raw crop supply strongly affects the tomato can production volume, factory operation rate, etc, and company's business status. With ICT technology, NEC has been providing the farming support service that optimizes fertilizer/water amount and controls yield. Our local subsidiaries overseas address customer negotiation/local technological matters and Japan headquarters undertake analysis. I now participate in the project to launch the above farming support service as a full-fledged business as a project manager. The service is provided via Website and our mission is to manage the nonstop service after transplanting tomato seedlings until harvesting. However, in this project, project members and stakeholders belonging to a wide range of business field made the service operation so complicated that we had difficulties in keeping the schedule and labor hours within the planned range. In this essay, I would like to examine the challenges and measures for a Japanese IT company to provide online farming support service to farmers outside Japan from the perspective of rationality and effectiveness.

Keywords and phrases: Agriculture ICT, IoT, Project Management, Global Relationship

1. Introduction

The global market of "food" is expected to increase to 680 trillion yen in 2020 by the Japanese government's survey. The value chain of food generally comprises the activities of cultivation, harvest, preservation, distribution, processing, dining service and consumption. Among them, cultivation and harvest belong to the agriculture sector and are also the major target market of the Agriculture ICT business.

Agriculture ICT project which I participated in as a project manager had the following three characteristics.

a. The stakeholoders outside Japan

While analysis is performed in Japan, our customers are farmers in the United States and European countries. In addition, the project receives technical support from the companies outside of Japan. NEC's local subsidiaries overseas play roles as mediators between stakeholders abroad and the project team in Japan.

b. The project team members from a variety of specialized divisions.

The project team consists of variously specialized divisions such as the sales division, IT system development division, data analysis division and Agriculture ICT laboratory.

c. The advanced service utilizing the simulator

In recent Agriculture ICT, the mainstream business model is to offer services such as helping farmers keep farming records on the website or delivering knowledge provided by other experienced farmers. On the other hand, in this project, controlling the harvest amount and time by calculating the optimal value of fertilizer and irrigation amount with the simulator can enhance the potential to increase farmers' revenues. In this context, the service provided in this project is defined as the farming support service in this essay.

The essay discusses the challenges, measures and effects of measures which I set as a project manager in light of the above three characteristics.

2. Background

Firstly, I illustrate the background of the project environment in the figure below.

The definitions of the terms used in this essay are shown below.

As described above, this project adopted highly advanced technologies but the technologies themselves were stabilized through many years of technical verification. Although our farmer customers and the companies in technical partnership with NEC were scattered across the United States and Europeans countries, the project team had already built trusted relationships with overseas subsidiaries which are contact points between NEC and overseas stakeholders.

Since this project attracted a far greater number of potential customers than in the past technical verification phase, as a project manager, I had to realize reasonable and efficient team operation to accomplish the project by making the best use of the limited time and human resources.

As described below, this project established a project team by gathering members from the departments of various specialized fields.

- Since the business is currently expanding its market, sales representatives were appointed as members who are competent to develop a business plan.
- Analysts were appointed as members who are capable of performing data analysis.
- To collaborate with soil analysis laboratories and ICT sensor companies, researchers were appointed as members who are able to respond to advanced technologies.
- Software engineers were appointed as system development members to develop the whole IT system of the farming support service.

Experiences of past projects had revealed that gathering project members from diverse departments could cause some problem. Each member tends not to pay attention to the tasks in the different field from that of one's original specialized one because of the lack of knowledge on them and considers those assigned tasks are working well. According to ”Organization Plan”, the human resource management process in PMBOK, the role assigned to each member should be clarified in order to effectively utilize the project resources. This project had planned to follow this and assign the roles to the members according to their original departments.

However, the actual project established a structure where the members cooperate each other regardless of which departments they came from. This resulted in improvement in the project team’s productivity and in earlier accomplishment of delivering the farming support service despite the limited resources while addressing the risks which could force us to shrink the project scope, which allowed us to gain the trust of farmer customers.

This essay discusses how we succeeded the project in challenging situations from the following three viewpoints:

- Setting challenges
- Implementing measures
- Evaluating the effects of the measures

Figure 1 Three Characteristics of the Agriculture ICT Project

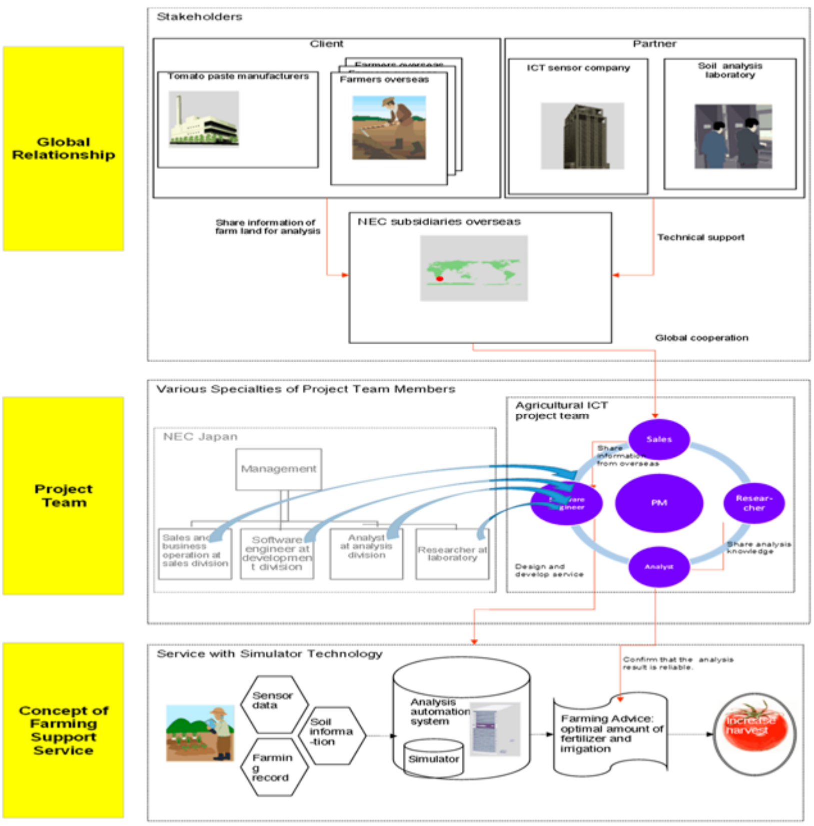

Table 1 Definition of Terms Used in This Essay

	Term	Meaning
Conception	Agriculture ICT project	The project which provides ICT solution for farmers.
	Farming support service	The service included in the service lineups of agriculture ICT project and also the online service which informs farmers of the optimal amount of fertilizer and irrigation which is calculated from the real-time farm monitoring data.
	Past verification record	The record of the farming support service in its verification phase. The verification was conducted over the past several years.
Organization	ICT sensor company	The company which provides sensors installed outdoors and is a collaborator in the farming support service.
	Soil analysis laboratory	The company which analyzes soil and provides chemical analysis results and is a collaborator in the farming support service.
	NEC Japan	The organization which the author of this essay belongs to.
	NEC's local subsidiaries overseas	The organizations which negotiate with stakeholders outside Japan and address local matters such as sensor installation.
	NEC Japan's sales division	The division which NEC's marketing persons belongs to.
	NEC Japan's IT system development division	The division which NEC's software engineers belong to.
	NEC Japan's data analysis division	The division which NES's analyst belongs to.
	NEC Japan's agriculture ICT laboratory	The division which NEC's researchers studying the agriculture ICT technology belong to.
	Project team, team	The project team which was formed for the agriculture ICT project.
Human Resource	Project manager	The author of this essay and also project manager.
	Software engineer	The software engineer in the project team who also belongs to IT system development division of NEC Japan.
	Sales representative	The sales, marketing and contact person in the project team who also belongs to NEC Japan's sales division.
	Analyst	The analyst in the project team who belongs to NEC Japan's agriculture ICT laboratory.
	Researcher	The researcher in the project team who belongs to NEC Japan's agriculture ICT laboratory.

3. Setting of Challenges

Examining the past projects, we set precondition and issue at the planning stage of this project before issue such as delay and bugs come to the surface. The precondition is based on the situation of a project that cannot be changed. The issue is a problem in the project which could be solved, resulting from the precondition.

Precondition: Strictly limited human resources and working hours

There was not sufficient manpower available and human resources were limited. It was essential that the farming support service schedule should follow the farming schedules of tomatoes. Thus any schedule with buffer was not able to be proposed for the farming support service, although IT companies usually make a proposal to set up the schedule with a buffer for general system development. Also working hours were limited.

Issue: Project members have different ways of thinking about the schedule and man-hours, because of the wide variety expertise fields among the project-related parties

As a project manager, I considered it would be a risk that the project-related parties have different ways of thinking about the schedule and man-hours. For example, project managers who put the first priority completing the project make a schedule to prioritize the work which can be completed within a day if the resource is limited to one day. On the other hand, even under the same conditions, researchers who put the first priority on technical verification often exceeded the resource limit of time and man-hours. As a result, they tended to have a slower progress of work. As described previously, the project members are not familier with fields other than theirs. Therefore, they tend to pay no attention to their unprofessional fields. In other words, the project managers have difficulty getting affirmative cooperation from any project member who is from the departments where a subtle progress management is not regarded as an important matter.

For example, if you ask an analyst, who generally is not aware of process management, to decide to estimate the necessity of the task which could be canceled considering the schedule, the analyst may give an ambiguous reply, such as “I feel that the task may be necessary, but I am not so sure”. Therefore, the necessity of the task cannot be efficiently decided sorely with the insufficient knowledge of the project managers.

In short, due to a wide variety of fields of expertise among the project members, a huge risk of schedule delay could challenge us, because there was no way to add members even though the productivity decreases caused by unfavorable cooperation.

The purpose of this project is to meet the needs of our customers by completing the farming support services with limited human resource and working hours. Therefore, it is essential to handle the risks described above. As a project manager, I considered measures to increase the project team’s productivity, leading to flexibility in scheduling.

The following chapters explain the measures to increase team productivity, effect of the measures and verification results.

4. Implementing measures

The measures are for reducing man-hours of the project, in order to finish the project on schedule and keep the man-hours within the limits accurately. In order to ensure service quality for our customers while reducing man-hours, we discussed organizing more rational team to streamline tasks, in terms of increasing the productivity of the project team.

Phase 1: Listing the task(s) for each role
Phase 2: Identifying tasks which require as many man-hours as it would be a risk, based on the past records
Phase 3: Segmentizing the identified tasks in Phase 2 into smaller ones
Phase 4: Observing project members
Phase 5: Assigning the tasks segmentized in Phase 3 to make effective use of the characteristics and skills of the project member

From Phase 1 through 5, we have reorganized a more efficient team by placing the right persons in the right jobs irrespective of their backgrounds.

Phase 1. Listing the task(s) for each role

Their tasks are classified per role on Table 4 below. The tasks are to provide farming support service.

Table *2* Tasks Classified according to Roles

No.	Tasks	Role
1	Enviroment configuration for analysis engine	System Engineer
2	Review settings of analysis engine considering situations on the site	Sales
3	Check input data for analysis	Analyst
4	Check parameters of analysis engine	
5	Check computational results of analysis engine	

The purpose of the measures is to reduce man-hours in the project by making the team more productive. First, the tasks which require many man-hours are identified in the next phase.

Phase 2. Identifying tasks which require as many man-hours as it would be a risk, based on the past records

We have not have past records in farming support services, because the service launced this time. Therefore, we estimated the required man-hours, based

on our experiences in other projects using the similar know-how.

- The service is provided online once a week. If the period of providing the service is 12 weeks, it will be provided 12 times.

In this essay, we estimated the man-hours, based on providing the farming support services for three months (May 1 to July 31). As a result, it was found that the vast majority of the man-hours were probably spend on specific tasks.

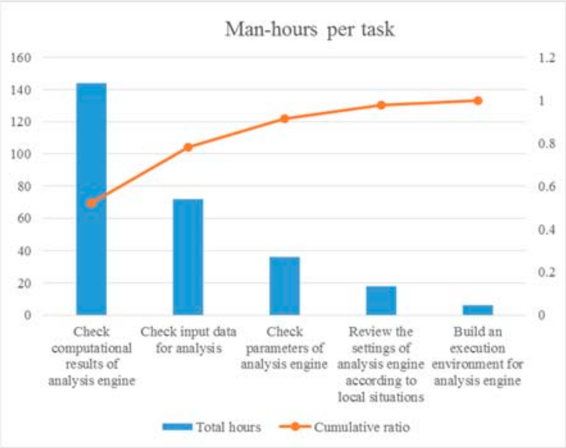

Figure 2 Man-hours Required for Farming Support Services

Table 3 Tasks Requiring Many Man-hours

No.	Tasks	Total hours	Role
1	Build an execution environment for analysis engine	6	System Engineer
2	Review the settings of analysis engine according to local situations	18	Sales
3	Check input data for analysis	72	Analyst
4	Check parameters of analysis engine	36	
5	Check computational results of analysis engine	144	

Phase 3. Segmentizing the identified tasks in Phase 2 into smaller ones

Tasks requiring many man-hours have been identified. Then, in order to reduce labor hours by streamlining the work process, we calculated the man-hours after subdividing the task into smaller ones. Accordingly, it was found that many man-hours were spent on some of the smaller tasks.

Furthermore, the common characteristic among the following three tasks, which require many man-hours, is that even well-trained analysts need much time to make judgments. We suspect it is due to the fact that they need to make professional judgments after giving comprehensive consideration to input data, settings of analysis engines, and actual states of farmers.

Table 4 Man-hours for each small task
* One analyst takes charge in ten farms. Each of the man-hours below is the time which it takes to analyze 10 farmers.

No	Tasks	Small tasks	Frequency	Total hours
3-1	Check input data for analysis	Sensor data is automatically generated from databa	Weekly	0
3-2		Confirm the generated sensor data visually, in order to confirm that there is neither loss of data nor an abnormal value. * Decide the abnormal value relatively, based on the threshold set by researchers.	Weekly	50
3-3		Measure against data loss and abnormal values (1/2): Contact the local subsidiary (afterward, the local subsidiary checks the situations of the sensor and of data input from the farmers)	Monthly	10
3-4		Measure against data loss and abnormal values (2	Monthly	12
4-1	Check parameters of analysis engine	Open setting files for analysis engine.	Weekly	0
4-2		Change the setting value of analysis engine, accord	Weekly	30
4-3		Return the setting value to its previous one, if the value has been changed for some reason such as a production test but is not yet returned. * See the design specification on which the setting value is described.	Monthly	6
5-1	Check computational results of analysis engine	Open a computational result of analysis engine.	Weekly	0
5-2		Confirm that the computational result is as expected. * Visually check the graph for the result. The laboratory provides documents describing the points to be checked.	Weekly	130
5-3		Convert the unit of the computational result.	Weekly	10
5-4		Upload the computational results to the website, in	Weekly	4

Phase: 4. Observing project members

As a result of collecting feedback from each analyst about why 3-2, 4-2, and 5-2 require many man-hours, we have found out the following two things:

- Since it is necessary to make professional judgments based on giving comprehensive consideration to input data, settings of analysis engines, and actual states of farmers, the analysts have difficulty in making the judgments.
- The man-hours required for 3-2, 4-2 and 5-2 are different among the analysts, and all the analysts have in common that the man-hours are focused on 3-2, 4-2 and 5-2.

It was unexpected that the labor times required for 3-2, 4-2 and 5-2 were different among the analysts. Since their workloads and specifications of terminals are not different, we estimate that their personal characteristics influence their labor times.

Table 5 Man-hours of Small Tasks per Analyst
* *The total amout of man-hours* from May

No	Tasks	Small tasks	Totla hours (weekly) per Analyst A to D			
			A	B	C	D
3-2	Check input data for analysis	Conform the generated sensor data visually, in order to confirm that there is neither loss of data nor abnormal value. * Decide the abnormal value relatively, based on the threshold set by researchers,	70	50	40	40
4-2	Check parameters of analysis engine	Change the setting value of analysis engine, according to the situation of the local farm.	40	20	35	20
5-2	Check computational results of analysis engine	Confirm that the computational result is as expected. * Visually check the graph for the result. The laboratory provides documents describing the points to be checked.	180	150	100	100

Table 6 Profiles of Analysts

Analyst	Natio nality	Personality		IT Skill	Remarks
		Accura cy	Speed		
A	Japan	Very high	Very slow	Low	Even slower than any other analyst, but keeps detailed records and contribute to accumulating know-how.
B	Swed en	Low	Very speedy	High	Lower in accuracy than any other analyst, but can perform several tasks simultaneously.
C	Japan	High	Speedy	Low	More accurate and speedy than expected
D	China	High	Speedy	HIgh	More accurate and speedy than expected

As a result of analyzing each of the analysts, it was found that Analyst A and Analyst B did their work less quickly or accurately than we had expected. Therefore, it was expected to lead to the risk for the schedule and man-hours.

It was found that their own personalities contribute to decreasing their working speed and accuracy, due to the nature of 3-2, 4-2, and 5-2, which require a personal judgment.

Analyst A is insistent on one's own way of doing work and tends to spend too much time on checking input data, parameters of analysis engines and calculation results of analysis engines until Analyst A is satisfied. Consequently, the working pace resulted in a significant decrease. On the other hand, Analyst B is less insistent on his/her own way of doing work than Analyst A. It was found that the work quality was often pointed out by other analysts and Analyst B was required to do the work again.

Compared with Analyst C and Analyst D, both Analyst A and B tend to do work based on only their own decisions, without asking for some advice from other members. It seems that Analyst A prefers to think independently as much as possible before asking for their opinions, whereas Analyst B has an opinion that there is no problem with making decisions based solely on his/her own criteria.

Phase 5. Assigning the tasks segmentized in Phase 3 to make effective use of the characteristics and skills of the project members

The organization of the project team has been revised, in order to improve Analyst_A's working pace and Analyst_B's accuracy to the level of Analyst C and D.

Table 7 Improvement of Task Roles

No	Tasks	Small tasks	Before	After
3-2	Check input data for analysis	Confirm the generated sensor data visually, in order to confirm that there is neither loss of data nor an abnormal value. * Decide the abnormal value relatively, based on the threshold set by researchers.	Analyst	Sales
4-2	Check parameters of analysis engine	Change the setting value of analysis engine, according to the situation of the local farm.	Analyst	Analyst Project Manager
5-2	Check computational results of analysis engine	Confirm that the computational result is as expected. * Visually check the graph for the result. The laboratory provides documents describing the points to be checked.	Analyst	Analyst Research er Sales

The points that should be improved are as follows:

・ The task No.3-2 is shifted from analysts to Sales division

The communication route has been changed from analysts through Sales division to overseas subsidiaries to that from Sales division, who checks sensor data for efficiency, to overseas subsidiaries as soon as a problem is found. I considered that personnel at Sales division are able to find troubles even without experiences in the technical field in the past, because the threshold level to be determined as troubles was sent by the research center. Also, Sales division plays a role of a bridge between NEC Japan and overseas subsidiaries, therefore; it was assumed that the personnel in the Sales ivision should be deeply familiar with the best timing for requesting and the work load to be requested a day.

・ A part of No.4-2 service is shifted to the project managers from analysts

Being the position that often receives communication regarding the farming conditions and considering the possibility to eliminate the setting value gap between the farmers, the project managers of the entire project are assigned to control the setting values of analysis engine. Analysts are assigned to determine the applicability of setting values based on the analysis engine.

- No.5-2 task is partially shifted to researchers and Sales divisions from analysts.

Both analyst A and analyst B tend to proceed their tasks based on their own judgment. Hence, personnel in the Sales division who communicate with farmers are to evaluate the necessity of work continuation, because the threshold level was based on the request obtained from hearing with the farmers. Also, some of the research laboratory members were capable of progress management. By shifting the progress management that had been done by the project manager to the researchers, subtle progress management became possible defying the boundaries of the tasks.

5. Verification of the effects of measures

In this section, the effect of measures applied in the project is verified.

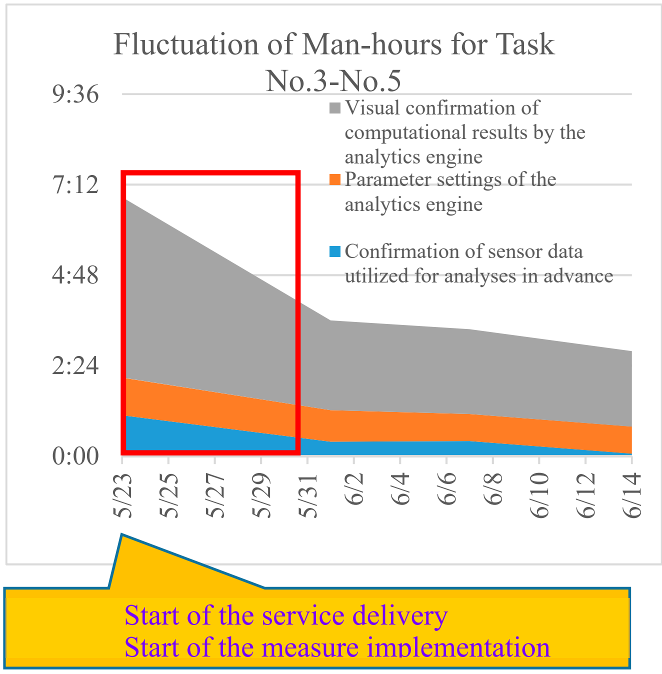

Figure 3 The fluctuation of man hours necessary for tasks to provide the service.

As the above graph suggests, work duration was reduced as the measures had been taken for the above described tasks. The duration for the tasks No.3, 4, and 5 was approx. six hours on 23 May when the service had been started, and on 1 June, a week since the service start, it was reduced to approx. three hours. This was a great contribution for man-hour reduction of the project.

The fact that the work duration has been reduced also suggests that the productivity of the team had been drastically improved in a week from 23 to 30 May. It means that this measure has infiltrated to the project team only in a week. It can be considered that the project members were cooperative and helpful with the implementation of the measures due to the following reasons.

We had necessity to tight up the schedule to match tomato firming, and due to highly advanced technologies, each specialists with different back ground should have cooperated to handle tasks within the specified time frames. Additionally, it was quite difficult to arrange the schedule as all the stakeholders were working overseas. Therefore, I as the project manager shared the information regarding our situation with each of the members and managed to obtain their understandings upon implementation of the measures.

6. Conclusion

This essay discusses how to reduce schedule risks of a project while improving the productivity without deteriorating the scope on the premise that human resources and work period are limited according to the actual project experience. The case study described in this essay is a project which utilizes an advanced technology, agriculture ICT, however, the measures to improve team productivity by constructing an efficient structure can be applicable also to general system developing projects. (An "efficient team structure" referred in this essay signifies the structure that can cope with a task with minimum duration.)

It is not rare that a project team is composed of members from different divisions just as the project in this essay. Instead of assigning roles based only on their divisions (specialized field), observing each of them to create more efficient team structure enables more effective utilization of various resources.

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A Consideration of Systemization of Change Impact Analysis on Software Maintenance Process

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Change impact analysis is a software maintenance activity, which is intended to specify the scope of a requested change. The change impact analysis is conducted by maintainers in software maintenance project. The maintainers have to understand the specifications of the software based on source codes and design documents to conduct the change impact analysis. However, in long-term software maintenance, there are two tendencies: obfuscation of source codes and obsolescence of design documents. The obfuscation of source codes is caused by repeated incremental developments. The obsolescence of design documents is caused by forgetting to update design documents. These two tendencies make it hard for the maintainers to understand the software specifications and to systematize the change impact analysis. The lack of systemization is a problem on the maintenance of software. This problem spoils the quality and the productivity about the change impact analysis. In this paper, we introduce systemization of a change impact analysis on software maintenance process in a software maintenance project. That project had lack of the systemization in the change impact analysis. We created a procedure of systematize the change impact analysis. In accordance with the procedure, we investigated the causes of the problem, and proposed three solutions; definition of software maintenance process, documentation of software maintenance procedure and obligation to use of change impact analysis tool. These solutions systemize the change impact analysis on software maintenance process. Additionally, we adopted these solutions to the software maintenance project. We confirmed adopted solutions can systematize the change impact analysis and improve quality and productivity of the project.

Keywords and phrases: Software Maintenance, Impact Analysis, Systemization

1. Introduction

Change impact analysis (CIA) is a software maintenance activity, which is intended to specify the scope of a requested change. The CIA is conducted by maintainers in software maintenance project. To conduct the CIA, the maintainers have to understand the specifications of the software based on source codes and design documents. However, software which maintained over the long term often has following two tendencies: obfuscation of source codes and obsolescence of design documents. The obfuscation of source codes is caused by repeated incremental developments. The obsolescence of design documents is caused by omission of update design documents. These two tendencies make it hard for the maintainers to understand the software specifications and to systematize the CIA. The lack of systemization spoils the quality and productivity of the CIA.

In this paper, we introduce systemization of a CIA on software maintenance process in a software maintenance project. That project had lack of the systemization in the CIA. We created a procedure of systematize the CIA. In accordance with the procedure, we investigated causes of problems, and proposed three solutions; definition of software maintenance process, documentation of software maintenance procedure and obligation to use of CIA tool. Additionally, we adopted these solutions to the software maintenance project. We confirmed adopted solutions can systematize the CIA and improve quality and productivity of the project.

2. Preceding Study

Systemization of CIA is aimed at avoiding dependency on maintainers' skills and experience on CIA and improving quality and productivity about CIA.

In order to create a procedure of systemization of CIA, we surveyed the preceding study and organized problems to systemize CIA in the software maintenance project.

2.1. Procedure of Systemization

Yokota (2000) proposed a method called Hoshu Kankyo Clinic. This method is a procedure for surveying and improving maintenance environment of software maintenance project. They showed that the method can be effective solutions for business improvement from the questionnaire result.

2.2. Relationship Between Systemization of Software Maintenance Process and Productivity or Quality.

Matsumoto et al. (2012) analyzed the relationship between systemization of software maintenance process and productivity on the basis of the data from 83 organizations. They concluded that systemization of software maintenance process improves software maintenance productivity.

Ito et al. (2015) showed the result of a simulation with past trouble cases that systemization of CIA improves CIA quality.

2.3. Problems to Systemize CIA in the Software Maintenance Project

We confirmed that Hoshu Kankyo Clinic could be applied as a procedure of systemization of CIA. In addition, the preceding studies described in 2.2 shows that systemization of CIA improve productivity and quality of CIA. Therefore

However, we have two problems to apply the procedure of systemization of CIA described in 2.1 to software maintenance project.

(a) Details of the Procedure

The procedure is not a procedure consistent with the systemization of CIA. Therefore we need to change to the procedure suitable for systemization of CIA.

(b) Verification of systemized CIA

The preceding studies described in 2.2 did not mention about the result of adoption to software maintenance projects. We might not be able to obtain the expected effects when adopting systemized CIA to software maintenance project. Therefore, we need to verify the effect of systemized CIA before systemized CIA is adopted to software maintenance project.

3. Consideration of procedure of systematization of CIA

We created a new procedure suitable for systemization of CIA in software maintenance project on the basis of Hoshu Kankyo Clinic.

3.1. Characteristics of the Software Maintenance Project

Table 1 shows the characteristics of software maintenance project (hereinafter referred to as the Project A) that we applied the procedure of systemization of CIA. The project A has maintained the software for over 20 years. Source codes are complicated and some design documents have not been updated, and therefore CIA work depends on experienced maintainers in the project A.

Table 1 Characteristics of the Project A

#	Characteristics
1	Program size is over 5M SLOC(source lines of code)
2	Duration of maintenance of the software is over 20 years
3	Used in-house Framework was developed more than 20 years ago
4	Complication of source codes
5	Obsolescence of design documents
6	CIA depends on experienced maintainers.
7	A certain amount of modification of software every year

3.2. Procedure of Systemization of CIA

We created a procedure of systemization of CIA for the project A described in 3.1. The procedure is shown in Figure 1. (<u>Added</u>) means work added to Hoshu Kankyo Clinic. (<u>Changed</u>) means modified work from Hoshu Kankyo Clinic.

Step 1. Planning Systemization of CIA
(1) Organize Systemization Team
(2) Make Plans
Step 2. Survey of Current CIA on Targeted Project
(1) Conduct Survey
(2) Summarize Result of the Survey
Step 3. Analysis of Problems of Current CIA
(1) Clarify Problems
(2) Analyze Problems
Step 4. Creation of Systemized CIA (<u>Changed</u>)
(1) Set Problems
(2) Create Solutions
(3) Select Solutions
(4) Systemize the current CIA (<u>Added</u>)
(5) Review Software Maintenance Process (<u>Added</u>)
(6) Create Manuals and Conventions (<u>Added</u>)
Step 5. Evaluation and Decision of Adopted Systemized CIA (<u>Changed</u>)
(1) Conduct Verification (<u>Changed</u>)
(2) Evaluate Adopted Systemized CIA (<u>Changed</u>)
(3) Decide Adoption of Systemized CIA (<u>Changed</u>)

Figure 1 Creation of Procedure of Systemization of CIA

We added the work (4), (5) and (6) to Step 4 of Hoshu Kankyo Clinic. This is because Step 4 of Hoshu Kankyo Clinic only suggests solutions and does not propose a procedure to adopt the suggested solutions to targeted project. Therefore we detailed a procedure that software maintenance process adopts the suggested solutions.

In Step 5, we changed to works to verify the effect of adoption of systemized CIA.

4. Systemization of a CIA on Software Maintenance Process (Details of Systemization Work)

We performed the procedure of systemization of CIA in the project A and evaluated the effectiveness of systemized CIA that was created from procedure described in 3.2.

Step1. Planning Systemization of CIA

We make a schedule to perform systemization of CIA. The schedule is shown in Figure. 2.
The systemization of CIA is performed under two time frames (Systemization I: Apr. – Dec. 2015, Systemization II: Apr. 2016 – Mar. 2017). Each systemization has following purpose shown below.

- Systemization I : Apr. – Dec. 2015
  Avoiding dependency on maintainers' skills and experience on CIA.
- Systemization II : Apr. 2016 – Mar. 2017
  Feedback the result of Systemization I to the CIA and improve quality and productivity of the CIA.

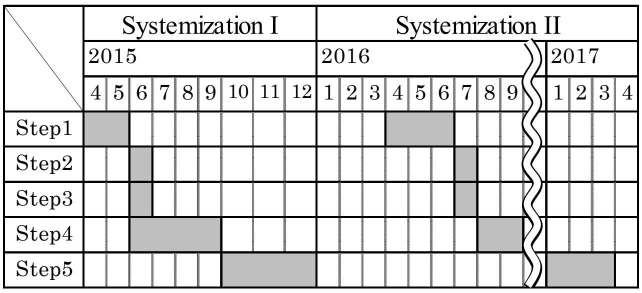

Figure 2 Schedule of Systemization of CIA

Step2. Survey of Current CIA on Targeted Project

In order to confirm the current CIA in the project A, we conducted interviews with the maintainers in project A. As a result of the interviews, we found that the contents of CIA work were different between experienced maintainers (who understand internal logic of the software well) and inexperienced maintainers (who do not understand enough about internal logic). Figure 3 shows the current CIA in the project A.

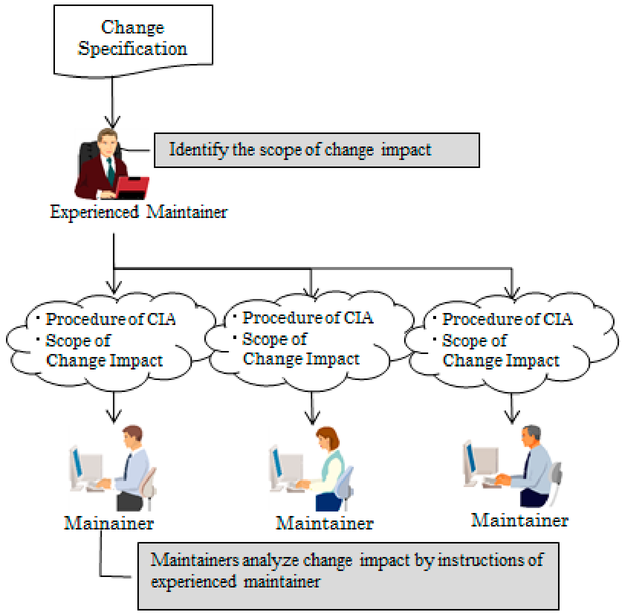

Figure 3 Current CIA in the Project A

The current CIA begins with the experienced maintainers' identification of the scope of change impact and inexperienced maintainers cannot start CIA until the experienced maintainers' identification completed. In the current CIA, the experienced maintainers' work becomes bottleneck in efficiency of CIA. In addition, the experienced maintainers should indicate the way of CIA to inexperienced maintainers. The inexperienced maintainers were not able to do CIA autonomously.

Step3. Analysis of Problems of Current CIA

We interviewed with three maintainers in the project A about why inexperienced maintainers cannot do CIA autonomously. The results of the interviews are shown in Table 2.

Table 2 The Results of the Interview

#	Category	Trouble	Total
1	Design documents	Lack of design documents	3
2		Obsolete design documents	2
3		Elusive Design Documents	1
4	Program	Complicated Source Codes	2
5		Lack of manuals to decide CIA target	1
6		Obfuscation of source codes	3
7	Maintenance skills / tools	Lack of CIA tools (only use grep command)	2
8		Cannot decide words to grep command	1
9		No manual to CIA	1
10	Application Framework	Unknown specification of in-house framework	1

Step4. Creation of Procedure of CIA

We rearranged the troubles described in Table 2 into problems and created solutions to the problems. The problems and solutions are shown in Table 3. *Adopted* column in Table 3 shows the status of adoption of the solution to the systemized CIA. "Partially applied" means that only a part of the solution was applied to the project A due to the period of Systemization I. In addition, "Not Adopted" indicates that the solution was not applied because it was judged that the solution is not within the scope of systemization of CIA.

Table 3 Adoption of Solutions

#	Problem	Solution	Adopted
1	Maintenance to keep Design documents up to date	Clarification of software maintenance process	Adopted
2	Improvement of accuracy of CIA work	Creation of CIA manuals	Adopted
3	Establishment of CIA procedure		
4	Grasp relationships of programs	Adoption of CIA tool	Partially Adopted
5	Automation of CIA work		
6	Grasp system structure		
7	Establishment of design criteria	Creation of design criteria documents	Not Adopted

Regarding the adopted solutions, we materialized the work for the inexperienced maintainers to pragmatic level, and created manuals of systemized CIA so that it can be actually applied in the project A.

(a) Clarification of software maintenance process

There was a lack of design documents and content mismatch between the program and the design document because work flow of the software maintenance process and artifacts created in each work are not clarified in the project A. Therefore we created flow diagrams of software maintenance process and detailed each works. In addition, we clarified the relation between each works and artifacts so that maintainers create quality artifacts.

(b) Creation of CIA manuals

CIA work is dependent on experienced maintainers because there was no document that describes CIA work. Therefore we interviewed experienced maintainers and created CIA manuals that describes detail of CIA work so that maintainers can do CIA according to the manuals without experienced maintainers instructions.

(c) Adoption of CIA tool

Unknown specification of in-house framework that controls call hierarchy prevented maintainers from doing CIA. Therefore we analysis calling programs on the software with CIA tool. With CIA tool, maintainers can do CIA without knowing details of the in-house framework.

Step5.

We conducted systemization of CIA two times. Therefore we conducted verification of the effect of adopted solutions two times. Each Verification is shown below.

- Verification I : Oct. 2015 – Dec. 2015
- Verification II : Jan. 2017 – Apr. 2017

5. Details of Verification Results

5.1. Verification I

(1) Maintainer

Table 4 shows Maintainer's experience. Two maintainers have different experience in the IT field, but have almost the same tenure of the project A.

Table 4 Experience of Maintainers

Maintainer	Tenure in the Project A [years]	Experience in the IT field [years]
a	0.2	27
b	0.5	2

(2) Verification Result

We conducted a survey about quality and productivity.

(a) Quality

The result of survey about the quality of the systemized CIA are shown in Table 5. We examined the number of issues pointed out in the design document review and compared it with the result of the CIA conducted by experienced maintainer in the past. As a result of the comparison, the indication density of Verification I was about 1.7 times that of experienced maintainer. It suggest the design quality turned out to be bad.

In the results of Table 5, there is a possibility of quality deterioration due to the leakage of the systemized CIA. Therefore we analyzed the contents of the design review as additional investigation. The analysis results are shown in Table 6. We confirmed that there were no indications of indication classification "Design leakage".

Table 5 Verification Result (Quality)

対象	Modified Program Size [K SLOC]	The Number Of Indication	Indication Density [times/K SLOC]
Experienced Maintainer	37	92	2.48
Verification I	8.9	37	4.18

Table 6 Adoption of Solutions

Classification of defect	Total
Design leakage	0
Lack of design consideration	3
Design error	4
Shortage of design description	20
Inconsistency in design description	5
Design Description error	5
Total	37

(b) Productivity

We conducted a survey on productivity of the systemized CIA. Survey results on productivity of the systemized CIA are shown in Table 7.As a result of adoption of the systemized CIA, we found that CIA work in whole was reduced by 11.0%.

Table 7 Verification Result (Productivity)

Spec Change	Maintainer	Modified Program Size [K SLOC]	CIA [man-month]	Reduction Rate[%]
A	a	3.12	0.50	9.5
B	b	5.69	0.70	12.0
合計		8.85	1.20	11.0

Table 8 Opinions on the Systemized CIA

#	Evaluation	Category	Remarks
1	Satisfied	Quality	Double check with CIA Tool and grep command
2	Satisfied	Quality	Contributing to prevention of design leakage
3	Request	Quality	Check the CRUD information
4	Dissatisfied	Productivity	The procedure is complicated
5	Dissatisfied	Productivity	Narrowing down the scope of change impact is not enough
6	Dissatisfied	Productivity	The procedure is complicated for database access
7	Dissatisfied	Productivity	Takes a lot of time to introduce CIA tool
8	Dissatisfied	Productivity	Failure to introduce CIA tool

(3) Maintainers Opinions

We asked the maintainers opinions on the systemized CIA. The results are shown in Table 8. They were satisfied with regard to quality. On the other hand, there were opinions that productivity of the systemized CIA was dissatisfied. Therefore we found that it was necessary to review the systemized CIA. We carried out the following work and reviewed the systemized CIA. In this paper, details of the implementation contents are omitted.

· Improvement of systemized CIA procedure and manual
· Change of CIA tool

5.2. Verification II

(1) Maintainer

Table 9 shows Maintainer's experience. Maintainers have different Experience in the IT field and tenure of the project A.

Table 9 Experience of Maintainers

Maintainer	Tenure in the Project A[years]	Experience in the IT field[years]
a	1	28
c	2	5
d	15	15
e	1	8
f	1	15
g	3	5

(2) Verification Result

We conducted a survey on productivity of the systemized CIA. Survey results on productivity of the systemized CIA are shown in Table 11. As a result of adoption of the systemized CIA, we found that CIA in whole was reduced by 5.1%.

Table 10 Verification Result (Productivity)

Spec Change	Maintainer	Modified Program Size [K SLOC]	Work time [man-month]	Reduction Rate[%]
C	a	2.9	12.2	3.9
D	c	0.1	1.2	7.7
E	a	0.7	16.0	4.2
F	d	4.0	20.0	-0.5
G	e	0.1	1.2	33.3
H	f	1.5	12.0	7.7
I	g	4.7	12.0	9.4
合計		14.0	74.6	5.1

(3) Maintainers Opinions

We asked the maintainers opinions on the procedure. The results are shown in Table 11.

As shown in Table 11, complaints about the CIA tool which were in the Verification I did not come up in the Verification II, and good responses were obtained for the CIA tool. In addition, we got answers that the effect of adopting the systemized CIA is small with respect to the specification change in which the influence research scope is narrow.

Table 11 Adoption of Solutions

#	Evaluation	Category	Remarks
1	Satisfied	Quality	Improve the review quality because output part of the design document from the CIA tool
2	Request	Quality	Analysis of the change impact between variables
2	Satisfied	Productivity	Improve CIA work efficiency with CIA tools
3	Satisfied	Productivity	Improve the review productivity because output part of the design document from the CIA tool
4	Dissatisfied	Productivity	Scope of Change Impact is narrow therefore the procedure is no effect

6. Evaluation of the Procedure of Systemization

6.1. Evaluation of Systemization I

We confirmed that there was no failure related to design leakage has occurred From Table 6. This indicates that there was no leakage of CIA. Therefore, we concluded that adoption of the systemized CIA shows that even inexperienced maintainers were able to do CIA with certain qualities.

In addition, we concluded that there were also effects of improving productivity by adoption of the systemized CIA from Table 7.

6.2. Evaluation of Systemization II

We considered that the effect of improving productivity as a whole by adoption of the systemized CIA from Table 10. However, the man-month reduction rate of Verification II is less than half of Verification I. We could not confirm the improvement of CIA efficiency by improving systemized CIA.

We considered that one of the reasons why the reduction rate of man-month has been reduced is considered to be due to the actuals that the adoption effect of systemization CIA is different between experienced maintainers and inexperienced maintainers. We found that there are the following three tendencies from Table 9 and Table 10.

(1) The man-hour reduction rate of maintainers who have short time to belong to the project A and have not enough experience in the IT field is high rate

(2) The man-hour reduction rate of maintainers who have short time to belong to the project A and have enough experience in the IT field is low rate

(3) The man-hour of maintainers who have long time to belong to the project A and have enough experience in the IT field increases.

In Verification II, 3 out of 6 are maintainers who correspond (2), (3). Therefore We considered that the tendency of (2), (3) reduce man-hours reduction rate.

For the above tendencies, we assumed causes, such as an increase in CIA procedures by systemization CIA. However we have not been able to clearly indicate the cause at this time. We need to conduct additional survey and identify the cause in the future.

7. Conclusion

We have created a procedure of systemization of CIA. We created systemized CIA using the procedure of systemization of CIA and adopted the systemized CIA to the software maintenance project A which depended on CIA by experienced maintainers. We confirmed that systemized CIA which has maintainers to do CIA with certain quality.

Moreover, we confirmed that the systemized CIA procedure created does not only exclude dependency on maintainers' skills and experience on CIA in project A, but also has the effect of improving the productivity of CIA.

Two points will be shown as future tasks in the procedure of systemization of CIA.

(1) Ask Experienced Maintainers Opinions

In this paper, adoption of the systemized CIA resulted in deterioration of the experienced maintainers' productivity of CIA. We need to ask experienced maintainers opinions about the reason why decrease of the productivity. Based on the results of their opinions, we need to improve the procedure of systemization of CIA so that the experienced maintainers' productivity of CIA increases.

(2) Examination of quality evaluation

In the verification I, we confirmed that there was not design leakage from the result of the review. On the other hand, we think that quality evaluation is insufficient. We need to examine and conduct the quality evaluation method and verify that adoption of the procedure of systemization of CIA improve quality of CIA.

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Lessons Learnt Obtained from Process Improvement Activities at Southeast Asian Countries

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NTT DATA CORPORATION

NTT DATA Corporation has been conducting process improvement activities based on ISO9001, CMMI, ITIL and so on. The targeted organizations encompass globally, including those external Japan – in China, India, North America, Latin America, Europe, and Southeast Asia. Some companies have achieved ISO9001 and CMMI Level 5. These process improvement activities have contributed to improvement in quality, productivity, customer satisfaction, employee satisfaction at each organization or each group company, and their effects actually have been proven quantitatively and qualitatively. This paper focuses on practical cases from our recent experience in southeast countries, where NTT DATA started the corporate-level systematic improvement activities in 2015. We describe the activity, effects, lessons learnt, challenges and future plans.

Keywords and phrases: Process Improvement, PM Training, Standardization, ISO9001, CMMI

1. Introduction

NTT DATA has been addressing the measures to enhance System Integration competitiveness including productivity improvement and project failure prevention in order to continue growing and to pursue customer satisfaction as a global IT enterprise that flexibly keeps pace with the changing technical trends, business environment, and the customer needs. Ootsuru(2010) refers to the relationship between project's success and organizational process improvement activity and maturity. NTT DATA has been conducting PI (Process Improvement) activities based on some global standards such as ISO9001, CMMI (Capability Maturity Model Integration), and ITIL. For the purpose of improvements on development capability and productivity through the continuous PI activities, and also of utilization as a globally common language, PI based on ISO9001 and CMMI has been conducted as a corporate measure since 2007, and deployed to group companies including those in Japan, the US, China, India, Spain, and so on. In 2011, NTT DATA established the corporate rule in order to systematically enforce PI activity to group companies and to establish the official governance function between Head Office and group companies. According to this rule, the Head Office launched PI in other regions in the world. By spreading PI activities globally in NTT DATA group, NTT DATA intends to build and maintain a “quality-oriented” brand image and establish its competitive superiority based on such image. Tsukamoto (2013) refers to global activities in NTT DATA in order to enhance project management capability.

Some organizations have implemented processes based on CMMI level 4 or 5, where projects conduct quantitative project management. As Kigure (2010, 2011, 2014, 2016), Ando (2010), Nakamura (2011), Sawada (2010) and Terao (2014) describe, the effects of their activities have been proven.

This paper focuses on activities in Southeast Asian companies, where the PI activity officially started in September 2015. We have dealt with several issues because most Southeast Asian companies had no experience of PI activity. In section 2, I show the basic concepts and activities of process improvement. In section 3, I describe the detailed activities at Southeast Asian companies. In section 4, I describe their effects and challenges. Finally in section 5, I conclude this paper.

2. Overview of Process Improvement Activity

NTT DATA has been conducting PI activities consisting of 3 phases of “Diagnosis”, “Action” and “Check” (Figure1). At the beginning of “Diagnosis” phase, the objectives of the PI are set based on the organizational needs and conditions. Next, based on the PI objectives, a gap analysis is conducted to identify gaps between the current status and the ideal status to be achieved as the result of PI activity. A gap analysis is conducted focused on the Process Areas stated in CMMI, and also on the target areas where the organization realizes as important (Figure2). The analysis basically observes three things – 1. the process documents in the organization that specifies how to perform their work (Process documents), 2. the artifacts created actually (Artifacts), 3. the way organizational members realize that they perform their work, which is normally observed with interviews with organizational members (Process realization). The results of the observation are described as “weaknesses”, and they are specified corresponding to Process Areas in CMMI. The target area (i.e. process) where weakness is found can vary from project management, engineering, service delivery, to process improvement, depending on each organization's situations, and on the predefined target areas of the gap analysis.

At the "Action" phase, improvements are developed for addressing the weaknesses identified at the "Diagnosis" phase. The improvements are basically reflected to existing or newly-created process documents to ensure that planned actions are performed at the target projects. The process documents are deployed to projects and used.

At the "Check" phase, the status of improvements is evaluated. This is conducted through CMMI appraisals or gap analysis by external people, or through evaluation by internal people.

In this way PI activity at each organization deals with the organization's process, and leads to improvement of project performance, as well as the ability to conduct project management well – i.e. project management capability.

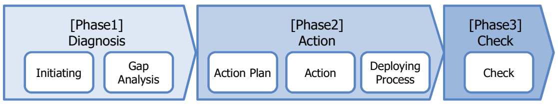


Figure 1 Three phases of PI activities

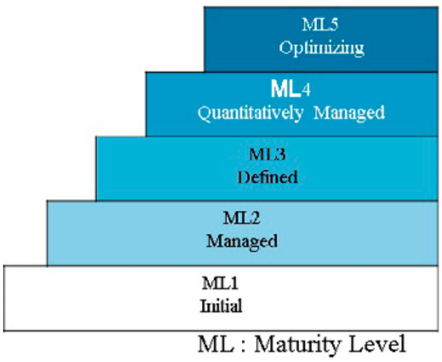


Figure 2 CMMI staged representation and levels.

PI activities are conducted with the involvement of MSG (Management Steering Group, the top manager of the organization who is responsible for the activity, and the driving force to approve project activities), PM (Project Manager) and project members, SEPG (Software Engineering Process Group, the staff to drive and facilitate PI activity) and the external supporting people (Figure 3). The improvements are described in the organizational standard processes, etc. and deployed to projects. Each project tailors the organizational processes to define the project's processes, conducts project activities and collects the results such as work products, actual data (quality, productivity, etc.) and improvement proposals, etc. These results are fed back to the organizational process assets. The SEPG collects and analyzes them and develops action proposals. The MSG offers the policy and goal of the activity and approves its status and results. This is the fundamental cycle of PI activity as shown in Figure 4.

Figure 3 PI structure

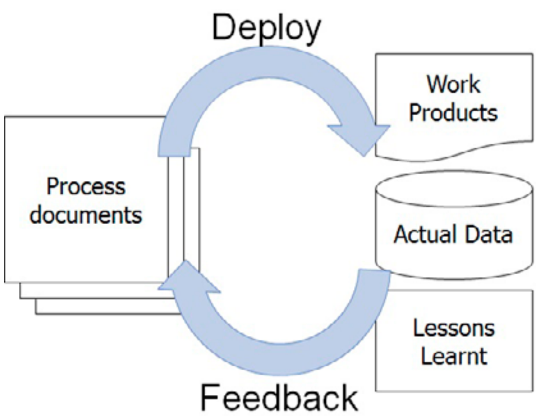


Figure 4 Basic concept of PI activities – improvement cycle of process documents

3. Activities in Southeast Asian countries

3.1 Overview of the Organization

The corporate rule covers PI activities at 9 companies in 9 countries – Singapore, Malaysia, Thailand, Indonesia, Myanmar, Philippines, Vietnam, India, and Australia (it has a little different scope from the normal definition of "Southeast Asia").

The common features of the 9 companies are they are relatively younger and smaller than companies in other regions. They were established in 2007 to

2016, and the market share within each country is not big. Then the number of head count of each company is around 30 to 300.

Based on these basic profile, Head Office started the "Diagnosis" phase at the first several companies, and found that business situations were different at each company. They may be affected by the IT environment or IT maturity of each country. In this way, Head Office determined to deal with each company separately as the unit of PI activity so that we may be able to clarify each company's current issues and objectives, and then take actions for each company's capability enhancement based on them. In addition to the differences in business situations, the foundation for PI activity was also different. Developed companies had already established the system for PI activity, and they have been operating their own PI activities effectively. In this way, the developed companies didn't need a lot of support from Head Office. On the contrary the emerging companies had less experience for PI activity, so Head Office needed to start the support from the beginning. Thus Head Office focused on support to emerging companies in Southeast Asia.

3.2 How to Support Emerging Companies

The common situations of emerging companies in Southeast Asia are that projects are dealing with a lot of tasks and issues with limited resources. Project members spend most of the time in solving the issues they are actually facing, and cannot afford to take time for improvement. This leads to the recurrence of the problems at the next project.

Escaping from this situation was the objective for the emerging companies. We observed projects and found the following. 1. Most PMs were junior and didn't have sufficient knowledge and experience. They had to learn a lot of new things from the beginning including the concept of project management, the concept of PI, and how to operate these activities correctly. For these reasons, it was hard to start a lot of new activities at one time. 2. Some companies didn't have standard way of work or standard processes. So the project activities depended strongly on each PM's understanding and skill.

Based on the situations above, Head Office considered starting PI activity smoothly at the emerging companies by reducing the burden of project members, and by having project members understand that the PI activity will lead to improvement of their daily activities. Head Office assumed that the companies which are unable to carry out proper project management would not succeed in PI activity as well. The reason is, even if the company wishes to start the PI activity, they have to spend most of the time in their project activities, so they have no more time for PI activity. In addition, PI activity itself requires management activity including setting objectives for PI activity, developing a plan and schedule for PI activity, and monitoring progress of PI activity, confirming results of PI activity, which are similar to management of project activity.

Based on the assumptions, Head Office decided to support improvement of project management activity first, and then continue to the PI activity. Head Office discussed with a couple of companies at "Diagnosis" phase and collected needs from CEO and PMs and project issues, and linked them to PMBOK knowledge areas. As the result, we selected 6 project management areas of Project Planning plus time management, issue management, specification management, cost management, quality management, risk management, and 1 organizational improvement area as stated in ISO9001 and CMMI (Figure 5). Names of the areas were slightly changed in order to adjust to the names used in NTT DATA standard processes.

Head Office composed a package to support the process improvement initiative based on this assumption and named it "COMPASS". COMPASS stands for "guide for enhancing Capability Of Management on Project Activity for Success and Satisfaction", representing a supporting package for projects to enhance their project management.

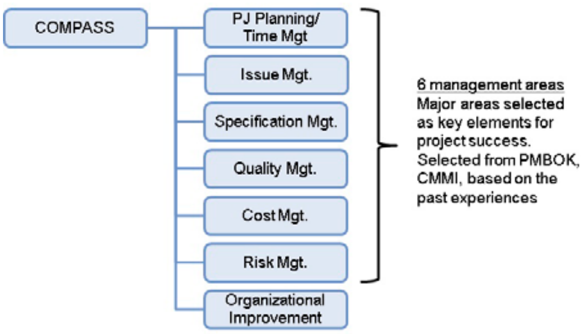


Figure 5 6 project management areas and 1 organizational improvement area of COMPASS

COMPASS defines 3 levels to show the course along which each project enhances their project management capability and reaches the stage of PI activity (Figure 6). Level 1 is an initial level where project management activity is conducted insufficiently and in different ways at different projects depending on PM's skill or understanding. Level 1 is the typical level which was initially observed at the emerging companies in Southeast Asia. When the companies try to improve this situation to achieve the level 2, they will standardize their way of work including project management process so that all PMs will conduct project management activities without omission and in the same manner. This is conducted within a single project or at the entire company, and the company achieves the level 2 as the part of the PI activity as well. This is the short-term objective for the emerging companies. As the result, at a company at level 2, project management activities are conducted in a same manner according to standard. Through developing and applying the standard, SEPG is assigned and PI activity is planned, and thus the framework of PI activity is also developed. However, sharing project outcomes, best practices and lessons learnt across projects are not fully conducted at this level. After the level 2, the project and company will expand their businesses and enhance its performance more. In order to do that, they continue the improvement of the existing standard processes. That's the improvement cycle expected at the level 3. At level 3, the company continues the PI activity in a self-directive manner. The company checks the current project issues and process implementation, identifies necessary improvements, plans and conducts actions for the improvement. Lastly they evaluate the results of PI activity to judge whether their PI objectives have been achieved, and to identify improvements to be addressed next.

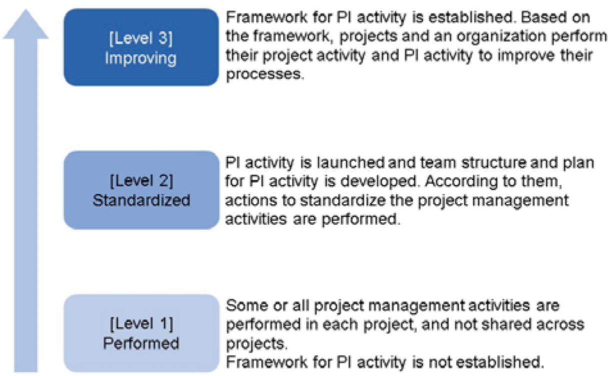


Figure 6 3 levels of COMPASS

The combination of 6 project management areas and 3 levels shows a matrix as shown in Figure 7. This structure enables each company to select areas to be improved first. This selection is made based on the company's current situation, issues, and needs. As Head Office intended to promote a self-directive PI activity at each company, we respected the company's will as much as possible with this structure. In addition, as the level 3 requires the organizational improvement, the project and company are able to move smoothly from lower levels of 1 or 2 to the organizational improvement (i.e. level 3). This shows the course of organizational improvement activity.

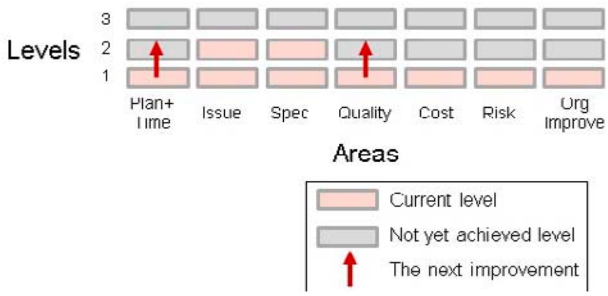
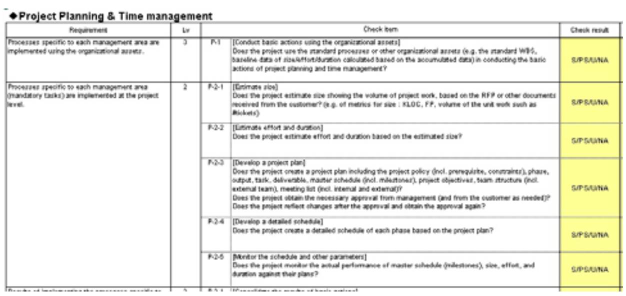


Figure 7 COMPASS areas and levels combination

COMPASS consists of a checklist, training materials, and templates for each of the 7 areas. A checklist is a list showing steps for each level referred in deciding the target for capability enhancement (Figure8). This is designed so that company's current status will be examined at the "Diagnosis" phase at the initial stage of PI activity, and later the company will check the progress of PI activity while its PI activity proceeds, in order to identify achievement and gaps for future improvement. Training materials show descriptions of the concepts and basic actions, procedures, know-how and practical cases of each area.


◆Project Planning & Time management

Requirement	Lv		Check item	Check result
Processes specific to each management area are implemented using the organizational assets.	3	P-1	[Conduct basic actions using the organizational assets] Does the project use the standard processes or other organizational assets (e.g. the standard WBS, baseline data of size/effort/duration calculated based on the accumulated data) in conducting the basic actions of project planning and time management?	S/PS/U/NA
Processes specific to each management area (mandatory tasks) are implemented at the project level.	2	P-2-1	[Estimate size] Does the project estimate size showing the volume of project work, based on the RFP or other documents received from the customer? (e.g. of metrics for size : KLOC, FP, volume of the unit work such as tickets)	S/PS/U/NA
		P-2-2	[Estimate effort and duration] Does the project estimate effort and duration based on the estimated size?	S/PS/U/NA
		P-2-3	[Develop a project plan] Does the project create a project plan including the project policy (incl. prerequisite, constraints), phase, output, task, deliverable, master schedule (incl. milestones), project objectives, team structure (incl. external team), meeting list (incl. internal and external)? Does the project obtain the necessary approval from management (and from the customer as needed)? Does the project reflect changes after the approval and obtain the approval again?	S/PS/U/NA
		P-2-4	[Develop a detailed schedule] Does the project create a detailed schedule of each phase based on the project plan?	S/PS/U/NA
		P-2-5	[Monitor the schedule and other parameters] Does the project monitor the actual performance of master schedule (milestones), size, effort, and duration against their plans?	S/PS/U/NA

Figure 8 COMPASS checklist

As PMs at emerging companies haven't acquired sufficient knowledge and experience, training is an essential activity, and Head Office developed training materials in COMPASS in order to make training activities effectively. Templates show standard formats of outputs defined in each area, with samples developed based on practical cases from real projects. The templates will help PMs understand procedures correctly, and operate the activities correctly.

3.2 Application of COMPASS

Here I describe the detailed PI activity using COMPASS.

First, Head Office conducted “Diagnosis” phase. We examined the current status of 7 areas using COMPASS checklist. When we assessed the companies at the first time, many areas were often judged as level 1. The results were officially announced to each company’s CEO in order to encourage each company to continue their PI activity.

The next is “Action” phase. Based on the examination results in the checklist, each company developed objectives and plan for the improvement. For emerging companies, it was not easy to develop objectives and a plan for PI activity. The typical situations are as follow: The company members didn’t know the concept of PI and they didn’t know how to develop PI objectives and plans. In this case, Head Office explained the concept and procedures of PI activity using COMPASS training materials. Another situation is that although quantitative objectives are desirable so that the company can later evaluate the achievement clearly, the company was unable to develop quantitative objectives because they had no data of current performance. In this case, Head Office advised them to set a short-term objective to measure the current performance first, and in addition, to start the initial PI activity without quantitative objectives. Another situation is that they were unable to develop an activity plan. They didn’t know what tasks should be planned, and estimation of time and effort for each task, and image of outputs of PI activity. Especially at the initial stage, beginner organization typically developed an ideal and unachievable plan. For instance, the company had no standard process and template, and they were going to plan to prepare quality benchmark within 3 months. This is because they had no experience and knowledge. Head Office explained COMPASS components of “Organizational Improvement” area for these demands. In addition, a PI activity kickoff and a workshop-style lecture were held where all stakeholders in the company are requested to join and discuss the company’s goal and actions plan. This was originally proposed by a company’s CEO. The MSG, PMs and SEPG discussed frankly each member’s realization of issues or proposals for improving the current situations, in order to elicit members’ opinions, and to reach a common understanding of PI activity’s purpose. The workshop helped for PMs and SEPG understand PI activity, and was a good trigger to start PI activity smoothly.

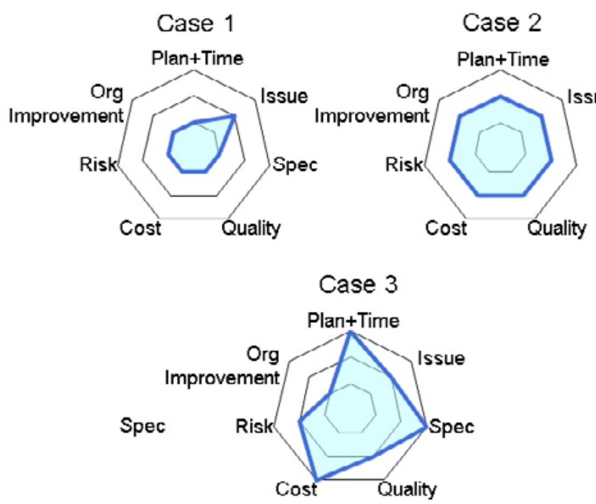


Figure 9 Cases of COMPASS levels

Figure 9 shows 3 cases of COMPASS levels determined at “Diagnosis” phase. Here I describe what actions were planned and taken for each case. Case 1 shows most areas are level 1, and only Issue Management is level 2. Among 6 project management areas, Issue Management is the most basic and PMs need to conduct it for their daily activity, so it is the easiest area to achieve level 2. However, the way to conduct Issue Management was different from PM to PM as it was judged not level 3 but level 2. This implies that they should standardize the way to manage issues. Typically, process and templates for Issue Management were relatively easy to standardize compared to other project management areas at Southeast Asian companies, thus taking actions for standardization of Issue Management was a good practice for the emerging companies to start standardization and PI activity. In-house tools for Issue Management were also available, so it was a powerful option for them to introduce the tool in order to standardize Issue Management. For other areas, they needed basic training, so we planned to conduct basic training to achieve level 2 and the standardize Issue Management in parallel. Case 2 shows that all areas are level 2. The situation was project management activities were conducted properly and in the same manner at most projects, but, sharing project outcomes with other projects was lacking. First we planned the process check to confirm whether all projects were following their standard processes correctly, and then requested a project to correct the breach. In addition, SEPG considered processes for sharing information across projects. SEPG identified information to be collected and shared, designed how to share it, and implemented it. Case 3 shows all project management areas are level 2 or 3, and only the organizational improvement area was level 1. In this case, SEPG was assigned and working for their PI activity, and the project management activities were conducted according to their standard processes for some areas only. As the reason was that the resource of SEPG was insufficient and unstable, we requested the company to assign more SEPG to continue their PI activity more stably. In this way, COMPASS levels show each company's capability of project management and PI activity which are very different at each company. In addition, COMPASS levels help understand the current status and progress of each company's PI activity visually.

Various trainings were provided from Head Office. As the training for process improvement, Head Office explained the concept, including how to conduct improvement activity within a project or across projects, roles of SEPG and other stakeholders of PI activity, how to develop a standard process, how to develop objectives and actions plan. Head Office provided training of other areas, including concepts of project management using COMPASS training materials, practical cases, and standard tools.

The next is "Check" phase. We evaluate the COMPASS levels using the COMPASS checklist to confirm the progress of PI activity. Head Office plans to perform the official check by the end of 2017, and will obtain the common understanding of PI activity status with each company's CEO.

Head Office considered carefully the involvement of the developed companies as we thought they had a critical role to provide best practices and advices to the emerging companies. In this way, we conducted the same cycle of "Diagnosis" and "Action" phases with developed companies. Head Office judged the developed companies as level 3, and requested them to develop the objectives and plans for their further improvement. With the foundation of their PI activities, the developed companies were able to submit their objectives and plans with no problem, and they continued to join this activity. This has contributed a lot to effective PI activities at emerging companies.

4. The Effects and Challenges

4.1 Effects

We describe the effects of PI activity through almost 2 years since September 2015.

(1) Foundation of PI activity

We confirmed the progress in PI activity at all companies. As is often the case with organizations in NTT DATA HQ (Japan), it is the hardest stage of PI activity that the organization with no past experience initiates its PI activity, because initially the necessity of PI activity is not understood. As of July 2017, 2 developed companies achieved level 3 for most of process areas in COMPASS. Even among the 7 emerging companies, most companies have achieved level 2 or 3 for each process area.. Some companies have still level 1 areas, but they are working on PI to achieve higher levels.

(2) Organizational Culture

Head Office formed a virtual team of assigned SEPG from each company. This working group gathers online periodically to share each company's current issues and progress. Recently the discussions are made widely, and information sharing among the companies are performed often. The topics cover PI activity and project management, and others – such as recent technology (e.g. Agile, DevOps, a package-based development), training, establishment of PMO (Project Management Office) function. The online meeting is held every two months, where most companies join.

I expect the working group has contributed to the sense of unity as a region, and to the motivation to join the PI activity, and to involvement in the PI activity as they can obtain effective stimuli and information from other companies.

(3) Success Factor

The key success factor of the PI activity is an effective motivation from the top management who is a CEO of each company, to the company members.

In general, the PI activity is a company-wide activity which requires the involvement of many organizational members. In this way, the clear direction from the top management is essential. Without it, members would spend their time in their busy project activities, and no one would take care of PI activity. The definition of 3 levels for 7 areas of COMPASS helped establish objective targets of PI activity using the common criteria for all companies. The progress of each company's PI activity was visualized with levels for each area, and monitored periodically. This might encourage CEO to carry out their PI activities.

In addition, PI activity tends to be abstract compared to project activity. Normally, project members at the organization which has no past experience have no idea on PI activity, its goals, and what they actually should do. Top management is responsible for communicating goals of PI activity clearly, and motivating the organizational members periodically. As COMPASS focuses on 6 project management areas as well as the organizational improvement area, even the project members at the initial stage of PI activity can easily grasp the scope of PI activities which are any of 6 management areas suggested by COMPASS.

4.2 Lessons Learnt and Challenges

Here we describe lessons learnt, challenges and future plans that we have faced through the PI activity.

(1) Improvement Style for Each Company

As PI activity leads to the organizational change, we have to consider how organizational members may react. It is less common in Southeast Asian companies that organizational members would conduct their PI activity even without clear directions from management as in Japan. It is not correct to expect or label each company before understanding it well. For instance, we may have to consider a case where members hesitate to correct others. Or another may regard importance on each member's evaluation.

(2) High Turnover

Another difference in emerging countries in Southeast Asia is that they have a high turnover than in Japan. It is common that skilled project members or SEPG members quit within 6 months after they joined the company. As PI activity is a long-term activity to see proactively the future in one year or more, and PI activity requires its specific knowledge, so frequent changes of SEPG may hamper the PI activity. It may be hard to address this issue through PI activity directly. Anyway, in this way, it may be risky that only a single SEPG member is assigned within a certain company. We should request CEO to assign multiple SEPG members, and train them. In addition, from another perspective, we expect that standard process is an important solution for a company with high turnover because a standard process can be a good solution to train new-comers of the company efficiently.

(3) More Effective Support

Although we observed progress in PI activity at each company, PI activities at some counties are need to be supported. Currently, Head Office periodically visit companies and monitor their PI activity. We realize that this visit is helpful to encourage the company to conduct PI activity, and to collect latest issues and needs from real projects. However, in the future Head Office intends the situation where the group companies will continue the PI activities by their own will without our visit. In this way, we consider it is important to educate the true SEPG within each company who understands the importance of continuous PI activity. COMPASS training material will support it. In addition, it is important to have each company think what and how to address in their PI activity. COMPASS checklist is one of the supporting tools for that.

5. Conclusion

I summarize and conclude this paper. NTT DATA started PI activity at overseas companies, including in Southeast Asian countries in 2015. NTT DATA has defined our PI activity of 3 phases, and additionally developed COMPASS to address the situations at Southeast Asian companies effectively. The COMPASS focuses on 6 project management areas and 1 organizational improvement area, and defines 3 levels. The COMPASS helped simplified the scope of the PI activity and understand PI activity. Through the activity in almost 2 years, most companies made progress. The success factor is a strong motivation from the top management to the organizational members, and this was encouraged by each company's PI status visualized with the common criteria of COMPASS levels. We need to continue the support so that each company will continue their PI activity without support from Head Office in the future, considering the difference in improvement style.

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A Case Study on the Measurement and Visualization of the Maturing Process of Team-Approached Medicine

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Hospitals in Japan have adopted team-approached medicine from around the year 2000. However, the maturing process of the medical team has not been thoroughly examined until now. In our research, we followed up and assessed the maturing process of a medical team using the Tuckman ladder model and CMMI. The method for this research was a case study based on the observation method. Starting with the minutes of meetings from the year 2002 to 2013 and interview surveys with the team members, we verified the maturing process of a Pressure Ulcer Care Team. The following 2 points are the conclusions suggested based on the results. First, the Pressure Ulcer Care Team followed the maturing process from Level 1 to Level 4 in CMMI. Second, the "Storming" of the Tuckman ladder model was shortened in the Pressure Ulcer Care Team, even when members changed, after the maturing process reached Level 3.

Keywords and phrases: Team-Approached Medicine, Maturing Process, Tuckman Ladder Model, CMMI

1. Introduction

Team-approached medicine was adopted in Japan from approximately the year 2000 when teams such as "in-hospital infection protection countermeasure teams," "pressure ulcer countermeasures teams" and "nutrition management teams" were set up within hospital organizations. The Ministry of Health, Labor and Welfare (2010) has defined team medical care as "The wide range of medical staff engaged in medical care are expected to share a common goal and share information based on their high level of expertise, and collaborate and complement each other while sharing in the work to provide medical treatment that responds in the most appropriate way to each patient."

Research on team medical care has been published many times since the 1990's, mainly in papers introducing case studies (Hosoda, 2001, 2013). However, the maturation process of the medical team has not yet been fully clarified. Meanwhile in the area of IT software development, studies on team maturation using the Tuckman ladder model of project and team development have increased. In addition, we can measure the maturity of the organization by means of the Capability Maturity Model Integration (CMMI), which is a process improvement model of the organization developed by Software Engineering Institute (SEI). Measurement results have been used to advance organizational improvements. Characteristics of the maturity levels of organizations in the CMMI model are assessed on a 1-to-5 five-level ranking with Level 5 as the most advanced. The appellations of the levels are as follows.

Level 1: Initial
Level 2: Managed
Level 3: Defined
Level 4: Quantitatively Managed
Level 5: Optimizing

This study measures the development and maturation process of a medical team using the Tuckman ladder model, which is employed in IT software development team training, and the organization maturity model (CMMI) developed in the IT field.

2. Purpose

The purpose of this study is to measure and visualize the maturation process of a medical team using the Tuckman ladder model and the organization maturity model (CMMI).

3. Materials and Method

3.1 Materials

The subject of this study was the pressure ulcer care team of A Hospital. The reasons for analyzing the pressure ulcer care team at A Hospital are as follows.

First, it was thought that since the pressure ulcer care team of A Hospital had been in existence for over 12 years since its establishment in April 2002 and the team records (minutes, etc.) were stored, analysis of the changes over time could be made.

Secondly, in a hospital questionnaire survey

Table 1 Outline of A Hospital

Items	Contents
Parent Organization	General incorporated foundation
Establishment	April 1956
Medical examination areas	Internal medicine, respiratory internal medicine, etc.
No. of beds	60 beds
No. of doctors	2
Pharmacists	2
No. of Nurses	21 registered nurses,4 practical nurses,8 nurse assistants
Pharmacists	2
Nutritionists	1 Registered Dietitian
Physical Therapists	3
Occupational Therapists	2
Radiological Technologists	1
Medical Social Workers	1

Note)The number includes full-time staff only.
Source: Okayama Prefecture Medical Function Information Providing System (Updated on November 4, 2014), Hospital Home Page, Internal Documents (Business Annual Report of 2013 Fiscal Year)

Table 2 Outline of Pressure Ulcer Care Team

Items	Contents
Member occupation and no. (12)	Doctor(hospital deputy director)(1)
	Pharmacist(1)
	Nutritionist(1)
	Physical Therapist(1)
	Nurse(director)(1)
	Nurse(section head)(1)
	Nurse(4)
	Nurse assistants(care workers)(2)
Main Activities	Committee activities(once a month)
	Rounds(4 times a month)
Content	(1) Survey report on pressure ulcer situation by ward every month (2) Details of treatment (method, evaluation), improvement progress record (record of treatment period, recording method and unification of photography method, periodic photography, treatment plan preparation) (3) Calculation of the rate of occurrence of pressure ulcers and cure rate (4) Case studies on medical chart round-taking, planning, enforcement, and recording of improvement measures (5) Presentation of in-hospital cases (6) Participation and report of external workshops (7) Education and public awareness of the current state of pressure ulcers and measures against pressure ulcers in the hospital (8) Appropriate use and management of body pressure distribution bedding (air mats) etc. (9) Examination and implementation of positioning and posture conversion for each patient (10) Cooperation with Nutrition Support Team(NST)

Note) as of April 2013
Source: Created from hospital internal documents.

conducted in 2009, the pressure ulcer care team was cited as a team that influenced changes in the hospital organization; therefore, we concluded that it is a team suitable for the observation and measurement of changes in maturation process.

Third, since A Hospital was accredited as a ‘chronic phase accredited medical institution’ by the Japan Association of Medical and Care Facilities in November 2010, we assumed that the Level of measures taken against pressure ulcers was assured.

3.2 Method

The method of this study is case a study by the observation method. Specifically, we measured the maturation process of the pressure ulcer care team of A Hospital by using the recorded minutes of the 12 year period from its launch in 2002 to 2013, by conducting interviews of the team, and by using the Tuckman ladder model and the maturity measurement scale of the organization maturity model (CMMI).

An outline of A Hospital is shown in Table 1 and Table 2 Outline of the pressure ulcer care team.

4. Results

4.1 Beginning Stage of the Team

The Ministry of Health, Labor and Welfare stipulated that from April 2002 all hospitals should set up a team to examine countermeasures against pressure ulcers. In accordance with this provision, A Hospital established a pressure ulcer countermeasure committee in April 2002 and launched a pressure ulcer care team with the committee members as the team members. It is the Forming period of the Tuckman ladder model. However, the minutes were not created until May 2003. Since the pressure ulcer countermeasure committee and the pressure ulcer care team at this time were immature as organizations, there were no minutes in a prescribed form. And since the actual treatment of pressure ulcer patients was dependent on individual skills, it seems that the degree level the maturation of the organization (team) was low.

4.2 The Stage When C Nurse Began to Demonstrate Leadership based on her Knowledge of Pressure Ulcers

In 2002, C nurse, a member of the team, joined the Japan Society of Pressure Ulcers to learn more about pressure ulcers. At that conference, she learned a new cleaning method for pressure ulcers. At this point, the method of pressure ulcer treatment in the same team was different from person to person or what CMMI calls Level 1, “dependent on individual skills.” C nurse began to demonstrate top-down leadership to have the new cleansing method based on the knowledge she learned comprehensively carried out by the pressure ulcer care team. In November 2002, an external lecturer was invited for in-hospital nurses and a practical training seminar was held on new washing methods and coverings. Nurses in the hospital learned about the new washing method and covering materials, and from then a new washing method that was unified started within the team.

4.3 The Stage When the Team Structure Took Shape

A Hospital enacted "Pressure Ulcer Countermeasure Committee Regulations" (Ver.1), "Pressure Ulcer Countermeasure Committee Management Regulations" (Ver.1), and "Pressure Ulcer Countermeasure Committee Activity Plan" (Ver.1) in January 2004. With this step, the members of the committee, the operational rules, and the action plan were codified, and the structure of the pressure ulcer care team was clarified.

In reflection of the previous year, at the committee meeting in March of 2004, opinions that “a concrete goal should be made” and “statistical methods should be consolidated” were given. It seems from this that the purpose of the team was not yet concrete and the direction of the team was not yet clear. Despite the consciousness of the consolidation of procedures, operation regulations, and an action plan, there were many factors of CMMI Level 1 at this time. In addition, from the opinion that “the viewpoint of the doctor with respect to pressure ulcers has changed,” it can be seen that the members were acting while exploring, and it was possible to observe the movement of the Tuckman ladder model during the Forming period.

4.4 The Stage When a Dermatologist Become a Member

Until around September 2004, when surgical treatment was required in the treatment of pressure ulcers, KA director, board chairman and surgeon at K hospital, a related institution within the same corporation, had been asked to give the treatment. He was also advised on the examinations of pressure ulcer patient and the activities of the team. The director of KA instructed that mildly acidic water would be suitable for washing the wound site, so mildly acidic water produced at K hospital was carried weekly to A hospital and used. After that, A hospital also began to make the mildly acidic water.

In October of 2004, M physician (dermatologist

/ part time) was appointed and joined the pressure ulcer care team. However, there were differences in opinion between surgeon and dermatologist concerning the use of mildly acidic water, and the team was swinging between the two. The team exhibited the Storming period of the Tuckman ladder model. Thereafter, the rule to receive the permission of KA director (surgeon), and to receive instructions from M doctor (dermatologist / part time) for each patient was determined about the use of mildly acidic water. Because it took a form that adopted the differing medical practices of two doctors, it took a step back from the aspect of treatment unity.

In December 2004 the pressure ulcer care team was still puzzled by the differences in instructions between the surgeon and the dermatologist. Therefore, standardizing the process of pressure ulcer treatment, documenting it and making a manual was discussed. As for conditions at that time, as a result of the questionnaire survey conducted among the members in March 2005, the following opinions were stated: "I think there is no consensus since there are too many members of the committee," "how about reducing the number of members (such as one from each department)" and "I cannot speak calmly because the room is too large." In order to resolve the conflict between the physicians, the members said that they did not want to do it in discussion but rather have one of the doctors leave in order to resolve the conflict. Psychologically stressed team members could be observed.

4.5 Stage When the Hospital Deputy Director Becomes a Member

As a new measure, A Hospital appointed E physician (full-time internist) as the hospital deputy director, and H hospital director (internist) and E deputy director were to become the physicians in charge of all in-patients. In addition, C nurse was made head nurse of the fourth floor ward. Along with this, E deputy director was appointed as the committee chairman and C nurse as the care manager of the pressure ulcer care committee. At the committee meeting of April 2005, there was the opinion that a manual for areas such as the treatment method, how to record the records, posture change, selection criteria for pressure distribution bedding, nutrition management, and medications was necessary. This indicates that members of the pressure ulcer care team concluded from the experience of handling the conflict between the dermatologist and the surgeon that making an overall manual from pressure ulcer management to treatment was necessary. That is, it was possible to observe the characteristic of Level 2 of CMMI from the attempt to document and unify standard pressure ulcer treatment methods.

That progression was being made to the CMMI Level 3 could be observed in the pressure ulcer care committee meeting in June 2005 in the progress report of the manual preparation by the fact that the manual preparation was progressing in the pharmacy and the physical therapy sections.

In January of 2006, J physiotherapist instructed the ward staff on how to change a patient's posture. In regard to this, the following month, fourth floor ward staff who were not members of the committee challenged her opinion. And it was reported that C nurse used trial and error while exchanging opinions with J physiotherapist. In other words, it was observed that a conflict had occurred between a member of the pressure ulcer care team, the physiotherapist, and the ward staff. And it can be seen that the fourth floor ward staff, including C head nurse and J physiotherapist, attempted to find the best solution to the problem by exchanging opinions.

In March of 2006, the nursing section manual was completed. With this, it was observed that the pharmaceutical, the physical therapy, and the nursing sections were CMMI Level 3.

We were able to observe the movement of the Norming period of the Tuckman ladder model in the fact that the team wanted to make treatment in the manual of their own making very thorough.

In March 2006, it was reported that the ward (fourth floor) to which C head nurse belonged started a new treatment method called wrap therapy from M physician (dermatologist/part time). It was observed that the team started adopting the latest treatment method for pressure ulcers at the advice of a specialist.

4.6 Departure of the Dermatologist and the Arrival of a Plastic Surgeon

As a replacement for M physician (dermatologist/part time) from April 2006, H physician (plastic surgeon/part time) became a member.

In April 2006, a rule was established to record consistently on the medical chart about the application of wrap therapy, the lesion conditions and the treatment method performed at the time.

Also, in April 2006, it was decided to measure the risk factors according to the Brenden scale, report the number of patients monthly to the committee and record them in the minutes. And it was decided to include this rule in the committee management regulations. From this it can be said that the team began to formulate rules for documenting the measurements of the degree of pressure ulcer lesions on a scale and recording the information and for the documenting other matters decided by the team outside those written in the minutes.

In addition, the administrator of the body pressure dispersion mattress was decided and a rule was formulated to report the use situation at the monthly committee meetings. We can observe the movement of CMMI to Level 3-4.

It was suggested that E deputy director keep track the state of the pressure ulcers in rounds made once every two weeks, which began in June 2006. With the start of these medical record rounds, objective measurement data of pressure ulcer lesions became more plentiful than before, information sharing among members advanced, and the response to the pressure ulcers became faster.

Regarding the treatment method, a rule was established that wrap therapy and usual treatment methods would be carried out in conformity with the pressure ulcer, while exudate and infectious lesion were not to be indicated to wrap therapy. In addition, it was decided that new agent A would be added as a drug used for pressure ulcers.

With the completion in July of 2006 of the nutrition section manual, all the manuals were completed. With these series of regulations and rules formulated, the movement of CMMI Level 3 could be observed in other sections as well.

At the committee meeting of October 2006, the new evaluation method DESIGN-scoring was studied and incorporated. DESIGN is an acronym derived from the six components of the tools used for evaluating pressure ulcers: i.e. depth, exudate, size, inflammation/infection, granulation tissue, and necrotic tissue. It enables us to express the condition of pressure ulcers in more detail.

At that time, evaluation by DESIGN was done by plastic surgeons only, and the ability of the members to use DESIGN to evaluate pressure ulcers was marginal.

4.7 Launch of the Internal Training Workshops

In February of 2007, the pressure ulcer care team held an internal training workshop and they announced the treatment and the number of those cured for five years previously from May 2002. The activities of the team were highly appreciated by H Hospital director and many other hospital staff members. Team members also gained a sense of accomplishment about their activities. By this time, since the team was equipped with the ability to cure refractory pressure ulcers, the team's activities were highly esteemed by the hospital director and other staff members of the hospital. As the members shared their success experiences, their activities picked up steam and became more active.

In June 2007, all members of the pressure ulcer care team participated in external training workshops, from which the Performing period of Tuckman ladder model can be observed.

When the records committee reported differences depending on the ward on how the treatment column of the medical record was filled in, a recommendation was made to unify entry methods, and in the records committee of January 2008, in addition to clearly stating how to fill in the pressure ulcer treatment column, they came up with a rule on how to fill in the medical records upon recovery.

At the committee meeting in May 2008, there was a report of good patient progress with the wrap therapy on the 4th floor ward. In addition, a rule was formulated to prepare a pressure ulcer evaluation table and a medical treatment plan once every three months with reference to other methods. With this, we can observe the movement to CMMI Level 3.

In August 2008, the entries for the pressure ulcers management table and mat use situation table were different according to the ward departments, so it was decided to unify the filling in method. Here we can observe the movement of CMMI Level 3.

In November 2008, there was a case of a complete cure in which wrap therapy had achieved the results. Wrap therapy was going to be repeated in other cases, and the wrap therapy improved by team members was also to be administered.

Also, in November there was a report from the fifth floor ward that a new time zone for posture change was set and implemented. It was confirmed that measures taken on each floor were to be taken into consideration and it was confirmed that information was to be exchanged on good methods and problems.

Around the time of 2008, A Hospital was

acknowledged by other hospitals as a hospital that could cure pressure ulcers. The team worked actively and achieved results. The movement of the Tuckman ladder model to the Performing period was observed.

4.8 C Head Nurse Leaves the Team

From April 2009, C head nurse departed as a member of the pressure ulcer care team due to a personnel change. Therefore, F head nurse, who had been a member since September 2008, was appointed as the new leader of the pressure ulcer care team.

In June of 2009, the Physical Therapy Division prepared photographic materials on the posture change patient by patient for an academic conference. The results of the thorough administration of posture changes, lead to great achievements and the collaborative cooperation with the ward staff was demonstrated. It was realized that thorough progress was made by means of manual documentation on posture change. With this, we could observe the movement to CMMI Level 3.

In October 2009, it was set that the date of occurrence of the pressure ulcer and the healing date were to be recorded. Adherence to rules indicates the movement to CMMI Level 3.

In May 2010, it was decided to make statistics and an evaluation using a calculation formula on each floor every month starting in September for the rate of pressure ulcer occurrence, the cure rate and chronic medical function evaluation of pressure ulcers. The measuring process increased throughout the hospital, and CMMI Level 4 was evident.

In August 2010, one of two nurses who participated in the Japan Society of Chronic Medicine reported in committee that A Hospital was engaged in various activities that were reported by other hospitals, which led to confidence in A Hospital's treatment. It was clear that the treatment methods for pressure ulcers at A Hospital had reached the national level.

After the training workshop in December 2008, posture change was considered important in the treatment of pressure ulcers, and the occurrence of pressure ulcers was taken as an indicator of the deterioration of the general condition.

4.9 At the Plastic Surgeon's Retirement

With the retirement of H physician (plastic surgeon / part time) in April 2011, KA director, board chairman and surgeon, once again became a member. Therefore, the Forming period of the Tuckman ladder model was brought back to the Storming period within the team due to conflict arising from differences in the treatment method from doctor to doctor. The team considered how to respond. They decided basically to provide treatment according to the manual they had made. Because KA director and board chairman (surgeon) became a member again, the pressure ulcer care team anticipated disagreement in treatment methods among the doctors. However, since they had put the established treatment method based on quantifiable results in a manual form, the maturity of the organization itself was manifest and much less conflict could be observed.

In May of 2011 DESIGN-scoring began to be used for the evaluation of pressure ulcer lesion healing, and from July 2011, members of the team (nurses) measured the pressure ulcer lesion's healing using the DESIGN tool. Once every month E deputy director made an assessment of it. In addition, because the evaluation table was outdated, a revised table (DESIGN-R revised in 2008) was made to be used throughout the hospital in an effort toward unification. From this situation, we can see the progress of pressure ulcer evaluations being quantified and started to be shared by the nurses and E deputy director. CMMI Level 4 was observed throughout the hospital.

4.10 C Nursing Section Head was Promoted to Nursing Director and Rejoined the Team

From January 2013, the head of the nursing section, C nurse, was promoted to the nurse director and returned as a member of the pressure ulcer care team. In conjunction with this, a new system was created in which nursing staff specializing in pressure ulcer management would be selected from the pressure ulcer care team members to be responsible for each ward.

In April 2013, in order thoroughly create the treatment plan, a rule was made in which every person responsible in each ward was to create an entry management table.

From June 2013, they decided to try the approach of posting the entry management table and at the end of the month if entries were not filled in, the person responsible was to be informed by memo. A CMMI Level 4 movement to measure the process of generating a treatment plan was observed.

By November 2013, it was ascertained that there were staff who were behind in preparing the preparation the treatment plan and did not know the necessity of preparing the plan even when treatment methods changed. Level 3 of CMMI was observed in the fact that the manual prepared from the treatment plan was not yet thoroughly implemented. Therefore, they decided to attempt to thoroughly spread information on the preparation procedure for the treatment plan.

In August 2013, the manual for pressure ulcer treatment was to be revised, and F chief of nursing reported that they were currently taking into consideration references to other institutions. It is apparent that the team was trying to revise ('kaizen') the manual based on the compliance measurement.

In September 2013, the C nurse director and two nurse members of the team participated in an external training workshop and learned new pressure ulcer treatment methods. Then she informed the members on the contents learned at an internal training workshop of the pressure ulcer care. C nurse director began again to demonstrate a 'top down' type of leadership based on newly acquired knowledge.

5. Considerations

From the above results, the following can be observed. First is that CMMI can be used to measure the maturation process of medical teams. In this study, we measured and analyzed the first 12 years after the launch of the pressure ulcer care team at A Hospital. As a result, the maturity Level from Level 1 to Level 4 was confirmed. Although there are points that are not clear in relationship to the outcome, the CMMI organization maturity model is considered to be useful for visualizing and measuring the growth process of the medical team.

Secondly, the five-step model of Tuckman can be applied to the analysis of the team growth process of the medical team. In this study, during the analysis of the team growth process of the pressure ulcer care team at A Hospital, the Forming period, the Storming period, the Norming period, and the Performing period could be confirmed. In the Storming period, a period of turbulence occurred when members with a relatively large influence on team activities were involved and when they had to collaborate with new members. In addition, a Storming period also occurred during the Performing period.

Third, differences in the Level of organizational maturity meant that the period of the Storming period would be different. In the first Storming period, the organization maturity level was still the Level 1 of CMMI, and the period during which the members were confused by conflicts lasted approximately 3 months. In the second Storming period, the organization maturity level was Level 2 of CMMI and it took two months to resolve the conflict. However, in the third Storming period, the organization maturity level was Level 3 of CMMI, and the members did not place much importance on the severity of assumed conflicts. This seems to be because their treatment method was established to some extent. Depending on the maturity level of the whole organization expressed by CMMI, the period of the Storming period in the Tuckman ladder model may differ.

6. Conclusion

The purpose of this study was to measure and visualize the maturation of a team as a result of understanding changes in activities depending on the maturity of the team.

The following conclusions were obtained as a result of this detailed case study of a pressure ulcer care team.

1) By analyzing 12 years of records, we have been able to observe the maturity process of the pressure ulcer care team from Level 1 to Level 4 in CMMI, in order.

2) The "Storming period" in the Tuckman model was shortened when the organization's maturity level reached Level 3 in CMMI.

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Importance of Cybersecurity Regarding Project Management

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In recent years, damage such as information leakage and business suspension of information system inside companies and organizations are increasing due to cyberattacks called “targeted attacks” which is aiming specific targets and “Ransomware” which is the infection of malware. As of the information system project, security measures are vulnerable in perspective of both human and system, especially before the release and after the change of the system. Therefore it is essential to do the appropriate risk management such as to patch the application and to do the access control. In addition, the importance of choosing business and education regarding cybersecurity is enhancing, since the supervisor should take a responsibility, even when the incident occurred at the subcontract business/company. Furthermore, in order to meet a demand of the lean startup in the market, development of agile type system method is prevailing lately. Because the customers and other stakeholders share prototype services and applications before the completion through the internet, the threat of cyberattack is increasing. It is important to understand and practice the latest cybersecurity at each phase of project management such as design, procurement, testing.

Keywords and phrases: Cybersecurity, Cyberattack, Security Training, Cyber Range

1. Introduction

These days threats of cyberattacks against information system of entities/organization is increasing. The purpose of this attack used to be just for fun or boasting their techniques, however recently this is changing to social/politic activity such as stealing money or information. Attackers belong to huge community and have their own fund for avoid security techniques or developing vulnerability, and also their attack method is being tactic.

Below is the recent methods of cyberattacks and examples of victim.

1.1 Attacking the vulnerability of social web-site

These days cyberattack that targeting vulnerability of software framework which is used for developing web application is occurring frequently. Apache Struts2 (OSS-open source software) has been induced a lot in the past and the vulnerability has been developed frequently. In July 2017, a major land transportation company of Japan became one of the victim of illegal access of utilizing that vulnerability of Apache Struts2. They announced that almost 30,000 customers’ information might have leaked from their website.

1.2 Infection of Ransomware

The victim of infection of malware called “Ransomware” has been increasing. Ransomware is infecting terminal by taking advantage of vulnerability of OS. Once infected it will encrypt data and disc inside the terminal and display warning message as shown in Figure 1, then charge money instead of decrypting. However there is no guarantee it will be decrypt even if you pay money.

Figure 1 Message displayed by Ransomware

One of the Ransomware “WannaCry” has been hot news since 2017 May. This is targeting vulnerability of Microsoft products (MS17-010, CVE-2017-0144) and infected from computer in LAN to other computer. As Elizabeth (2017) mentioned, at least 150 countries 200,000 terminals had been infected.

1.3 APT (Advanced Persistent Threat) Attack

APT attack is targeting specific person and then intrude/hide in target person’s computer by adaptable method and keep on attacking for several month and years. APT attack is starting from previous investigation to collect information of target person. Once it success to intrude inside of terminal to remote control from outside, it will enlarge the infection from that terminal and start to exploit the information.

By collecting information of employees from targeting organization through SNS, it will send deceivable e-mail such as changing subject or attachment so that they will open easily. A Japanese organization providing public services became one of the victim of APT attacks in May 2015, it was announced that 1.25 million personal information had leaked. E-mail of APT attacks used a title related business of the organization on the e-mail subject and 5 personnel opened the attachment. Since that, the infected terminal had been spread to 31 terminals.

2. Hidden issues of IT Project

As an increase of the threat of cyberattacks, various vulnerability might exists in each phase of the IT project. Moreover, the recent rapid change of market, in order to answer the request of customer's lean start up, un-waterfall model style for developing software such as iterative development and agile development is being natural but this is one of the reason for generating the vulnerability.

In this section, there will be an explanation of the cause which will be considered as a vulnerable point of IT project. Let's see the difference of conventional waterfall model project and un-waterfall model project.

2.1 Issues of conventional IT project

Figure 2 is a project phase of general waterfall model for IT project.

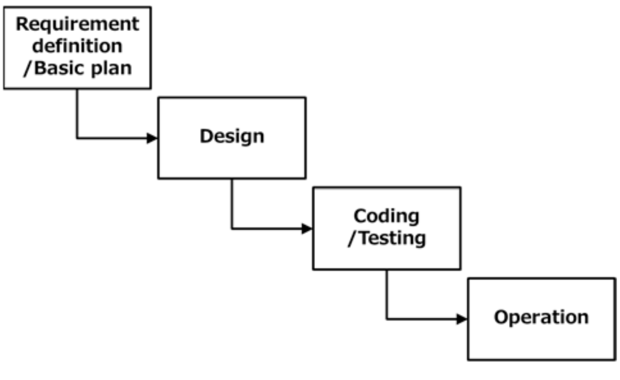

Figure 2 Phase of general waterfall model

Below is an example of vulnerability of each project phase for cyberattacks.

2.1.1 Requirement definition and standard plan phase

As of big project, it is general to outsource the part of the business to other company. However, the company you outsourced might have a possibility to be targeted of threat or APT attack. Sometime some company outsource the business by providing customers' information as for test. Moreover, there is a case that design will be a confidential information of competitive market area or security area. Compare employee to other company, there is a possibility to be a target of cyberattacks if their security level is low.

2.1.2 Design phase

As of operation design, if there is no definition of security patch regarding OS, middleware and application, vulnerability will being left for long time and being easy to be a target of official website cyberattacks as explained in previous section.

Using back up need to be considered of cyber-attacks. If you do not prepare for this risk, malware such as Ransomware will be left in recovery data and you might be infected again.

It is common that attackers delete the evidence so the discovery will be late and being difficult to know where does the attack came from. Therefore it is necessary to consider the design to conduct secure evidence or data analysis of computer which is called digital forensic. If this design is not sufficient, high volatility such as memory will be lost and will not be able to know which information has leaked.

2.1.3 Coding and testing phase

Secure coding is important for development phase. Application which secure coding is not conducted, risk will be high that attackers will exploit management right to enter the illegal character string called injection attacks or high jack attacks which compromise requests and respond of server and clients.

For doing the test, not only looking for a bug, but also it is necessary to conduct a test for developing vulnerability for cyberattacks. System and application that test is not conducted is very week as a perspective of the vulnerability. There are various tool for checking the vulnerability. Also there is a test called penetration test. This is a checking test by trying to intrude the server/system or do fuzzing to send unusual data on purpose.

2.1.4 Operation Phase

About operation phase, it is important to plan the process how to handle the incident in advance in case when you become a victim of cyberattacks. Without this process, no one can do suitable report or do not know where to report, so it will take time to understand the situation and enlarge the damage. Also it is important to know the process how to collect the vulnerable information. Being late to get the urgent information which has a high vulnerability means there is no way to protect from attackers. To select the information, it is necessary to know and recode which OS, middleware and framework are being used to manage your own system.

2.1.5 Summary regarding vulnerability of each phase

Table 1 is a vulnerability chart against cyber-attacks of each phase of IT project.

Table 1 Vulnerability of each phase

Phase	Example of Vulnerability
Requirement definition/ Basic plan	APT attacks to outsourcing company
Design	Inadequate operation design (regarding security patch, back up) No consideration of digital forensics
Coding/ Testing	Not adopting secure coding Not implemented vulnerability test
Operation	Unplanned incident handling process Inadequacy in collecting and using vulnerability information

2.2 Issues regarding un-waterfall model project

Next is about vulnerability against cyberattacks regarding agile development and iterative development which is the most representative method of un waterfall model. Prevail of this development method, cloud technology and smart device is being connected closely.

2.2.1 Issues regarding agile development

Agile development is easy to secure the quality and security since the development cycle (iteration) will be conducted in small number of people. However, it is necessary to correct the completed software in a step of continuation of iteration. Therefore, there is a risk to make a vulnerability of new type of cyberattack and regression (degrade) may occur.

2.2.2 Issues regarding Iterative and Incremental Development

As for Iterative and Incremental development is necessary to disclose the prototype before the release to get the feedback from stakeholders such as customers. Ideally, disclosure should be conducted in closed environment. But if the prototype is uploaded where access from outside is possible such as the cloud, it may be possible to be accessed from illegal attackers without sufficient access control.

3. The importance of cybersecurity

In the previous section, I described threats of intensifying cyberattacks and issues in IT projects. In order not to suffer the damage of cyberattacks, efforts to strengthen security to counter cyberattacks that is cybersecurity are indispensable.

There are three ways to strengthen cybersecurity. The first is a method of introducing countermeasure technologies. The second is a method of improving skills and appropriately controlling each personnel. The third is a method of outsourcing security monitoring and management. It is important to combine these methods appropriately. At the moment, the method that each personnel improves skills and controls appropriately is most important. Because there is a cyberattack called "Zero Day" that countermeasure technology does not pass for. Moreover, security experts tend to be deficient globally.

3.1 How to Improve Cybersecurity Skills

In general, skills acquisition methods include OJT (On The Job Training) to learn through business and Off-JT (Off The Job Training) to take training etc. off work. With regard to cybersecurity, OJT is not suitable because it has few opportunities to actually undergo cyberattacks other than security specialists, and it is desirable to do it in Off-JT. Off-JT has various kinds. Training to actually operate servers and terminals is particularly effective.

3.2 Cyber security training system

NEC systematizes a security training as shown in Table 2.

Table 2 NEC's security training system

Level	Area		
High	For security specialists		
Intermediate	Network security	Server hardening	Secure coding

	Understanding attacking method	Incident handling
Elementary	Introduction of security technology	
Prerequisite	Basic knowledge of ICT (System Infrastructure, OS, AP, etc.)	

At the intermediate level, training is classified by security area. Higher level is also classified by security area, and more advanced courses for security experts are recommended.

The following shows the purpose of training for each area of security of intermediate level.

3.2.1 Network security

Learn and understand the concepts and points of designing secure networks which is focused on firewalls and next generation firewalls.

3.2.2 Server hardening

Understand the security measures of public server construction by considering numerous threats and risks such as SQL injection, cross site scripting, session hijacking.

3.2.3 Secure coding

It is possible to create safe applications after understanding the necessity of Input/Output value checking, and cautions of security management.

3.2.4 Understanding attacking method

Experience the hacking technique of flow such as "preliminary investigation" "authority acquisition" "illegal execution" "post-treatment" to learn the defense method.

3.2.5 Incident handling

Learn skills to minimize the damage in collaboration with personnel in each department, system engineers, CISO, security vendors, etc. when security incidents occurred.

3.3 Skills that each project personnel should acquire

With reference to the training system in the previous section, the skills of cybersecurity for which each IT project personnel should preferentially acquire are as follows.

3.3.1 Skills that project manager should acquire

The project manager is required to be able to see the risk of cyberattacks of the entire project by understanding the latest attack methods and vulnerabilities. Therefore, it is important to understand the attacker's object and the overall picture of the method through attack cases.

3.3.2 Skills that architect should acquire

Architects need a broad understanding of threats and vulnerabilities in information systems such as networks and servers. It is required to learn techniques of network security and server hardening preferentially.

3.3.3 Skills that programmer should acquire

Programmers must acquire secure coding skills. It is also important to learn penetration test method in the higher level for those who specialize in testing.

3.3.4 Skills that operator (administrator) should acquire

Since the operator is responsible for system management after operated, the skill of incident handling is most required. It is advisable to take comprehensive exercise training to prepare for the incident by considering daily operation such as applying patches and backing up.

3.3.5 Summary of Skills that each personnel should acquire

Table 3 is summarizing the cybersecurity skills that each personnel of IT project should acquire.

Table 3 Security skills required for each personnel

Personnel	Cybersecurity skills to learn
PM	Understanding attacking method
Architects	Network security, Server hardening
Programmers	Secure coding (Penetration test method)
Operators	Incident handling

4. Examples of measures to improve skills

In order to meet the growing need for cybersecurity skill improvement, we planned and launched an exercise which aimed to improve incident handling skills for operators and managers, and measured the effect of the exercise.

This section also introduces trends of new human development resource called “Cyber Range”.

4.1 Incident handling exercise

In this incident handling exercise, students become roles of administrators and operators of companies and organizations, and experience incidents due to cyberattacks based on actual cases, while operating servers and terminals in an environment imitating the actual organization's LAN.

4.1.1 The goal of taking an incident handling exercise

The goals of taking the incident handling exercise are the following four points.

- ·Able to plan actions when a cyberattack occurs in advance.
- ·Able to take appropriate first action by considering business continuity when your organization actually receives a cyberattack.
- ·Able to solve it promptly in cooperation with stakeholders when an incident occurs.
- ·It can fulfill accountability appropriately to the outside and take measures to prevent recurrence.

4.1.2 Curriculum of incident handling exercise

This incident handling exercise will be conducted in two days, and the curriculum is as shown in Table 4.

Table 4 Curriculum of incident handling exercise

Curriculum	Outline
Day 1	
Lecture	The instructor explains the basic knowledge which is necessary for incident handling.
Explain the operation of practical training	The instructor explains the environment of the practical training and the tools to be used.
Practical training	Students take practical training using real machines.
Day 2	
Practical training	Continuation of Day 1.
Report	Learn how to fill out a report which is to report the cases to outside of community.
Commentary	The instructor gives comments and advices based on the student's behavior.

4.1.3 Training contents of incident handling exercise

In the incident handling exercise, students take practical training using real machines. As shown in Table 5, we created contents that students will experience during practical training.

Table 5 Contents of practical training

No.	Contents of practical training
1	Detection of cyberattacks
2	Incident discovery
3	Notification of incident
4	Digital forensic
5	Log analysis (proxy server, PC etc.)
6	Capture malware and examine its behavior
7	Identify vulnerability
8	Internal infection investigation
9	Identify leakage information
10	Accountability

4.1.4 Advantages of incident handling exercise

Conducted a test to measure improved skills by taking the incident handling exercise. Making a test of 40 points with all 10 questions to determine if they reached the four goals shown in 4.1.1. It was given to about 30 students each time, before taking the exercise and after taking it. Figure 3 shows the average value of the correct answer rates of the tests conducted in all nine exercises.

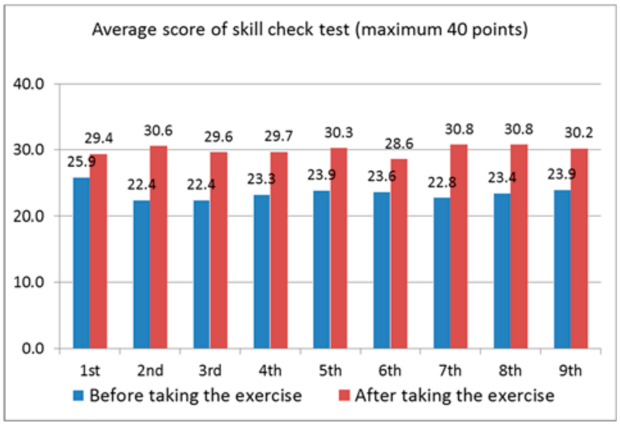

Figure 3 Change in score of skill check tests

By attending the incident handling exercise, it was confirmed that the skills of the students improved at each exercises.

4.2 Cyber Range

In order to strengthen the organized ability to defend from cyberattacks, the systems and services specialized in training called Cyber Range, are frequently used in recent years.

4.2.1 Cyber Range Configurations

A typical Cyber Range configuration is shown in Figure 4. Students are divided into a defense (blue) team and an attack (red) team, and their networks and servers are reproduced on the virtual environment. From the attack of the red team, the blue team defends while hardening the LAN and the Web server, so that they can acquire defense skills against real cyberattacks.

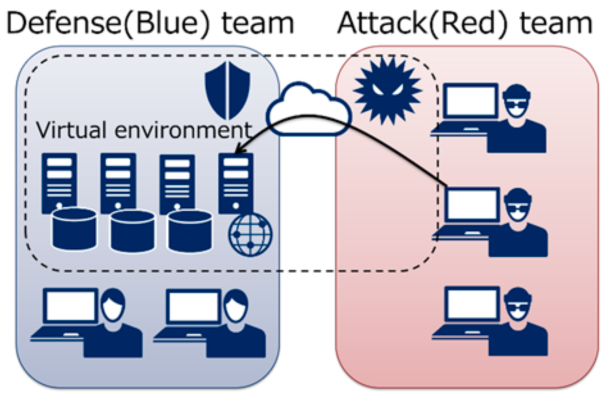

Figure 4 Typical Cybre Range configuration

4.2.2 Advantage of Cyber Range

Advantages of system security assessment by Cyber Range are shown by Winter (2012). Pre-release applications and prototypes can be placed in the Cyber Range virtual environment and penetration tests can be performed on them. By Using Cyber Range, students can simulate cyberattacks and can acquire more practical skills than exercises based on the scenario shown in 4.1. As stated above, Cyber Range has an advantage for improving the system's cybersecurity and personnel skills.

5. Conclusion

Recently IT projects are threatened with various cyberattacks. In order to counter threats, it is indispensable to strengthen the skills of cybersecurity of each personnel. Through the launch and implementation of the incident handling exercise, it is demonstrated that exercises using real machines are effective for enhancing the skills of cybersecurity. New technologies for human resource development like Cyber Range will also be popularized in the future.

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Project success under Northeast Asia corporate governance

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The definition of project success in the business area is differed by project governance which is cascaded down from corporate governance. Each corporate under good governance structure set up their business vision/strategy to meet the target in a certain timeframe and develop the business plan accordingly. Then, the corporate often launches portfolio/program/project to achieve target aligned to stakeholder's benefit. However, not all corporate has good governance to align the project success with stakeholder's benefit. One of the good examples of this is corporate governance in South Korea. South Korean corporate governance has been notorious for its poor corporate governance due to family own business structure called Chaebol. Interestingly, the origin of "Chaebol" is from Japan called "Zaibatsu". Zaibatsu and Chaebol are the just different pronunciation of the identical Chinese character. The Zaibatsu partially dissolved after World War 2 but after that, the ex-zaibatsu companies were re-organized as so-called Keiretsu by cross-shareholdings. Keiretsu's corporate governance has similarity with Chaebol in Korea. This paper analyzes two major EPC (Engineering, Procurement, and Construction) companies from South Korea and Japan which are/were a part of Chaebol/Zaibatsu by comparing their corporate governance structure and maturity and reviewing the financial result to find out how it effects on the project success in 2016. Also, it discusses further project collaboration opportunities in overseas infrastructure project under the similar corporate governance structure.

Keywords and phrases: Corporate Governance; Project Governance; EPC Contractors; Project Collaboration

1. Introduction: Corporate governance and project governance

The Association for Project Management (APM) in the UK defined project governance as the extension of the principles of corporate governance into the management of individual projects. As indicated in Figure 1, project governance is a subset of corporate governance, and it guides and monitors the process of converting corporate strategic decision into the benefit of the corporation, thereby delivering the anticipated benefits to shareholders. The structure of project governance is established because the corporate structures generally do not provide the necessary framework to deliver a project. This is due to projects requiring flexibility, a high level of sustained focus and timely decision making, of which the hierarchical nature of corporate governance does not necessarily allow for. At the same time, project governance should draw key decisions from corporate governance such as the strategic importance of pursuing projects for new business or product development.

Having robust corporate governance can create market confidence and business integrity, which in turn is essential for companies that need access to equity capital for long-term investments. Access to equity capital is particularly important for companies that are oriented towards future growth and to balance any increase in leveraging. The question can, therefore, be raised regarding what if the corporate governance is not sufficient enough to deliver on the shareholders' benefit? Additionally, how does this affect the projects' success? To answer this, it is necessary to compare the corporate governance structures between Korean and Japanese EPC companies. This will allow us to discover the characteristics of project success under different corporate structures.

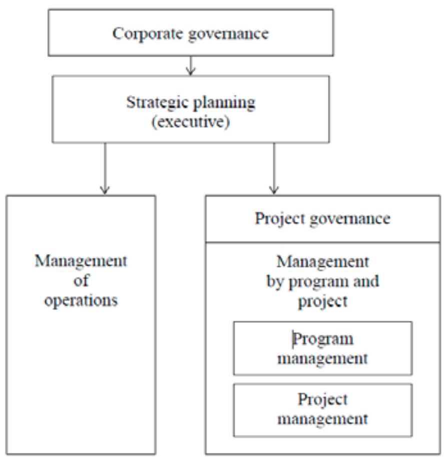

Figure 1 Project Governance Structure by APM[6]

2. Example from Korean and Japanese EPC companies

The Engineering, Procurement, and Construction (EPC) industry has considerably small portions of operation management activities compared to the manufacturing or other industries. This is due to EPC companies mainly providing services to their clients instead of manufactured products that are fixed assets from production facilities like factories. Hence, we can assume that the normal operation part of a business such as manufacturing products, storing assets and managing the labor force is less prevalent with EPC companies. By this assumption, the project governance of EPC companies can be seen as being completely affected by the strategic planning that is aligned with the corporate governance as shown in Figure 2. Project success can, therefore, be determined by analyzing their financial results since all business activities come from projects, and not from selling inventory or maintaining stock.

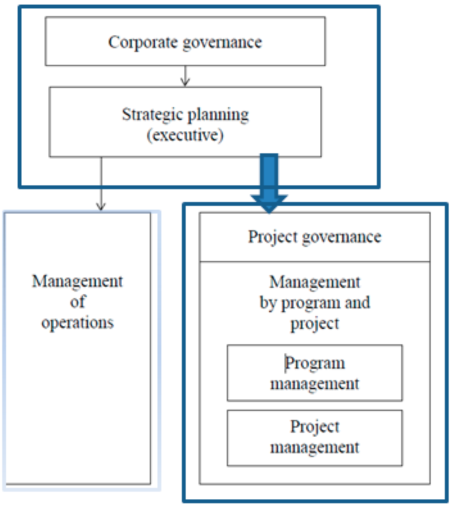

Figure 2 EPC Industry Project Governance Structure

Under the robust corporate structure, good strategic planning is cascaded down to the project governance structure, and it can lead to the project success for shareholders to have expected outcomes and benefits. This paper chooses one of the major EPC Companies from both Korea and Japan and collects project and corporate data from financial statements and the corporate websites. Additionally, data was collected by conducting a comparative analysis based on the six principles of corporate governance reported by OECD as shown below.

•Ensuring the basis for an effective corporate governance framework:

The corporate governance framework should promote transparent and fair markets and the efficient allocation of resources. It should be consistent with the rule of law and support effective supervision and enforcement.

•The rights and equitable treatment of shareholders and key ownership functions:

The corporate governance framework should protect and facilitate the exercise of shareholders' rights and ensure the equitable treatment of all shareholders, including minority and foreign shareholders. All shareholders should have the opportunity to obtain effective redress for violation of their rights.

•Institutional investors, the stock market, and other intermediaries:

The corporate governance framework should provide sound incentives throughout the investment chain and provide for stock markets to function in a way that contributes to good corporate governance.

•The role of stakeholders in corporate governance:

The corporate governance framework should recognize the rights of stakeholders established by law or through mutual agreements, and encourage active co-operation between corporations and stakeholders in creating wealth, jobs, and the sustainability of financially sound enterprises.

•Disclosure and transparency:

The corporate governance framework should ensure that timely and accurate disclosure is made on all material matters regarding the corporation, including the financial situation, performance, ownership, and governance of the company.

•The responsibilities of the board:

The corporate governance framework should ensure the strategic guidance of the company, the effective monitoring of management by the board, and the board's accountability to the company and the shareholders.

3. Chiyoda Corporation in Japan

3.1 The Origin of Chiyoda Corporation

Chiyoda Corporation (Chiyoda) was established by an ex-manager of the construction division in Mitsubishi Oil (Currently JXTG Nippon Oil & Energy Corporation) after World War 2. The founder of Chiyoda received support from his mother company, Mitsubishi Oil, and established the company in 1948. Therefore, the first president of the company was an ex-executive from Mitsubishi Oil. From 1870 to 1947, the Mitsubishi Group companies existed as a form of

Zaibatsu (wealth group) that were family-controlled, vertical monopolies, and were disbanded during the allied occupation after the surrender of Japan in the 1950's mainly for war support. However, the complete dissolution of the Zaibatsu was never achieved due to the Korean and Cold Wars, and ex-Zaibatsu companies were instead reformed into Keiretsu (series) or horizontal businesses grouped by a cross-shareholding structure that use the same trademarks. Thus, we can say that Chiyoda Corporation was a semi-member of the Mitsubishi Keiretsu, meaning the company was backed by Mitsubishi without using the Mitsubishi trademark.

3.2 Shareholding Structure

The type of shareholding structure can determine the structure of corporate governance because corporate strategies for businesses should achieve the shareholders' benefit under the guidelines of good corporate governance. As seen in Table 1, while Chiyoda Corporation is mostly held by private and institutional investors, 39% of their shares are shared by the Mitsubishi Keiretsu companies including Mitsubishi Corporation, Mitsubishi UFJ, Mitsubishi UFJ Trust and Banking and Meiji-Yasuda Life Insurance, all of which are globally renowned financial enterprises. In particular, Mitsubishi Corporation has the most shares among the Mitsubishi Keiretsu companies and is the flagship enterprise of the keiretsu. They develop and operate businesses across all industries that are deeply related to Chiyoda's business sector including infrastructure, oil and gas, and energy.

Table 1 Chiyoda Shareholding Structure

Shareholder	Percentage of Shares (%)	Remark
Mitsubishi Corporation	33.39	Mitsubishi Keiretsu
Master Trust of Bank	7.93	Private
Japanese Trustee Services Bank	4.45	Private
Mitsubishi UFJ	3.47	Mitsubishi Keiretsu
Trust & Custody Bank	2.54	Private
Mitsubishi UFJ Trust Bank	1.64	Mitsubishi Keiretsu
State Street Bank and Trust Company	1.42	Private
Japanese Trustee Services Bank9	1.37	Private
Japanese Trustee Services Bank5	1.14	Private
Meiji-Yasuda life Insurance	0.87	Mitsubishi Keiretsu
Rest of Investor	42	-

3.3 Corporate Governance Structure

The current Chiyoda Corporation corporate website provides meaningful data to understand the company's corporate governance structure. Furthermore, by comparing the data with the OECD guideline mentioned in Chapter 2, the corporate governance structure can be evaluated in regards to showing desirable evidence on the corporate governance.

Table 2 Chiyoda Corporate Governance

No	Criteria	Chiyoda Corporation	Maturity Level
1	Ensuring the basis for an effective corporate governance framework	The website shows clear corporate governance structure. Chiyoda Corporation Corporate governance policy	H
2	The rights and equitable treatment of shareholders and key ownership functions	Chiyoda Corporation Corporate governance policy Chapter 1.	H
3	Institutional investors, stock market, and other intermediaries	Chiyoda Corporation Corporate governance policy Chapter 1.	H
4	The role of stakeholders in corporate governance	Chiyoda Corporation Corporate governance policy Chapter 2	H
5	Disclosure and transparency	Chiyoda Corporation Corporate governance policy Chapter 3,5	H

6	The responsibilities of the board	Chiyoda Corporation Corporate governance policy Chapter 4.	H

As shown in Table 2, Chiyoda has achieved the minimum standard in over 6 criteria with clear evidence. The characteristics of Chiyoda's corporate governance include the addition of implementing an executive officer system together with a board of directors system. Chiyoda separately implemented audit and supervisory committees comprised of three or more Directors, a majority of which are from outside companies. Also, by introducing an internal audit unit, they frequently reinforce their corporate governance system. Thus, Chiyoda has a mutual corporate governance level and we can assume that the company's business plans and strategies are feasible well decided on to support the stakeholders' benefit and that the relevance in regards to the project/program's success is defined accordingly.

There are limitations to knowing project governance since each company has different systems and cultures. However, by examining corporate governance and stakeholders` previous chapter status together with the results of financial statements, we can discover linkages between corporate governance and project success.

3.4 Project Success in 2016

In 2016, Chiyoda reported a 40 Million USD profit loss mainly from project loss and failure of their early 2016 investments in the subsea industry, marking the first on record of a profit loss since 2008. Chiyoda Corporation has strength in LNG business where 70% of the company's revenue came from LNG related projects. Nonetheless, Chiyoda decided to target new businesses in the offshore and subsea markets together with Ezra holdings (Singapore) and NSK (Japan, a member of Mitsubishi keiretsu). These ventures were ultimately not successful due to recent oil price decreases. In looking at Chiyoda's press information during the 2016 business year as shown in Table 3, we see that Chiyoda focused on diversifying their project portfolio into various business sectors other than LNG business including metal, pharmaceutical and new energy in response to an oversupply of LNG in the short term and a delay in oil price recovery. Due to market conditions, however, the recovery of performance has proven to be challenging.

Table 3 Chiyoda Projects ordered in 2016

Type of Business	Client	Country	Awarded date
Copper Smelting	PT Freeport Indonesia	Indonesia	Mar 23 2016
Vegetable factory business	Al Ghurair Group	UAE	July 07 2016
Offshore/Subsea	Saudi Aramco	Saudi Arabia	July 25 2016
LNG	BP Berau	Indonesia	Aug 05 2016
Petrochemical	Dialog Plant Services BHd	Malaysia	Jan 11 2017
Renewable jet and diesel fuels	Euglena	Japan	Feb 10 2017
Chemical	Tosoh	Japan	Feb 17 2017

4. Samsung Engineering in South Korea

4.1 The Origin of Samsung Engineering

Samsung Engineering (Samsung), originally named Korea Engineering, was established in 1970 by the Korean government as the first domestic engineering firm. Responding to the necessity for expediting the industrialization of South Korea after the Korean War, the government needed to facilitate an engineering company to build its petrochemical/refinery complexes. In 1978, Samsung Group acquired Korea Engineering, and one of the main reasons was that Samsung Group owned petrochemical/refinery firms under their umbrella. In 1991, the company was renamed from Korean Engineering to Samsung Engineering. During the early 2000s, Samsung Engineering expanded their presence to oversee markets and have had significant growth in the EPC contractor market, reaching 10 Billion USD revenue volumes after 2010. Samsung Group was founded in 1938 with its start as a small trading company during the Japanese occupation era. The company has been growing alongside the rapid development of South Korea`s economy and has become one of the biggest Chaebol in Korea. The conglomerate is owned by the Lee family and comprises of complex cross-shareholding among each of its companies that amount to over 15% of Korea's GDP.

4.2 Shareholding Structure

The major shareholder of Samsung Engineering is

Samsung SDI, which is one of the affiliates of Samsung Group that runs their Li-Ion battery and electronic material business related to Samsung Electronics. Additionally, it is shared by Samsung Corporation, the operator of its EPC business that has operations similar to Samsung Engineering and is the de facto holding company of the entire Samsung Group. Remarkably, Jae-Yong Lee, the key successor of the Lee family, acquired new shares after Samsung Engineering implemented a paid-in capital increase in 2016 when the company faced a shortage of capital due to over a 1.2 Billion USD loss from overrun project costs in 2015. Because of the same reason, many company executives continue to hold these shares now as shown in Table 4

Table 4 Samsung Engineering Shareholder Structure

Shareholder	Percentage of Shares (%)	Remark
Samsung SDI	11.69	Affiliate of Samsung Group
Samsung Corporation	6.97	Affiliate of Samsung Group
Lee Jae-Yong	1.54	Executive Affiliate of Samsung Group
Samsung Fire & Marine Insurance	0.22	Affiliate of Samsung Group
Samsung Life Insurance	0.06	Affiliate of Samsung Group
Park Jung-hun	0.02	Company Executive (Board Member)
Kim Myong-Soo	0.02	Company Executive (Board Member)
National Pension Service	5.98	National Institute
Company Executives	0.23	Company Executive (Non-board Member)
Other	73.27	Not reported

4.3 Corporate Governance Structure

Samsung Engineering ranks on the medium level of corporate governance maturity in terms of the 6 criteria in the OECD suggested principles as shown in Table 5. The roles of the board are relatively well described, and the disclosures are made in a timely manner while the rights of shareholders and incentives for investor-related information are limited. The stakeholders' (investors, shareholders, and employees) responsibilities are not defined well. Hence, from the corporate governance structure, we assume that the company's business plan and strategies are not well aligned to the shareholders` benefit.

Table 5 Samsung Engineering Corporate Structure

	Criteria	Samsung Engineering	Maturity Level
1	Ensuring the basis for an effective corporate governance framework	The governance structure is not shown clearly, only board members system are mentioned.	M
2	The rights and equitable treatment of shareholder s and key ownership functions	Homepages mentioned but the only state `Various stakeholders', not specified.	L
3	Institutional investors, stock market, and other intermediari es	There is no dividend policy mentioned. Dividends not paid out since 2013.	L
4	The role of stakeholders in corporate governance	Homepages mentioned but only say "various stakeholders' not specified.	L
5	Disclosure and transparenc y	Disclosure is made in every quarter basis and opened in DART (Data Analysis Retrieval Transfer System) but not in the homepage of the company.	M
6	The responsibilit ies of the board	Homepage Invest relationship page mentioned Responsibility of board member and its structure.	H

4.4 Project Success in 2016

Samsung Engineering faced the impairment of capital due to a 1.3 Billion USD loss because the company won project contracts at competitive prices over rivals in 2015. Currently, the companies are recovering from their worst business performance after 1.1 Billion USD in the capital has been issued to the public, and from driving harsh restructuring. In 2016, Samsung Engineering generated approximately 5 Billion USD of turnover, and an estimated 45% of the revenue originated from the projects` order of affiliates of Samsung including Samsung Display, Samsung Electronics, and Samsung Biologics. According to finance reports summarized in Table 6, Samsung Engineering ordered 8 projects in 2016, 4 of which are being contracted from affiliates of Samsung. Furthermore, due to accumulated experience in building pharmaceutical plants ordered from Samsung Biologics that are being developed as new future cash cow businesses in Samsung group, they were able to contract new pharmaceutical plants from the Korean Pharmaceutical Company called Hanmi. Thus, Samsung Engineering is well supported by Samsung Group and is slowly overcoming continuous low oil prices and competing with new entrants from India and China.

Table 6 Samsung Engineering Projects Ordered

Type of Business	Client	Country	Awarded date
Industrial Plant	Samsung Display	South Korea	Jan 2016
Industrial Plant	Samsung Electronic	South Korea	Jan 2016
Pharmaceutical Plant	Hami Pharmaceutical	South Korea	Mar 2016
Refinery	Pemex	Mexico	Jan 2016
Industrial Plant	Nexen	Czech	Oct 2016
Gas Plant	PTT	Thailand	Dec 2016
Industrial Plant	Samsung SDI	Hungry	Nov 2016
Industrial Plant	Samsung Electro-Mechanics	Vietnam	Oct 2016

5. Discussion

5.1Corporate Governance: similar but different

Chiyoda Corporation and Samsung Engineering have similarities in their shareholding structure since each company is a part of a Keiretsu and Chaebol, respectively. Chiyoda's major shareholders are Mitsubishi Corporation and Mitsubishi UFJ and belong to the Mitsubishi Keiretsu while Samsung Engineering's major shareholders are Samsung SDI and Samsung Corporation. It is noteworthy that these companies share a similar history in regards to their shareholding structure change. In 1996, Chiyoda posted operating losses in their business due to harsh competition with Korean EPC contractors. Thus, as part of restructuring activities until 2002, Mitsubishi UFJ and Mitsubishi Corporation purchased newly issued shares in order to support Chiyoda. After 20 years, Samsung Engineering also issued new shares as part of their restructuring activities in 2016. Subsequently, Samsung SDI, Samsung Corporation and Jae-Yong Lee, a successor of Samsung Group, purchased the shares. This clearly indicates the characteristics and differences between the family-owned chaebol and the Keiretsu grouping enterprise. Therefore, both companies belong to large business groups in both countries, and the company corporate governance is closely linked with their supporters as shareholders and members of the business group.

The corporate governance maturity of Chiyoda shows the differences with the company`s corporate structure as being well organized compared to Samsung Engineering according to the comparison analysis shown in Table 7.

Table 7 Corporate Governance Comparison

	Criteria	Samsung Engineering	Chiyoda Corporation
1	Ensuring the basis for an effective corporate governance framework	M	H
2	The rights and equitable treatment of shareholders and key ownership functions	L	H
3	Institutional investors, stock market, and other intermediaries	L	H

4	The role of stakeholders in corporate governance	L	H
5	Disclosure and transparency	M	H
6	The responsibilities of the board	H	H
Average		M	H

In contrast, Samsung Engineering`s corporate governance indicates an unclear role of shareholders, a weak protection and delivering of benefits with rare payouts of dividends, and a corporate governance structure framework that is undefined. Thus, their business decision-making process lacks transparency and clearness for its stakeholders. In addition to the comparison study, the 2016 Corporate Governance (CG) watch report from CLSA ranked Market CG scores, measuring the maturity of the CG ecosystem in Asian countries. Korea is ranked 8th among eleven Asian countries, and only China, the Philippines, and Indonesia are ranked lower while Japan ranked 3rd, followed by Singapore and Hong Kong. Therefore, the results support the results of the comparison analysis of Chiyoda and Samsung Engineering`s corporate governance shown in Table 7.

A noteworthy example of weak corporate governance within Samsung can be seen with the board-appointed son in-law who was chosen as an executive from 2011 at the peak of Samsung Engineering's performance, as well as with his resignation from the position in 2014. Since he had no background in the EPC industry, his appointment was controversial and believed to be part of the ownership transition strategies in the Lee family. Furthermore, in 2014, Samsung Engineering announced their merger with Samsung Shipbuilding to pursue an offshore and onshore engineering company. This attempt was not achieved because the rest of shareholders did not agree with it as they expected a limited effect on the shareholders' benefit, and both companies faced performance issues due to the lack of experience and technology in the offshore and onshore business. Rather, the EPC market questioned that the purpose of this merger was to deliver benefits solely to the family owner by strengthening the ownership of both companies. The reasoning behind this was that the two companies' main shareholder is Samsung's flagship company, Samsung Electronics, is mainly owned by the Lee family. Likewise, Samsung Engineering's corporate governance appears to be more focused on the family's benefit rather than the rest of the shareholders` benefit, and the stakeholders did not clearly understand whether the corporate governance was certainly pursuing long-term growth for the company or not.

5.2Project Success in 2016: tough but different approach

In looking at the 2016 project contracts` history and financial results, we can discover one notable point in that both companies are trying to overcome from recent oil price drops in the market by diversifying their project portfolios that are backed by their group company. Chiyoda Corporation established the EMAS Chiyoda Subsea Company in order to diversify their portfolio away from NGL projects, and towards an offshore business that was co-shared by NSK, a major shipping & logistics company in Japan and a member of the Mitsubishi Keiretsu.

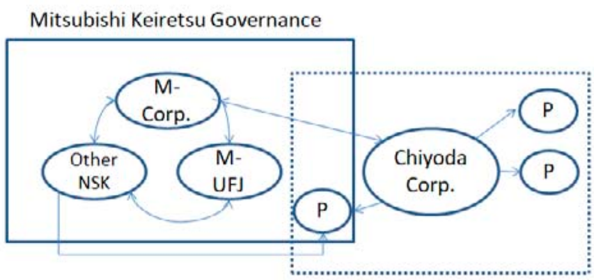

Figure 3 Chioyda Corporation Project Governance Model in 2016

Also, Samsung Engineering contracted several industrial projects from Samsung Electronics and Samsung bio business companies. Consequently, Chiyoda's major projects went bankrupt and forwarded an operating loss to shareholders while Samsung's projects contributed to 40% of their total revenue with cash stability and accumulated a new capability of pharmaceutical industrial plants. However, Samsung Engineering outperformed in terms of its project success, showing that the company could not succeed without support from their group company that questioned the lack of technical capability in the upstream and other high-end product markets. Conversely, Chiyoda`s situation shows the success of NGL projects that required relatively advanced technology and experience.

Samsung Engineering's project success, on the other hand, is more aligned to the Samsung group's success.

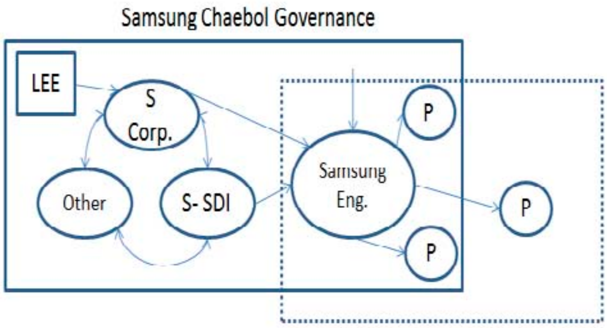

Figure 4 Samsung Engineering Project Governance Model in 2016

Samsung affiliates expand and upgrade the production line frequently to respond speedily to market trends. Due to the confidentiality of production systems, together with short terms of investment, Samsung gave the project order only to their group company. One of the examples that demonstrate this case is the Samsung Display SMD A2 project mentioned on the Samsung Engineering's website. It states "In 2011, Samsung Engineering completed the AMOLED Plant for Samsung Display, which included the largest mobile display clean room in the world. Despite the record-breaking nature of this project, it was very important for the client that Samsung Engineering complete the clean room in only six months, half the normal length of time for a project of this size and complexity". Also, it stated that they operated under 24-hour shifts to complete this project, an extreme case of high working hours. Therefore, because of the unique corporate governance structure of Samsung Display as a customer, but at the same time a part of the same governance group, the project success covered broader business categories and showed more complexity than Chiyoda's project success.

5.3 Project collaboration opportunities under similar corporate governance structure

The unique corporate governance of Japanese and South Korean company was originated from the similar strategies of rapid economic development in their early development stage. Japanese economic development was well driven by policy maker and financial support by government in 1960's That experience were read-across to South Korean economic development in 1970's. Those development structure contribute to form unique Chaebol/Keiretsu corporate governance and those strategies that government are facilitating industry development by technical and financial support by agency shown in Table 8 remain in current era in oversea infrastructure business.

Table 8 government agency in Japan and South Korea

	Japan	Korea
Technical support	Ministry of international Trade and Industry(MITI)	Ministry of Trade, Industry and Energy (MTIE)
Financial support	Ministry of Finance (MOF)	Ministry of Strategy and Finance(MOSF)

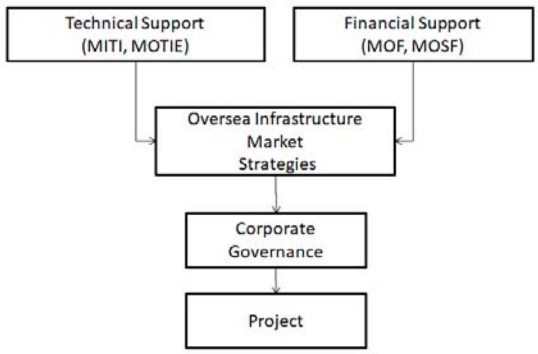

Figure 5 Project collaboration opportunities

In term of oversea infrastructure market which Chiyoda and Samsung's main business, it contained high country risk and associated financial risk depending on project financing structure such private public partnership (PPP). PPP method is wide-spread to develop bankable project since many of overseas infrastructure project are initiated in developing countries and the project owner tend to face the lack of financial capabilities and project management skill. Thus, finical support from Export Credit Agency (ECA), government owned special purpose bank such as Japan Bank of International Cooperation and the Export and Import Bank of Korea play critical role to support EPC contractors to participate in infrastructure business in oversea market. ECA can drive project initiation to fill up the financing risk and guarantee the project success with counter party country since ECA deal are treated as inter-government deal. Also, it can be 'tied financing' which mandate utilizing lender's county’s production and service.

Good examples are SATORP (Saudi Aramco Total Refining and Petrochemical Company Project) project in Saudi Arabia during 2010 and one of package of project were awarded to Joint Venture of Chiyoda and Samsung Engineering. Chiyoda was in charge of engineering portion and Samsung Engineering portion were procurement and construction to cover up the weak point of each company respectively and this project were partially financed by both countries’ ECA shown in Table 9.

Table 9 ECA participant in SATORP project

ECA Participant	Nationality
Korea Export Insurance Corporation (KEIC)	Korea
Compañía Española de Seguros de Crédito a la Exportación (CESCE)	France
Export-Import Bank of Korea (K-EXIM);	Korea
Compagnie Française d'Assurance pour le Commerce Extérieur (COFACE)	France
Japan Bank for International Cooperation (JBIC)	Japan
Nippon Export and Investment Insurance (NEXI)	Japan
Euler Hermes Kreditversicherungs-AG (Hermes)	Germany

Thus, this similar of government strategies linked with corporate governance can be useful platform to create project collaboration opportunities for project success from creating project opportunities to implementing project success.

6. Conclusion

Through a comparative study of Chiyoda Corporation and Samsung Engineering, the characteristics of project success under Northeast Asian corporate governance were examined. The results show that first, under the projects of Korean and Japanese EPC contractors within large business groups like Chaebol, Keiretsu respectively are supported by their group company with a shareholding structure and business partnerships. As shown in Figure 3, for example, Chiyoda exercised capital investments to establish a new offshore company with a member company of Mitsubishi Keiretsu called NSK. This project can be illustrated in co-shared governance boundaries, and a capital investment, therefore, will not happen without the agreement and support of the whole Mitsubishi Keiretsu’s governance.

Second, due to the different corporate governance structure, the project success in Korean EPC contractors tends to be aligned with minor shareholders’ (family-owned) benefit. Also, the project successes are led by much larger-scaled corporate strategies such as supporting other affiliate’s business strategy under the same business group. It is demonstrated in Figure 4 that most of Samsung Engineering’s projects were launched under co-shared governance boundaries between Samsung Engineering and Samsung Chaebol’s governance, and the relationship linkages are connected to the Lee family. Furthermore, by examining case previously mentioned case with the Samsung Display SMD A2 project in Samsung Engineering, we see that single project successes can affect entire business group strategies in extensive ways as well.

Third, because of the similar of corporate governance resulted from rapid economic development drove by each government agency there are project collaboration opportunities in oversea infrastructure project between two countries as shown on figure 5. ECA play pivotal role to create bankable project in recent oversea infrastructure market and project success is determined from the beginning of project stage by mitigating financing risk and country risk by ECA. Like SATROP project, oversea infrastructure collaboration backed by government private tie up becomes good opportunities for project success.

Finally, based on further studies, the projects' success supported by sister companies could deliver the benefits to the corporation and stakeholders in the short-term. In the long-term, however, this project success might not be continued without the generic effort to improve project capability including technologies and project management competency. Also, sound project governance flows down from robust corporate governance can attract stand-alone capital markets and make feasible corporate decisions essential to lead to project success.

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Proposal of quality visualization measures in Agile development

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Many projects in global projects often use agile development processes and iteration development styles modified from the waterfall development process. In global system development, it is difficult for a company to completely shift to agile development due to some reasons such as loss of quality management control. However, In order to increase customer satisfaction, it is important for customers to release new systems as soon as possible. To accomplish this, we need to know the criteria or key performance indicator (KPI) agreed with the customer using the traditional waterfall development process knowledge. Using these measures is an effective way to release a new system and prevent project quality problems. This paper describes how to visualize quality levels and define quality dependencies before releasing a new system.

Key Words & Phrases: agile development, waterfall development, Quality management, Metrics

1. Introduction

The Internet of Things (IoT), Big data, and Artificial intelligence (AI), are examples of various new technologies which have been emerging in recent years, and software development vendors need to deal with those technologies and globalization as well. Many projects in global projects often take the agile development process or development methodology changed from the waterfall model to manage software development projects and helps to move quickly to offer new programs.

According to agile success and metrics, the leading causes of failed agile projects are external pressure to follow traditional waterfall processes (36%), ineffective management collaboration (34%), and inability to continuously prioritize work (28%). There is a large element group of failure factors. (10th annual STATE of AGILE Report, 2017)

Regarding one of the quality metrics in agile development, utilizing offshore is a quality management activity for agile development and its evaluation which is quality in agile development metrics leveraged offshore. (Adachi , 2011)

There are considerations in quantitative software quality evaluation method in agile software development such as evaluation using multiple linear regression analysis and mathematical model. (Aoki T, 2009) However, those practices are not enough in the activities to make the quality visible to customers and users who have become familiar with the waterfall model. In the development of the waterfall model, it is common to manage the quality evaluation in each process such as basic design, detailed design, coding, unit test, combined test and analyze quality level on each process.

On the other hand, in agile development, there are many cases where the same function is repeatedly repaired based on the customer requirements, and it is difficult to properly evaluate the quality level by using the same quality evaluation way of the waterfall model. For example, if you developed 1,000 lines of code and you made 10 issues with Sprint 1 term, 10 issues in Sprint 2 term, and 10 issues in Sprint 3 term, it was 30 issues in total, in that case, you might simply evaluate that there are 30 issues per 1,000 lines of code. There is also the possibility of misjudging the evaluation such as the quality of program is bad. Actually, it might only be that there are many lines of code that are changing the function in each sprint. The quality of the program should be evaluated in other ways. If you want to evaluate the quality of program by using defect ratio based on lines of code, you should gather modification area on program by each sprint. It is also necessary to keep track of corrected lines of code accurately.

Also, in the agile process, when planning the next sprint, prioritizing tasks is an important event to increase customer satisfaction. Therefore, it is important to decide whether to prioritize expanding the function rather than the quality level, or to determine the program quality of the function. Customers in global projects often have a gap in the way of traditional Japanese quality requirements and reasonable quality levels that customers expect. In an extreme case, a new system can be released even if there is a problem. This is because the use frequency of the function is extremely low, thus it can be said that occurrence of defects are extremely small. That is an acceptable situation in some global projects.

This paper describes how to evaluate the quality level before starting the Key User Test (KUT) and how to agree with customers and users by visualizing the quality of software.

2. Project outline

The evaluation project used in this study is one of the global projects in my company which is a large-scale enterprise system construction project with a development scale of 4 million lines of code.

Figure 1 shows the project structure. This figure indicates that the structure of the project consists of users in the business department, the Business Process Re-engineering Team (BPRT), customer IT department, and development vendors. Designers and developers are projects in which multiple vendors are involved, and basically the company and the team are different in function units. However, some staff members belong to different teams. The development team could not contact users directly. Always Development teams must contact BPRT to ask the requirements.

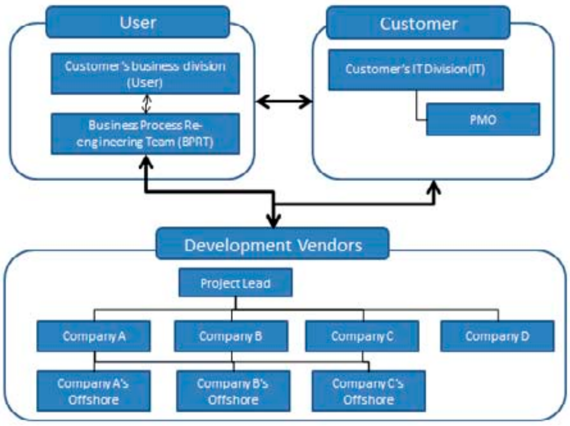


Figure 1 Project structure

For development scale, it was necessary to add or modify about 1 million lines of code to original program which created 4 million lines of code. In the past, there were some track records of releasing it to neighboring countries utilizing the same original program. However, this project structure and required specification were complicated compared with before experiences, thus quality management was important task in this project.

In addition, users use different systems because of different affiliated companies, and the requirements are different as well. Therefore, the new system should have complex functionality to satisfy user requirements, and the policy of the project changed frequently. For example, the schedule of KUT was changed frequently, and it was necessary to prioritize the development of the function in order to release it for the KUT.

The development process did not conform to the strict agile process. However, it was an example of implementation of iteration development style. The process was prioritizing by the product owner, developing the function, and releasing it in small units. Scrum is used as the agile process, and the sprint is the term of Scrum and refers to the iterative development period. Scrum is one of the agile frameworks for completing complex projects. In this project, the term of sprint is 2 months and the evaluation term was 3 sprints during 6 months. After a specific sprint had been finished, the project moved to the integration test phase. In this phase, project staff members will test the business scenario with BPRT in the integration test phase. And then if this business scenario passed, KUT phase will be started. KUT also will be done several times. After all of KUT has been finished, project phase will be moved to business simulation phase. Figure 2 shows schedule and dependency of each phase. It is important to agree with customers who belong to IT division and users about quality of program and quality of system. That is a challenge for moving the KUT phase.

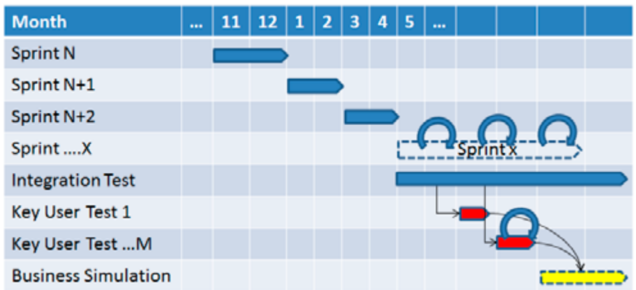


Figure 2 Schedule of sprint term

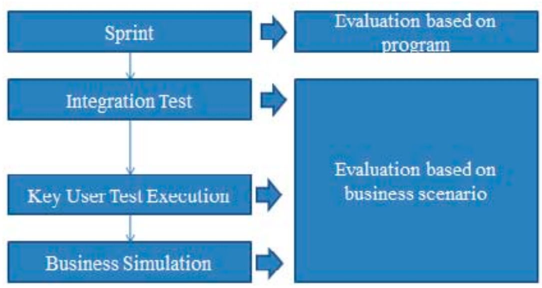


Figure 3 Test process

3. Methods in quality analysis and the way of release

This section describes the methods for analyzing program in order to agree with the stakeholders about the quality of program. Figure 3 shows test process. During sprint, quality control was performed based on program quality, and the Integration Test phase, KUT phase and Business Simulation phase were evaluated based on the business scenario.

3.1 Traditional quality analysis

In the traditional waterfall model, quantitatively it is analyzed by using the number of defects with developed program scale, and qualitatively it is evaluated by analyzing the content of the defect. In this measure, quality metrics were determined based on the traditional method and metrics to be applied were examined. Table 1 shows applied quality metrics. Quality metrics have several patterns and several axes. They will be compared with each sprint.

Table 1 Quality metrics

Pattern	Axis				
Defect ratio	Function	Team	Company	Designer	Developer
Qualitative Analysis	Defect Quality	Priority	Built in phase	Defect cause	
Frequency of occurrence	Time				
Program coverage	Function	Team			

3.2 Metrics based on program

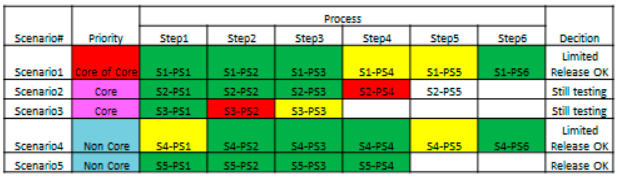
In this project, the customer often uses traditional waterfall process, thus our idea is to use traditional metrics like defect ratio. Most of the projects which use agile development do not focus on creating documents and a program checklist. The project policy decided not to make a checklist for each function and a checklist ratio was removed from quality metrics. Also, different tendency and comparison between each sprint result are an effective way to show quality of program.

3.3 Metrics based on business scenario

From the user's point of view, improving their business by using the new system is more important than program quality. Users are not interested in defect ratio. Therefore, the idea is to use a new metrics which is scenario passes status. Also this idea includes how to share the status of the target scenario with users.

At first, this method identifies user operations as an End to End scenario test and to divide scenarios for each main data pattern as much as possible. If there is a lot of flexibility in the scenario, it is difficult to finish the entire scenario.

The next step is to analyze transaction volume of the as-is system for each main data pattern in order to make it understand the volume by scenario. Utilizing the concept of ABC analysis, the test order is to test from the scenario occupying the majority of the transaction volumes and to solve in order from the core scenario which is important. ABC analysis is a well-established categorization technique based on the Pareto Principle for determining which items should get priority in the management of a company's inventory (Ravinder, 2014). Figure 4 is the sample worksheet to share the status of a progressive business scenario with the customer. It is easy to understand which scenario has issues or which step has issues based on the color. Red means that function has stopped. Users cannot choose another root to avoid this issue. Yellow means that there are issues. However, users can process the scenario by using another way. It is not a critical issue. Green means that there is no issue to process the scenario. Each step is related to an individual function.



Scenario#	Priority	Process: Step1	Step2	Step3	Step4	Step5	Step6	Decition
Scenario1	Core of Core	S1-PS1	S1-PS2	S1-PS3	S1-PS4	S1-PS5	S1-PS6	Limited Release OK
Scenario2	Core	S2-PS1	S2-PS2	S2-PS3	S2-PS4	S2-PS5		Still testing
Scenario3	Core	S3-PS1	S3-PS2	S3-PS3				Still testing
Scenario4	Non Core	S4-PS1	S4-PS2	S4-PS3	S4-PS4	S4-PS5	S4-PS6	Limited Release OK
Scenario5	Non Core	S5-PS1	S5-PS2	S5-PS3	S5-PS4			Release OK

Figure 4 Business scenario matrixes

3.4 How to process Business Simulation

After confirming the majority of the business scenario with KUT, the project will be moved to the business simulation phase which is doing the daily tasks involving the actual business users. Input data exactly the same as the transaction entered in the as-is system to the new system. Business simulation also confirms whether it can be realized in both the new system and the feasibility of work about manual operations such as tell or e-mail or paper work as well. Also, the business simulation period was implemented in units of at least one month and the monthly processing was also tested during this term.

4. Results and Evaluation

This section shows the results of evaluating the proposal metrics.

4.1 Evaluation of system viewpoint

Evaluation based on the system viewpoint was conducted based on defect management information. Quantitative and qualitative analysis was an important task in getting approval to move KUT phase between system development vendors and customer IT departments. Figure 5 shows the number of issues on each sprint. Customers who belong to the IT department were able to understand program quality roughly. Green means issues that are related to Solution Design Error. Yellow means issues that are an Internal Design Error. Red means issues that are related to coding. Blue are not actual issues. They are related to additional requirement. In Sprint N phase, there were a lot of program quality issues. Project management decided to review the source code and SQL to improve program quality. In Sprint N+1 phase, there were a lot of solution design issues. Project management took immediate action to solve these issues.

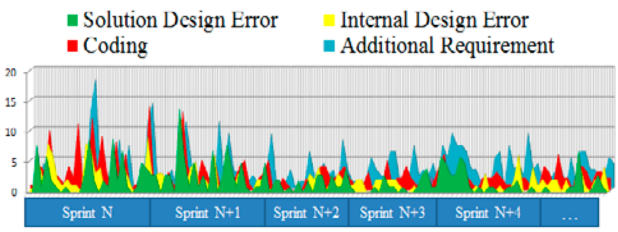


Figure 5 Number of defects in time series

Figure 6 and Figure 7 show the defect built in phase ratios per sprint. Figure 6 shows the summary of data. Figure 7 shows each team's result. It is easy to understand issues tendency on each sprint. According to Figure 7 data, Team C found issues that the developer's skill was weak because there were too many coding and internal design issues. There were many solution errors and additional requirements in Team E. Team E did not fully confirm user requirements at that time. The project leader was able to confirm related issues.

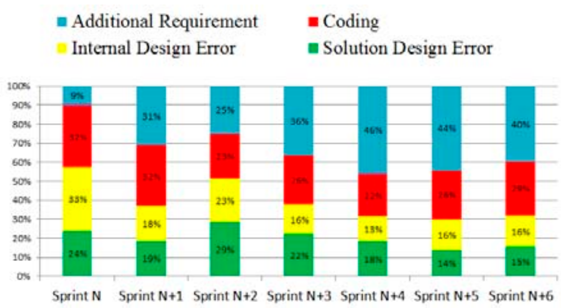


Figure 6 Defect built in phase ratios per sprint

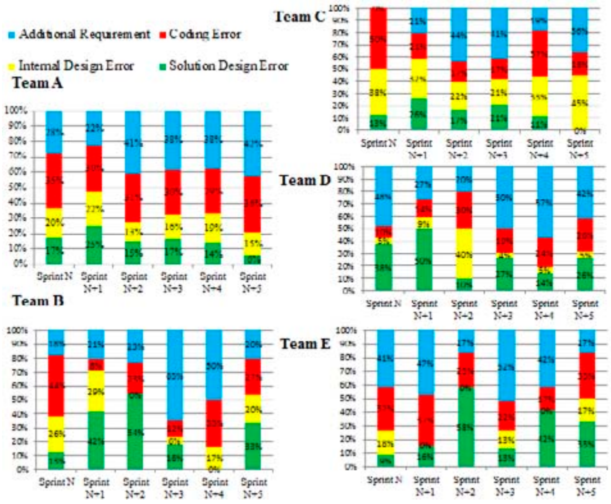


Figure 7 Defect built in phase ratios per Team

Figure 8 shows defect ratio per team. This figure was effective in grasping Team's ability. Compared to other teams, Team E in the figure shows that a lot of issues were occurring. In this case, the project leader confirmed the fault ratio of each person in charge, we could judge that it was attributed to the person in charge, and as a result we were able to take measures early.

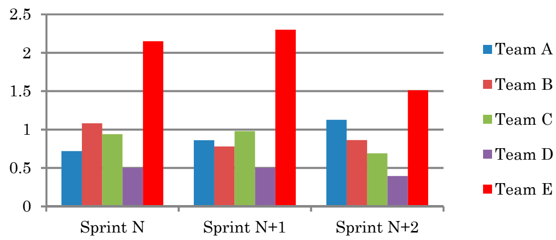


Figure 8 Defect ratios per sprint

Table 2 Issue criteria show the metrics to categorize issues which happened. Level 1 is the highest priority more than Level 2 and the other Levels. These metrics should be shared with the customer. Figure 9 shows that defect ratio by cause using these criteria. Figure 9 shows that Sprint N+2 was getting worse compared to the previous sprint. However, the project leader was able to take action to solve that issue by using this information.

Figure 10 shows Event vs defect count. The bar graph indicates the number of defects and the area chart indicates number of the access events by this scenario testing.

In the left side result, there are many defects compared with right side result in spite of few test executions. This figure was effective to prove that there are few defects after the adequate test scenario has been implemented. On the other hand, Left side functions were not good quality compared with other functions.

Table 2 Issue criteria

Issue level	Criteria
LEVEL1	・The system generate unintended data. ・Cannot create or update data. No workaround to continue test.
LEVEL2	・Search result is incorrect or cannot create or update data or there is workaround to continue test. ・Data transfer between screens is incorrect.
LEVEL3	・Cannot click Link, Pulldown, Button or value isn't populate or incorrect. ・Validation logic is incorrect.
LEVEL4	・Missing data validation or missing field. ・The screen populates incorrect default value. ・Data format is incorrect. ・Clear or reset bottom doesn't work correctly.
LEVEL5	・The screen doesn't populate default value. ・Upper or lower case handling.
LEVEL6	・Want to add or change search criteria or logic. ・Missing inquiry field.
LEVEL7	・Can edit field that doesn't need to edit. ・Narrow down popup or pulldown list. ・Screen transition is incorrect.
LEVEL8	・Unnecessary field, link, pulldown and button exits. ・Want to add the sorting order. ・Want to add popup or pulldown to search.

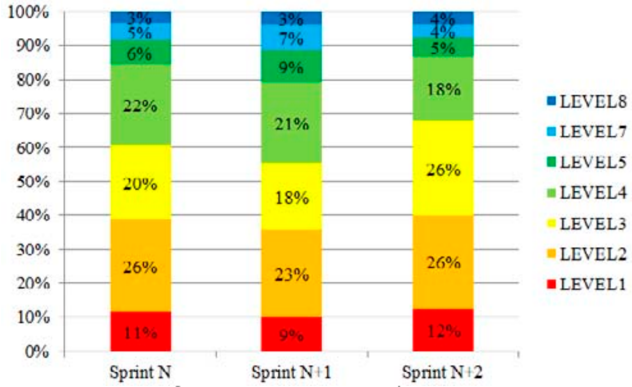


Figure 9 Defect ratios by cause

Figure 11 shows event coverage ratio per team. Evaluation at the event coverage rate was effective for judging whether the scenario was executing at the assumed level. However, it was not able to validate that the event execution covered with all of the corrected programs.

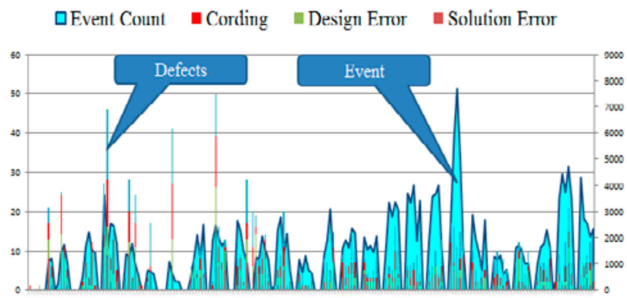


Figure 10 Event vs defect count

Category	Test in Sprint	Event Coverage	Test vs Event coverage
Team A	64.7%	70.6%	109%
Team B	66.0%	63.4%	96%
Team C	84.1%	78.0%	93%
Team D	74.8%	70.3%	94%
Team E	74.2%	72.1%	97%

Figure 11 Event coverage ratios

4.2 Evaluation of business scenario viewpoint

Prioritization of scenarios was classified into three stages; core of core scenario, core scenario, and non-core scenario. These three levels of classification could be classified efficiently in order to confirm which priority is high with customers and what is most necessary among core scenarios.

The level of detail described in this scenario was able to create a scenario efficiently without increasing the degree of flexibility. It was effective in the sense that there are not too many details. On the other hand, in case of high flexibility scenario, there were unnecessity requests from users by conducting the test which seems to be not the original scenario. To prevent this, we adopted a method to prevent the operation from the entrance by invalidating the link of the menu screen, the event button and so on. Furthermore, if it is necessary to control update and reference privileges, it was effective to adjust the access control.

In addition, in the progress report of the scenario, the integration test was performed by color coding of Green (No problem), Yellow (Problematic) and Red (Failed). However, extra discussion with BPRT occurred in these color classifications.
Basically, development vendor tends to set in Green. However, customers never said Passed without Issue. After all, most of it became Yellow. This was sensitive not only to customers but also to the colors of Green, Yellow, and Red on the user side. Green tended to think as "Ready to Go-Live", and there was a tendency to avoid making it Green.

As a result, at the beginning of the introduction of this measure, basically it did not become Passed Green. So we divided Performed (Tested) into two with Minor Issue (Light blue) and Major Issue (Orange). However, as these criteria could not agree with the customer on the standards of Minor Issue and Major Issue, most of it was Orange with Major Issue. When reporting to our management level, there was a possibility that a misunderstanding that we could not proceed with KUT phase because of many issues.

As a further remedy, the update of each step of the scenario was changed from the above three method to the two methods, and "Done" (Tested), "Failed" (Tested. However, could not be processed).

Furthermore, regardless of the presence or absence of an Issue, it is not expressed by color. As a result of implementing the business scenario, the detected issue was managed as linked to the operation scenario as much as possible, monitored for process critical issue, and reported to the customer IT departments and users at any time. Figure 11 is an improved scenario matrix.

Scenario#	Priority	Process						Decision
		Step1	Step2	Step3	Step4	Step5	Step6	
Scenario1	Core of Core	S1-PS1 Done	S1-PS2 Done	S1-PS3 Done	S1-PS4 Ready to Test	S1-PS5 Ready to Test	S1-PS6 Done	Limited Release OK
Scenario2	Core	S2-PS1 Done	S2-PS2 Done	S2-PS3 Done	S2-PS4 **Failed**			Still testing
Scenario3	Core	S3-PS1 Done	S3-PS2 Ready to Test	S3-PS3 Ready to Test				Still testing
Scenario4	Non Core	S4-PS1 Ready to Test	S4-PS2 Done	S4-PS3 Done	S4-PS4 Done	S4-PS5 Ready to Test	S4-PS6 Done	Limited Release OK
Scenario5	Non Core	S5-PS1 Done	S5-PS2 Done	S5-PS3 Done	S5-PS4 Done			Release OK

Figure 12 An improved scenario matrix

The visualization of this scenario matrix showed only whether the scenario went to the end or not. In addition to this, Success criteria were provided for each operation step. Success criteria were the minimum requirement for executing business at End-to-End. For example, that the amount calculation is correct, that Order can book and create Shipping Order. Also, even if other issues were found, they were marked "Done" and the color was "Gray" if the function was satisfied, the above Success criteria and the operation could be completed. If the function fails to satisfy the above Success criteria, it is marked as "Failed". As a meaning, the target scenario showed that it cannot proceed to the next process. Furthermore, apart from this chart, the Issue list was managed and categorized into categories such as whether issue is process critical, as-is guarantee, improvement request, and it was supplemental information for priority determination. By doing this, we were able to efficiently reduce scenario digestion and unnecessary remarks from key users. As a result, project was able to move to KUT phase as planned.

Finally, Table 3 shows a summary of evaluation metrics in each phase. This table indicates the Ease of evaluation and Evaluation of stakeholders. Agile process has benefits that helps delivered system to customer quickly and frequently. Therefore, Ease of evaluation is important how easy it can be evaluated. It indicates that most of the metrics can be used in this project. However, there were some challenges regarding defect ratio and event coverage. If we use defect ratio, we must calculate the number of lines of code to analyze the defect ratio for each sprint. Furthermore, it was difficult to link Event coverage with scenario coverage.

Table 3 Summary of evaluation metrics

No	Phase	Analyzed metrics	Ease of evaluation	Evaluation of stakeholders			
				Development vendor	Customer IT	BPRT	Users
1	Sprint	**Figure 5** Number of defects by each sprint	Good	Good	Good	N/A	N/A
2		**Figure 6** Defect built in phase ratios per sprint	Good	Good	Good	N/A	N/A
3		**Figure 7** Defect built in phase ratios per Team	Good	Good	Good	N/A	N/A
4		**Figure 8** Defect ratios per sprint	Fair	Good	Good	N/A	N/A
5		**Table 2** Issue criteria	Good	Good	Good	N/A	N/A
6		**Figure 9** Defect ratio by cause	Fair	Good	Good	N/A	N/A
7		**Figure 10** Event vs defect count	Good	Good	Good	N/A	N/A
8		**Figure 11** Event coverage ratios	Poor	Fair	N/A	N/A	N/A
9	Integration Test	**Figure 4** Business scenario matrix	Good	Good	Good	Poor	N/A
10		**Figure 12** An improved scenario matrix	Good	Good	Good	Good	N/A
11	KUT	**Figure 12** An improved scenario matrix	Good	Good	Good	Good	Good

We were able to confirm the effectiveness in each sprint by carrying out the analysis close to quality analysis with traditional waterfall model. On the other hand, expressing using detailed data can be an indicator for customer IT departments. However, there is a possibility of creating extra discussion from the user's point of view. Furthermore, in order to collect several metrics information, there is a possibility that the analysis cost will increase unless the collection method is automated by using the tools. Therefore, it is important to create a mechanism for automation in the execution logs and covering area when user tested.

In agile development, it is essential to release gradually. Based on the business scenario, we realized what can be released and found it important to share with customers. Especially, in the case of project management in the global project, gaps often occur in terms of how to use words, how to use colors, and so on. In order to drive the project, it was important to consider the customer’s culture, thought, and background as well.

5. Conclusions

In this paper, we introduced the approach of quality control based on an example of agile development in the global environment. Also, based on the information obtained as a result of these efforts, we analyzed consideration points for evaluation in sprint and considerations before KUT phase. We found that visualization of quality in agile development is an important tool for having a common recognition among customers, users and system development vendors in large-scale system development to lead the Project to success.

As discussed in this paper, we believe that we can utilize where we can utilize the traditional waterfall process and solve it by taking the characteristics of the global project into account. Further consideration will be needed to apply and evaluate this Metrics to other projects and to improve the accuracy of visualization of further quality.

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Project Characteristics for Agile Development with the Diamond Framework

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Agile development has been recognized as a method to deliver business value quickly to customers under a business environment where technology and market are changing so fast. However, agile development has not been so much widely used as compared with waterfall development. Agile development is an iterative method that adapts to changes. On the other hand, waterfall development is a linear and sequential method. These two methods are different. Project managers should select a right development method according to project characteristics. In this paper, the project characteristics to be suitable for agile development or waterfall development are defined by using the Diamond framework. The Diamond framework is a good tool to express project characteristics essentially and simply by four dimensions: Novelty, Technology, Complexity and Pace. For projects with high Novelty, Technology or Pace, it is considered effective to apply agile development which provides early value delivery and early risk mitigation through customer feedback. On the contrary, because formal project management is generally required to a project with high Complexity, project managers should pay attention to applying agile development. In geographically distributed organizations, the Complexity become high, so project managers need some actions when applying agile development. This paper will propose a way of selecting the right development method by using the Diamond framework. The effectiveness is going to be validated by examples of real projects.

Keywords & Phrases: Agile, Waterfall, Diamond framework, NTCP model, Novelty, Technology, Complexity, Pace

1. Introduction

The world is changing at very rapid pace. IBM Global Business Services. (2015) published the Global C-suite Study. It said that many executives in companies in the globe believed technology and market factors are by far the biggest of the various external forces buffeting their organizations. The boundaries between industries are continuing to erode, as companies in one sector apply their expertise to others. Companies are more looking and bolder about exploring the opportunities in related industries. Once a company decides to launch a new business model, product or service, the company must run a project fast successfully to realize profitable commercialization from innovative idea. Not only successful project delivery but also delivery speed is important for business success.

Agile development has been recognized as a method to deliver value quickly to customers. However, the agile development has not been so much widely used as compared with waterfall development. According to a recent survey on agile usage by VersionOne, Inc. (2017), 60% of respondents stated less than half of teams in their organizations are using agile practices. There is still plenty of room for growth of agile usage. The agile development is an iterative method that adapts to change. On the other hand, the waterfall development is a linear and sequential method. These two methods have different characters. Some projects are suitable for the agile development and others are for the waterfall development. If right development method is applied, the possibility of project success is getting high. However, if the right development method is not selected, the project risk is getting high. That is why project managers should know one size does not fit all and how to select right development method according to project characteristics.

Are there any good ways of selecting right development method for project? Judgement based on project manager's experiences may be often used. But, it cannot provide objective reason for selected method. As the more objective way, Mary, L. (2013) defines some factors which project managers consider when considering which methodology to use. Some organizations may have a kind of checklist which can calculate an appropriate candidate of development method for project managers. Fair, J. (2012) proposed a checklist to evaluate agile readiness of an organization. Such a checklist tends to have many questions, so the reason for the selection result can be sometimes complicated and the fundamental factor which affected the selection can be vague. Accordingly, the paper will propose a new simple way of selecting right development method with the Diamond framework. This approach can provide objective and clear reason for the selection of the right development method.

Shenhar, A. J. and Dvir, D. (2007) defined the Diamond framework, which is a good tool that can essentially and simply express the project characteristics by four dimensions: Novelty, Technology, Complexity and Pace. Project manager can recognize project characteristics visually with the framework and select right approach to manage project successfully. Novelty determine how new the product created by the project is to the mark, customer and potential users. Technology indicate technological uncertainty for project managers and project members. Complexity depends on product complexity. Pace is determined by how much time is available to complete the project. The further explanation on the Diamond framework is described in the section 2. For projects with strong characteristics of Novelty, Technology or Pace, it can be considered that effective to apply the agile development because the agile development can provide value to customers early and project managers can get customer feedback to adjust product requirement and design in early project phases.

The project characteristics are clarified with the Diamond framework for the agile development and the waterfall development in the section 3 and 4 respectively, which are based on advantages and disadvantages of agile and waterfall approach. The section 5 summarizes the relationship between project characteristics and development methods with one diagram. Some examples of real projects that are applied to the proposed diagram are also shown to verify the effectiveness. Conclusion is provided finally in the section 6.

2. The Diamond framework

2.1 Overview of the Diamond framework

Project characteristics can be defined in the Diamond framework by the NTCP model shown in Figure 1, which were proposed by Shenhar, A. J. and Dvir, D. (2007) . The NTCP model has four dimensions which are Novelty, Technology, Complexity, Pace. Each dimension includes three or four levels which define project characteristics. The NTCP model is a structured framework that project managers can use when making decisions about projects and about how they should be run. These decisions may involve selecting the right projects and their managers, allocating resources, planning, assessing risk, selecting the project management style, selecting the project's structure, building process, and choosing tools. In the following subsections, brief explanation of each dimension is described.

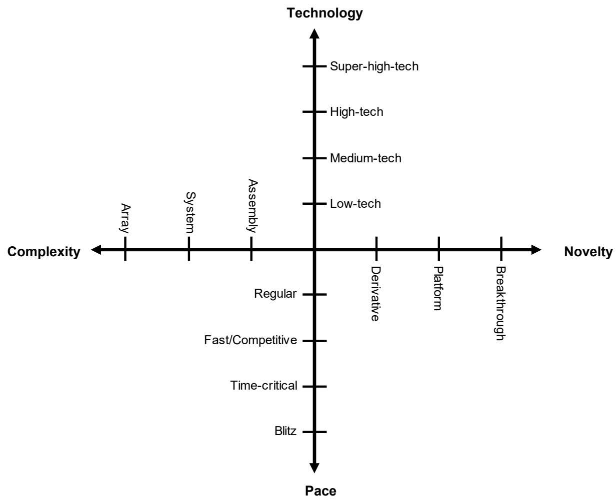

Figure 1 The NTCP model

2.2 Novelty

The Novelty base is determined by how new the product is to the market, customers, and potential users. The Novelty affects three major issues: the reliability of marketing research, the time it takes to define and freeze product requirements, and the specific marketing strategies for the product. The Novelty has three levels, Derivative, Platform and Breakthrough, which are defined as follows:

- Derivative: Extending or improving existing products or services,
- Platform: Developing and producing new generation of existing product lines or new types of services to existing or new markets and customers and
- Breakthrough: Introducing a new-to-the-world product of concept, a new idea or a new use of a product that customer have never seen before.

2.3 Technology

The Technology base represents the project's level of technological uncertainty. It is determined by how much new technology is required. The Technology includes four types: low-tech, medium-tech, high-tech and super-high-tech, which are defined as follows:

- Low-tech: uses only existing, well established and mature technologies,
- Medium-tech: mostly existing technologies and limited new technology or a new feature,
- High-tech: uses many new, recently developed, existing technologies and
- Super-high-tech: key project technology does not exist at the time of project initiation.

2.4 Complexity

The Complexity base represents the complexity of the product, the task and the project organization. The Complexity includes three types: assembly, system and array which are defined as follows:

- Assembly: physical substance, fundamental element and collection of components and modules combined into one unit and performing a single function of a limited scale,
- System: Complex collection of units, subsystems and assemblies performing multiple functions and
- Array: Large, widespread collection or network of systems functioning together to achieve common mission.

2.5 Pace

The Pace base represents the urgency of the project. The Pace includes four types: regular, fast/competitive, time-critical and blitz which are defined as follows:

- Regular: Time not critical to organizational success,
- Fast/Competitive: Project completion on time is important for company's competitive advantage,
- Time-critical: Meeting time goal is critical for project success; any delay means project failure and
- Blitz: Crisis projects; utmost urgency; project should be completed as soon as possible.

2.6 Impact of the NTCP dimensions on project management

Each of the NTCP dimensions affects project management in different way. Figure 2 shows impact of the NTCP dimensions on project management. The Novelty affects the accuracy of market predictions, the ability to determine requirements and timing of requirements freeze. The project hardly cannot get market data and the requirement freeze tend to be late when project's Novelty level is high. A higher Technology level requires increased design and development activities, more design cycles, later design freeze. The Complexity affects the project organization and procedures. When the level of Complexity is high, the project organization will be more complex and the project will need the more formal procedures. The Pace required increased attention to time deadlines. The project will need the greater autonomy under the high Pace characteristics.

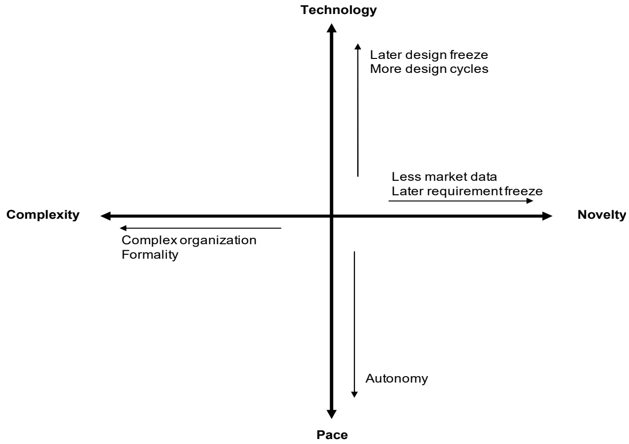

Figure 2 The impact of the NTCP dimensions on project management

Once project managers can recognize project characteristics correctly, the project managers can select a right development method and apply right project management method. However, if the project managers misunderstand project characteristics, the project will result in failure. The right understanding of project characteristics is one of keys to project success.

3. Project characteristics for waterfall development

This section describes project characteristics which are suitable for the waterfall development by using the Diamond framework.

3.1 Advantages and disadvantages of waterfall development

Goodpasture, J.C. (2010) considered that the waterfall development had both advantages and disadvantages. Some of major advantages of the waterfall development are as follows:

- Fits large and very large projects, distributed and outsourced workflow,
- Handles dependencies among large workforce and deliverables
- Has the potential for developing exceptional process capability maturity for repeatable and predictable outcomes,
- Large trained base of practitioners.

The waterfall development also has disadvantages as follows:

- Inappropriate where requirement cannot be fixed, or where customer changes are frequent,
- Delivery of business value is late in the life cycle,
- Changes coming late are very expensive to insert,
- Heavy, expensive, process and documentation.

3.2 Project characteristics for waterfall development with the Diamond framework

Based on the analysis described in the previous subsection, the project characteristics which are suitable for the waterfall development can be drawn with the NTCP model in Figure 3.

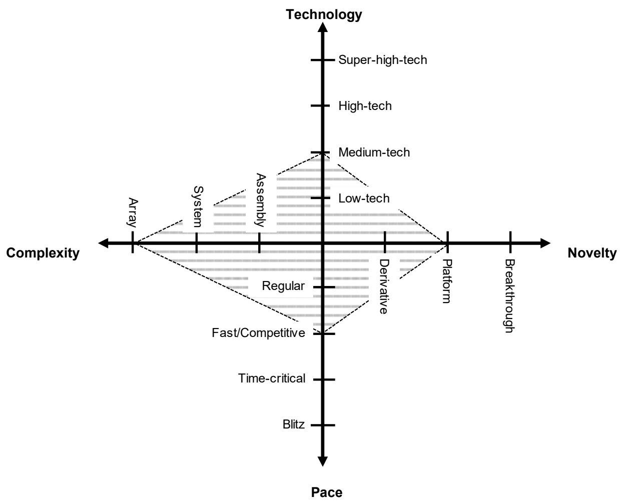

Figure 3 Project characteristics for waterfall development

The shaded area represents the project characteristics where the waterfall development can be effective. The waterfall project can be used from Derivative level to Platform level in Novelty because it is not appropriate to apply the waterfall project into Breakthrough project where requirement cannot be fixed until late timing of project lifecycle and many changes can occur. As for Technology, the waterfall development can be effective from Low-tech level to Medium-tech level. Although High-tech level and Super-high-tech level need multiple design cycle to freeze product design, the waterfall development is not iterative method but a linear and sequential method. The waterfall development can be used in all levels of Complexity because the waterfall development can fit large projects and handle large workforce and many deliverables as described in the previous subsection. Regular and Fast/Competitive in Pace base can be covered by the waterfall development. Because heavy processes and many documentations sometimes prevent the project from running quickly, project managers should pay attention to keeping agility in Fast/Competitive project.

4. Project characteristics for agile development

This section describes project characteristics for agile development by using the Diamond framework.

4.1 Advantages and disadvantages of agile development

Goodpasture, J.C. (2010) considered that the agile development had also both advantages and disadvantages. The major advantages of agile development are listed as follows:

- Rapid and frequent deliveries to production get the benefit stream going early,
- Relatively strong commitment to business milestones,
- Efficient adaption to changing customer priorities and requirements keeps the project current and relevant,
- The project objective is customer-centric and not necessary bound to a plan that is out of date,
- Validation of customer value is built in and almost automatic by design.

There are some disadvantage of the agile development as follows:

- Weak commitment to overall cost and scope
- Difficult to scale the small-team dynamics to an enterprise scope project
- Difficult to scale without commitment to documentation
- Difficult to contract the work team because requirements and scope are not known with adequate certainty

4.2 Project characteristics for agile development with the Diamond framework

The project characteristics which are suitable for the agile development can be shown with the NTCP model in Figure 4. The shaded area represents the project characteristics where the agile development can be effective.

The agile development can be effective in all levels of Novelty axis, Derivative, Platform and Breakthrough. Because the agile development is an iterative method, it can provide customer value to validate and adjust it through iterations. The agile approach can handle uncertainty of requirements better than the waterfall approach. The agile development can be also used in all levels of Technology axis, Low-tech, Medium-tech, High-tech and Super-high-tech. There are multiple design cycles and many changes raised to freeze design in a high Technology level project. The agile project can handle uncertainty of technology through iterations better than waterfall project like Novelty case. On the other hand, as for Complexity, the waterfall project can handle it better than the agile project. Only Assembly level of Complexity axis can be effective in the agile development because the agile method is difficult to scale project team dynamics to an enterprise level as described in the previous subsection. If the agile development is applied to a globally distributed organization, whose Complexity usually becomes high, project managers should take special actions, which are described in the documents by Amber, S. W. and Lines, M. (2013) and Woodward, E., Surdek, S. and Gains, M. (2010). Project managers must organize multiple teams, manage Product Backlog for multiple teams, put comprehensive communication method in place like the Scrum of Scrums and adopt collaboration tools between multiple teams. The agile development can be effective in all levels of Pace axis, Regular, Fast/Competitive, Time-critical and Blitz. The agile method can provide strong commitment to business milestones and frequent deliveries to production rapidly.

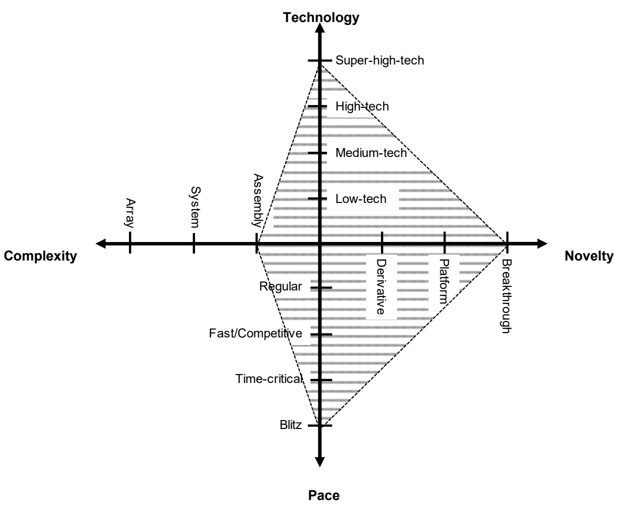

Figure 4 Project Characteristics for agile development

5. Project characteristics and development methods

5.1 Project characteristics and development methods with the Diamond framework

According to section 3 and 4, the relationship between project characteristics and development methods can be drawn in Figure 5 with the Diamond framework.

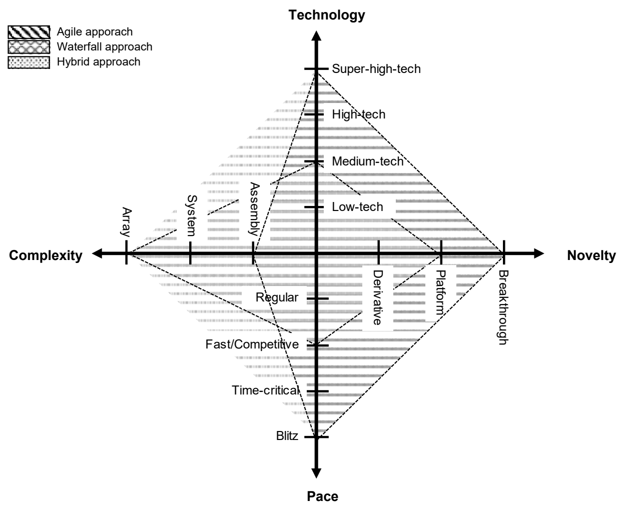

Figure 5 Project characteristics and development methods

The area of diagonal striped shade represents the project characteristics which suitable for the agile development. The area of diagonal grid pattern represents the project characteristics for the waterfall development. The overlapped area located at center of the Diamond diagram is the project characteristics which is effective for both the agile development and the waterfall development. The light gray grid area, which is the remaining area not described in the previous sections, is not suitable for either the agile development only or the waterfall development only. The project has very high risk in Technology and Complexity, Complexity and Pace or all of them. What project managers can do in such a project is applying hybrid approach which can enable advantages of both agile and waterfall approach or decomposing the project into some sub-projects which have only agile characteristics or waterfall characteristics.

By using the diagram proposed above, project managers can recognize project characteristics and suitable development method correctly. Then, the project managers can apply right project management approach. The next subsection provides examples of projects applied to the diagram.

5.2 Project examples

The first example is a real project building a new entire enterprise Information Technology (IT) system for a bank in Japan, which is denoted by Project A. The project has been executed successfully by the waterfall development.

The Project A built a new IT system, so the project had Platform level in Novelty. The project used existing technologies, then the Technology level of the Project A was Low-tech. The Complexity of the Project A was System level because the project consisted of many subprojects which developed IT infrastructures and business applications in parallel. The Pace of the project was Regular level. Then, the project characteristics of the Project A can be drawn by the checked diagram in Figure 6. The area of the Project A is in the area for the waterfall approach. The diagram can indicate the Project A is suitable for the waterfall development.

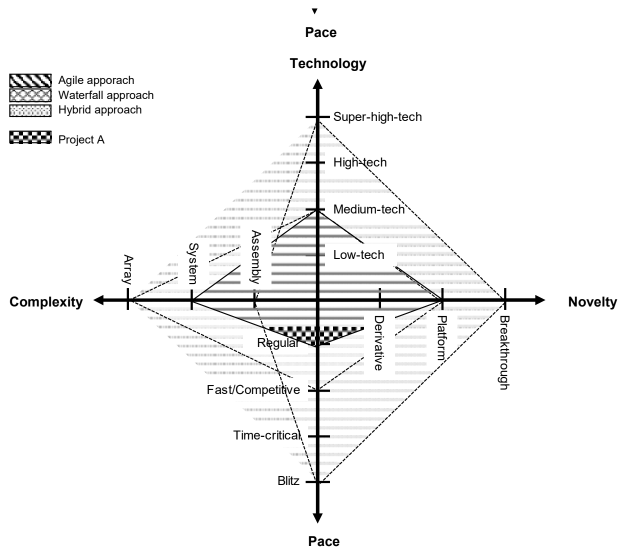

Figure 6 Project characteristics of Project A

The second example is a project creating new business process and IT system to run a benchmark on business status in a company, which is denoted by Project B. The project has been executed successfully by the agile development.

The project created new business process which was realized by some new technologies. Then the Project B had Platform level in Novelty and High-tech level in Technology. The project B has Assembly level in Complexity and Regular level in Pace because there were no special requirements for them. The characteristics of the Project B can be drawn by the checked area in Figure 7. The characteristics of the Project B in the area which is suitable for the agile development. The diagram can also identify the Project B is suitable for the agile development.

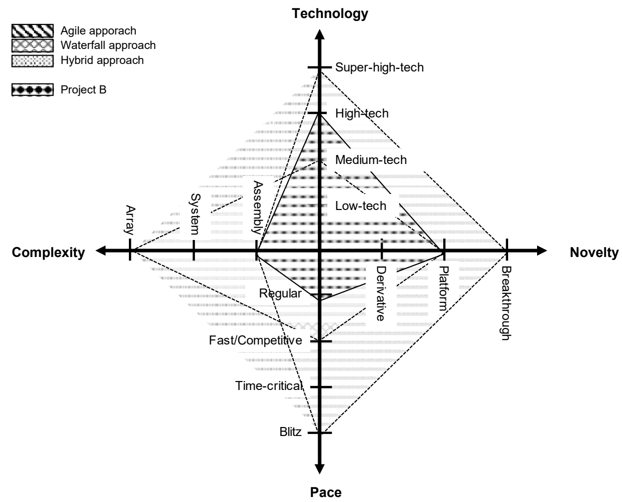

Figure 7 Project characteristics of Project B

The examples described above show that the proposed diagram can be used for the selection of development methods based on the project characteristics.

6. Conclusion

The paper proposed the project characteristics which were suitable for the waterfall development and the agile development by using the Diamond framework. The diamond framework is the tool which can express the project characteristics simply and visually. Project managers can identify the right development method for projects by using the proposed diagram. The effectiveness of the proposed diagram was verified by examples of real projects.

The waterfall development is effective to the project which have high Complexity. The agile development can be applied to the project which have high Novelty, Technology and Pace. Project managers should recognize right project characteristics and select right project approach for project and business success. Although the agile development has not been so much widely used as compared with the waterfall development, the agile development, which has advantage for Novelty, Technology and Pace, can get commonly used under the competitive business environment where many executives indicate technology and market factors are the biggest external forces, that is, there is high uncertainty of Technology and Novelty.

The further detailed study on project management method of the agile development when the each of the NTCP dimensions is high is the future work for more spread of the agile usage.

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A New Way of Managing the Unexpected in Projects?

- Intelligently handling formalised structures -

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Abstract: This conceptual paper, based on intense literature review in the field of project management, human factors and organisational research, argues that important lessons can be drawn from high-reliability organisations for managing complex und uncertain projects, with regard to an open and no-blame learning culture, decentralised decision-making processes and mindfulness. To manage the unexpected demands the combination of apparently opposites: both a high degree of flexibility and open communication and a culture of clear decision-making structures and responsibilities. To balance this centralization and decentralization is one of the cornerstones of mindful organising. A few core cultural values, enforced by group pressure, combined with a flexible choice of means by which these values are realized help managing unexpected events. This paper will underline that becoming mature in managing the unexpected in projects asks for a redefinition of hierarchy in terms of a shift towards intelligently handling formalised structures. It remains important to have a clear basis to act on when faced with the unexpected. But the project team and its manager should become empowered to negotiate its way to actions.

Keywords and phrases: Unexpected, Uncertainty, Complexity, Human Factors, Situation Awareness

1. Introduction

We today live in a world characterised by volatility, uncertainty, complexity and ambiguity (VUCA, Bennett and Lemoine, 2014). Project teams and project-oriented organisations attempt to overcome uncertainties by anticipating possible changes as early as possible. Consequently, the management of complexity is often interpreted as transferring uncertainty into defined, controllable structures and processes. While trying to deliver the desired strategic outcomes in a predictable manner, some organisations nowadays increase direct control, and reduce trust and transparency when faced with the unexpected.

Against this trend, others believe the opposite to be promising in uncertain situations: a high degree of freedom for the project team allowing for quicker decisions and self-determined choice to successfully respond to unexpected events. These organisations react with internal flexibilisation, such as agile project work and ad hoc teams, expert pools and fluid organisations, resilient and adaptive structures (Snowden and Boone, 2007; Busby and Iszatt-White, 2015).

Common to both solutions is the opinion, that new procedures must be implemented to manage the unexpected, focusing on the need to re-arrange structure and flexibility. Based on theoretical considerations this conceptual article asks what the challenges for project-oriented organisations in complex and uncertain environments are, and which configurations make sense to achieve resilience of project teams?

2. Complexity, uncertainty and the unexpected

Project-oriented organisations face environments differing in complexity. Accordingly, they need varying degrees of maturity in dealing with uncertainty. While organisations in complicated environments get by with a well-developed risk management, ‘mature’ organisations are characterised by being able to deal also with complex situations with a high level of uncertainty.

Complexity is herein defined as a state where more linkages exist than we (normally) can describe or analyse (Luhmann, 1995). Complex systems are characterized by unstable input-output relationships, system boundaries changing over time, and system behaviour that is not (fully) depending on the past (Checkland, 1999). In this situation, we are forced to select important and not so important causes and effects, and have to decide when to stop searching for further linkages. Any one best way is redefined to one best way for each given situation and for each given person.

The concepts of risk and uncertainty are concerned with future predictability, and thus are closely connected to information: Basically, the less information we have, the more difficult are statements about future developments. The major difference between these concepts is predictability.

Risk is, at least in principle, calculable, and predictions can be expressed by a statistically or mathematically determined probability.

Uncertainty, on the other hand demarks events in the future that are unknown and/or their consequences cannot be estimated. It is no surprise then that any (traditional) management approach is also about avoiding uncertainty. Whenever uncertainties occur, they are to be converted into risks as far as possible, thus making them plannable and manageable. This holds true especially for project management. Ensuring conformance to time, budget and scope constraints is the maxim of traditional project management. The idea is that formalised planning and controlling procedures allow for a tighter control in order to be successful. In this vein, processes like risk management are supposed to make it possible to transfer threats and opportunities into – basically calculable and therefore decidable – risks. The concept of risk even seeks to describe in detail such situations which are not fully predictable and controllable and thereby calculate their probability of occurrence: 'The typical way to incorporate this uncertainty in project modelling is by means of stochastic networks where activity costs and durations are not deterministic but follow certain probability distributions' (Acebes et al., 2014, 424).

When referring to the *unexpected*, we can differentiate between events that occur totally surprising, and 'outcomes or events that actors have identified as possibly existing, but do not know whether they will take place or not' (Geraldi et. al, 2010, 553). This spectrum of growing uncertainty is frequently known by the labels of known knowns, known unknowns, unknown knowns and unknown unknowns (Winch, 2010; Winch and Maytorena, 2012; Sanderson, 2012; Cléden, 2009; De Meyer et al., 2002). Uncertainty can either be seen as a lack of data necessary to assign objective probabilities to an event ('unknown knowns' where expectations grounded in historical practice are used for a subjective probability) or as an inherently unknowable future ('unknown unknowns' which are socially constructed; Sanderson, 2012; Winch and Maytorena, 2012). The conceptualization of the 'unknown unknowns' reflect 'the actuality of projects as social processes requiring ongoing construction of the appearance of certainty and clarity in the midst of complex uncertainty and ambiguity' (Atkinson, Crawford, and Ward, 2006, 696). Project uncertainty can be determined by environmental, individual, complexity, information, temporal and capability factors (Saunders, Gale, and Sherry, 2015).

3. Exploring new avenues

Rather than following best practice project management models as starting point of research, newer approaches, such as 'projects-as-practice' (Blomquist et al., 2010), highlight the everyday struggle of keeping projects on track while dealing with uncertainty. The identification of uncertainties needs an open approach less oriented towards planning: 'projects are better described as journeys of exploration in given direction, rather than strict plan-following endeavors' (Perminova et al., 2008, 74).

Traditional perspectives declare impulsive action, feelings and intuition as subjective processes which compromise coordination and decision-making. In contrast, recent studies attach high importance to these subjective processes as a pre-condition for coordination. Atkinson et al. (2006, 688) suggested that uncertainty management asks for 'generic management processes associated with building trust, sensemaking-organisational learning, and building an appropriate organisational culture'. Recent approaches of managing uncertainty are promoting irrational perceptions as the major source of information, of quick decision-making and of quality of actions. Information is no longer made available only through rational, analytic and conscious thought but also through sensual perception (Neumer, 2009).

3.1 Governing in projects

Recent methodologies of work organisation such as agile and lean project management, design thinking, or holacracy are proposing other ways of coordination to deal with uncertainty. What they all have in common, is summarized by Bernstein et al. (2016, para. 17): 'Members share accountability for the work, authority over how goals are met, discretion over resource use, and ownership of information and knowledge related to the work.'

As all these forms are short-cyclical and inspire participative and responsive structures (Bernstein et al., 2016), customer or stakeholder feedback is being received quickly. This allows for a more flexible approach towards managing uncertainty. A no-blame culture and high transparency of task fulfilment ensure permanent and joint learning.

To balance centralization and decentralization is one of the cornerstones of mindful organising. A few core cultural values, enforced by group pressure, combined with a flexible choice of means by which these values are realized help managing unexpected events. 'When problems occur, let decision making migrate to the people who have the most expertise to deal with the problem.' (Weick and Sutcliffe, 2007, 160).

But still plans have to be made: 'Project Plans are repositories of expectations on which managers build their daily activities and hence there is a logical chain where our expectations about the future guide our actions today' (Söderholm, 2008, 81). Plans set aims and thus help selecting means and operations. Plans define a collective understanding for the project, and enable people to detect and correct deviating developments.

Additionally, project managers also need to 'exercise the art of managing the unexpected parallel to executing the plan' (Söderholm, 2008, 81). Project governance as a consciously designed form of organisation concentrates on building organisational infrastructure, capabilities and culture to facilitate trust (Atkinson et al., 2006; Clegg et. al, 2002; Pitsis et al., 2003). Whereas spontaneous governing in projects, partly considered in the 'projects-as-practice' approach, focuses on how projects are carried out in a social and institutional context under the influence of different socially situated activities, norms, values and routines, and people (Hällgren and Söderholm, 2012). Söderholm (2008) showed that project managers make use of innovative action (by creatively designing action patterns such as re-shuffling of resources or outsourcing), extensive meetings keeping up team commitment and urgency, detachment from other project activities, or negotiation of project conditions to deal with unexpected events rather than just executing the plan.

3.2 High-reliability projects

Weick and Sutcliffe suggest following principles taken from High Reliability Organisations (HRO) as a lens when interpreting unexpected events. In retrospect, project managers should take their teams through decision-making involved by using systematic review procedures, and reflect on how to handle the event more mindfully (Weick and Sutcliffe, 2007). Mindfulness requires people to focus on failures rather than successes, on gut instinct rather than on strategies and to acknowledge that others might know more than oneself.

Also, Saunders, Gale, and Sherry (2016) analysed project management responses to project uncertainty taken from high reliability practices. In an empirical study based on 47 vignettes of safety-critical civil nuclear and aerospace projects, they found out that project managers adopted high reliability practices for managing uncertainty in projects (Saunders et al., 2016):

- They worked with assumptions and drew on all expertise available both within and beyond the project organisation to try to reduce uncertainties;
- They took visible actions that rewarded openness and knowledge sharing and had received decision-making powers delegated from top management;
- They were allowed to flexible and staged conformance to project processes and to encourage the team to negotiate their way to a situation-specific action plan.
- They emphasized the need to understand what they did not know by actively asking simple questions and having regular meetings and status reports to help uncover the status of specific issues.
- They adopted a 'risk mind-set' that enabled them to deal with ambiguity, to balance the tension between being in complete possession of all information required and the need to drive project progress.

Even though high-reliability organising has originally focused on safety-critical environments only and on absolute reliability, we believe that important lessons can be drawn for managing complex projects, with regard to an open and no-blame learning culture, decentralised decision-making processes and mindfulness. When drafting 'high reliability project organising', Saunders (2015) has generated the following hypotheses:

- High-reliability projects have clear high-level decision-making rules to enable the project team to make progress even in uncertain situations. A strong sense of mission needs to be developed and articulated in the team.
- High reliability projects have a strong organisational culture built on openness,

communities of practice, team learning from mistakes, knowledge sharing, multidisciplinary problem solving and trust.

- In high reliability projects, the team is encouraged to discuss and negotiate its way to a plan of action matching the specific project situation; a flexible and staged conformance to project processes is possible.
- Complacency is a threat to project success: the project team is resilient and reluctant to simplify interpretations of project situations. Reflection, robust debate and even elements of anarchy are fostered in high reliability projects.
- With an 'ability to prosper in the paradoxes', high reliability project organising is encouraging redundancy and conceptual slack in terms of processing multiple interpretations of events.

4. Managing the unexpected in projects

With Saunders' approach in mind, this conceptual paper will now address the relevant target groups, namely project managers, project teams and the organisation and identify their options for action along the following timeline:

(1) the phase *before* an unexpected event occurs, marked by the need to anticipate the unexpected as early as possible;
(2) the phase *during* the handling of the unexpected, which requires the team to accept the new situation without trying to force it into existing mental models;
(3) the phase *after* having managed the unexpected, marked by alignment of the organisation with the gained knowledge in order to better prepare the staff for future events.

4.1 Project manager's perspective: Empowering others

Before the unexpected occurs, the project manager should create a constructive team atmosphere and empower the team to define its way to reach the project goals by itself. He or she should also ensure that the team is well-trained with regard to developing resilience in times of crises.

During the management of the unexpected it is not automatically the project manager's responsibility to take decisions. The project manager should quickly delegate the decision power to the one team member that can contribute the most to solving the problem by knowing the most about the unexpected situation. In this phase, it is important for the project manager to communicate with the top management in an efficient and direct way, with oral reporting rather than lengthy reports in written form.

After handling the unexpected, the project manager needs to make sure that learning processes are brought into action so that the team can better deal with similar situations in the future.

4.2 Project team perspective: Shared situation awareness

Before the unexpected occurs, team building efforts should become of utmost importance, with the goal to achieve shared points of reference for decisions and to become mindful and open towards uncertainty. There is a need to create a team culture that is sensible for the unexpected. That is closely connected to a no-blame or just-action attitude, a high transparency of task fulfilment and permanent and joint learning, especially with regard to developing resilience.

The advantage of flexible reaction *during* the handling of the unexpected is lost, if persons set existing knowledge, beliefs, expectations, and skills absolute. There therefore is a need for mental models that help to portray the 'real' conditions appropriately. For once, the 'wisdom of doubt' protects persons to apply existing knowledge without reflection to new situations (Weick and Sutcliffe, 2001). In most cases, a better understanding can only be achieved by a diverse team with different views and approaches. Shared situation awareness allows the team to understand the initial situation in a common image and to take the actions the new situation requires (Schaub, 2012). A 'shared situation awareness' must therefore be assigned a key role in managing the unexpected. Shared situation awareness requires three things: appropriate visual preparations which are understood by all parties concerned; the willingness to raise and to allow critical questions on the team level, and even invite team members to take the position of a 'devil's advocate'; and an organisational culture that calls for contradictory observations and views and welcomes the opinions of unconventional thinkers.

Through mutual feedback, project teams can prepare themselves *after* having managed the unexpected to avoid mistakes in the future. We need a 'culture of errors' that allows to talk about errors and failures rather than displace them, a culture in which mistakes are accepted.

4.3 Organisational perspective: Accepting 'illegality'

To be able to communicate quickly, it is important to have a clear picture of one's communication network *before* the unexpected occurs that could be activated in crisis situations. The form of communication should also be clarified in advance.

All researchers agree that more and open communication is crucial to address the unexpected (Barton and Sutcliffe, 2017). Weick and Sutcliffe (2007) stress the importance of face-to-face interactions and direct communication *during* change or crisis situations to create a collective understanding of the situation. But the tighter the time horizon, the more restricted communication must be to avoid information overflow and allow for quick reaction. Communication is very time consuming. To gain valuable information in a timely manner and to secure the co-ordinated action in response to the unexpected, it appears necessary to communicate at the same time more intense, but also to be more specific and selective. And it is equally important to have clear and comprehensive language at hand.

Many authors ask for flat hierarchies and liquid, at least adjustable responsibilities. As Weick and Sutcliffe (2001, 160) put it: 'When problems occur, let decision making migrate to the people who have the most expertise to deal with the problem.' Approaches like Agility (Beck et al., 2001) or concepts like Holacracy (Robertson, 2015) promise to be better suited for a complex and fast-changing world with a bunch of daily surprises just because they reduce traditional hierarchies, duties and fixed responsibilities.

A closer look at these concepts shows that they do not abolish hierarchy in the original meaning, i.e.: defined area of accountability, functional responsibility and communication flow patterns (Luhmann, 1964). Rather they re-define them away from stable and formal norms to learning and adaptable structures. Just because the unexpected can disrupt structures, it is even more important to have a clear basis to act on: As structures serve as a guide in the minds of the members of the organisation, they must continue to exist particularly in crisis situations, so that the individuals can align their actions to it meaningfully (Weick and Sutcliffe, 2001).

Previous research on micro-politics in organisations has stressed the mutual dependency of control and autonomy, formality and informality (Crozier and Friedberg, 1980). Some would even go one step further and tolerate a certain degree of illegality, if this illegality is useful (Neuberger, 1995). In business life, 'useful illegality' is widely accepted – and embedded in still clear (formal and informal) structures (Kühl, 2007).

Even with flat hierarchies and open communication, coordination and common orientations are still necessary, especially in turbulent fields. Thus, reducing the impact of more formal decision-making premises must be accompanied by a growing importance of less structured premises for the decision process: these are persons and (organisational, team) culture.

For managing unexpected situations, organisations should allow for flexible teams along informal knowledge and adaptable responsibilities. Decision power should migrate to the persons with the most expertise of the specific uncertain situation. This asks for a new hierarchical understanding where informal networks are given the competence to act.

This culture change must also be accompanied by a structural change in HRM systems, most notably reward and career systems. *After* the unexpected has been managed, organisations and managers must concentrate on rewarding team performance and organisational reliability (Nachbagauer, 2013; Neckel & Dröge, 2008) rather than individual performance.

5. Conclusion

The focus in project management research and practice has shifted from tools and techniques to understanding the human factor, organisational culture and change processes.

Newer approaches, such as agility and high-reliability practices, promise solutions by redefining hierarchy in terms of a shift towards intelligently handling formalised structures. New chains of responsibilities need to become established when the unexpected occurs. Rules should be flexible enough to act within them. But if necessary, a certain form of 'illegality' and breaking of rules should be accepted by the organisation. This allows the project team to negotiate its way to actions adequate for handling the uncertain situation.

Ex ante team building efforts and face-to-face interactions in crisis situations help generate intersubjective meaning and develop a common situational model for action (sensemaking), combined with the 'wisdom of doubt'. But the need for intense communication also asks for clear communication structures and a shared language when faced with high time-pressure. Communication should be selective, specific and intense but in an efficient and oral manner according to a predefined communication form for each type of information. It remains (or is even more) important to have a clear basis to act on when faced with the unexpected.

To manage the unexpected demands the combination of apparently opposites: We ask both for a culture of clear decision-making structures and responsibilities and a high degree of flexibility and open communication. This cannot be solved in an either-or-manner, but deserves a unique equilibrium of structure and autonomy for each project.

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A Study of the Lessons based on Historical Sub-Leaders from the Point of Project Management

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At Project management field, several project management theories, management tool etc. are proposed to carry out project management. However, it was said that experience of each project member and knowledge based on their experience were more important factors for the successful project management. As one of the method to prepare the lessons learnt from this point of views, analyzing and studying the historical projects and/or personal characters are proposed. For example, some study reports are analyzing about the historical leader such as Hideyoshi Toyotomi the reason why he could successfully carried out his project. On the other hand, the performance of sub-leader is one of the important factors on successful project management and good operation of his organization through the following missions. For example, there are support to leader, acting on behalf of leader and communication between leader and his project members and so on. It is reported that performance of sub-leader is sometimes critical matter for result of project. It is significant to study the performance of sub-leaders because it helps to increase the success probability of projects. In this paper, the performance of the sub-leader to support leader in various period is analyzed and studied from the point of project management. Then, the lessons learnt for sub-leaders' performance are generalized by extracting common key factors from successful project management.

Keywords and phrases: Assist, Staff Officer, Deputy Leader, History, PMBOK

1. Introduction

At Project management field, several project management theories, management tool etc. are proposed to carry out project management. However, it was said that experience of each project member and knowledge based on their experience or intuition were more important factors for the successful project management. As one of the methods to prepare the lessons learnt from this point of views, analyzing and studying the historical projects and/or personal characters have been proposed (Uchihori, 2008). For example, some study reports are analyzing about the historical leader such as Hideyoshi Toyotomi, who united the whole country in the Warring States, the reason why he could successfully carried out his project.

On the other hand, the performance of sub-leaders is one of the important factors on successful project management and good operation of his organization through the following missions (Tejima, 2012). For example, a sub-leader has three missions or roles as following (CIA, 2015).

(1) Supporting to leader

It is to become a consultation partner of the leader and to compensate for the deficiency in the leader's thought

(2) Acting on behalf of leader

It is to fulfill the role as a leader in the absence of him.

(3) Bridge between leader and his project members

It is to tell members thoughts of leader which is difficult to convey directly. It is also to tell leader opinions or requests of members which is difficult to ask directly.

In this paper, the performance of the sub-leader to support leader in various period is analyzed and studied from the point of project management. Then, the lessons learnt for sub-leaders' performance are generalized by extracting common key factors from successful project management.

2. Purpose of the research

The purpose of this research is to find the lessons of project sub-leader's behavior which are applicable nowadays. The approach is consist of two steps. The first step is to analyze and study the performance of the sub-leader to support leader in various period from the point of project management. The second step is to generalize the lessons learnt for sub-leaders' performance by extracting common key factors from successful project management.

3. Research methods

In this research, some sub-leaders in various period are selected and their behavior is extracted and analyzed from the point of ten knowledge areas in PMBOK (PMBOK, 2014).

The criteria of selecting sub-leaders are as follows.

(a) Japanese people

Japanese people are focused in this study because the purpose of this study is to find lessons for Japanese people. Lessons extracted from foreign people must not be fitted to Japanese people due to the difference of personality, sense of values and behavior.

(b) Various periods

Sub-leaders are selected from various periods because the purpose of this study is to find lessons which are independent of periods.

(c) Well-known leader

The leaders are well-known because there is likely to be various documents in which the stories of them are described.

The sub-leaders selected in this study based on the above criteria are shown in table 1.

4. The analysis results

The selected behavior of sub-leaders is shown in table 2 and the result of classification of them into ten knowledge areas in PMBOK is shown in table 3.

5. Discussion

The knowledge areas including supportive behavior of sub-leaders are human resource, stakeholder and integration in order as described in table 3.

The knowledge area with the most supportive behavior of the sub-leaders is human resource. Human resource includes motivation of project members. Improvement in motivation leads to improved productivity and leads to the project success (Aida, 2000). It is found from supportive behavior relating motivation of sub-leaders that they manages motivation not only of members but also of leaders.

The knowledge area with the second supportive behavior of the sub-leaders is stakeholder. It is found from supportive behavior relating stakeholder of sub-leaders that they do various kinds of works such as communication to people outside of the project team, collecting information from them, coordination with them and so on instead of leaders who must focus management of the whole of the project team.

The knowledge area with the third supportive behavior of the sub-leaders is integration. Integration includes various works relating the whole project. It is found from supportive behavior relating integration of sub-leaders that they make policies as a persons in charge of some specific areas like tactics, technology etc. There are many cases in which sub-leaders also contribute to the whole project team.

The lessons applicable nowadays from above discussion are as follows.

(a) Lesson 1

Sub-leaders must manage motivation of not only project members but also project leader.

It is based on B1, C1, E4, H1 and I1 in table 3.

Though a leader manages the motivation of the project team members as a whole, no one in a project may manage leader's motivation. If a leader becomes negative in the face of problem or difficulties, it is sometimes difficult to maintain his motivation by himself. In such cases, a sub-leader is responsible for leader's motivation management. It will lead to motivation management not only for the leader but also for the entire project team.

(b) Lesson 2

Sub-leaders must work as a bridge not only between leader and his project members but also between stakeholder outside the team and his project team.

It is based on A2, C2, C3, C8, C9, D3, E1, E2 and E5 in table 3.

As mentioned above, a sub-leader has a lot of involvement with outside stakeholders. However, among the three roles of the sub-leader mentioned in the section 1, there is no role as a bridge between the project team and the outside stakeholder of the team. Because a leader tends to concentrate on the management of the entire project team, it is thought that a sub-leader need to deal with external stakeholders.

(C) Lesson 3

A sub-leader must be in charge of some specific areas.

It is based on B3 C2, C4, F1, H1 and I1 in table 3.

As mentioned above, a sub-leader is often responsible for some specific areas and the establishment of operation policies concerning them. It leads to a reduction in the burden on the leader, easier taking over in the absence of a leader and better communication with project team members. In the problem of modern sub-leaders, it is often said that sub-leaders themselves cannot identify their work and do not know what to do in their project team (Suzuki, 2009). It will lead to motivation management of the sub-leaders to play some roles.

6. Conclusion

In this paper, behavior of some historical sub-leaders in various periods are analyzed from the viewpoint of project management and three lessons are extracted. By utilizing these lessons in the present period, it is thought that the project can be made easier to lead to success.

Future works are as follows.

(i) Focusing on historical sub-leaders of foreigners

By focusing on historical sub-leaders of foreigners, lessons which are not seen by Japanese sub-leaders may be found.

(ii) Increasing the number of historical sub-leaders to be surveyed

As only nine historical sub-leaders have been surveyed in this paper, the other lessons will be able to be obtained by increasing the number of sub-leaders to be surveyed.

(iii) Verification of extracted lessons for sub-leaders

In this paper, it is extracted three lessons for sub-leaders in order to make a project easier to lead to success. To verify them in the present period is for further study.

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Table 1 Sub-leaders to be surveyed in this paper

Sub-leader	Birth year - Death year	Leader	Summary of the Sub-leader
Nakatomi no Kamatari	614-669	Naka no Oe no Oji	NAKATOMI no Kamatari contacted Prince Naka no Oe no Oji in anticipation of Japanese politics that The Soga clan control as they like. They raise the coup d'état called Taika Reforms in which Naka no Oe no Oji killed Soga no Iruka. The Fujiwara clan who wins power in the Heian period corresponds to the descendant of NAKATOMI no Kamatari.
Ooe no Hiromoto	1148-1225	Minamoto No Yoritomo	Ooe no Hiromoto was a lower aristocrat serving the Imperial Court until mid-thirties. He could not get ahead, so he went down to Kamakura based on his elder brother's advice. He became a close adviser of Minamoto No Yoritomo who established Kamakura Shogunate because he had the experience of serving Imperial Court and he is very wise. He worked hard to maintain the Kamakura Shogunate even after Death of Minamoto No Yoritomo. He is the ancestor of Mori Motonari who was a prominent daimyo, feudal lord, in the west Chūgoku region of Japan during the Sengoku period.
Tadayoshi Ashikaga	1306-1352	Tadayoshi Ashikaga	Tadayoshi Ashikaga killed the Kamakura Shogunate with Emperor Godaigo and his elder brother Takauji Ashikaga. He established the Muromachi Shogunate with Takauji Ashikaga in conflict with the Emperor Godaigo. He maintained the Muromachi Shogunate instead of Takauji Ashikaga who is good at military but not interested in politics. He died suspiciously after hostility and reconciliation with Takauji Ashikaga and his deputy.
Kansuke Yamamoto	1493-1561	Shingen Takeda	Kansuke Yamamoto had weak legs, one-eyed and bad looks. He was hired as a strategist by Shingen Takeda who is a pre-eminent daimyo in Sengoku period and is an expert at finding one's talent. In the fourth battle of Kawanakajima, he suggested 'woodpecker strategy' but it was overlooked by Kenshin Uesugi who is an enemy side daimyo of Shingen. He felt responsible and assaulted headquarters of Kenshin and died in the battle.
Kanbei Kuroda	1546-1604	Hideyoshi Toyotomi	After serving Nobunaga Oda, Kanbei Kuroda served Hideyoshi Toyotomi and became a strategist. Cooperated with unification of the whole country by Hideyoshi Toyotomi, but he was kept away by Hideyoshi Toyotomi due to his outstanding personality and talent. So he retired after transferring family headship to his son, Nagamasa Kuroda.
Kenkichi Nagaoka	1834-1872	Ryoma Sakamoto	Kenkichi Nagaoka was an intellectual and became a doctor. He escaped from Tosa Domain twice and became a lordless samurai even though he had a family. He supported the Kameyama Shachu company established by Ryoma Sakamoto and changed its name to Kaientai as a secretary of Ryoma Sakamoto. It is said that Kenkichis wrote a lot of documents concerning Ryoma's life story.
Toshizo Hijikata	1835-1869	Isami Kondo	Toshizo Hijikata was a mischievous boy called 'Baragaki' implying reckless. He encountered Isami Kondo in a Tennenrishin-ryu sword school he was practicing. He worked for Shinsengumi which was a special police force organized by the Bakufu, military government, during Japan's late Edo period and cracked down on the group as " pitiless vice commander". The number of people in the Shinsengumi group killed by Shinsengumi was bigger than that in outside the group.
Arataro Takahashi	1903-2003	Konosuke Matsushita	Arataro Takahashi studied a lot while working in a store just after graduation of primary school. When he was 33 years old, he moved to Matsushita Electric Industrial Co., now Panasonic, and improved a business management system of the company as a right hand man of Konosuke Matsushita.
Takeo Fujisawa	1910-1988	Soichiro Honda	Takeo Fujisawa was in charge of management of Honda Motor Co., Ltd. and the company was expanded into a large global enterprise by him. It was said that President Soichiro Honda was a leader of technology in this company and managing director Takeo Fujiwara was a leader of sale. When Mr. Fujiwara told President Honda the intention of retirement, President Honda said "I can't be President without Mr. Fujisawa" and he also retired.

Table 2 projects relating selected sub-leaders and supportive behavior of sub-leaders

Sub-leader	Project	Project outline	Sub-leader's behavior	ID
Kamatari Nakatomi	Taika Reforms	Seizing political power by killing the Soga clan	He asked Prince Naka no Oe for killing The Soga clan in anticipation of Japanese politics that they control as they like (Authoer1, 2016).	A1
			He won SOGA no Ishikawamaro who is one of The Soga clan over to his side (Nagatsuki, 2017).	A2
Ooe no Hiromoto	Establishment of Shugo and Jito	Arrangement of the samurais of the shogunate throughout the country in order to maintain and watch people in provincial area and manor	He suggested establishment of Shugo (military commander and administrator) and Jito (manager and lord of manor) . He forced Emperor Go-Shirakawa to accept it by regarding the official intension as to arrest the rebel, Yoshitune Minamoto. The real intention is to rule over Japan by samurais of the shogunate (Authoer2, 2013).	B1
	Diplomatic battles to the Imperial Court	The shogunate that substantially governed Japan made the Imperial Court that formally governed authorize various political measures such as establishment of Shugo, Jito, Mandokoro and so on etc.	Because he was originally serving the Imperial Court, he was familiar with the situation of the capital and the character of the noble. While he was far from the capital, he kept winning diplomatic battles with the Imperial Court by reasonable advices and judgments based on Yusoku kojitsu. Yusoku kojitsu means usages or practices of the court or military households such as laws, institutions, customs, office work and ceremonies concernig the Imperial Court, court noble and samurais. (Toriyama, 2012).	B2
	Establishment of Mandokoro	Mandokoro which is Administrative Board in charge of court noble affairs, general affairs, finance was established.	He was the first chief officer of Mandokoro as his achievements were recognized. He also was in the various posts such as Myoho Hakase(docor of law), Saemon no daijo (Senior Lieutenant at the Left Division of Outer Palace Guards) and Kebiishi (officials with judicial and police powers) (Toriyama, 2012).	B3
	Jokyu War	Kamakura shogunate fought against the Imperial Court whose leader is Retired Emperor Gotoba after death of Minamoto no Yoritomo, the first shogun of the Kamakura bakufu, and won.	He inspired the immediate vassals of the Kamakura Shogunate to "fight firmly" in the war. He coordinated with Masako Hojyo, wife of Minamoto no Yoritomo , who declared for war.	B4
Tadayoshi Ashikaga	Engen War	Samurais rebelled against the Kenmu administration who neglected the samurais and deprived the administrative power.	On behalf of his brother, Takauji Ashikaga, who was not enthusiastic about the rebellion against the Imperial Court, he took the initiative, beat the Emperor Godaigo and led to establish a samurai government(Yamada, 2013).	C1
	Restriction on Dengaku viewing	The number of times of going to see Dengaku, ritual music and dancing in shrines and temples, Takauji Ashikaga loved was limited to once a month.	Takauji Ashikaga was the founder of the shogunate but was a playboy, Tadayoshi Ashikaga advised Takauji to limit the playing day, concentrate on political activities and make a major policy of the shogunate (Yamada, 2013).	C2
	Duarchy	After establishment of the Muromachi Shogunate, the administrative power was divided into brothers, Takauji Ashikaga and Tadayoshi Ashikaga.	Althogh Takauji was a mild person, Tadayoshi executed the criminals without mercy based on his strict nature. So he kept the order of the Muromachi Shogunate (Yamada, 2013).	C3
			Though it was the common sense in those days that Shogun, Takauji, carried out the both political and military affairs, Tadayoshi carried out political affairs and Takauji carried out military affairs in order to complemented each other's weak areas (Yamada, 2013).	C4
Kansuke Yamamoto	Battle of Uedahara	The battle in Uedahara between Shingen Takeda,Sengoku period daimyo (Japanese feudal warlord) in Kai Province, and Yoshikiyo Murakami, Sengoku period daimyo in Shinano Province	In order to help the Takeda army who was attacked by the Murakami army and became inferior, he led 50 horsebacks and left the headquarters where Shingen Takeda was. Takeda army was saved because Murakami army saw that, misunderstood Shingen's escape and left the headquarters (Author3, 2014).	D1
	The fourth battle of Kawanakajima	It was the battle in Kawanakajima between Shingen Takeda and Kenshin Uesugi, Sengoku period daimyo in Echigo Province. It was the largest in all five times. Kansuke Yamamoto was died in this battle.	He devised and executed a strategy called woodpecker strategy to divide the Takeda army into two units and attack enemy headquarters. Because he failed it and felt responsible, he charged himself against enemy and died (Author3, 2014).	D2

Sub-leader	Project	Project outline	Sub-leader's behavior	ID
Kanbei Kuroda	Chugoku ogaeshi	The movement of the army of Hideyosi Toyotomi from the Chugoku, Okayama, area to Kyoto in a very short period just after he heard Mitsuhide Akechi who was the retainer of Nobunaga Oda killed Nobunaga Oda who was the Hideyoshi's lord.	In response to Hideyoshi who is shocked when the lord, Nobunaga, was killed, he urged Hideyoshi himself to be a chance to become a major daimyo, and made him prepared for it (Kuroda, 2016).	E1
			In order to battle against Mitsuhide, he promptly promoted peaceful reunion with Mori Hideyoshi battled for a long time (Kuroda, 2016).	E2
	Battle of Yamazaki	The battle in Yamazaki between Hideyoshi Toyotomi and Mitsuhide Akechi which won by Hideyoshi	He sent a letter to the warriors under the Oda family who seemed to be on the side of Mitsuhide and stop turning. The letter was saying, "Since Nobunaga lives, refrain from thoughtless behavior" (Kuroda, 2016).	E3
			He borrowed a lot of flags from Mori who got peaceful reunion with in order to make Akechi army misuunderstand that the number of Toyotomi army was larger than it was (Kuroda, 2016).	E4
			He was convinced that Tennozan would be a key part of the battle and occupied eariler than Akechi army did (Kuroda, 2016).	E5
	Attack of the Shikoku region	It was the battle in Shikoku between Hideyoshi Toyotomi and Motochika Chosokabe. Toyotomi attacked Kioka-jo castle and Awa-jo castle.	He joined as a military supervisor of Ukita Hideie instead of Hideyoshi who was sick (Kuroda, 2016).	E6
			He made his army attack the Kioka-jo castle after he cut a pine tree on the nearby mountain, Takamatsuyama, and buried deep empty spots around Kioka-jo castle (Kuroda, 2016).	E7
			When he scouted Ueda-jo castle, he considered attacking Awa-jo castle with Motochika in order to save his military power (Kuroda, 2016).	E8
	Battle of Odawara	It was the battle in Odawara between Hideyoshi Toyotomi and Ujimasa and Ujinao Hojyo. Toyotomi won and unified the whole country.	He came in alone to enemy's Odawara-jo castle, persuaded lord of the castle, Ujimasa and Ujinao Hojyo, and made them surrender without blood (Kuroda, 2016).	E9
Kenkichi Nagaoka	Documentation	Making out some drafts of documents such as rules for Kaientai, basic policy of the new nation structure called 'Sencyuhassaku' and a petition of restoration of imperial rule. Kaientai was a trading and shipping company and private navy founded by Ryoma Sakamoto in Nagasaki.	He produced various documents based on ideas Ryoma talked to him (Author4,2008).	F1
	Negosiation of monetary compensation for the Iroha Maru Sinking	Acquisition of monetary compensation concerning Iroha Maru which was operated by Kaientai, collided with the ship of the Kishu clan and sank.	Kenkichi negotiated with the Kishu clan using the international law he was learning and succeeded in acquiring 80,000 compensation. He fulfilled the role of a modern lawyer. He also produced detailed report of the accident (Author5, 2012).	F2
	Ryoma assassination	Assassination of Ryoma who is the captain of Kaientai	After Ryoma's death, he was appointed Captain of the Kaientai (Author5, 2012).	F3
Toshizo Hijikata	Ikedaya incident	. An incident in which a lot of talented samurais belonging school of overthrowing the Shogunate were killed by Shinsengumi and the plan of overthrowing the Shogunate was prevented beforhand Shinsengumi was a shogunate police and military force located in Kyoto and dedicated to suppressing anti-shogunate activities.	He captured one of the samurais of school of overthrowing the Shogunate, Frutaka, tortured him and made him to tell the plan of overthrowing the Shogunate. He made a raid on the members of school of overthrowing the Shogunate after that he heard that talented samurais of the school would stay in Ikedaya Inn (Author 6, 2016).	G1
			When he arrived at Ikedaya Inn, he did not rush soon, but deployed Shinsengumi samurais around Ikedaya Inn and prevented samurais of the Aizu clan and the Kuwana clan who came to support Shinsengumi from entering the Ikedaya Inn . The reason of that was to monopolize the feat with Shinsengumi (Author 6, 2016).	G2
	Aburakoji incident	An incident in which some samurais of Goryo-eji (guards of Imperial mausoleums) who planed assassination captain of Shinsengumi, Isami Kondo were killed.Goryo-eji was organized by Koushitaro Ito who was left Shinsengumi.	He grasped Kondo assassination plan at an early stage by sending Shinsengumi samurai, Hajime Saito, as a spy to the Goryo-eji (Kitamura, 2016).	G3
	Battle of Toba–Fushimi	A battle occurred between the former shogunate army and the New government armyThe former shogunate army to which Shinsengumi belongs lost and Isamu Kondo who is the captain of Shinsengumi died.	He worried about the inferior Kondo and tried to rally by hastening the request for the support of the former shogunate army (Kitamura, 2016).	G4
			He pleaded with the New government for Kondo's life, which was refused and Kondo was deheaded (Kitamura, 2016).	G5

Sub-leader	Project	Project outline	Sub-leader's behavior	ID
Arataro Takahashi	Widespread understanding of management philosophies	Thoroughness for all employees on how to proceed with work such as activities, review and improvement according to the management philosophy.	He was attracted by Konosuke's management philosophy and made it permeate inside the company. He was called "Mr. management philosophy" from employees and " Mr. Takahashi is higher than me about management philosophy" from Mr. Konosuke. His boss and his subordinates had a great longing for him (Takashima, 2007).	H1
	Establishment of business management system	Establishment of business management system of Matsushita Electric Industrial Co., Ltd. consisting of notifying employees of the monthly settlement situation etc. when changing from individual company to a stock company.	In order to introduce double entry bookkeeping, he established his original management accounting system and contributed greatly to the modernization of accounting system of Matsushita Electric Industrial Co(Komiya,1996).	H2
	Business partnership with Philips Corporation	Business partnership with Phillips of the Netherlands to incorporate European technology.	He was in charge of partnership negotiations, but the negotiations were difficult and were on the verge of a break. As a result, the partnership succeeded because of his tenacity and high bargaining skill (Matsushita, 1956).	H3
Takeo Fujisawa	New employee interview	Recruitment activity of sales staff	In a typical company, President Honda would conduct employment interviews by sales staff, but Honda left it to Mr. Fujisawa. He was appointed from president Honda for all aspects of management, such as finance and sale which Honda were not good at (Ise, 2003).	I1
	Popularization of super cub	Development of innovative product of motor cycle, super cub, and making widespread it in the international market	Fujisawa invented the super cub as a motorcycle that can be purchased even by ordinary people despite its high performance, sold it at a bicycle store nationwide and spread it. He thought it would spread to the world if it sold in the United States, and also succeeded in selling there (Ise, 2003).	I2
	Adoption of officers' large room system	Adoption of officers' large room system in order to resolve factions in the company	He adopted an executive large room system that gathers executives in large rooms so that executives can freely interact (Ida, 2003).	I3
	Competing world big car races	Competing world big car races such as Isle of Man TT, Formula One and so on	He attempted to raise the morale of employees by making them see the level of overseas cars or making them compete (Ise, 2003).	I4
	Controversy of cooling technology type of car engine	A technical controversy dividing the inside of the company, which is better air-cooled engine supported by president Honda or water-cooled engine supported by young engineers	He was asked for help from young engineers. He said to President Honda, "You are a technician or the president?", then president Honda solved the controversy. (Ida, 2003).	I5

Table 3 The relationship between projects relating selected sub-leaders and ten knowledge area of PMBOK

ID	Integration	Scope	Cost	Risk	Stakeholder	communication	Human Resource	Time	Quality	Procurement
A1				1 (*1)			1 (*2)			
A2							1 (*3)			
B1	1 (*4)				1 (*5)					
B2					1 (*6)					1 (*7)
B3	1 (*8)						1 (*9)			
B4							1 (*10)			
C1							1 (*11)			
C2	1 (*12)						1 (*13)			
C3						1 (*14)				
C4	1 (*15)									
D1					1 (*16)		1 (*17)			
D2				1 (*18)	1 (*19)				1 (*20)	
E1	1 (*21)						1 (*22)			
E2					1 (*23)			1 (*24)		
E3				1 (*25)	1 (*26)					
E4					1 (*27)					1 (*28)
E5		1 (*29)		1 (*30)	1 (*31)			(*32)		
E6							1 (*33)			
E7										1 (*34)
E8					1 (*35)		1 (*36)			
E9	1 (*37)			1 (*38)	1 (*39)				1 (*40)	
F1	1 (*41)	1 (*42)								
F2			1 (*43)		1 (*44)				1 (*45)	1 (*46)
F3	1 (*47)						1 (*48)			
G1	1 (*49)			1 (*50)	1 (*51)		1 (*52)	1 (*53)		
G2				1 (*54)	1 (*55)		1 (*56)		1 (*57)	
G3					1 (*58)		1 (*59)			
G4				1 (*60)	1 (*61)			1 (*62)		1 (*63)
G5	1 (*64)			1 (*65)	1 (*66)				1 (*67)	
H1	1 (*68)					1 (*69)	1 (*70)			
H2	1 (*71)									
H3				1 (*72)	1 (*73)	1 (*74)				
I1	1 (*75)		1 (*76)				1 (*77)			
I2	1 (*78)				1 (*79)					
I3						1 (*80)	1 (*81)			
I4						1 (*82)	1 (*83)			
I5						1 (*84)	1 (*85)			

(*1) Because of action based on awareness of political crisis
(*2) Because he motivated of The Soga clan overthrowing by getting a human resource like Naka no Oe no Oji.
(*3) Because of getting a human resource like SOGA no Ishikawamaro
(*4) Because this policy triggered the development of the Kamakura shogunate nationwide
(*5) Because of using policing power of Emperor Go-Shirakawa
(*6) Because of project concerning the Imperial Court outside the team
(*7) Because of knowledge procurement concerning the Imperial Court
(*8) Because of role assignment in the Kamakura shogunate establishment
(*9) Because of personnel affairs
(*10) Because of motivation management of immediate vassals
(*11) Because of making samurai's motivation increase by strong leadership
(*12) Because he left everything concerning overall government of the Muromachi shogunate
(*13) Because of Takauji's motivation management by holiday restriction
(*14) Because strict management to people in the shogunate
(*15) Because of role assignment in the Muromachi shogunate establishment
(*16) Because of bargaining with the Murakami army
(*17) Because he led human resources with 50 horsebacks.
(*18) Because he was at risk of assaulting his enemy.
(*19) Because of the battle with the Uesugi army.
(*20) Because it ended as a project failure that woodpecker strategy was failed.
(*21) Because Hideyoshi's motivation affected the motivation of whole Toyotomi army
(*22) Because he increased Hideyoshi's motivation.
(*23) Because of the battle with the Mori army
(*24) Because he negotiated with Mori very quickly.
(*25) Because of avoiding the risk relating to Akechi army increase
(*26) Because of communication with the warriors under the Oda family
(*27) Because of the corroboration with the Mori family
(*28) Because of procurement of flag.
(*29) Because of decision relating to Mt. Tenno occupation as a key place of the battle
(*30) Because of avoiding the risk relating to occupation of Mt. Tenno by Akechi
(*31) Because of the battle with the Akechi army
(*32) Because of the occupation of Mt. Tenno earlier than Akechi did
(*33) Because he utilized himself as human resource to the Ukita Army.
(*34) Because of pine trees procurement
(*35) Because of the battle with the Chosokabe army
(*36) Because of economizing human resources
(*37) Because of the finish of battle relating to whole project
(*38) Because he took the risk of coming in alone to enemy's Odawara-jo castle.
(*39) Because of the negotiation with the Hojyo army
(*40) Because he kept the quality of bloodless castle.
(*41) Because he made rules for the whole country.
(*42) Because of making documents after he narrowed down the scope of the contract.
(*43) Because of acquiring 80,000 compensation
(*44) Because of the negotiation with the Kishu family
(*45) Because he kept the quality of bloodless castle.
(*46) Because of procurement of knowledge
(*47) Because of procurement of knowledge
(*48) Because he utilized Kenkichi as human resource.
(*49) Because he raised the reputation of the Shinsengumi by the killing.
(*50) Because there was a risk associated with the killing.
(*51) Because of the battle with the school of overthrowing the Shogunate
(*52) Because he made a raid with some of Sinsengumi samurais.
(*53) Because the timing of raid was important.
(*54) Because he took the risk of not going immediately to support.
(*55) Because of the battle with the Aizu clan and the Kuwana clan
(*56) Because of the deployment of Shinsengumi samurais around Ikedaya Inn
(*57) Because of great achievement of monopolizing the feat with Shinsengumi
(*58) Because of the battle with the Goryo-eji
(*59) Because he sent Shinsengumi samurai, Hajime Saito, as a spy to the Goryo-eji
(*60) Because of the risk of killing Kondo
(*61) Because of the battle with the former shogunate army
(*62) Because the action took urgent.

(*63) Because of procurement of the support of the former shogunate army
(*64) Because the motivation of Shinsengumi samurais was affected by Kondo's death
(*65) Because of the risk of killing Kondo
(*66) Because of the negotiation with the new government
(*67) Because it ended as a project failure that Kondo was killed.
(*68) Because the role affected the whole company.
(*69) Because of the communication with employees
(*70) Because of the management of Konosuke's motivation
(*71) Because the establishment of the management accounting system affected the whole company.
(*72) Because of the risk of breakdown of negotiations
(*73) Because of the collaboration with Phillips Corporation
(*74) Because of focus on negotiation with Phillips Corporation
(*75) Because the role affected the whole company.
(*76) Because the role treated money management like finance and sales.
(*77) Because of the management of Honda's motivation
(*78) Because it was a project to decide the future of HONDA
(*79) Because of the relationship with consumers
(*80) Because of the communication with employees
(*81) Because it affected the motivation of executives
(*82) Because of the relationship with employees
(*83) Because of making employees' motivation increase
(*84) Because of the controversy with employees
(*85) Because of the motivation management of both Honda and employee

Development of a Lecture in Three Frames Based on an ICE Rubric to Acquire Application Capability

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An educational technique was implemented to develop the application capability for tools and techniques in project management ("PM" hereafter), which narrows a lecture's key points to three frames: classroom learning, exercise, and presentation. First, the course was condensed to three key points: utilizing a standard knowledge system, making decisions based on objectives and numerical values, and preparing the work environment. Additionally, the process of applying tools and techniques in PM was designed using an ICE rubric to establish the following goals: to quickly and accurately take out many relevant tools and techniques for classroom learning; to design a management system by correctly combining the Input and Output processes for many tools and techniques in exercise; and to present a management system to businesspersons that could be used in business presentations. Teaching materials were then developed for lectures, worksheets, and simulated project games that reflect these goals, as devices to step up to the stages of learning, connecting, and applying knowledge. Further, an attempt was made to invite businesspersons to give lectures and evaluate presentations to improve the motivation for learning. Consequently, a questionnaire sent to students yielded substantially improved average scores: 4.57 (compared with 4.10 in the previous year) for the "ability improved by the lecture, " and 4.72 (compared with 4.16 in the previous year) for "a good lecture, from an overall judgment." Future objectives include not only preparing lectures to facilitate an understanding of the connection between management systems and the work of "manufacturing goods and preparing matters" but also developing achievement evaluation methods that contribute to students' growth and the improvement of education.

Keywords and phrases: PM Education, Education Improvement Program, ICE Rubric, Workshop

1. Introduction

The industrial structure is currently experiencing significant changes that require intellectual capability in both understanding the essence of base technologies and applying it in creation (Ministry of Education, Culture, Sports, Science and Technology Educational Program Planning Special Committee, 2015). Active learning, project-based leaning, and flip teaching, outlines the course, and Figure 1 illustrates its positioning. As Figure 1 indicates, this course offers an opportunity to simultaneously delve into expert knowledge covering PM in its entirety, such as laboratory research assignments and the completion of a PBL course, which are important events for undergraduate students.

Table 1 Project engineering outline

Course subject	All PM course students Management information science course
Open time of the course	5 semesters (first part of third year)
Course classification	Management system course students: mandatory PM course students: optional
Number of students	Approximately 160 students (lectured in two classes)

among others, have been developed as educational methods to improve students' application capabilities, and many cases have reported their practice in colleges and similar settings (Michio, N. et al., 2015). The present author oversees a project engineering course, which involves developing application abilities for the tools and techniques that are base technologies in PM. Table 1

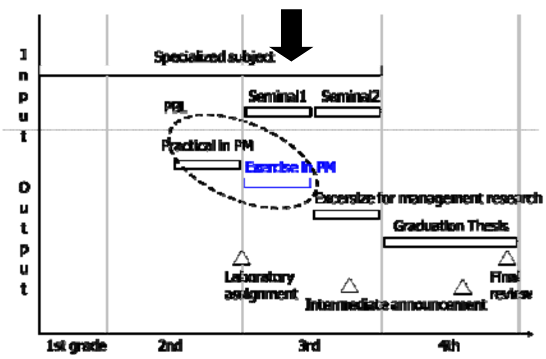

Figure 1 Project engineering positioning
(Atsushi, S. et al., 2014)

The author introduced "flip teaching" in this course in 2015 to construct a device by which students

Figure 2 How the 2015 lecture introduced flip teaching

could attempt to improve PM application ability both actively and enthusiastically.

This course adopted the following system: students acquired prior knowledge from preparation videos; each student group applied the acquired knowledge to design a management system to solve practical business issues during lecture hours; the students then created presentations. Figure 2 displays the website for video preparation and describes how the group work proceeded.

However, it was difficult to state that the system worked as planned after considering the lecture's questionnaire answers and its perceived responses. Issues mentioned in the questionnaire's free answer column from the 2016 lecture course were essentially as follows (Chiba Institute of Technology, 2015):

Issue 1: Both time and prior knowledge were felt to be inadequate to meet the demands of application achievement;

Issue 2: Preparation videos were arduous, but could hardly convey the teacher's enthusiasm to interest their viewers;

Issue 3: There were too many students in a work group and their approaches varied significantly; (Note 1)

Issue 4: Too many groups made presentations, and Q&A time was too short to provide adequate feedback on achievements (Note 1)

Alternatively, there were some affirmative comments, such as "the group work was pleasant" or "ability was acquired that would not have been obtained from an ordinary lecture." These comments were presumably from some students who typically provided active and enthusiastic participation in lectures. Students who "developed application ability" were found to feel pleasure and significance. It seemed that, in other words, a specialized subject course could be pleasant and significant if a detailed knowledge application process could be designed for all students to step up along the process. Hence, it was decided that an ICE rubric would be used, to which an ICE model is applied: behavioral characteristics, or the qualitative goal at each step, could be designed regarding the learning, connection, and application of knowledge; a device could be closely examined necessary for students' involvement in each stage; and these could be reflected in a subsequent lecture.

2. Development of Educational Methods

The course's aforementioned positioning and issues were considered in establishing the following basic policies:

Policy 1: Hurdles are clearly defined that are necessary to enhance the acquisition, connection, and application of knowledge regarding PM tools and techniques. These will enable students to build a framework to overcome the hurdles by themselves.

Policy 2: Teachers serve as a foundation "like a tree trunk," facilitate surveys and examinations, and motivate students toward the acquisition of application ability for students to build the aforementioned framework.

The following describes the educational methods contrived based on the aforementioned basic policies.

2.1 Designing behavioral characteristics by the ICE rubric

The ICE rubric was introduced at an ICE model workshop, leading to self-motivated learning in this institute's FD Project. This was used not only to analyze the behavioral characteristics of students presumably involved in the learning, connection, and application of knowledge, but also to practice Policy 1 as described above. The ICE model is an educational evaluation model that has been developed and practiced in Canada. "I" means Ideas, "C" means Connections, and "E" means Extensions. Evaluate which stage (I, C, E) are in depending on how students answer the question. Figure 3 illustrates an ICE rubric worksheet from this workshop.

An operation from this worksheet resulted in the following behavioral characteristics exhibited by "excellent" students who learned, connected, and applied knowledge as a result of this course:

- Acquiring knowledge (Idea):

"Can utilize the relevant tools and techniques quickly and accurately" (primarily in classroom learning).

- Connection of knowledge (Connection):

"Can correctly combine Input and Output processes for many tools and techniques to design a management system" (primarily in the exercise).

- Knowledge application (Extensions):

"Can present a management system to businesspersons that could be used in business" (primarily in the presentation).

These behavioral characteristics were set as goals for the acquisition of application ability in this course.

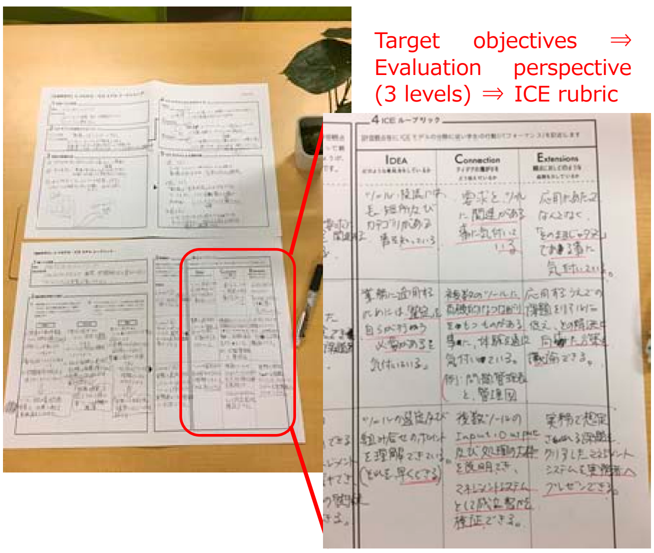

Figure 3 ICE rubric worksheet
(Chiba Institute of Technology FD Committee, 2016)

2.2 The lecture in three frames

To reach the aforementioned goals, the lecture environment must be prepared to enable all students' self-directed studies. This year's lecture is based on a review of the previous year, and reflects the following devices:

- Device1: Concentrating central application concepts

In the previous year, all PM tools and techniques were explained in detail via preparation videos during flip teaching, and group work was performed based on these to develop application ability. However, sufficient time could not be secured for this development, yielding an overall result of indigestion. Central concepts to apply PM tools and techniques considered this result, and were condensed to this year's following three points:

1) Utilize a standard knowledge system (existing findings);

2) Make decisions based on objectives and numerical values; and

3) Prepare the work environment.

For example, the proceeding second point involved the explanation of quality control management techniques, with a central concept as a starting point in the classroom-learning framework (see Figure 4). This was followed by a worksheet exercise to design a framework for customization and business application (see Figure 5). Each member then prepared a combination of planned ideas in an exercise to present a management system that could be used in business, through a presentation framework (see Figure 6). As sufficient time was not secured for feedback in the previous year's presentation framework, an iPad mini's camera was used to film presentations of approximately two minutes. A video for each group was collected and displayed through a cloud service to create an environment for smooth presentations and feedback (Hironori T., 2016).

- Device 2: A cycle of classroom learning, connection, and presentation for each central concept

Hurdles were clearly set to improve the learning, connection, and application of the aforementioned PM tools and techniques for a cycle of knowledge provided in classroom learning, the preparation for application through individual exercises, and the presentation of achievement through group applications for each of the aforementioned three central concepts. Table 2 outlines the course syllabus to reflect this device.

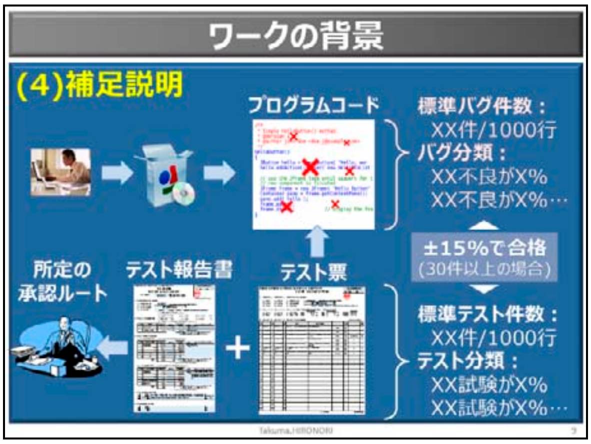

Figure 4 Sample lecture material used in classroom learning (explaining how numerical values operate for quality objectives)

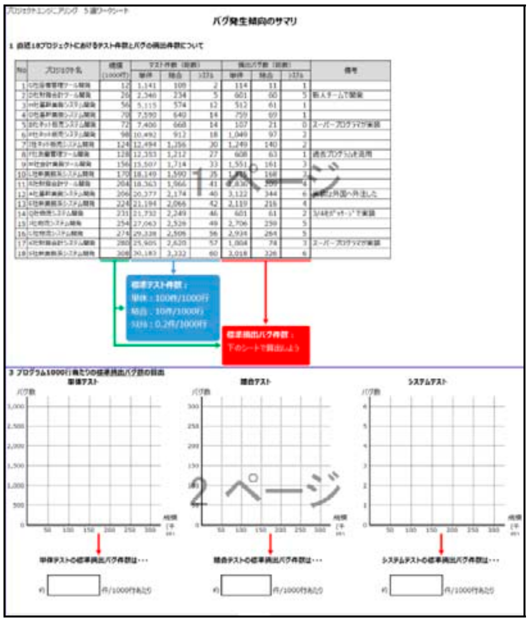

Figure 5 Sample worksheet used in exercise (an exercise was given to set quality standards based on an actual case)

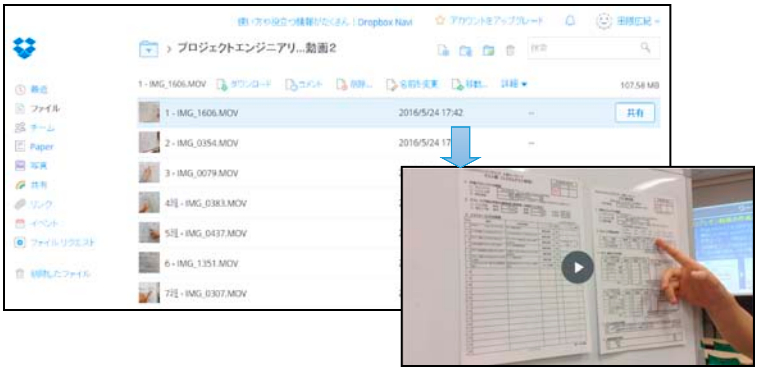

Figure 6 Sample of a video presented for a management system, to which PM tools and techniques were applied

- Device 3: Lecture and presentation evaluated by businesspersons to improve enthusiasm for learning

As described in the aforementioned Policy 2, the following examples were considered useful for students to enthusiastically overcome the hurdles necessary to improve their learning, connection, and application of knowledge: special lectures within the lecture by graduates of this institute with exceptional performance; and opportunities for businesspersons from popular employment firms to evaluate application achievement presentations. Further, this course communicated with managers from PM-expert departments in large system integrators, which have historically employed graduates from this Institute. These managers were asked to list five business issues in a work environment preparation theme, or the last frame of the cycle, then directly evaluate the presentations by taking advantage of the special system within the lecture course. Prior to turning the cycle, an entrepreneur and PM course graduate was asked to give a guest lecture on the "importance of trying without fear of failure" in an attempt to inspire students in the knowledge application course. Further, a simulated project game was inserted twice to provide opportunities to experience various practical uses for PM techniques. For example, a game was played in which the author acted as an indecisive client, in an environment where members found it difficult to collaborate. A student explained a decision to the client that was derived through collaboration, and a frame was provided in which members contemplated the client's misunderstanding and how to correct it. This game design was based on the author's experiences in actual projects.

Table 2 Outline of this course Syllabus

No.	Content	Classroom Learning	Exercise	Presentation
1	Utilize "standard knowledge system" (1)	o		
2	Utilize "standard knowledge system" (2)		o	
3	Utilize "standard knowledge system" (3)			o
4	Decide based on "objectives and numerical values" (1)	o		
5	Decide based on "objectives and numerical values" (2)		o	
6	Decide bases on "objectives and numerical values" (3)			o
7	Guest lecturer: PM course graduate			
8	Mid-term exam			
9	Game 1: Initiating the project			
10	Prepare "work environment" (1)	o		
11	Prepare "work environment" (2)		o	
12	Game 2: Reconstruct the project			
13	Prepare "work environment" (3) (present achievement to businesspersons)			o
14	Term-end test			
15	Summarize the lecture			

3. Results

Figure 7 and Table 3 on the following page provide an evaluation of the lecture questionnaire for various devices' results, based on the ICE rubric described in Chapter 2. (Chiba Institute of Technology, 2015, and 2016) The author's impressions of the questionnaire results are as follows:

1) Items other than "students' enthusiasm" demonstrated substantial improvement, by 0.41-0.56.
-->Various devices are believed to have yielded favorable results. Specifically, the average score for "Question 19: This course allowed growth" increased by 0.47. Students conceivably felt this growth.
2) "Students' enthusiasm" did not demonstrate substantial improvement.
-->Specifically, the average score for "Question 4: The utilization of the institute's various facilities and systems, such as the library, office hours, learning support system, teachers, friends, etc., in study progress" was low, at 3.97. This seemed to reveal the tendency for students to restrict their field of learning to the lecture.
3) The following comments were provided in the free answer column:
-->Devices are believed to have demonstrated their intended effects.
- The exercise provided knowledge different from that learned in the classroom.
- It was good to review PM tools and techniques and practice them in an exercise.
- It was good to hear PM topics presented by outsiders.
- Although problems occurred in the group work, the lecture was pleasurable when the problems were handled.
- The enthusiasm of the teachers in charge of this course was conveyed to students.
- Separate group work and presentations for each field made the content easier to understand.

4. Conclusion

This paper introduced "a lecture contained in three frames," regarding classroom learning, exercise, and presentation based on an ICE rubric as an educational method for developing application ability for PM tools and techniques. This educational technique provided students in this institute with favorable results in developing application ability for base technologies compared with past classroom learning or flip teaching methods. This result implies that the application of a particular lecturing method requires a detailed understanding of the technique's "improvement effect" and its "device," followed by an adjustment to course conditions for its reproduction.

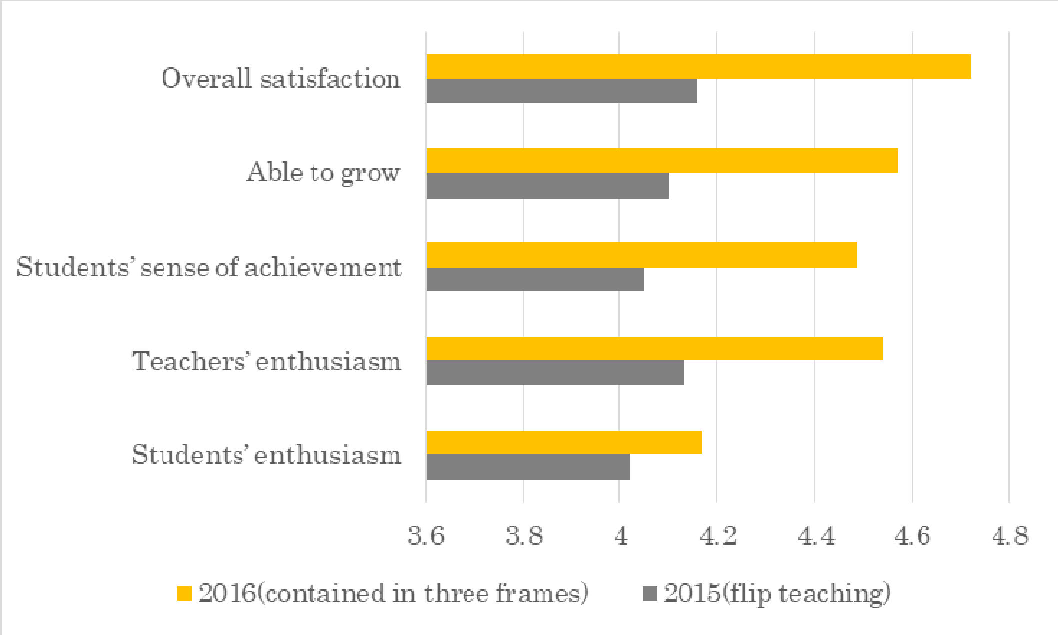

Figure 7 Average score in student questionnaire (averages of the two classes)
(Chiba Institute of Technology, 2015 and 2016)

Table 3 Average score in student questionnaire
(Chiba Institute of Technology, 2015 and 2016)

Lecture Outline (two classes' averages)			Evaluation score in questionnaire (two classes' averages)				
Year (lecture style)	Number of students	N	Students' enthusiasm Question 1-5	Teachers' enthusiasm Question 6-13	Students' sense of achievement Questions 14-18	Able to grow Question 19	Overall satisfaction Question 20
2015 (flip teaching)	152	141	4.02	4.13	4.05	4.10	4.16
2016 (contained in three frames)	148	131	4.17	4.54	4.49	4.57	4.72
Difference from the previous year	-	-	+0.15	+0.41	+0.44	+0.47	+0.56

For this adjustment, in addition to the average value of the previous lesson evaluation, the description of the free format and the impression that the faculty received in the lecture are useful information.

Alternatively, it may also be asserted that students' enthusiasm demonstrated relatively small increments, and the learning field could not be expanded beyond lecture hours. The author believes that human resources that can practice the ICE rubric's "E: application" yield results only after the evaluation of this item improves. The author plans to promote learning enthusiasm outside lecture hours, contrive and practice devices to reflect achievement evaluation results (Kayo M., 2012), and prepare a lecture to contribute to the development of application ability.

Notes

Note 1) As one class consisted of approximately 80 students, there were 9 to 10 groups, with each approximately comprised of eight students.

Note 2) Because the answer in the free reply column is not open to the public, we will disclose it according to your request.

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Projects diagnosis and performance improvement Fundamentals & Solutions

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All organizations need to run projects to many purposes. So due to this major importance of projects, many standard, frameworks and methodologies are presented to effective and efficient improvement in projects and programs management. However, they still face with several problems and challenges in different domains and aspects. In this article we study various perspectives of projects management and leadership and related health and success factors, projects diagnosis and finally (and the most important), a comprehensive methodology for project performance diagnosis and improvement in order to solve that problems and challenges.

1. Keywords and phrases

Contractor-side: At the project's contractor place and from his/her point of view

Client-side: At the project's owner, sponsor or executive organization place and from his/her point of view

Executive agents: All persons, teams or organizations that play a role in project or program activities such as project manager, project team, contractor and subcontractors, consultants, suppliers and etc.

2. Introduction

Solving project challenges and improving its performance, need a comprehensive plan including a whole diagnose and root-cause analysis based on deep understanding of their goals, purposes and environment and offering an efficient solution in accordance with organization capability and maturity. So first we need to know various aspects and levels of project management and define project health factors according to these aspects. After that, perform an assessments based on accredited patterns and in according to predefined health factors and finally, design and implement an effective and efficient roadmap and model to improve the project performance.

3. Fundamentals

3.1 Why we need projects?

Contrary to popular belief, all organizations and businesses, even those who their business model is built on doing projects for external clients and who earn business value by running programs and projects for themselves, need to implement projects in many reasons as below:

- Earning money and profit from doing projects for customers (like contractors)
- Achieving strategic goals.
- Implementing organizational improvement and development programs.
- Research and development (R&D), quality improvement, Innovation and creating new products and services.
- And etc.

So we can say all public and private organizations, individuals and companies, contractors, productive and services industries, profitable and non-profit businesses and etc. need to define and implement programs and projects in various levels to achieve their goals and benefits.

A little study in various organizations shows that a major part of their activities, funds and human resources are involved in implementation of programs and projects.

3.2 Challenges

However, despite a lot of activity and high funding allocation, organizations usually have many challenges like these:

- Time and cost increase more than primary estimation.
- Dissatisfaction of client, sponsor or other stakeholders.
- Inconsistency and high challenges between project elements such as client, consultant, contractor, subcontractors, suppliers and etc.
- Risks and Changes more than usual or primary estimated and planning failure.
- Failure to meet the needs and expectations of stakeholders.
- Failure to meet applicable and performance requirements, business requirements, technical requirements and etc.
- Failure to meet desired high level goals and interests from programs and projects Despite the successful implementation of them.
- Lack or miscalculations in budgeting. Failure to provide timely funding and finally multiple problems in project funding.
- Problems in finding and selecting a qualified contractor and supplier.
- Claims, legal and contractual issues.
- Inconsistency with other organization projects and activities, disturbing them and taking their resources.
- And many other issues.

In general, the above problems cause the project to fail in the initial demands framework. Or, despite the completion of the project in the requested frameworks, the interest and purpose that has been defined from the beginning cannot be achieved. In either case, the project cannot be called successful.

This superficial look seems correct at first glance. But in order to achieve an effective solution, we need to look deeper into the subject.

3.3 Root problems

At a deeper level, we can divide the problems into two categories in general:

3.3.1 Problems due to bad implementation of projects

Such as Increasing time and cost, reducing quality, abundant reworks, poor procurement and supply problems, major project changes and resulting planning problems, occurrence of risks and timely failure to respond to them and dissatisfaction of sponsor, clients and other stakeholders as a result.

These issues can cause many problems such as disadvantageous of project (due to time and cost increase), wasting organization resources, reducing customers and stakeholders' satisfaction, decline of organization professional reputation, inner and outer challenges and legal consequences and many other unpleasant consequences.

3.3.2 Problems due to bad selection of projects and their poor efficiency

Since the projects are the main tools of the organization for achievement of strategic and high-level objectives, these problems can cause serious disadvantages such as the negative impact of the project on other projects and activities of the organization, failure to obtain the desired benefits or achieve strategic goals from the implementation of the project for the organization and etc.

Diagnosing and a deeper analysis of these challenges show that their major contribution is due to inadequate selection of projects and programs and their inefficient management at various levels of strategic (organizational and client-side) and operational (executive and contractor-side). This weakness leads to waste of time, the company's capital and energy, and most importantly, the loss of opportunities in the current competitive business environment.

So, before rooting and improving problems, we first need to examine the following two issues:

3.4 Various project implementation levels

In general, the whole domains, tasks, considerations and concerns of each of the main elements of the project could be divided in two levels:

- Leadership level:
  Client-side, organizational and strategic domain.
- Executive or management level:
  Operational and contractor-side domain.

3.4.1 Who is client?

Client, owner or sponsor of a project or program, is a person or an organization who select and define it based on various goals requirements, prepare the context and provide financial resources of the work, outsource the execution of the project to selected contractors, monitor and control them, get and exploit the project deliverable(s) catch its benefits and outcomes.

3.4.2 what is program and project leadership?

According to the above definition, the client is someone who is not directly involved in operational affairs or, in other words, executive management of the work. But delegates the implementation of the work to the executing agent (contractor, project manager, etc.) and exploits the product or result of the project in line with its goals and interests. So what a client should do is completely different.

From this point of view, "program and project leadership" from the perspective of the client, sponsor or organization, is plan and lead the following elements:

3.4.2.1 Select and define program and project

On the basis of criteria such as alignment with major plans and strategies, the effectiveness and value creation, the economic justification and profitability, alignment with other activities, projects, programs, portfolios and strategic plans.

The elements, tools and techniques for compiling and measuring the above criteria are described in detail in the strategic, portfolio and program management knowledge areas.

3.4.2.2 Define project delivery system

One of the most important strategic decisions of a project that will have a significant impact on other domain, phases and success factors, includes 4 subsystems as project delivery method (PDM), project selection method (PSM), Project payment method (PPM) and project management meth (PMM).

3.4.2.3 Project finance

Provide funding and budget needed for the program and project from various methods (public, public-private partnership PPP or private finance), various obligors (Sovereign, corporate or project financing) and various resources and instruments (equity or debt, credit tools, sureties, insurance and etc.).

3.4.2.4 Outsourcing project execution

Resource finding, contractors and suppliers selection, making contract and delegate the work, monitor and control their work.

3.4.2.5 Delivery and exploiting the outcome

Get the project deliverable (product, service or result), exploit and achieve its benefits.

3.4.3 Who is contractor?

Contractor, executive agent or project manager, is a person or an organization who takes a predefined project from client or sponsor in a specified frameworks and documents with a defined budget, perform all operational phases and activities and finally delivers project outcome to client or sponsor.

3.4.4 What is project management?

Project management is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of the project management processes identified for the project.

These processes are grouped in 5 process groups and 10 knowledge areas.

3.4.5 Project health and its success criteria from different perspectives

Since the project assessment is based on a number of factors and determinants, the basics and criteria must be specified before the evaluation. Given the challenges and the above categorization, the criteria for assessing the health and success of the project vary from one perspective to another. In summary, the criteria for project success and health can be categorized as follows:

3.4.5.1 Leadership level

3.4.5.1.1 Strategic and organizational domain

- Alignment with high level plans and strategies.
- Efficiency and creating value and benefit.
- Economic justification and profitability.
- Alignment with other strategies, portfolios, programs, projects and activities.

These criteria and their defining and assessment techniques are completely described in relevant methods such as balanced scorecard BSC and etc.

3.4.5.1.2 leadership domain

- Preciseness of budgeting.
- Effectiveness of project finance.
- Proper definition of Project delivery system
- Effectiveness of project delegating and outsourcing (Preciseness of Resource finding, contracting and outsourcing and monitoring and controlling of contractors' performance).
- Correct project outcome delivery.
- And etc.

3.4.5.2 Executive or management level: operational and contractor-side domain

Parameters that validates preciseness of:

- Maintenance of scope, time, cost and quality baseline.
- Controlling communication, stakeholders and their satisfaction.
- Controlling risks.
- Controlling and managing changes.
- Fulfillment of requirements.
- Controlling project team and subcontractor's performance.

3.5 Assessment and diagnosis

Now, after recognizing and defining health criteria, the project or organization should start to be evaluated

3.5.1 What is organizational diagnosis?

Organizational diagnosis is the starting point and most sensitive component of the development of organization's improvement process. It briefly contains the process of using the concepts and methods of behavioral sciences in order to define and describe the existing status of organizations and find ways to increase their effectiveness.

An efficient and effective organizational diagnosis can be considered as one of the most important steps that successful organizations do to improve their productivity.

3.5.2 Assessments and improvement models

There are several models for organizational diagnosis as below:

- Weisbord 7-dimensional model.
- Human resource Development HRD model.
- Harrison diagnosis model.
- 7S McKinney.
- And etc.

4. Solutions

4.1 Need to a comprehensive and holistic model and methodology

Despite all the challenges and factors above, the ultimate wish of any project manager and any organization is that its project has been successfully completed and the project stakeholders become satisfied. And, of course, this route can even be completed with the least problems and challenges. Therefore, project managers or higher-level managers use a variety of models and standards for project management and, by deploying these systems and using their tools and techniques, try to increase the success rate of their project and reduce common problems.

But despite the establishment of the PM system in some projects, unfortunately, most of them are still encountering problems, and these systems and standards have not been succeeded in the project's success and reduction of their problems. Although there is no doubt about the accuracy and adequacy of standards and necessity of PM system establishment in projects and project-based organizations, but the insignificant results of system deployment to improve the performance of audiences, show this fact that there are many important factors in effective implementation and improvement plans. Neglecting these factors will not only lead to the failure of the improvement program and to the failure of the projects, but worse, it can also lead to the loss of confidence in accredited and scientific standards and methodologies.

4.2 What is an improvement model?

A performance improvement model (or methodology) is a coherent set of processes, procedures, tools, techniques and Other Essential Requirements in a specific domain based on scientific and international standards. By implementing and following it, the user can improve the project performance or organization in the desired area, reduce the problems, and ultimately increase the success rate of the project in achieving the goals and gain the desired benefits.

4.3 Elements of an efficient model

Undoubtedly, all people who have experienced the implementation and use of improvement models, patterns and standards for even once in each area and at each level, acknowledge that the main conditions for their efficiency, are the following considerations in their elaboration and implementation:

- The appropriateness of executive guidelines, tools and techniques of the model with the conditions, requirements and maturity of the project and the target organization.

- The correct implementation of the model in the project and the target organization, without causing any disruptions or adverse effects on other components and current activities.
- The correct use of the model by users through the acquisition of trainings and skills to apply it.

There are many valid, comprehensive and effective models and standards that, due to the inappropriateness of the organization's and target's objectives, the inappropriateness of the level of users' maturity, the lack of sufficient knowledge and skills of the user to use it, and so on, eventually not only don't have any significant impact on the respondent performance, but may also have a negative impact on the organization's current procedures.

Therefore, in order to better implementation of improvement patterns and increase their efficiency in the project and organization success, I have been organized them in the form of "Performance Improvement Service Packs" based on the results of my practical experiences in implementing improvement systems, as follows:

4.3.1 Applicability of the model

Most of the complaints or challenges of the audience are about that these systems and models:

- Are not applicable and practical.
- Are theoretical, ceremonial, and fantasy and do not match to real work.
- Don't help us to solve current problems.
- Increase paperwork, bureaucracy and more.
- Not suitable for our industry or circumstances.

And many other familiar things that unfortunately must be confessed that they are perfectly right.

As outlined in the standards, these systems are the general framework and best practices. So the system designer or improvement manager has to adapts the methodology, tools and techniques to the target project or organization.

System applicability or, in other words, what should be considered in the design of an application system is:

4.3.1.1 Attend to the nature of the target project or organization

Different nature and circumstances of organizations and projects should be considered in adjusting the solutions. The difference can be found in the following factors:

- Type and variety of activities.
- Degree of complexity.
- Variety of stakeholders and their expectations.
- Changes rate.
- Variety and impact or risks.

And many other factors that separates the management system of, for example, a simple construction project from a very complicated IT project. Undoubtedly, these differences should be considered in system design, and the prescription of a single version and methodology for several different projects will not be useful.

4.3.1.2 Attend to the maturity level of the target project or organization

Undoubtedly, the most perfect and precise systems and solutions will be condemned to failure if they cannot be used by users. Therefore, in compiling or tailoring the model for each project or organization, it is necessary to pay attention to the ability of the organization and users in using the system. In other word, the proposed model should be appropriate to the current level of maturity and ability of users and organization so that individuals can use it.

The main challenge of this step is the inappropriateness of the knowledge, skills and maturity of the target organization with the even lowest level of the system implementation. Here that the designer must develop an effective program to improve their maturity level, elegantly based on his experience and knowledge. There are numerous models for evaluating and enhancing the organization maturity level, and the clever use of them can help to successfully implement the system in the project and organization.

4.3.1.3 Attend to the current bottlenecks and challenges

Most projects or organizations that implement PM systems are currently involved in running one or more project and are faced with numerous executive or organizational problems. Although implementation and adherence to systems and standards undoubtedly play an important role in preventing problems, but in such circumstances, the organization needs a solution that not only can improve the conditions and prevent problems in long time, but also more important (or perhaps more urgent), can provide an effective and quick solution for existing challenges and getting out of crises.

My practical experiences in many cases prove this, and my clients has explicitly stated that "Although following the models will be effective in improving our performance, but we are now in trouble and need a prescription for the crisis exit." For this reason, before developing and implementing a PM improvement model, it is not only useful, but also necessary and inevitable to perform a comprehensive diagnosis and short-term improvement program aligning with the advantages of diagnosis.

4.3.2 Culture making and motivation

Training, knowledge transferring and other development plans, cannot be an effective factor in following the new system and model alone. We all know that change is hard. So why should someone leave his/her habitual (good or bad) method of doing works that have been used for many years and do the work in a new and unfamiliar way? (even useful in your opinion)? Certainly, the incentive for individuals will not be created only by the orders of senior executives and conducting several training courses.

My studies on discrete educational courses results, indicated that the obligatory passing of these courses did not change their performance for those who did not have the necessary initial motivation. And, conversely, there were people who, even without primary knowledge and experience, were merely looking for new solutions and, in practice, more successful in their own right, with an interest in learning and motivation for advancement. Therefore, it is necessary to develop a comprehensive program for motivating the users in designing and implementing the model.

The topic of motivation in the field of human resources is broad, sensitive and long-term, and can vary widely depending on the circumstances of individuals and organizations (including cultural programs, monetary or non-monetary rewards, and many more), that using HR experts' opinions and comments can be highly effective and profitable.

4.3.3 Continuous support, monitor and improvement of model

After designing and implementing the model in project and organization, we cannot be sure that users can follow the procedures and use the components and tools as perfect as desired. Many problems will happen during work that users need guide and help to solve them. In addition, there might be something missing in the model that now shows itself and should be revised and improved.

So a perfect model and development program must have a future continuous support and also a monitor and control plan in order to improve itself and empower the users during the work.

5. Introduction and elements of Project Management Improvement Model PMIM

In order to increase the efficiency of implementing improvement models in project and organization success, we develop certain models that contains all above elements and considerations.

These models are developed, relying on several years of applied, scientific and research experience, and with the study and diagnosing of wide range of programs and projects, in order to move towards optimal project management, reduce problems, increase the project success rate and create value for the organization and their owners.

General framework of these models are based on accredited international PM standards. Also in order to increase efficiency, flexibility and proportionality, the model will be tailored and revised for the target organization and project requirements and circumstances.

5.1 Scientific fundamentals of PMIM

The most important standards that are the basis for PMIM model are:

- PMBOK, program and portfolio management standards from PMI.
- Organizational project management maturity model OPM3 from PMI.
- Standards of American general contractors AGC institute.

5.2 PMIM trends and context

PMIM models have been developed in the following trends with different characteristics and areas of influence:

5.2.1 ePMIM: executive Project Management Improvement Model

Methodology for improving executive project management (contractor-side).

5.2.2 cPLIM: client-side Project Leadership Improvement Model

Methodology for improving organizational and strategic project leadership (client-side).

5.3 PMIM elements

The total services, domains, elements and implementation steps for each model are:

5.3.1 Diagnosis, organization assessment and gap analysis

Evaluation of programs and projects health, analyzing the current status of the project and organization from different perspectives, including the PM system, organizational process assets (OPA), tools and procedures, the maturity level of organization in project management knowledge, methods of managing projects, Organizational structure and so on, diagnosis and root-cause analyzing of existing challenges and other factors influencing the performance and success of programs and projects.

5.3.2 Provide an improvement pattern

Providing a comprehensive pattern and roadmap including system, structure, methodology, processes, tools and forms, guidelines and procedures, and other needed requirements for improving the organization's performance in the desired level and trend.

5.3.2.1 ePMIM: executive Project Management Improvement Model

An effective model of project implementation from the operational aspect and contractor point of view. It leads to optimal management of all project areas from executive perspective such as time, cost, quality, risks, human resources, monitoring and control project work, and other areas related to the successful delivery of desired output by the inner agents and within the Different areas of work such as planning, implementation, monitoring and control and delivery.

5.3.2.2 ePMIM goals

The main purpose of this model is Improving the project management system in projects and executing organizations (including contractors and individuals) with effective PM approach (planning, implementation, monitoring and control) in order to achieve results and deliver the desired outputs with less challenge and better result.

5.3.2.3 ePMIM including domains

- Correct Definition, efficient planning and organizing and maintaining the project integrity.
- Optimal Managing the project risks in various domains.
- Optimal Managing the quality of project deliverables, processes and performance.
- Optimal Managing the project supporting domains (HR, communication, stakeholders, ...).
- Optimal monitor and control of project performance, evaluation current and estimated future status of the project.

5.3.2.4 cPLIM: client-side Project Leadership Improvement Model

Applicable model for efficient programs and projects leadership from client, sponsor or organization aspect with the outsourcing approach and delegating the implementation of the work to the external agent (contractor, consultant, etc.) and effective monitoring them in different related areas.

5.3.2.5 cPLIM goals

The main purpose of this model is Improving the programs and projects leadership system in any organizations (who delegate the work to external agents such as contractors and consultants) with these approaches:

- Optimal management of efficient selection, proper definition of programs and projects align with organizational goals.
- Effective planning and organizing od outsourcing and delegating the work to external agents.
- Efficient leadership of executive agents aligning with program and organization goals and benefits.

5.3.2.6 cPLIM including domains

- Evaluation and efficient selection of programs and projects aligning with high-level goals and strategies.
- Proper technical and economic evaluation of projects and define their finance models.
- Proper definition of project delivery system and outsourcing strategy.
- Proper management of outsourcing the project in different domains like identification, evaluation, tendering, selection, referral, managing contracts and relationships.
- Proper management of executive agents, monitor and control their performance, preventing and managing claims and other challenges.

5.3.3 Tailoring the model

Adaptation and modifying the proposed model to the organization's or the project's circumstance and maturity level in order to adapt and proportionate the guidelines and tools to the needs and requirements of the organization and project, based on the results of the evaluation.

This modification is performed based on this requirements:

- Attend to the nature of the target project or organization.
- Attend to the maturity level of the target project or organization.
- Attend to the current Bottlenecks and challenges.

5.3.4 Tutorial on deployment and using the model

Training the components, instructions and implementation of the provided template to the project managers, organization managers and other related agents and how to effectively apply their tools and techniques.

5.3.5 Empowerment and future support

As described in section 5.3.3, both ePMIM and cPLIM models contain a supporting phase including advising and answering, updating tools and processes, guidance and support, optimizing the use of guidelines in practical work, troubleshooting and resolving potential uncertainties, and the like, in a certain period.

5.4 Benefits of implementing and using ePMIM

- Increasing the effectiveness of activities and reduction of project time and cost.
- Increasing the quality of project performance and deliverable and satisfaction of client and other stakeholders.
- Decreasing problems and challenges, preventing the waste of organization resources, reducing inner and outer challenges (between project team, with suppliers and subcontractors, with client or other stakeholders).
- Increasing the success rate and profitability of the projects and organizations.

5.5 Benefits of implementing and using cPLIM

- Increasing the success rate and benefits of the programs and achieve the organization goals.
- Increasing the efficiency and reducing problems, challenges, waste of organizational resources and conflicts (between client, contractors, suppliers, etc.).

6. Conclusion

With a good understanding from different aspects and levels of project management and leadership, identifying health and success criteria, evaluating the current status of the target organization, and finally, developing a comprehensive plan based on the mentioned elements (such as suggested ePMIM and cPLIM models), we can be sure that improvement programs in organizations and projects will be successful and their implementation problems will be overcome.

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Use of CCPM Theory for the Purpose of Optimizing the Organization

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Still the delays in the field of IT project is more likely to occur. Many of the delays have been attributed to the bad project management. It is a CCPM (Critical Chain Project Management) that have attracted recent attention as a theory to solve it. However, there are many cases to report the results due to the application of the CCPM to 1 project. The essence of the problem is hypothesized that it is optimized for throughput improvement of the organization rather than the improvement of the each project. I've tried the approach to apply the CCPM to the organization with the customer. We obtained significant results of throughput 20% improvement. It is a way of thinking that can contribute to solving the problems of the IT organization. I think that it would be the final aim to build Win-Win relationship with customer and vender by sharing benefits obtained by optimizing the organization and improving throughput.

Keywords and Phrases: CCPM, TOC, Throughput Improvement, Optimizing the Organization

1. Introduction

Still the delays in the field of IT project is more likely to occur. The project completed according to schedule has stayed in 21.9% according to the report that investigates the delays in the IT project. (Japan Users Association of Information Systems (JUAS), “IT trend investigation 2016”)

Many of the delays have been attributed to the bad project management. "Strengthen of the project management skill" has been enumerated in 1st place according to the report investigates the problem in the information system department. (FUJITSU Family Association: LS Research group “ICT white paper” P.4 in fiscal year 2014) The problem of the selected solution or the problem of member's skill might cause the delays. However, the quality of management often connects directly with the delays.

Being paid attention as a theory that solves this problem of current management is CCPM (Critical Chain Project Management). CCPM is a theory that uses TOC (Theory of Constraints) to the field of project. TOC is the theory advocated by Dr. Goldratt. TOC has been used in a lot of industrial fields for the theory to aim the “Global optimization”. As for CCPM, the case to the IT project was few, however it has increased after it was applied in DAIWA HOUSE INDUSTRY CO., LTD in 2011. A lot of articles on CCPM of IT project can be found in the site of Nikkei IT Pro.

However, there are many cases to report the results due to the application of the CCPM to each IT project. Many are these patterns in the case reported by “CCPM conference Project Flow 2014/2016 in Japan”. “Project Flow” is the conference about CCPM held by Fujitsu. And it cannot touch the organization optimizing by CCPM even with other paper.

The essence of the problem is hypothesized that it is optimized for throughput improvement of the organization rather than the improvement of the each IT project. Because it is only the “Local optimization” in the entire organization even if optimized only each IT project. “Global optimization” is requested.

The purpose of this research is a proposal to apply CCPM into the organization to achieve the “Global optimization” and throughput improvement. I've tried the approach to apply the CCPM to the organization with the customer to verify this hypothesis. And a big result of throughput 23% improvement is achieved. This paper discusses the idea and the technique of this approach.

2. CCPM to solve the problem of current management

2.1 Element that causes the delays

The element that causes the delays in current management are included in the following four point.

(1) Management by “rate (%)”:

This is a method of managing the advancement condition by "rate (%)" of the completion rate or the progress rate. It is likely to start it from an easy part and excessive rate might be shown. It is likely to advances up to 90% well, but it doesn’t advances to rest (10%). It is not possible to judge the timing of “When does the task end?”

(2) Management by “the INAZUMA line”:

The INAZUMA line expresses the difference between the plan and results by using the line. A task that is later than the plan is plotted from the point of today left and it is a task that should do the attention. There is a possibility of mistaking the priority level when there are two or more late tasks. The influence to project might be few even if some tasks runs behind schedule.

(3) Management by “fixed date”:

This is a method of providing and managing beginning date and expected completion date of all tasks. It is not possible to avoid it though various problem behavior is caused by the following human psychology and behavioral characteristics. It is a person's “Saga”.

(1) All budgets and time are spent. (Parkinson's Law).
(2) Student syndrome
(3) Even if it is ended early, it does not report.
(4) It fudges the count. The buffer is piled up.
(5) Even if it is unprepared, it begins because it is a beginning expected date.

(4) “Multitasking”

This is a method of allocating two or more tasks in the same resource at same time. The switch loss of the head is generated when the task is switched, and a lot of time is required consequentially.

2.2 Management by CCPM

Management of the remaining duration by "How many days do you need?" and priority level of buffer have been achieved the non-delays in CCPM management. In the confirmation of the progress of every day, we confirm not the advancement condition compare to plan’s date but the remaining duration completing the task. The delivery date is not set to each task. The point is reporting on not the “past” but the “future”. As a result, “when does the task end?” is clear in the early stage. And even if the problem occurs in the task, we are good early at measures. It becomes an environment that it is difficult to occur (3) of 2.1. In addition, the priority level of project/task is decided by using the consumption rate of the buffer. It is possible to concentrate on the high priority project/task with high priority.

3. Problem of CCPM application to single project

3.1 Approach of CCPM

There are greatly two approach in the method of approaching CCPM. It are "Single-project" and "Multi-project". (Figure 1)

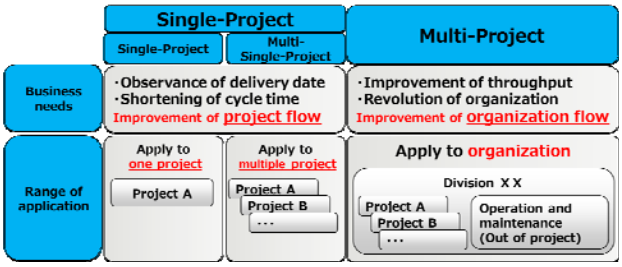

Figure 1 Approach of CCPM

3.2 Problem in single project approach

There are a lot of cases where it first starts it from the approach of a single-project when CCPM is applied. Because the following psychology works.

(1) Does the theory of new management suit us?
(2) First of all, we want to evaluate the trial by a small-scale project.

When CCPM is applied as a trial by a small-scale project, there are many case that the trial evaluation is difficult. It is because another project and operation and the maintenance work influence the term of works. It often serves concurrently as the resource that takes charge of a small-scale project with other projects. The support request from other projects always comes. The occurrence of Q&A and the trouble cannot be expected when operation and the maintenance serves concurrently.

It is only “Local optimization” in the organization even though the result was put out by a single-project. It acts against “Global optimization” that is the concept of TOC.

4. Application of CCPM to organization

The essence of the problem is hypothesized that it is optimized for throughput improvement of the organization rather than the improvement of the each project when thinking about the solution of the problem described in Chapter 3. Business needs for a single project (Observance of delivery date and shortening cycle time etc.) are feasible to improve the throughput of the organization.

To verify this hypothesis, an idea and a technique are discussed based on the case where the approach that applies the CCPM theory to the organization with the customer.

5. Practicality of proposed approach

5.1 Current Reality Study

5.1.1 Flow arrangement

First Current Reality Study is to dig up all work in the organization and arrange flow. In this case, it is divided into two work of "Project" and "Short work". (Figure 2)

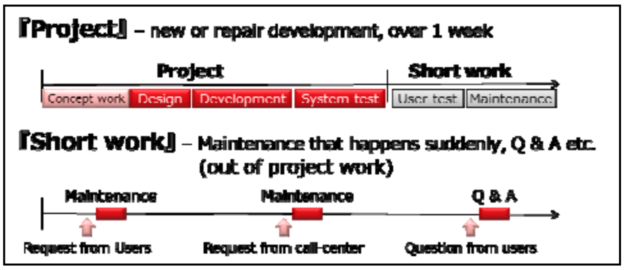

Figure 2 Flow arrangement of work in organization

5.1.2 Resource arrangement

Second Current Reality Study is to arrange the resource in the organization. All members are serving as a project and short work concurrently in this case. Table 1 shows the result of analyzing the percent of short work during a day. It is understood that almost of all resources do short work at a high percentage.

Table 1 Resource according to percent of short work

% of short work	Number of resources	Name of resources
70-80%	5	A、B、C、D、F
50%	9	G、H、I、J、K、L、M、N、O
0-20%	2	P、Q
Total	16	

5.1.3 Analysis at waiting time

Third Current Reality Study is to analyze "How much is the following four waiting times generated?"

(1) Waiting time due to shortage of input
(2) Waiting time due to shortage of resource
(3) Waiting time by manager/specialist waiting
(4) Waiting time by confluence of task

Table 2 shows the result of analyzing the waiting time.

Table 2 Analysis at waiting time

	Design	Development	System Test
Shortage of Input	50%	0-20%	0%
Shortage of Resource	50%	50%	50%
Waiting for specialist	0-10%	0-10%	0-10%
Confluence of task	0%	0%	0%

The figure means the percent within time from beginning one task to the end what percentage was waiting times. It is understood a lot of waiting times due to shortage of input and resource are generated.

5.2 Solution Design

The problem symptom of the organization is specified the following three points through the result of Current Reality Study of 5.1 and hearing from the member.

(1) All number of project have a short work while progressing.
(2) It is a conviction of progressing because it can do if starting it.
(3) Arrangement of fixed resource

These three causes the delay of project and short work. It is necessary to change this problem symptom.

So following three rules are provided by "To what to change?"

Rule 1: Pipe lining
(1) Separation of project team and short work team (expert team)
(2) Decrease "work in progress" of project/task and concentrate the resource
(3) Control the turning of project and keep the best "work in progress" number

Rule 2: Full kit
(1) The full kit point is set up ahead of "Design" phase
(2) Start the task after thorough advance preparation

Rule 3: Buffer management
(1) Arrange the resource according to the priority level of the buffer
(2) Establish the process of resolving the problem

5.3 Target setting

It is important to set the target and agree with stakeholder. How many does throughput go up compared with current? It is provided as a well-grounded numerical target. And it uses for the evaluation after application.

When the target is set, Little's Law (Figure 3) is used. It expresses it by the following three values in Little's Law.

(1) *TP*(Throughput) : Number of completion each period
(2) *WIP*(Work In Progress) : Number of "work in progress"

(3) *CT*(Cycle Time) : Period from beginning to ending

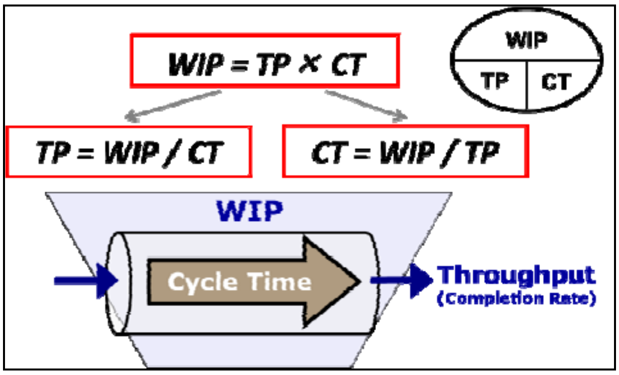

Figure 3 Little's Law

It explains by using the simplified example (Figure 4). It is assumed that Project A-Project F (six projects) was executed by three team in year in the organization. When it apply to Little's Law,

TP = *WIP*/*CT* --> 6 = 3 / 0.5

It is necessary to raise *WIP* (3) or shorten *CT* (0.5) for increasing *TP* (6). However, raising *WIP* is not a good solution in the environment of high *WIP*. We should decrease *WIP* according to 3 rules. In this case, throughput increases if *CT* (0.5) is shortened more than *WIP* (3) is decreased.

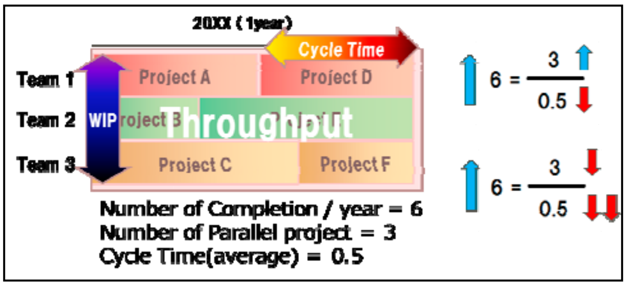

Figure 4 Little's Law (simplified example)

In this case, at first current baseline arrange from the project performance data (information on the start date and the end date of Project) of last 1 year. Next, the *WIP* decrease and the *CT* shortening from a current baseline are provisionally calculated by applying three rules (solution) based on the analysis result of the waiting time of 5.1.3. Then the target of *TP* is set. (Table 3)

Each value of Target

WIP : 14 -> 9 (36 % down)

CT : 40 -> 21 (48 % down)

TP : 7 -> 8.6 (23 % up)

Summary, about 23% of throughput improvement is set as target. And it is necessary to lower *WIP* from 14 to 9.

Table 3 Current baseline and Target

	Current				Target			
		Des.	Dev.	Test		Des.	Dev.	Test
WIP	14	3.5	7	3.5	9	2	5	2
CT (days)	40	10	20	10	21	4.5	12	4.5
TP (monthly)	7				8.6			

5.4 Execution process decision

It is necessary to drop down three rules set by 5.2 to the viable process. In this chapter, it applies and explains the focus in a feature process by the Multi-Project.

5.4.1 Control the turning of project

Each phase (Concept work, Design, Development, System test, Short work) are defined as the "Pipe". The pipe is an image of the tube where the tolerable quantity is decided. Tolerable quantity of Pipe is the same meaning as the upper bound of WIP. It is important to turn on in each pipe according to the completion speed. "One-in" after "One-out" is repeated. It treats as WIQ (queue) before it is turned on. Figure 5 shows the whole of turning on control image.

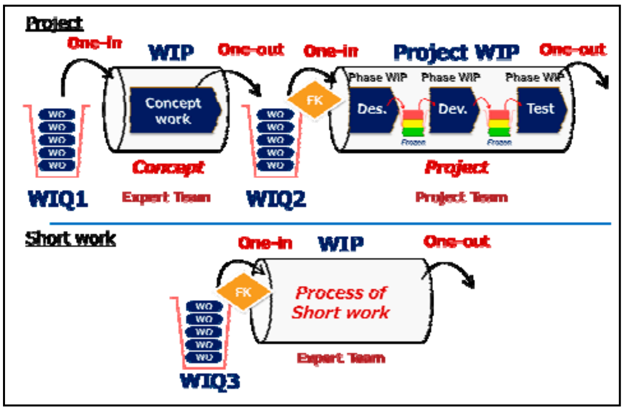

Figure 5 Control the turning of project

It keeps the status of each project by using administrative file. Figure 6 is the image of administrative file. Current phase of each project can be seen. And current WIP can be seen. The manager controls the turning of project and keeps the target WIP.

	WIQ1	Concept	WIQ2	Des.	Frozen	Dev.	Frozen	Test
Target				2		5		2
Current WIP	1	2	0	2	0	3	1	1

#	Project Name	WIQ1	Concept	WIQ2	Des.	Frozen	Dev.	Frozen	Test
1	AAAAA	->	->	->	->	->	->	Frozen	
2	BBBBB	->	->	->	->	->	->	->	WIP
3	CCCCC	->	->	->	->	->	WIP		
4	DDDDD	->	->	->	->	->	WIP		
5	EEEEE	->	->	->	->	->	WIP		
6	FFFFF	->	->	->	WIP				
7	GGGGG	->	->	->	WIP				
8	HHHHH	->	WIP						
9	IIIII	->	WIP						
10	JJJJJ	WIQ							

Figure 6 Administrative file

5.4.2 Buffer management

Using priority level of buffer when we judge the priority of project/task is very valuable. The priority level of the buffer is expressed numerically. And the organization can have the objective and single standard of priority level. The state of the portfolio is plot by "Longest Chain Complete" and "Buffer Consumed" of each project. (Figure 7) The priority level of each project is decided by this state of the portfolio.

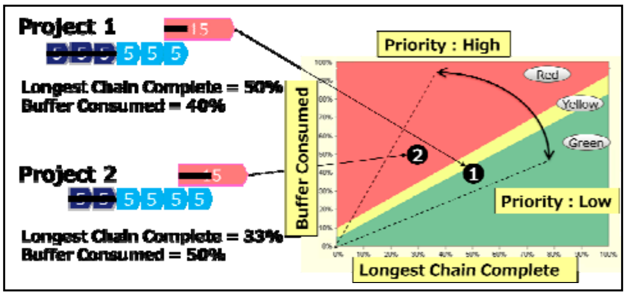

Figure 7 State of the portfolio

When the angle is strong in view of the starting point, the priority level is high. And the color also expresses the priority level. Red is the highest priority. Yellow is second priority. Green is third priority. The priority level of Project 2 is higher than Project1 in the example of Figure 7.

6. Conclusion

6.1 Summary

In this case, the following two results were achieved.

(1) It keeps the target throughput (8.6/month, 23% improvement)

(2) It can be starting the foundation solution to decrease short work by using the resource who is create by throughput improvement. This result is a secondary effect.

It can be said that the "Global optimization" was achieved.

However, there is one problem that should be got over. In addition, a further improvement of this approach is described.

6.2 Problem of "dependent on individual skills"

When this solution is applied, the maximum challenging is a problem of "dependent on individual skills". All members cannot understand every system in the environment of current IT organization. There are various, complex information systems.

In this case, when the team of a project and short work separated, it was not possible to separate team completely on the boundary of a certain day. The approach that removes "dependent on individual skills" is done at the same time. It not only works but also makes the document as the operation manual when they receive the question or request from end-user or call center.

6.3 Possibility of new business model

It is thought that this solution hides the potential of the new business model gotten rid of a current "man-month business".

It is likely to have to doubt about current "man-month business" as IT vender when receiving an order of new system development or system maintenance. Is the following ways (current "man-month" business) preferable for the customer?

(1) Each development/maintenance is estimated by the man-hour piling by themselves.

(2) If the customer's budget is over, it carried over next year.

It is thought that completion bonus model may be a new business model. Figure 8 shows the image.

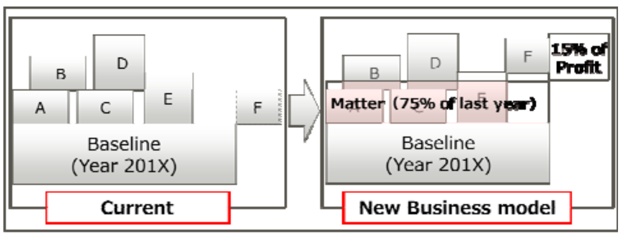

Figure 8 New business model (image)

In most current cases, there is a "Baseline" for maintenance. And "Matter" other than maintenance, it estimates individually and cost is presented. The matter that exceeds it to the customer budget (F of Figure 8) will be carried over next year.

On the other hand, each one is not estimated in the new business model. The cost is presented by “amount of last year * 75%" in addition to "Baseline" at the beginning of the year. In addition, 15% of the profit of the customer business area section to which the system that introduces it contributes is obtained as an incentive at the beginning of the next year. The matter are executed by an existing resource while controlling *WIP* that agrees with the customer.

There is an advantage on which the order cost downs when seeing from the customer. The possibility that the matter that was carried over next year (F of Figure 8) can be digested rises because throughput goes up.

As for the vender, the incentive income can be expected next year though the amount of money of the order decreases temporarily. For instance, the business area of system is construction materials business area. If the profit of the construction materials business area is 100 million yen, 15 million yen that is the 15% can be obtained. Big incentive can be obtained only after the system that introduces it into the customer is effectively used and it contributes to the customer's business. It is a business model of not only a system integration but the value offer model.

6.4 Conclusion

It can be said that the idea and the technique of this paper are ideas to be able to achieve the “Global optimization” and throughput improvement.

And it contribute to the solution of the problem of the IT organization. It is thought that it is an environment that the project exists together with short work in any IT organization, and it can propose to solve the problem with the customer.

It is thought that it is the most important thing to examine how to use the profit created by optimizing and improving the organization throughput. It is the true business needs that previously include business needs. A certain organization will turn to the investment for the future like the employee education. A certain organization will make the employee take their vacation for the purpose of the improving of how to work.

It would be the final aim to build Win-Win relationship with customer and vender by sharing benefits obtained by optimizing the organization and improving throughput.

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Necessary Considerations for the Successful System Development Project

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User requirements of computer system development have variety of their backgrounds. We can see wide range of these backgrounds, such as renewing current system due to deterioration, adapting to the changes of business rules/systems, and new business strategies requiring more advanced system. These backgrounds shall establish system requirements, and those development projects are launched. The important points to be concerned and communication style in the projects shall vary a lot in accordance with these different business background aspects. Especially a strategic project with new business may have higher difficulty than renewing deteriorated system with know-how piled-up, because the user must establish new scheme of such new business. The project of that kind tends to encounter vague user requirements. The vagueness of user's systematization requirements usually are from the lack of user's sufficient consideration of target business scheme. However, sometimes it is the case that such a project management is to blame as of insufficient understandings of that target business. The author, a sales management staff of computer system, with experiences of working as a member of the customer's IT division also, has encountered many cases of such "project management is to blame" cases. This thesis shall propose some project management style to avoid such a case through the author's own experience with viewpoints of both the user of IT division and the sales management staff of the same project.

Keywords and phrases: Strategic Business Requirements, Sales Manager and Customer's IT Division Member

1. Introduction

Our company provides variety of IT services, which includes IT outsourcing service to a certain financial institution (the customer). The outsourcing was launched more than ten years ago. The author, a member of sales management staff of that IT outsourcing service, went on loan to the IT division of the customer for three years. The purpose of the loan was to establish a long term relationship with the customer. During the loan, the author took charge of building up RFP of computer system development, managing development process of launched projects, and so on. The customer has many inducements to request system development. (Refer to Table 1) PMBOK does not provide characteristics and categories of projects based on their backgrounds. However, the author regards that the way of project management varies corresponding to these characteristics and categories. For example, a project categorized as "strategic" tends to be the development from scratch with higher difficulty, because it is to establish new work flow and, even more, new business scheme of the end-user division. Such a project easily encounters reworks and troubles in the later development stages due to insufficient requirements detail concerns in the early stages. This kind of case is caused from the fact that the many items are failed to be defined in the user's planning paper and RFP.

Table 1 Backgrounds of System Development

Category	Overview	Primary project characteristics
Strategy	To correspond to new business and/or new scheme for higher profitability	・Development tends to be from scratch. ・User requirements tend to be vague. ・Detail requirements tend to be insufficient.
Maintenance	To renew current system due to hardware deterioration and/or termination of software support service	・Comparison with current system required. ・Development deadline clarified.
Legislative system	To adapt to the changes of business rules, such as legislative system	・Requirements and development deadline tend to be clarified. ・Impact from the changes shall be concerned.
Security	IT risk management for computer viruses and cyber attacks	・Imperiousness required according to the scale of threat. ・Comparison with existing countermeasure of other companies required.

One of the causes of these troubles is the user's insufficient concerns, however, sometimes the contract forces the developer to blame, because usually the developer is responsible for the project management. So, the developer's communication style with the user in the early stages shall be very important.

This thesis is about some hypothesis, verification, and considerations of such a "strategic" project. The author made some hypothesis as the user in early stages. Later after the loan, the author was in charge of the same project as a sales management staff, and verified the own hypothesis.

2. Explanation of the Example Project

The existing computer system was to assist registration work based on submitted application forms. The system development project was to "strategically" change user verification method. The project objective was to realize low cost operations by terminating existing exclusive verification hardware by changing the verification method. The project had no precedent example, no other financial institution hadn't realized this kind of change. Therefore, as the user's standpoint, many items such as compliance viewpoint and the way of running new business scheme, had to be concerned and investigated.

The development project was divided into two phases according to the customer's request. The first phase was to establish the new business scheme, and the second phase was to terminate existing method and change the workflow of registration work. The development schedule was more than 1 year through 2 phases. In the first phase, the project was to establish a new verification method by adding it to the existing workflow. However, the existing verification method remained in the workflow, only skipped by the user operation. The second phase was to terminate the existing verification method and to connect the pre-process and the after process directly. Because of the change of the workflow, it was necessary to modify the related forms and operational screens. By the reason above, the second phase required longer time schedule and much cost than the first phase.

In the first phase, the author joined the project as a member of the customer IT division, made a requirement adjustment with the user division, and performed project management of development team. In the second phase the author returned from a loaned position and joined the same project as a sales management staff who had deep knowledge of the user requirements with the project manager. (Refer to Table 2 and Figure 1, 2)

Table 2 Overview of the Project

Overview	A strategic project to change user verification method to assist registration work based on submitted application form.	
Phase	The first phase	The second phase
Phase explanation	Establish new verification method	Terminate existing hardware Change the workflow of registration work
Program K steps	2.9K steps	5.9K steps
Duration	5 months	8 months
Cost	20M	55M
The author's standpoint	The customer (IT division)	The sales management staff

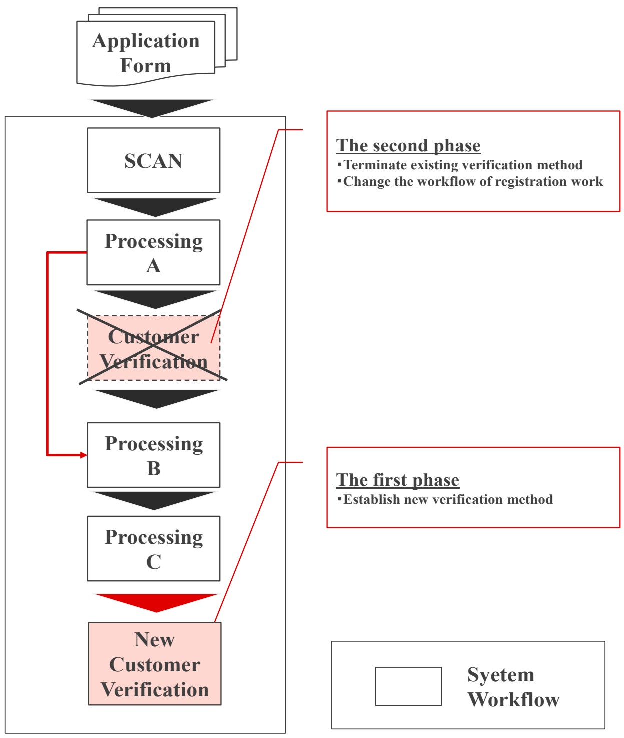

Figure 1 Corresponding Image of the Project

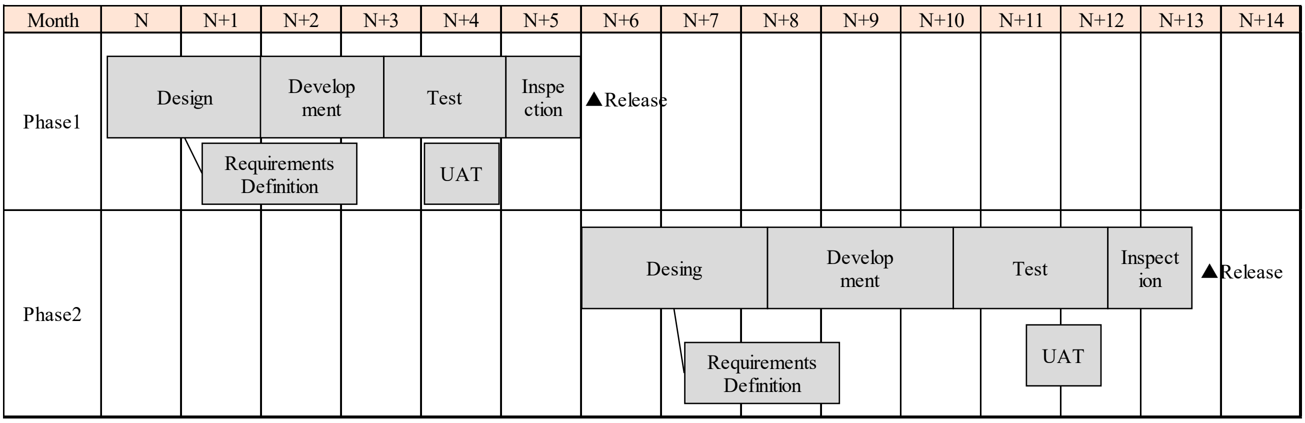

Figure 2 Project Schedule

3. Problems in the First Phase

In the first phase, there were many items to be examined at the customer side, before establishing new work scheme. These items were to estimate positive effects from establishing new work scheme, to build up consensus of changing the workflow with the end-users, and to study and adjust compliance matters with the change. Some of these items were examined partly by collecting information from the developer side. Though there were many uncertainties, given time duration was not enough and the deadline of the first phase was already fixed. These examinations took longer and longer as usual. In addition, even in the later design stage, multiple requirements needed to be adjusted emerged, which were not tangible in the former requirements definition stage. As a result, the project had to postpone the prefixed due day.

4. Analysis of the Problems in the First Phase

What caused the project due day postponed? At first thought, it seemed to be clear that lack of sufficient adjustment of the customer side was the cause of the delay. However, was it really so that all the causes are from customer side only? The author, at that time joined the project as a customer member, regards the main cause to be the lack of sufficient mutual information exchanges among project stakeholders including the project manager(hereinafter "btwn CS-PM.") At that time, questions and answers were exchanged btwn CS-PM, which seemed that sufficient information was exchanged at a glance. However, it is not necessarily true that the project had to wait until the later stages that all the problems of delay became apparent. A certain amount of those problems should have been detected earlier by PM's proactive approach to the customer and positive communication with the customer. (Refer to Table 3)

Table 3 Part of Major Problems of Delay in the First Phase

Explanation	PM's action	Negative effect
Research on verification of effects	No research was conducted until requested, though research with system was possible	Lengthening of cost-effectiveness and target price calculation
Check on the user in the new method	Proceeded investigation under the estimation that the current users will handle the new system.(Became tangible in the design stage that other users will handle)	Additional requirements, Reworks of estimation
Confirmation of the screen and the operations	Brought over to the design stage, though rough image could have been confirmed in the requirements definition stage	

These problems described above show that merely answering questions of the customers' concerns is not enough to proceed the project successfully. Instead, truly important matters are if you can be aware of underlying issues which still are out of awareness of the customer, and how close you can be to their standpoint, simultaneously to the third party standpoint.

PMBOK provides description of project risks in the knowledge area - risk management section. It says project risks are originated from "uncertain events and conditions," which are underlying requirements items, pre-conditions, and restrictions. Some of them correspond to the problems of this project.

The author experienced the importance of proactive involvement in the customers in early stages as much as the project devoted to establish new business scheme, "a strategic project."

5. Verification of Hypothesis in the Second Phase

The author turned to be the sales management staff from the customer to proceed the project in the second phase. The author concluded that this phase had the same project characteristics as the first phase, because calculating cost-effectiveness and operational changes brought from new workflow were expected similarly in the first phase. Therefore, the author decided to conduct proactive involvement in the customer with the PM in the early stages.

Table 4 Proactive Approaches in the Second Phase

Viewpoints of risk avoidance (PMBOK)	Action	Descriptions
Providing necessary information	(1)Supporting the customer's business related to the project	・Calculation of positive effects by the termination of current workflow ・Calculation of efficiency improvements by the changes of existing workflow
Clarifying requirements	(2)Dealing with the vague requirements	・Early user verification Checking on the image of operations and screens with the end users before proceeding the development
Communication improvement / Obtaining necessary information	(3)Investigating underlying requirements	・Changing communication method to face to face discussion from mere one question and one answer style ・Opening regular progress meetings with the end users ・Opening regular progress meetings with the IT division

PMBOK has descriptions of risk avoidance in the knowledge area - project risk management. That description includes the viewpoints to avoid initial risks in projects. With referring to them, the author decided to take three concrete actions in the early stage as follows: (Refer to Table 4)

Action 1: Supporting the customer's business related to the project

Conducted support to the customer of budgeting, with understanding their decision making scheme

Action 2: Dealing with the vague requirements

Set the table to discuss with the user division to detect detail requirements with the changes of workflow earlier.

Action 3: Investigating underlying requirements

Grabbed the customer's underlying requirements by increasing face to face discussion occasions with opening regular progress meetings.

6. Effects of Hypothesis Verification and Looking Back

Effects verification of the three major actions taken in the second phase is as below. These actions produced a certain amount of effects both quantitatively and qualitatively, which lead the project to be successful.
To be concrete, the results of three actions are as follows: (Refer to Table 5).

Table 5 Effects Verification of Each Action

Action	Quantitative Effects	Qualitative Effects
(1)	Time duration for information gathering shortened by starting studying the customer's business before requested so from the customer. Effect:1week shortened	The customer's early budgeting realized by proactively providing necessary information for additional budgeting.
(2)	The project proceeded as initially planned, by detecting overlooked system requirements early. Pointed out numbers: Screen items: 12 Operational items: 4	Design fix due date surely kept by detecting detail requirements early.
(3)	Unnecessary functional requirements excluded by operational image deepened through the regular discussions with both the user division and IT division. Excluded functions: 3	Productivity improved thanks to communication opportunity increased, which changed the developer from just waiting for the orders, to proactively grab own tasks.

Action 1: The customer smoothly obtained budget in early, by the developer's proactive execution of the requests from the customer.

Action 2: The requirements, which were not recognized by the IT division only, were discovered early.

Action 3: Exclusion of unnecessary requirements and productivity improvement were realized thanks to obtaining high knowledge of application business

By taking actions above described, the project successfully kept the schedule and due date which was of the highest priority. In addition, the customer praised the developer for proceeding the project satisfactory comparing to the first phase.

7. Points of View from an Experienced Sales Manager

The author has suggested, through his own project, the importance of proactive communications with the customer in the project with a strategic background. And the co-author, having conducted many project monitoring, makes comments from the different point of view. From the initial stage to the design stage, there are lots of cases the users themselves don't have clear idea what they really want, or even more, they cannot reach to that considerations. It happens when the system development project is the first time for the user or the project is to establish the new business scheme. The cause of such issue may be that the lack of adapting business study by the users themselves and the problems of process management, (what to do and how shall be done is not clear to the users.) Especially in the initial stage of the project, because the development organization has not been satisfactorily established, the communications from the sales organization to the customers is the important point. Even so, merely making close communications to the customer does not solve such problems. It is desirable to provide some hints or suggestions for the customers to proceed investigations. Some potent points of such and hints and suggestions are as below.

1. Making output

In the initial stage, the investing points and the orders tend to be vague and each person has different images of the pre acquired input information. To solve these, we have to make outputs as much as possible. Because making outputs serves to have deep understandings of the investigating points and the orders. Even more, sharing those outputs also serves to obtain the common understandings and to know information among stake holders more efficiently. It is strongly suggested to make outputs assertively, especially in the initial stages when things tend to be vague.

2. The study on the market, the industry, and the trend

Not only IT but also every industry has some preconditions and rules, and every business exists based on each context. So when conducting investigations on proceeding examples and trends, it is necessary to grasp the essentials of the business rather than their surface only. When investing proceeding examples, it is without saying true that only one example is not sufficient subjectively and collecting multiple examples is desirable. By extracting meta-information from a wide viewpoint, providing essential information and suggestions with the customer is surely very useful to proceed investigations.

The two points above mentioned are widely known as usual basic conductions, but surprisingly not so many people are actually practicing by knowing those essentials. This thesis omits those concrete methods and frameworks but since they obtain some positive effects to proceed the project smoothly, the author expects the reader to find them useful in the actual project.

8. Conclusion

This project proved that it has a certain amount of effects to proactively involve in the customer in early stages of the projects with strong strategic characteristics. This thesis is based on the case study of one project, so hereafter the author is willing to analyze tendencies of several projects with different project backgrounds. In the first place, just like a project itself has several natures like living animals, there is no single method which is high enough to avoid project risks. Therefore, communications and risk management prepared for the uncertain issues and conditions are necessary. As one of the material to decide those communications and risk management style, the backgrounds of the user requirements are important. The author sincerely expects the readers to understand these matters through this thesis. (Refer to Figure 3)

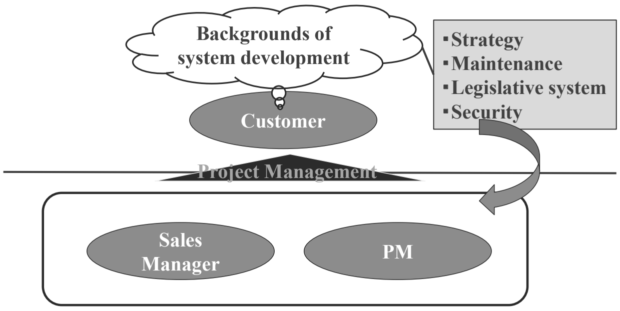

Figure 3 Project Backgrounds Affecting Project Management

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Implementation of Web-Based and Face-to-Face Trainings on Project Risk Management for Local Subsidiaries

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In recent years, projects implemented by local subsidiaries have become more sophisticated, more complex and larger in scale. Such trends have increased failed projects due to cost overrun and missed delivery deadlines. As preventive measures, the enforcement of project risk management processes such as the gate-screening and mandatory reporting has been initiated. To implement these measures successfully, full cooperation from local subsidiaries including management, staff members, sales divisions as well as project managers and project team members is indispensable. However, the implementation of the above processes can be a burden and the enforcement of the processes may be difficult due to resistance from the local subsidiaries. To resolve these issues, various measures such as instructions from headquarters management, explanatory meetings, newsletter to the local subsidiaries and systematization of reporting are taken. Consequently, for the purpose of making all the persons of local subsidiaries involved in projects understand the importance of project risk management and observe its rules, we have planned and implemented web-based training of employees and have given face-to-face training to local executives who are assigned to local subsidiaries. These activities have had the considerable effect of reducing resistance and increasing cooperation from local subsidiaries.

Keywords and phrases: Risk Management Training, Risk Awareness, Local Subsidiary, Local Hindrance, Gate Screening

1. Introduction

In recent years the use of ICT technology in the field of social infrastructure has accelerated worldwide. This trend has made projects more complex and larger in scale. Local subsidiaries as regional enterprises are implementing projects together with the headquarters in Japan. These local subsidiaries, which were originally sales or manufacturing companies, have begun handling complex and large-scale projects. This in turn has caused failed projects due to cost overrun and missed delivery deadlines.

To mitigate the risk of failed projects, the enforcement of project risk management and process control is necessary. Also, local subsidiaries need to familiarize themselves with these processes while measures are taken by headquarters in Japan to enforce the governance of the local projects. Specifically implemented are gate screening for project risk management and process control. Gate screening mandates reporting to and approval by headquarters. Full cooperation on the part of local subsidiaries, including the management, staff members, sales divisions, as well as project managers and team members, is indispensable.

However the implementation of above processes can be a burden to local subsidiaries whose resources are limited. Thus gate screening and reporting stipulated by corporate headquarters in Japan may not be implemented easily due to the reluctance of local subsidiaries.

To remove the hindrances, various measures such as instructions from top headquarters management, explanatory meetings, newsletter to the local subsidiaries and systematization of reporting are taken. Consequently, for the purpose of making all the employees of local subsidiaries involved in the projects understand the importance of the project risk management and observe its rules, we have implemented web-based training for employees and have given face-to-face training for executives who are assigned to local subsidiaries. These activities have had the considerable effect of reducing resistance and increasing cooperation from local subsidiaries. We report these trainings in this paper.

In the next section, the challenges in establishing the project risk management system are explained. In section 3, how to establish the project risk management system is described. In section 4, the results of the trainings are explained. In section 5 the effects of the training are discussed. In section 6 the conclusion of this paper is provided.

2. Challenges in Establishing the Project Risk Management System

The project risk management system stipulated by the headquarters in Japan as one of the measures to cope with failed projects tends to increase the burden on local subsidiaries whose resources are insufficient. This has led to resistance on the part of the local side to adopt the system. The following are the specific comments often heard from them.

From project teams:

- We don’t want to be controlled by headquarters.
- Gate screening and reporting demanded by headquarters are additional work.
- There is no benefit to the project itself.
- The Japanese system is much too complex to adopt locally.
- The quality of the project and the risk management process that headquarters demands are too much.

From local management:

- We would like to prioritize the project implementation.
- We don’t want to put extra load on the project team.
- Gate screening or reporting to headquarters is not a matter of first priority.
- We cannot explain the benefits of the system to the members of project team.
- The Japanese system is much too complex to explain to the local members.
- We don’t have resources to spare for gate screening or reporting.
- Local subsidiary employees are unfamiliar with project management because they started out as sales agents and later took on implementing projects.

These comments, with the exception of “We don’t want to be controlled by headquarters”, are considered to be due to insufficient local resources, lack of understanding of the project risk management system and a lack of recognition of its importance. Though a lack of local resources is an important issue, we think that improved efficiency as a result of the implementation of the project risk management system may help mitigate a lack of resources. Moreover a lack of local resources goes beyond the scope of the project risk management at local subsidiaries.

Therefore, the issue we focus on here is a lack of understanding of the project risk management system and a lack of recognition of its importance.

3. Measures to Establish the Project Risk Management System

To remove hindrances, various measures such as instructions from headquarters management, explanatory meetings and newsletter to local subsidiaries and systematization of reporting are taken. However just taking these measures doesn't work if people in local subsidiaries don't share the importance of the project risk management system from the heart. Consequently, for the purpose of making all employees of local subsidiaries involved in the projects understand the importance of the project risk management and observe its rules, we have implemented web-based training of all employees. Also we have given face-to-face training to the executives who are assigned to local subsidiaries so that they understand the project risk management system well and be able to allocate the necessary resources.

3.1 Web-Based Training of All Employees

3.1.1 Objective

To understand the impact of the materialized project risks and the importance of the project risk management. To understand the project risk management system as a specific means and to be able to implement the process as stipulated by the system.

3.1.2 Training Recipients

All members of the Global Business Unit including salespersons and staff members. Training recipients in local subsidiaries are decided by local PMO members.

3.1.3 Method

Web-based Training.

3.1.4 Contents

- Explanation of the impact of the materialization of project risks on a business.
- Examples of failed projects
- Explanation of project risks and the importance of risk management
- Explanation of the project risk management system
- Explanation of gate screening and reporting required of local subsidiaries

These contents are explained to learners in a more familiar manner by using many questions and answers.

3.1.5 Approximate Amount of Time to Complete the Training

60 minutes

3.2 Face-to-Face Training of Executives at Local Subsidiaries

3.2.1 Objective

To understand the project risk management system and be able to allocate the necessary resources. To understand the contents of the Project Risk Management Manual for Executives of Country Affiliates and be able to use it.

3.2.2 Object Person

Persons who are assigned to the management of local subsidiaries.

3.2.3 Method

Face-to-face training.

3.2.4 Text

"Project Risk Management Manual for Executives of Country Affiliates" is used as text.

3.2.5 Contents of Text

- Explanation of the project risk management system
- Explanation of gate screening and reporting required by the local subsidiary
- Examples of failed projects
- Instructions to be given by the executives of the local subsidiary to the project manager and project team

3.2.6 Duration

30 minutes as a topic of the training course for overseas assignment.

4. Result of the Trainings

In total 80% of respondents who received the web-based training for all employees and the training for executives who are assigned to overseas subsidiaries replied that these trainings were very effective or effective.

4.1 Web-Based Training

Web-based training was provided twice in FY2014 and FY2016. The training completion rate was 83% and 86% respectively.

The result of the questionnaire for the FY2016 training "Do you think this course will be useful for you in your job?" is as follows:

- Very useful 27%
- Useful 50%
- Neither useful nor not useful 16%
- Not very useful 4%
- Not useful at all 3%

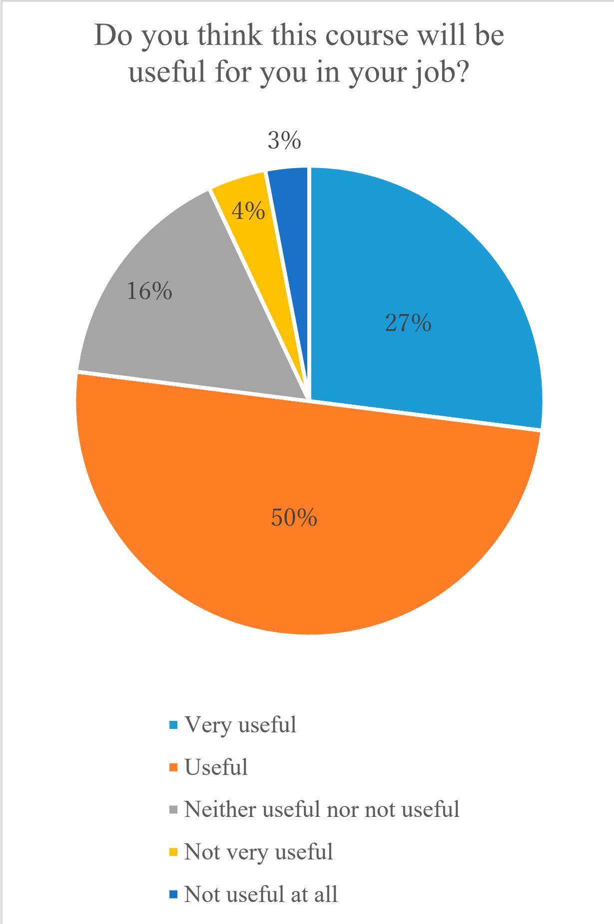

Fig.1 Questionnaire result (Web-based training)

For the FY2016 training, the following positive feedback was received:

- Useful
- Well-organized
- Splendid!
- Would like to utilize it in my division
- Would like to receive the training material as electronic data
- Would like to receive the training material to introduce to other divisions.

On the other hand, there was negative feedback as shown below, and some of them are already reflected in FY2017 training (ongoing). We would also like to reflect the remaining feedback that was not reflected in FY2017 training as much as possible in the future.

- I am not the targeted person for this training.
- The contents are dense and lengthy.
- Would like to receive training in a language other than English (Spanish, Chinese)
- Would like to have video, interactive contents, and F2F training
- Would like the currency used in the training to be in U.S. dollars (yen is hard to grasp)
- Would like to receive a glossary

4.2 Face-to-Face Training of Local Executives

Training of local executives was provided more than ten times from FY2015.

The major feedback is as follows:

- Very beneficial 45%
- Beneficial 35%
- Do not think the training is practical 10%
- There is nothing new to learn 10%

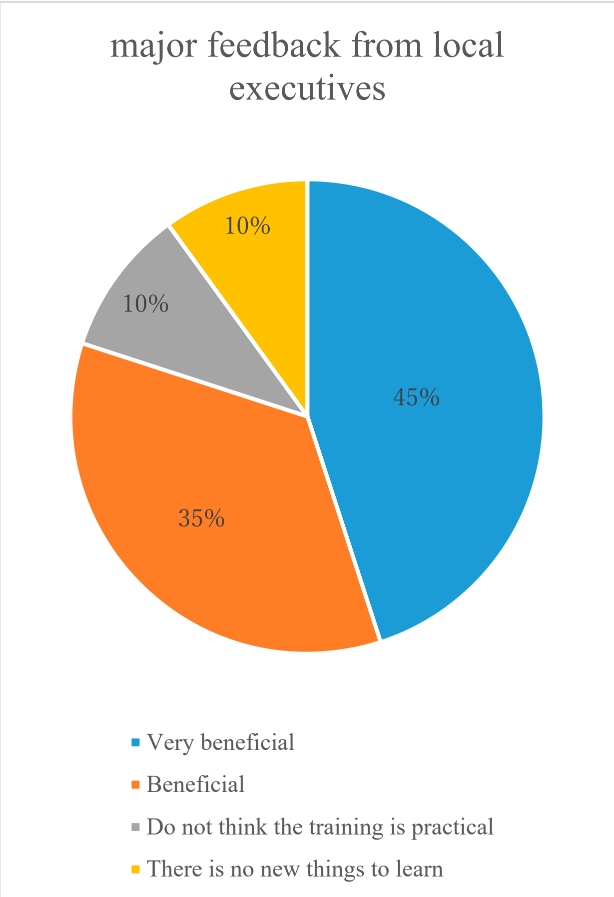

Fig.2 Questionnaire result (Face-to-face training)

5. Effects of the Training

The following effects were observed by us, who manage the gate screening in Japan:

- The training has nurtured a common ground between Japan and the local side on gate screening and reporting. The local side has begun positively to request improvement on the project risk management system instead of being against it.
- At the initial screening stage of project selection, all members from the top to the project team at the local subsidiary have come to think that gate screening should be conducted.
- Inquiries as to whether the screening is required or not have begun to come from the local side in advance.
- With the penetration of the screening template and increased risk management awareness, required project information for gate screening has begun to be provided in advance.
- With the penetration of the risk analysis sheet (one of the screening materials) and improved knowledge about the risks that a project faces, risk analysis and measures provided by the local subsidiaries have improved.
- Some of the local subsidiaries who are against the project risk management system can be persuaded to adopt it by referring to this training.
- Glossary used in the training is well-shared among those who are engaged in the project and the level of communication has improved.

The original purpose of the project risk management training was to reduce the resistance at the local side to implement the system and to make the employees of local subsidiaries deeply understand the importance of the project risk management and the project risk rules. This training has also produced the following good effects on us, who plan and carry out these trainings:

- We contact the local PMO members frequently to prepare the training, and this has made good communication between our side and the local side.
- We have read the project risk management rules and past training materials many times, and created the training material to include responses to the comments on the previous versions of the training material. With all these actions, we could deepen our understanding of project risks and project risk management rules.

The followings challenges are yet to be solved:

- There is no quantitative measurement to indicate the decrease of resistance on the part of the local subsidiaries.
- Gate screenings for latter phases of project have not been well-recognized nor adopted yet.
- Quarterly reporting from the project team to the headquarters has been made, but monthly reporting has not been well-established yet.

Issues

- A lack of understanding of the project risk management system
- A lack of recognition of the importance of the project risk management

Measures

- Explanation of the impact of materialization of project risks on a business
- Explanation of the risks surrounding a project and the importance of project risk management
- Explanation of the project risk management system (especially the screening and reporting that local subsidiaries need to conduct.)

Effects

- Improvement of understanding of project risks
- Improvement of gate screening including preparations
- Effective use of the templates
- Not resisting the screening system but making specific requests for improving them
- Improved communication among members concerned by using common industry terminology repeatedly mentioned in the trainings

Fig.3 Issues and effects

6. Conclusion

In order to increase the success rate of projects which have become more complex and larger in scale, the reinforcement of governance over local projects, the introduction of the gate screening system to manage project risks and process control, which requires the approval of the headquarters in Japan, and the mandated reporting to the headquarters in Japan have been instituted.

As one of the measures to implement the project risk management system, we have created web-based training of the employees and face-to-face training of the executives who take on overseas assignments in order for them to understand and observe the importance the project risk management system.

At the initial screening stage of project selection, all members from the top to the project team at the local subsidiary have come to think that the screening should be conducted.

Also a common ground between local subsidiaries and the headquarters in Japan and the environment to discuss the improvement of the project risk management system instead of resisting it has developed. As gate screenings for latter phases of project have not yet been recognized nor adopted extensively, we would like to repeatedly conduct not only the trainings we have explained in this paper but also explanatory meetings and/or educative activities to the project managers, members of project teams and the project management offices, and establish the project risk management system at the local subsidiaries.

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Framework for increase empowerment in project training

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What a Player-manager Can Learn from Project Management in Organizational Management

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As a matter of fact, most managers in IT businesses are "player-managers". In other words, they manage projects while they manage their sections, departments, or divisions. Unfortunately, however, managers including myself are weak in organizational management while they are strong in project management. In general, a body of knowledge for project management has been common as a result of a number of documents including PMBOK references. In the meantime, knowledge of organizational management has been published in many books, but every single organization varies from one another. Publications on organizational management contribute nothing to an actual practice. If anything, those make project managers think it too serious to manage his or her organization since it has been unclear how to manage organizations. In Japanese businesses, a "player-manager" has been conventional. What and how do project managers manage organizations? Based on experiences of my own, I hereby describe what I do as a "player-manager", analyze my past mistakes in managing my organization, and look into and propose what a "player-manager" can learn from project management.
I sincerely hope this paper makes contribution for a player-manager to be a real player-manager.

Keywords and phrases: Organizational Management, Communication Breakdown, Project Activity, Management, Player-manager

1. Introduction

Can a player-manager really perform both project management and organizational management?
According to data reported by Sanno University in 2016, some 90 percent of managers (especially section managers) in Japan are player-managers, which means that only about 10 percent concentrate fully on purely managerial tasks.(SANNO Institute of Management, Feb 2016)

Player-managers can be divided into two main types:

1. Player-managers who are good at project management but bad at organizational management.
2. Player-managers who are good at both project management and organizational management.

I suspect that the vast majority of managers who focus on project management believe that they are also good at organizational management. I myself was one of them.

Given this situation, the question is how they perform organizational management and whether the results are as good as they believe. A player-manager must perform the duties of both project management and organizational management.

Many player-managers understand how project management works. They have experience and a good track record in this area. In this paper, I will describe an approach that applies this experience to organizational management as well.

2. Difference between project management and organizational management

Table 1 Comparison of project management and organizational management

	Project management	Organizational management
Body of knowledge	Systematic body of knowledge exists	No systematic body of knowledge
qualification	Exist	Does not exist

There are differences between the two types of management with different targets. It is the existence of the objectives difference and the Body of knowledge.

For project management, a body of well documented project management knowledge exists, and there are also competency qualifications related to this kind of management. By contrast, there are no specialized journals devoted to organizational management. Books and other general documents do

exist, but due to the wide diversity of organizations these are not of much use in actual practice.
As a result, managers tend to refer to the project management body of knowledge even when performing organizational management tasks, which may be causing them to see things as more complicated than they actually are.

2.1 Project management

The goal of project management is the successful completion of a project. In order to achieve this goal, the manager uses generally recognized guidelines and indicators as well as various specialized techniques.

The guidelines and indicators also specify methods and principles for project management, but I will first present examples based on actual project activities.

Various kinds of teams ranging from small to large are formed, and project members are assigned to suitable teams according to their technical skills. The project invariably has a deadline. Therefore a schedule is created, aiming to ensure that the deadline will be met. But in any project, whether large or small, problems are bound to occur. Risk management and quality management procedures are therefore applied in order to prevent problems from arising. The project also always has a budget. It is therefore necessary to predict and control the expected labor costs, since a project that goes into the red has not fulfilled its purpose.

To meet all requirements that a project has to fulfill, expertise, skill, tools and techniques must be applied correctly to the project activities.
It goes without saying that for actual project activities, team formation, schedule management, quality management, and cost management are essential aspects that must be mastered.

And to ensure that project activities proceed as planned, excellent personality and leadership qualities are also important.

2.2 Organizational management

The objective of organizational management is to promote activities of the organization. This comprises a wide range of tasks such as ensuring that the organization achieves revenue and profit, motivation of organizational members, enhancing their skills and educational levels, control of overtime work, promoting the taking of annual leaves, conducting proposal drives and more.

In our company, there are many organizational entities such as divisions, departments, and sections. Within each of these entities, organizational management aims at human resources development, achieving sales and profits, and allocation of human resources to projects.

For the task of allocating human resources, it is of course necessary to fully know the technical skills of the members. If there is a deficiency in skills, training will have to be conducted to enhance competence. In managing an organization, sales and profits must be secured. In order to secure profits, it is necessary to increase sales and assess and control costs.

The person performing organizational management must have a good character and possess leadership qualities.

Furthermore, organizational management needs clear goals and objectives. The organization must be made to work as a whole towards the achievement of these goals and objectives. The role of the manager is to clearly define initiatives and goals and to lead the organization accordingly.

2.3 Differences

The differences between project management and organizational management are outlined below.

Table 2 Differences between project management and organizational management

	Project management	Organizational management
Stakeholders	Project clients	Suppliers, staff, company
Work location	Generally the same location	Various different locations
Deadline	Dependent on project	As long as the organization exists
Costs	Personnel cost	Personnel cost, travel expenses, miscellaneous costs

Body of knowledge	Systematic body of knowledge exists	No systematic body of knowledge
Objectives	Successful completion of project	Promote organizational activities

Among the various differences, the following two are especially pronounced:

1. Objectives
2. Body of knowledge

The differences in objectives are quite evident. Project management is management performed only within the scope of activities for a given project. All activities are aimed at bringing the project to completion.

Organizational management on the other hand occurs within the scope of the entire organization. The objectives are varied, including for example the securing of profit or the training and motivation of members of the organization.

The other main difference relates to the body of knowledge.

A systematic body of knowledge with specific indexes exists for project management. This fact is a great help in carrying out management activities.

By contrast, no such body of knowledge exists for organizational management. Activities need to be carried out on an ad-hoc or self-defined basis, finding solutions as one goes along. Sometimes these will be effective, but quite often, they are not. The absence of objective knowledge may be the reason why managers believe they are good at organizational management.

3. Lessons learned from failures

When managers not used to organizational management, such as myself, tackle organizational management for the first time, they tend to fail. This is due to the unfamiliar situation compared to project management, and the vast differences in knowledge and expertise. So what is the best way to acquire the required knowledge and experience?

In the following, I will propose some solutions and approaches based on problem examples.

3.1 Failure due to inadequate communication

Because project activities are usually carried out in a single location by the project members, mutual communication is achieved easily. If all members of the organization participate in a project, there is no problem. But often they will be working in various different locations. There are fewer chances for talking with members, which can lead to inadequate communication.

For example, one might have experienced the following situation.

Members working at different locations only get to meet once or twice per month. Although they understand the project in which they are involved, they do not know what others are doing in concrete terms. Each member also has no full grasp of the day-to-day status of the project.

As a result, leave of absence due to poor physical condition continues, which affects the work progress of the project. The actual situation is discovered for the first time when a complaint from the customer is received. In this case, necessary reports from absent members were missed, and required escalation from project managing members did not occur.

As a manager doing organizational management, even small details must be attended to. It is not enough to simply wait for reports. The manager needs to maintain a constant dialog with members.

If he or she just waits for escalation, any measure will always come late. A proactive approach with the ability to respond ahead of time is needed.

3.2 Failure due to insufficient understanding

In a project management scenario, there is usually only one customer per project. By contrast, in organizational management the members usually belong to various projects of different kinds, so that the relationship is 1 organization versus N projects. Consequently there are also many customers requiring follow-up.

Because the particular characteristics of the customer and the project are not fully understood, it is not possible to give proper advice to members.

For example, one might have experienced the following situation.

When visiting the customer for a project in which members are involved, inquiries by the customer cannot be answered straight away due to lack of understanding. This inability to provide a quick response results in a missed business opportunity.

Arranging for a prior meeting with members to obtain information is of course possible, but the understanding may still be superficial without a full grasp of the essence of the project.

As a manager, it is necessary to have a good understanding of the customer for the project on which the members are working. The manager must always be aware of what the customer needs, and be able to translate this knowledge into action. However, understanding the real essence of the customer is by no means easy. The manager should engage in a dialog with the customer about their vision for the future. This would include talking about what his or her organization can contribute and what still needs to be prepared. The relationship should be based on a feeling of growing the business together.

3.3 Lessons and suggestions

From the above examples of inadequate communication and insufficient understanding, the following lessons can be formulated.

1. An ongoing dialog must be maintained even with members at physically removed work locations.
2. It is not enough to simply wait for escalation by members. A framework for early detection of possible risks must be established.
3. Systematic efforts must be made to fully understand the essence of the customer for each project.

All of these are universal requirements for persons who perform organizational management. However, in reality there are many managers who do not live up to these expectations.

From the lessons, one can derive the following suggestions.

1. Conduct a dialog once per week to obtain information about the current status.
2. Even if no problem occurs, check the project status on a continuous basis.
3. Increase contact points with customers.

All of these suggestions are quite obvious and implementation should be easy. However, problems do occur because managers fail to take the obvious steps. It is the same as not being able to erect a building because the foundation is not solid.

Table 3 Suggestions from failure

failure	suggestions
Failure due to inadequate communication	Conduct a dialog once per week to obtain information about the current status. Even if no problem occurs, check the project status on a continuous basis.
Failure due to insufficient understanding	Increase contact points with customers.

4. Effectiveness of lessons

Let us consider how to effectively apply the new awareness gained from the above mentioned lessons to actual project activities.

The targets and objectives of project management and organizational management are different. However, especially with regard to the following two points, there is a similarity in management methods.

1. Assign priority to objectives.
2. Stay in contact with people on-site and implement required measures.

These are common to both project management and organizational management. After realizing this fact, I myself was able to approach organizational management with more confidence and perform it as successfully as project management.

4.1 Maintaining a dialog and obtaining status information

Using regular gatherings that are part of project activities such as daily morning meetings and evening sessions, a dialog can be maintained and members can be quizzed about the current situation. If information about issues and the current progress status is shared with other members and managers in the context of a meeting, transparency is enhanced and the sense of uncertainty disappears. In the course of project activities, not a day goes by without a dialog with members. This is possible because they all work at the same location.

In an organization, however, work locations are often spread out, making it difficult to have a dialog and obtain status information every day. But how about once a week? Having no dialog at all is a problem, and efforts should be made to have it at least within reasonable intervals. This will make it possible to recognize minor developments or changes that could turn into problems later on.

An actual dialog not only will reveal the daily situation but will also let the manager know more about the members themselves.

4.2 Increasing contact points with customers

Within the scope of project activities, how much actual contact points are there with the customer? Often the contact will consist in monthly consultations and other meetings with the customer. The more contact points there are, the more chances to assess the needs of the customer, which is beneficial for system development.

The same can be said for organizational management. It is important to actively seek contact with the respective customers of projects on which members are working. If once a week is not feasible, one should aim for at least once a month. Any contact is always better than no contact at all.

By visiting the customer multiple times, a trust relationship can be formed which is always a good thing.

4.3 Acting as a player-manager

A player-manager has to take care of his or her own project while also handling organizational management. Because of the higher number of management targets, it is easy to lose sight of what needs to be done at any given moment. To prevent this from happening, priorities need to be set and followed, and communication with on-site members should be maintained to identify measures that need to be taken.

The project manager maintains a dialog with project members and obtains information about the current status. He or she also fosters points of contact with the customer and develops an understanding of the customer. In order to bring a project to a successful conclusion, risk management based on a daily dialog is performed, to detect the possibility of problems in advance.

The organization manager also engages in a regular dialog with members and obtains information about the current situation. He or she has regular points of contact with the customer and develops an understanding of the customer. Maintaining a regular dialog makes it possible to not only deal with problems after they were escalated but to detect them beforehand.

Table 4 What you need as a player-manager

Project management	Organizational management
Dialog with project members and obtains information about the current status	Regular conversations with members
Customer and develops an understanding	Knowing customers
Detect the possibility of problems in advance	Risk management
excellent personality and leadership qualities are also important	excellent personality and leadership qualities are also important

5. Conclusion

Organizational management is based on similar principles as project management and there is no need to overthink it.

If one encounters difficulty in organizational management, one can think of it as a project activity. If communication with members is a problem, the solution is to set up dialog opportunities. In terms of project activities, this is the same as calling a meeting.

A project manager who is good at his or her job can apply the same skills and adopt a similar viewpoint to organizational management. Things that may seem difficult will be easier to deal with on one's own turf, so to speak.

In Japan, player-managers have become an established presence. The respective targets of projects and organizations need to be fully understood when performing management. Rather than thinking that one is not good at organizational management, one should recall once more the essential project management methods.

Set priorities and implement necessary measures. These obvious principles apply not only to project management but to organizational management as well. I recommend basing future activities on this understanding.

Table 5 Conclusion

	Organizational management
If you have difficulty with organizational management	A project manager who is good at his or her job can apply the same skills and adopt a similar viewpoint to organizational management

Reference

SANNO Institute of Management, (Feb 2016). *The 3rd fact-finding survey to section chiefs of the public-listed companies.*

Proposal of Resource Management Indicator in EVM

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Earned value management (EVM) is a management tool to measure project performance and progress using two efficiency indicators to track whether projects achieve their goals. The two indicators are cost performance index (CPI) and schedule performance index (SPI). Although, conventionally, the two indicators are monitored simultaneously, yet independently, there are a few instances when they are managed in relation to each other. Therefore, in this research CPI is considered as an indicator for production efficiency and SPI as an index for delivery time. By combining these two indicators with resource management indicators we propose a method of integrated management. This method pays attention to the fact that SPI can be expressed as a product of CPI and as an index of the resource input amount, and is characterized by the addition of a resource management viewpoint. Because resource input needs time for preparation, it is effective to utilize the resource management index as an indicator to utilize it for preparing future resources. The result of predicting the application result using actual project data is reported.

Keywords and phrases: Earned value management , Resource Management, Leading indicator, Value producing management

1. Introduction

In project management, quality, cost, and schedule are often regarded as success criteria. To achieve these success criteria, earned value management (EVM) is spreading as a management technique for managing cost and schedule.

In EVM, earned value (EV), planned value (PV), and actual cost (AC) are determined for each subdivided work period, and management helps achieve budget at completion (BAC). In doing so, schedule performance index (SPI) is calculated to achieve the schedule success criterion and cost performance index (CPI) is calculated to achieve the cost success criteria, and they are monitored simultaneously. Since these indicators clarify the efficiency of the organization by using the past actual values up to a certain point in time, it can be regarded as a method of performance management (Kimura, R. 2006; ISO 2012).

As mentioned above, EVM is a proven and widely prevalent management method. However, in recent years the environment surrounding project management has changed with increasing demand for a new management method. Specifically, due to changes in the business environment, the speed of development and the importance of schedule management has increased. For this reason, to comply with the schedule, it is essential to provide management indicators in a timely manner during a project.

Several studies exist on EVM, however, few attempt to improve accuracy by devising methods of calculating management indices such as SPI and CPI. Essentially, therefore, it is a management method using actual values up to a certain point in time. Since the constituent elements of these management indicators are actual values, such as deliverables (EV) and investment (AC) besides planning (PV), it is difficult to break the situation.

This research aims to address improve the above situation. To provide timely management indices during a project, it is necessary to introduce a new way of thinking into the constituent elements of EVM. Our key idea is that AC can be regarded not only as a cost consumed in the past but also as a resource needed in the future. Furthermore, in general, significantly improvement of the productivity of the organization during the project period cannot be expected. Therefore, as a countermeasure against a plan delay, focus should be paid to securing resource quantity rather than resource quality. For example, if the extent of resource addition in the future can be grasped to recover the plan delay at a certain point in time, it is possible to start the advance arrangement of additional resources. As a result, early rectification of the delay is also possible.

In this research, a method to promptly improve plan delays by adding indicators for resource management to conventional indicators of productivity (CPI) and delivery indicators (SPI) is proposed. Our method is able to utilize as a leading indicator for resource management. This paper consists of five chapters. Chapter 2 outlines previous research and describes the approach of this research. Then, in Chapter 3, the resource management index proposed by this research is stated. Finally, in Chapter 4, numerical examples are reported.

2. Previous research

Regarding the indicators used in EVM, there are several prior studies.

In forecasting EAC, Hayashi, K. et al. (2009) suggest changing the calculation method of EAC according to the phase considering the change in CPI for each project phase. In addition, Nakajima, Y. et al. (2011) propose to improve Hayashi's method. In this method, EAC prediction can be performed early and accurately by considering the delay of the task.

Tanimoto, S. et al. (2012) propose a method to calculate EAC by dividing the project into static phase and dynamic phase from the viewpoint of CPI change. Here the static phase is defined at the start of the project. On the other hand, the dynamic phase is defined as a period in which the CPI changes significantly due to an event that cannot be predicted and its effect persists.

Sakabe, A. (2011) states that it is necessary to properly set the criterion value of management when considering systemization of progress management using SPI and CPI. Since it is expected that the criterion value will vary depending on the size and duration of the project, they propose criteria for EVM. In addition, Itagaki, S. and Konosu, T. (2007) point out that EVM can only evaluate projects from the viewpoint of cost and schedule, and not the human aspect. They propose a method that introduces an index that converts the human resources capability into a monetary value for EVM.

These previous studies can be regarded as improving SPI and CPI. However, both are the result of management and are not guidelines for obtaining desired results in the future. Therefore, this research will consider methods to obtain guidelines to make use of EVM's idea for future management. For this purpose, indices for project management based on an idea that AC should be considered as a necessary resource in the future will be proposed.

3. Proposal of leading indicators for resource management

3.1 Introduction of business performance index

As reference information on resource management, value producing management (VPM) (Techno Management Research Institute Manufacturing Center 2012) is an indicator that measures whether a resource on a manufacturing site can be effectively utilized. VPM is used to identify the bottleneck process from the manufacturing process. This index calculates "productivity" from "overall performance" and "business performance." The calculation formula is shown below.

Productivity
= Overall performance * Business performance

Where,

Productivity
= (Standard man-hour * Production amount) /Total Man-hours
Overall performance
= (Standard man-hour * production amount) /Direct man-hours
Business performance
= Direct man-hours/Total man-hours

Here, applying the above equation to project resource management is considered. By comparing the VPM index with the EVM index, it can be regarded as EV for "Standard man-hour * Production amount," AC for "Direct man-hours," and PV for "Total man-hours." Since "Overall Performance" can now be calculated as EV/AC, it can be regarded as CPI. Moreover, "Productivity" can be regarded as SPI because it is calculated as EV/PV. Since "Business performance" can now be calculated as "Productivity/Overall Performance," it is AC/PV when expressed by the EVM index. "Business performance" in VPM can be thought of as input to planned value. This is expressed as a new indicator business performance index (BPI) in EVM as an index for managing project resources. As a result, the relationship of each EVM index can be expressed by the following equation.

$$SPI = CPI \times BPI \qquad (1)$$

Where,

$$SPI = EV / PV \qquad (2)$$

$$CPI = EV / AC \qquad (3)$$

$$BPI = AC / PV \qquad (4)$$

Here, AC of BPI of expression (4) is regarded as a resource required in the future. As a result, equation (1) can be interpreted as indicating that it is essential to make necessary resource investment while improving production efficiency to comply with the schedule. Here the work efficiency BPI can be regarded as the ratio of the planned resource amount and the resource amount necessary for complying with the schedule.

3.2 Proposal of resource management indicator based on business performance

The concept of time will be introduced to the business efficiency BPI introduced in EVM in the previous section..

Then, improving the SPI at a certain time point t in the period t+1 will be considered. For this purpose, it is necessary to make EV_{t+1} follow PV_{t+1} as shown in equation (2). On the other hand, consider indicators that can be managed in the EVM indices EV, AC, and PV. As a result, it is understood that it is the only means to consider AC_{t+1} as a resource investing in the next term and increase it. Therefore, AC_{t+1} necessary to make EV_{t+1} follow PV_{t+1} and $SPI_{t+1} \geqq 1$ is estimated.

In estimating AC_{t+1}, the idea of Estimate to Complete with CPI (ETC_c) by Tominaga, A. (2003) is adopted. In ETC_c, the cost to project completion is predicted using the cost efficiency index CPI. ETC_c is defined by the following equation.

$$ETCc = (BAC - EV)/CPI$$

In this research, the difference necessary to achieve PV_{t+1} and estimate AC_{t+1} using cost efficiency index CPI is considered.

Assuming that the estimated value is $AC_{e\ t+1}$, the following equation is obtained.

$$AC_{e\ \ t+1} = AC_t + (PV_{t+1} - EV_t)/CPI_t \quad (5)$$

In the estimation of EV_{t+1}, if the assumption that CPI_t does not change abruptly is adopted, it becomes as shown in equation (6).

$$EV_{e\ \ t+1} = AC_{e\ \ t+1} \times CPI_t \quad (6)$$

$CPI_{e\ t+1}$ and $SPI_{e\ t+1}$ are obtained based on expressions (2) and (3) using $AC_{e\ t+1}$ and $EV_{e\ t+1}$.

$$CPI_{e\ \ t+1} = EV_{e\ \ t+1} / AC_{et+1} \quad (7)$$

$$SPI_{e\ \ t+1} = EV_{e\ \ t+1} / PC_{et+1} \quad (8)$$

Further, $BPI_{e\ t+1}$ is obtained based on expression (4) using $AC_{e\ t+1}$ and $EV_{e\ t+1}$. $BPI_{e\ t+1}$ is a numerical value meaning how many times the resource is required for the originally planned PV to make the SPI 1.0 at the next t + 1 at time t.

$$BPI_{e\ \ t+1} = \frac{(PV_{t+1} - EV_t)/CPI_t}{(PV_{t+1} - PV_t)} \quad (9)$$

4. Project management using resource-management indicators

4.1 Numerical example of resource management index

In this section, numerical examples of the resource management index proposed in the previous chapter and usage method will be explained.

(a) Outline of the project

1) The work period of the project consists of three periods. The PV for each period rises by 5.
2) The first phase has already been completed, PV, AC, EV, CPI, SPI have already been confirmed. The SPI already deviates from the ideal value by -0.4.
3) The project manager decides that the project fails as it is and decides to review the plan to make SPI $\geqq$ 1 in the second phase.

Table 1 shows the above conditions and formula for calculating management index. The flow of time in the horizontal direction of the table and the index of management in the vertical direction of the table are displayed. Time is displayed from the 0th period to the 3rd period. There are 11 management indicators in total. Numbers 1 to 6 are indices that do not consider moving at the time point, and numbers 7 to 11 are leading indicators. The leading indicator is calculated in the order of No. 7 to No. 11.

(b) Method of numerical experiment

Based on the result of Phase 1, each indicator in Phase 2 is calculated by the following procedure.

1) Calculation of operational efficiency BPI

Calculate BPI according to equation (4).

$$\begin{aligned} BPI &= AC/PV \\ &= 3/5 \\ &= 0.6 \end{aligned}$$

In the first phase, planned resources cannot be secured and as a result EV has not been achieved for the plan. From this index, the fact that resource management is the cause of failure can be revealed.

2) Calculation of $AC_{e\ t+1}$ and $EV_{e\ t+1}$

Conditions for obtaining $SPI_{e\ t+1} \geqq 1.0$ are obtained by equations (5) and (6).

$$AC_{e2} = AC_1 + (PV_2 - EV_1)/CPI_1$$
$$= 3 + (10 - 3)/1.0$$
$$= 10$$

$$EV_{e2} = AC_{e2} \times CPI_1$$
$$= 10 \times 1.0$$
$$= 10$$

By securing the second phase resource AC 10, we can recover the EV and make it the same 10 as PV.

3) Calculation of $CPI_{e\ t+1}$ and $SPI_{e\ t+1}$

As a reference index, the following calculations are performed according to equations (7) and (8).

$$CPI_{e2} = EV_{e2} / AC_{e2}$$
$$= 10/10$$
$$= 1.0$$

$$SPI_{e2} = EV_{e2} / PV_{e2}$$
$$= 10/10$$
$$= 1.0$$

4) Calculation of $BPI_{e\ t+1}$

Calculate the following by Eq. (9).

$$BPI_{e2} = \frac{(PV_2 - EV_1)/CPI_1}{(PV_2 - PV_1)}$$
$$= \frac{(10-3)/1.0}{(10-5)}$$
$$= 1.4$$

To recover the EV in the 2nd phase and make the SPI 1.0, the resource of 7 is necessary. This is more than the originally planned resource of 5 and is 1.4 times the original resource plan.

The above results are shown in Table 2. In overview of Table 2, conventionally, there were only management indexes No. 1 to 5 based on actual values from the past to the present. On the other hand, by adding BPI No. 6, it is possible to grasp whether or not the conventional problem is in resource management. Furthermore, from No. 7 to No. 11 it is possible to grasp indicators for future management. That is, to achieve SPI = 1.0 that can comply with the delivery date, it is possible to grasp how much additional resources are required for the initial plan. There are many cases that this cannot be achieved in practice but it is meaningful to always be able to grasp the necessary amount.

Table 1 Calculation method of resource management index

No.	EVM \ t	0	1	2	3
1	PV	0	5	10	15
2	AC	0	3		
3	EV	0	3		
4	CPI	0	1.0		
5	SPI	0	0.6		
6	BPI	0	eq. (4)		
7	AC_e			eq. (5)	
8	EV_e			eq. (6)	
9	CPI_e			eq. (7)	
10	SPI_e			eq. (8)	
11	BPI_e			eq. (9)	

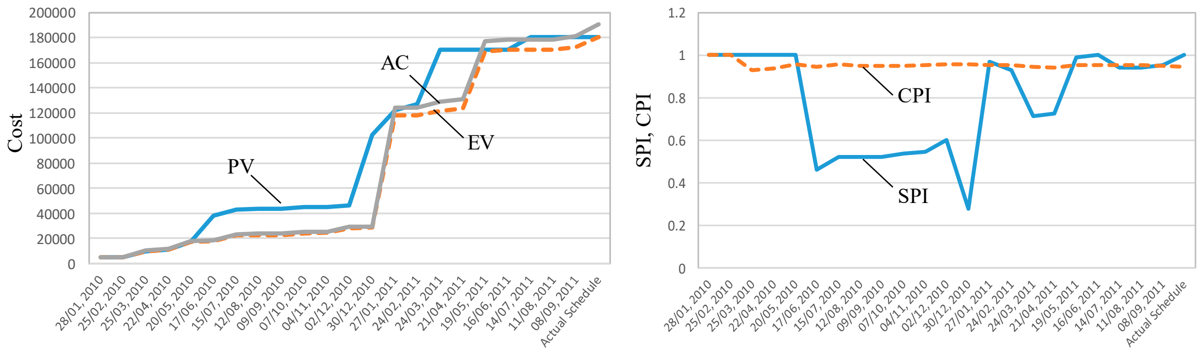
Table 2 Numerical example of resource management index

No.	EVM \ t	0	1	2	3
1	PV	0	5	10	15
2	AC	0	3		
3	EV	0	3		
4	CPI	0	1.0		
5	SPI	0	0.6		
6	BPI	0	0.6		
7	AC_e			10	
8	EV_e			10	
9	CPI_e			1.0	
10	SPI_e			1.0	
11	BPI_e			1.4	

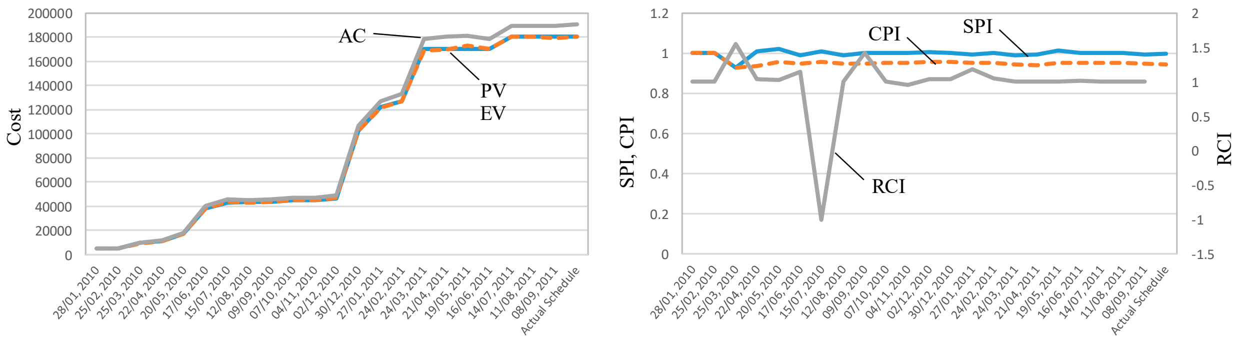
4.2 Example of application to actual data

To verify the feasibility of the proposed method, a simulation using real published data was carried out. The results are shown in Figure 1.

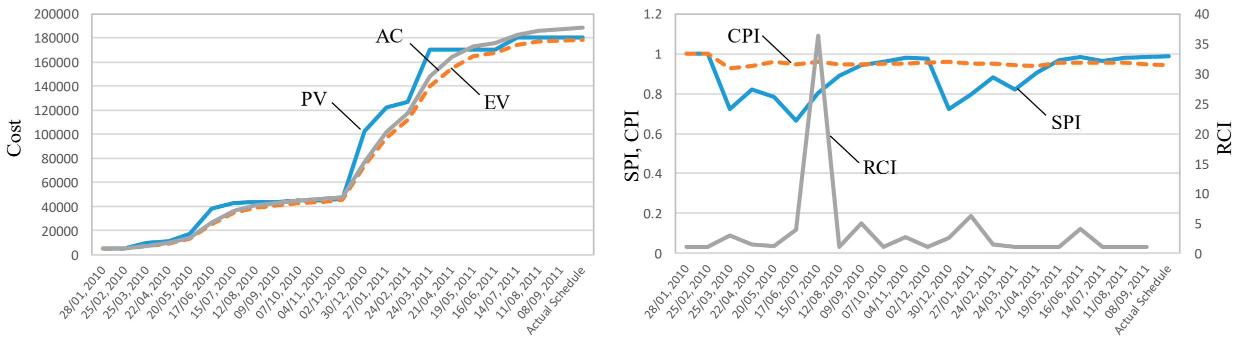
The targeted data is the development data of the patient transportation system (Operations Research & Scheduling Research Group 2011). Figure 1 (a) shows actual data and the graph on the left is EVM. From this graph, toward the end, the target values of delivery and cost are nearly achieved but there are periods during



(a) Actual data



(b) Simulation result (Resource securing rate is 100%)



(c) Simulation result (Resource securing rate is 50%)

Figure 1 Example of application to actual data

which AC and EV cannot be maintained with PV. SPI and CPI are shown on the graph on the right. Although the CPI has been able to maintain near 1, there is a period in which the SPI drops below 0.5.

Figure 1 (b) shows the simulation result with the proposed method applied. The resource securing rate shown in the figure is a simulation parameter that shows what percentage of necessary resources can be secured. Figure 1 (b) shows a case where the resource securing rate is 100%. It is assumed that 100% of the necessary resources calculated as BPI $_{e\ t+1}$ can be secured. In addition to SPI and CPI, BPI $_{e\ t+1}$ is displayed corresponding to the right axis in the graph on the right. Focusing on BPI $_{e\ t+1}$, it has increased to about 1.7 immediately after the start of the project. The reason for this is that the resource shortage was supplemented as a result of the decline in CPI. BPI $_{e\ t+1}$ dropped to -1.0 because resources were added but SPI went up by 1.0. Since then SPI has been steady around 1.0, BPI $_{e\ t+1}$ is also stable. Looking at the EVM graph on the left, the EV can follow the sudden change of PV.

Figure 1 (c) shows a case where the resource securing rate is 50%. Unlike the above case, BPI $_{e\ t+1}$ is about 3 to 4 to improve SPI in the case where CPI is less than 1.0. However, SPI has declined because only half the required resources can be secured. BPI $_{e\ t+1}$ has risen to about 37 at the time when PV changes significantly and secures additional resources during an emergency. As a result, SPI has improved to 1.0. BPI $_{e\ t+1}$ rises to about 6.0 at the time when PV again changes dramatically and quickly returns to near 1.0 even as SPI drops by securing additional resources. Looking at the EVM graph on the left, there are places where EV cannot follow due to a sudden change in PV, but it can follow up in a relatively short time.

The above results are summarized. As shown in Fig. 1 (a), when management is performed using past performance values of EVM, a period during which SPI decreases occur. However, by applying the proposed method if the necessary amount of resources can be secured, there is almost no drop in SPI. In addition, even when required resource amounts cannot be secured, the drop in SPI is kept to a minimum. Based on the above results, the proposed method can grasp the resources necessary to achieve future PV as a leading indicator, so it will be easier to introduce resources in a timely manner and increase the accuracy of achieving the plan. By using the proposed leading index as a guideline for securing additional resources, it can be expected to prevent the SPI from declining and realize stable project progress. As a result, waste due to resource delay can be eliminated and resources can be reserved with good timing. This can be expected to lead to a significant schedule delay and prevention of cost overruns and quality degradation due to forcible recovery.

5. Conclusion

In this research, a leading indicator for resource management in EVM is proposed. First, BPI as a new index was proposed with reference to resource management indicators used to identify bottleneck processes in the field of production management. BPI can be regarded as the ratio of the amount of resources planned and the amount of resources required to comply with the schedule. Next, BPI was extended in time series. At a certain time t, a calculation method to estimate the amount of resources required to set the SPI to 1.0 at the next t + 1 was formulated. the management method with a simple numerical example is explained and feasibility of our method with application result of actual data was shown. By using the proposed BPI, it is possible to grasp the difficulty level of securing necessary resources to comply with the plan and it is possible to raise the plan achievement accuracy by responding at an early stage.

As a future task, it is necessary to consider increasing the preceding period of the leading indicator. Since a preparation period is required for resource procurement, the longer the preceding period the more advantageous. On the other hand, as the preceding period becomes longer, it is necessary to predict the future and therefore the reliability of the indicator will decrease. As a concrete approach, the concept of time series analysis used for demand forecasting is helpful. For example, by using the moving average method or something similar, it is possible to grasp the latest trend and extrapolate into the near future.

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Case Study Analysis of Unprofitable Projects

- Common Errors in Estimating Productivity -

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Unprofitable projects are unavoidable, as all projects must take on a certain level of risk. This is recognized as a major problem in Japan's systems development industry, where there is generally strong loyalty to organizations, given the high risk of the strong preference towards avoidance, leading to exhaustion of personnel and even further damage. As leaders of a PMO organization for five years, we have monitored and supported many unprofitable projects. Through this work, we have noticed that several problematic projects would stumble and fall into the same pitfalls. This paper reports on four kinds of case studies - "when there is little expertise on the client's business," "when software development is large in scale," "when reusing existing software," and "when there are concerns about the quality of a migration-base system" - and focuses on factors that influence productivity. By considering these examples and sharing and discussing solutions, we hope to contribute toward a slight reduction in unprofitable projects.

Keywords and phrases: Productivity, Estimation ,Software Development, Large-scale Development, Learned Individual

1. Introduction

The system of public works development in Japan has a unique practice where bids are made in comprehensive lumps, including defining detailed requirements to launch of service. Before starting the formal requirements definition process, development costs must be accepted by the client in its entirety. Specifically, since the risk of any extension in requirements, which should by be handled by the client, is shouldered by the developer and this field involves greater obligation than other types of system development works. Accordingly, as a PMO organization in this field, we check the estimates before presenting them to clients, and the levels of productivity that form the basis of these estimates as matters of particular interest. Therefore, it would seem that organizational rules prescribe undertaking quantitative estimations based on the performance results of similar projects in the past, and this is a largely well-established practice. Nonetheless, due to underestimating productivity, numerous projects have turned out to be unprofitable.

The purpose of this paper is to categorize project case studies where productivity was incorrectly estimated according to topic, and to share and discuss identified solutions. In doing so, we hope to prevent further recurrence of incorrect productivity estimates in this field. The research findings also include rules and policies that organizations are already implementing. Sections 2 to 5 below set out case studies, discussions, and solutions for each of the topics. The conclusions are presented in section 6.

2. Topic 1: Expertise and productivity

2.1 Case studies

A project with "good knowledge of the client's business" is an important factor in system construction. Even in cases where a project ended up making losses, the third party had checked if the company entrusted with the task of system development has business expertise or not.

(1) Project A

The existing system was developed in-house and operated and maintained for several decades; therefore, shortages in business expertise were not perceived as a great risk

(2) Project B

This was renewal of a system developed in-house five years prior and with the prospect of many developers getting involved in the project in the interim, there was deemed to be sufficient expertise.

(3)Project C

This was a renewal of requirements from a system developed by another company, but since there was an abundance of people with similar work experience and they already did the task named the analysis of the current system timely. This was considered to be adequate compensation for shortages in expertise.

(4)Project D

The team had developed a package that embodied the best practices in the clients field of business and supplied numerous clients, confirming the presence of experts in the client's field of business.

Business expertise risk was deemed to be within a permissible range for each project, and all projects were launched. However, for A, B, C, and D unplanned amounts of additional costs arose during development, and all turned out to be unprofitable projects.

2.2 Discussion

A process that leads to unprofitability due to shortage of business expertise can be sorted into the following two patterns (See Figure 1).

<Problem Pattern1> Quality in the requirements definition and design processes cannot be guaranteed due to a bottleneck in expertise. Quality issues become clear during manufacturing and testing, and productivity worsens considerably due to undertaking design, manufacturing, and testing again.

<Problem Pattern2> Upper processes (requirements definition; design process) are prolonged due to shortages in business expertise. To recover from this, large volumes of human resources are invested in later processes, and productivity worsens considerably.

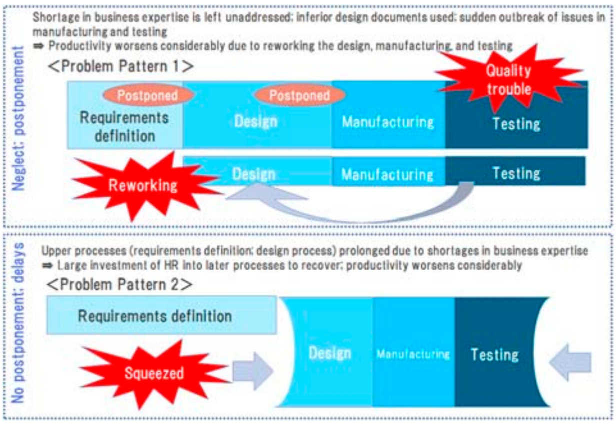

Figure 1 Patterns of expertise shortage issues

Whether efforts are made to guarantee quality by having experts to review requirements specifications, or moving to the next process without such reviews, both cases result in worsening of productivity. In cases where a client's field of business is particularly special, and a unique bespoke system is being developed, the quantity and quality (level) of expertise may be factors that support productivity.

2.3 Solutions

However, it is actually rare for projects to have abundant business expertise participating from the start. Accordingly, it is important to invest in human resources at an early stage and plan and implement tasks for training personnel in the requirements specification process. In order to achieve this, it is necessary to make preparations for low productivity and lengthy risk buffers in the requirements definition process. (See Figure 2) If we consider the risks of returning from the testing process to the requirements definition process, however, choosing not to squeeze on costs in the upper processes leads to much higher overall productivity. However, as will be detailed under Section 3, prior, official consent from the client must be acquired when reviewing the schedule or scope of development when completion has not been attained within the given period.

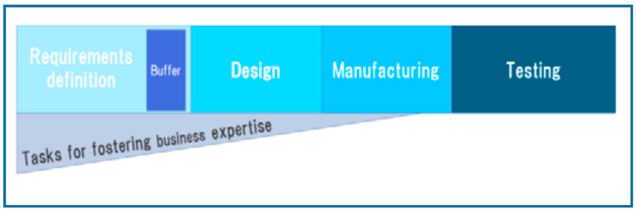

Figure 2 Tasks for fostering business expertise

Points regarding business expertise are as follows.

(1) Personnel maintaining and operating an existing system do not necessarily constitute ideal business expertise. There is the concern that they may only possess knowledge limited to those functions that are frequently maintained.

(2) Gaps and shortfalls cannot be judged without checking the level of business expertise, not as a single lump unit such as the "system" or "subsystem," but clusters of functions consists with around 50-100 Kilo steps each

(3) There are several levels of expertise; Level 3+ expertise will need to receive systematic on-the-job training (OJT). (Off-the-job training, or OFF-JT, is not a possibility.) (See Figure 3)

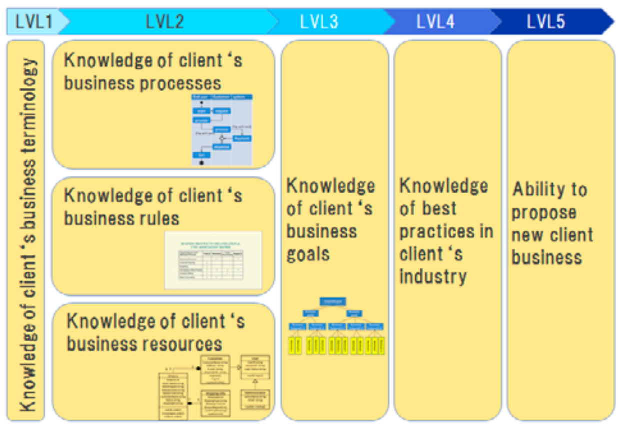

Figure 3 Diagram of business expertise levels

As detailed in Section 4, in order to make use of the existing software, in some cases Level 5 personnel will be required when there is a need to improve/reform a client's business process to match the software.Particularly with new clients, the client's ability with requirements definition is an unknown quantity. In light of the above points, it is important to confirm before receiving an order whether or not a given proportion of expertise relative to the scale of development has been secured.

Table 1 Visualization of business knowledge

Category	Business skills required	Overview of business skills	Number of personnel at present					Structures for skill improvement
			LV1	LV2	LV3	LV4	LV5	
Consulting	Client business review	Has same business knowledge as a client; able to eliminate client design errors at minute detail level.	0	0	0	0	1	Create test problems related to client business, regularly measure business knowledge, and determine grades for each personnel member. Require participation of members who possess at least a certain grade of qualifications for design document reviews.
From-scratch development	Client business from-scratch development	Has good command of terminology specific to client business; is able to listen to outline-level demands from client, turn them into specific system requirements, and propose them to the client, and design, test, and supply them.						Young PM-candidate company members experience across-the-board business application development.
	Account		3	1	0	0	1	
	HR		0	0	2	3	0	
BPR	Client business package application (Financial accounts)	Able to undertake fit/gap analysis of in-house financial accounting package with client business, and to change client processes to fit client business with package.	0	1	1	1	0	Build structures for periodic personnel rotation with the package development team.

*BPR: Business Process Re-engineering

(4) Table 1 not only clarifies that business knowledge will foster competitive strength on a per-organization basis but also the numbers of personnel at each level in the organization. It is a document which stipulates how many people will be required for future projects and in particular the methods that will be used in skill improvement. Since individual projects face limits in the costs of carrying out policies from a long-term perspective, it is important that bodies such as the parent organization and the PMO organization offer some compensation here.

3. Topic 2: Large-scale development and productivity

3.1 Case study

There are occasional cases of development groups, used to small-scale software development (around 50-200Ks) (i.e., Kstep) projects that undertake large-scale development (over 500-1,000Ks) and end up making losses. Below we will detail examples of unprofitable projects and the issues which have occurred, from the perspective of each process.

(1) Requirements definition process

- Estimates were undertaken having simply substituted small-scale development for large-scale development without any changes; the requirements definition process does not converge as planned, and development moves onto the next process with many issues still remaining. Or else, the requirements definition process is greatly delayed, putting pressure on the period for design and testing processes.
- In projects where requirements definition has been entrusted to a business partner, there is little incentive to make effective use of the software, leading to significantly less-than-predicted reuse of software.

(2) Design process

The design process is entrusted to, or ordered from a business partner because the original developer does not have adequate personnel. However, since elements such as shared design policies, quality management processes and so forth have not been clearly defined, there are discrepancies in the quality of work. Moreover, the inferior quality of the design documents cannot be perceived in the design process, leading to the discovery of many fatal design flaws in the testing process.

(3) Manufacturing and testing processes

Quality issues become apparent, large numbers of errors occur, and it becomes clear that the desired quality cannot be attained within the time limit. Attempts are made to adhere to the due date by supplementing personnel, but the requirements definition documents are not kept up-to-date, and the contents of the design documents are vague, making it extremely difficult to join the project midway. As a result, there is a bottleneck in existing expertise, and productivity sinks even further.

3.2 Discussion

Henry Ford (1922) use mass production strategies to increase the productivity of automobiles for the following reasons.

(1) Increasing production efficiency after reducing various losses such as the time for making arrangements when switching over production facilities/equipment.

(2) Making effective use of cheap labor through simplifying processes by dividing work.

(3) Reducing parts that are dependent on workers' skills, and making products of uniform quality in large quantities.Software development differs considerably in that it does not involve production of the same item in large quantities. Nonetheless,

if patterns cannot be set up in software development, productivity will worsen considerably, leading to swift failures.

3.3 Solutions

(1) Requirements definition process

・What is of immediate importance for a project is establishing a detailed requirements definition schedule with complete and clear 5W1Hs.
(i.e., who, what, when, where, and how)

・As this is a process prone to being affected by the schedules of busy clients, it is important to set up a schedule which also features clients by name and, on the premise that delays in the schedule will result in the postponement of the development schedules, verify feasibility of plans with the client, and achieve official, mutual agreement.

・The manner in which requirements are to be elicited from the client, or how their demands are to be developed, is important; thus, it is necessary to reach an agreement with the client having stipulated, in detail, the features of the final product based on a requirements definition template prepared and provided by an PMO organization, and who and in what manner will respond on the client's side,

・Introduce structures for measuring and managing adjustments to the scope of requirements on a weekly basis. (See Figure 6)

・There is a need to swiftly recognize any tendency for the scope of requirements expanding, and building mechanisms for escalating this up to the client's before requirements definition.

(2) Design process

It is necessary to agree with the business partners about the product design and the level of granularity it has to be produced. There is also a need for prior consideration of a quality assurance program, and for agreement on quality management rules for making this a reality. With smaller-scale development, it is feasible to consider about these elements during development, but with large-scale development this can prove fatal. One should assume that a certain percentage (%) of the members at the start of design will leave due to various circumstances. It is important to fix patterns and to prepare documentation aiming for such a level so that members who have joined the project midway are able to execute their duties without issues.

(3) Manufacturing and testing processes

It is important to prescribe coding approaches, methods of selecting items for testing, and so forth thoroughly. In order to be able to later analyze why quality is poor in which projects, documentation that makes records of bugs (faults, breakdowns) is vital. It is necessary to not only record when and during which processes bugs occur, but to also correctly detail the processes caused, as well as what led to the fault. If such elements are not recorded, additional testing to improve quality is undertaken, in a manner akin to carpet-bombing, and productivity declines steeply. There is a need to train all the members involved in the project and to make arrangements for regular inspection tasks thereof. After entering the process, there are limits to what can be dealt with; thus, if effective measures are not taken at least in the design process, unprofitability becomes inevitable.

(4) During all the processes

With large-scale development, unless development processes and end-products are determined at least before ordering work from business partners, it is extremely difficult to guarantee planned productivity. While in many projects there is indeed agreement of the product, one pitfall of large-scale development is that the slightest split at the seams will lead to collapse of the entire project.

4. Topic 3: Productivity when reusing existing software

4.1 Case studies

The most efficient way of increasing productivity is to make effective use of existing software property. Year by year, increasing numbers of projects are using this approach as an effective way to secure price competitiveness; yet, several projects ended up making severe losses. Note that existing software assets are often called "packages" in projects, and thus, for convenience, this form of development is termed "package-based development."

(1) Project E

・Comprehensive package aimed at medium-scale businesses; client developing large-scale business

・Customization scale usually within 100Ks, but estimated development scale of 700Ks (total scale of a package is 1,500Ks). (Expansion to 900Ks after requirements definition)

・Insufficient personnel for requirements definition (fit/gap analysis); tackled requirements definition by training business partner's employees.

(2) Project F

・Project was a desperate and final attempt to cut client costs through using large-scale client software by repurposing it, with its principles intact, for medium-scale clients

・Project was launched, supported by the executives on the condition that the client's business would be adapted to fit the software.

・At the time when the project was launched, the minimum scale of customization required was projected to be around 200Ks.
(This later expanded to 500Ks)

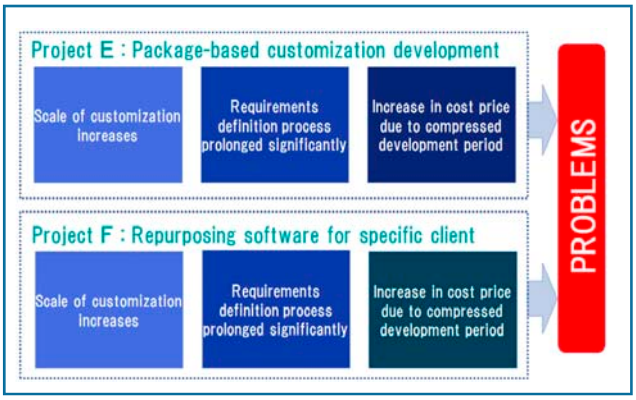

Figure 4 How repurposing becomes problematic

Figure 4 shows the path followed by each project towards unprofitability. The two projects embarked on exactly the same journey.

4.2 Discussion

(1) Human resources perspective

The essential difference between development from scratch and package-based development lies in the required skill sets. Namely, in development from scratch, the skills needed are in "eliciting demands from the client" and "converting client demands into system demands."

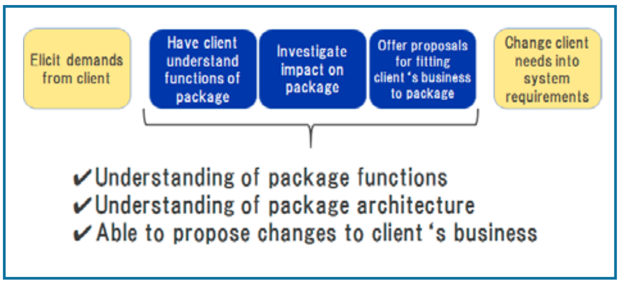

Figure 5 Skills needed in package-based development

In package-based development, additional skills are needed: "understanding, and being able to explain to the client, the functions/features of the package," "understanding the package architecture, and investigating the impact of client demands on the package," and "offering proposals such that the client's business processes fit the package." Particularly when the scale of customization exceeds estimations and a dearth of personnel who possess these skills, there may be insufficient power to suppress the scale of customization, thereby causing it to expand and prolonging the requirements definition process accordingly.

(2) Management perspective

・Regardless of the skill levels of personnel, if the proportion of the package which does not fit the client's needs exceeds 10%, it is an unavoidable aspect of the project that the scale of customization will expand. It is necessary to adjust the project's scope with the client, and managing the scope to check that the scale of customization does not expand beyond the initial plans, and when there is a tendency of the scope expanding, i.e., costs and due dates are in danger, escalating this to the top management of the client in order to solve the problem

・When customization scale is at least 10-20% of the total scale of the packages. Particularly when this involves revision of core functions, productivity actually tends to worsen more than the case of development from scratch.

・When no package architecture has been designed in advance (when repurposing software whereby the customizable and the core parts are not separated), it is necessary to consider that productivity may worsen markedly compared with packages.

4.3 Solutions

(1) Human resources perspective

It may be easy to suggest that employees should be trained in advance as shown in Figure 5, but this will not necessarily be cost-efficient. This is because training personnel with an understanding at the architectural level of the functions of the package in question will not be profitable without the prerequisite that the particular package does hold promise for future use, and that there will be the same needs again. Excluding exceptional cases in which there is participation of Level 4 or Level 5 expertise, which would enable fit/gap analysis to be undertaken with the client without any outsourcing, package-repurposing development as a temporary measure cannot lead to production which, through repurposing, is improved in comparison with from-scratch development. This is because development does not progress as planned.

(2) Management perspective

It is important to perform fit/gap analysis on the client's business regarding the package functions and to check the requirements definition process that the initial customization scale estimates provided by the client have not expanded more than assumed. One useful solution is to manage any increases/decreases in scope on a weekly basis during the requirements definition process period, with the first estimation as a baseline. Headquarters of our company group are developing in-house standard management tools. (See Figure 6)

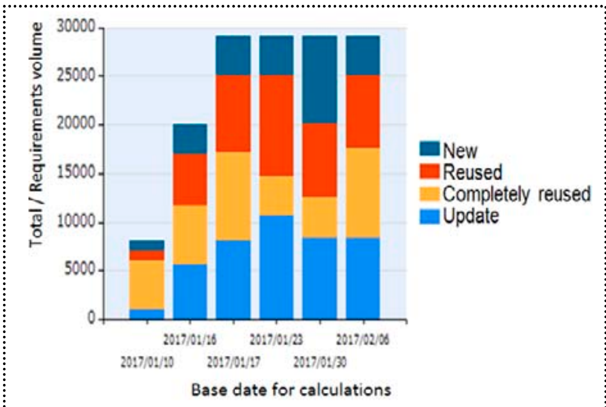

Figure 6 Example of requirements scope management

Moreover - we will repeat this due to its importance - after some risk, it is important to decide in advancehow specifically it will be escalated to the clientowner. Note that, while our sample size is still small, it is our current understanding that when the scale of customization exceeds 20% of the parent product being reused, productivity will be higher if repurposing is abandoned and the product is made from scratch.

5. Topic 4: Base system quality and productivity

5.1 Case studies

With system renewal (migration) projects, the quality of the system in current operations is a factor that affects productivity significantly. When the migration base system is one in actual use and in operation, and improvement and addition of functions to applications have been partial, since existing source code and design plans can be reused, estimations are made under the expectation that productivity will be higher than when developing from scratch. In theory this is not mistaken, yet in practice there are cases that end up diverging from expectations.

(1) While there source codes may be available, corresponding design documents are lacking or nonexistent; thus, its functionality becomes a black box, and even in the final stage of the testing process there is no clarity on correct function design.

(2) The developer did not notice the poor quality of the design documents corresponding to the source code, and carried through with development having reused the unchanged migration -base application design documents; thus, it is not possible to select the correct features for testing based on the design documents. There is also the risk of mistakes resulting due to ambiguity in the details of the design documents.

(3) The migration-base application architecture is complicated and of extremely low serviceability, needing a rewrite, including improvements in performance.

(4) There is overlap between the work to address sporadic functionality faults in the migration-base application and repairs in development, complicating library management and causing frequent degradation of the developing software.

(5) On client's request, the developer undertakes processes for assuring quality by comparing results of new and old systems, but even partial additions of functions can complicate the processes worsen productivity excessively.

Regardless of whether it was developed in-house or externally, the migration-base application may lead to mistaken estimations in productivity, and becoming, of all the topics discussed so far here, the greatest cause of unprofitability.

5.2 Discussion

Unless a client can share all assets of software to a developer in order to assess them all, it is impossible to predict how great a risk there may be regarding the design documents and the source code of the migration-base system. For both in-house and externally-developed systems, it is necessary to suggest an assessment of current software assets to the client. It will often be difficult to have the client accept assessments of the value of existing software assets. This is because, first, such assessments are akin to a report card for the system sector, and the client may be motivated by not wanting negative information to be known; in addition, there are costs involved. However, as many unprofitable projects disclose, undertaking work without conducting this task is a suicidal move.

5.3 Solutions

Organizational processes must be in place to ensure quantitative assessment of existing software assets (e.g., source code, design documentation) by a third party from the following perspectives. This assessment is an analysis of the input of an extremely large volume of documents. Since undertaking it by hand would involve exceptional operational power, we believe greater efficiency, through machine learning technologies, is also necessary.

(1) Investigation of scale of actual assets (i.e., excluding codes not being used)
(2) Checking whether understanding of design includes all necessary information
(3) Checking consistency between design documentation and source code
(4) Checking for incompatibilities caused by differences in language
(5) Assessing source code architecture, etc.

Furthermore, after migrating applications with functions intact, adding and improving these functions in the development process makes it easier to secure existing functionality and increases productivity.

6. Conclusion

This paper identified four topics that influence productivity, namely, insufficient knowledge of the client's business, large-scale project development, reusing existing software, and base system quality, and presented solutions for each based on case studies. The application of these solutions is being implemented in upcoming projects. In order to investigate the suitability of these solutions, we need to follow trends and changes over several years. However, we hope these solutions function effectively in order to prevent further unproductive projects.

Figure 7 is a conceptual diagram that shows each topic number and corresponding parts that require addressing. We can see that for the people, systems, and the processes required to start a project, there are issues threatening productivity. Also, some of the solutions detailed so far cannot be completely implemented once a project has started, or immediately before it starts. For instance, it may not be realistic, in terms of guaranteeing competitiveness with other companies, to train personnel with business knowledge at the time the requirements definition process is commencing. Essentially it is important to clearly define development processes as the norm, and to establish, organizationally, the custom of measuring and visualizing the actual power of one's own group/organization, in its current state.

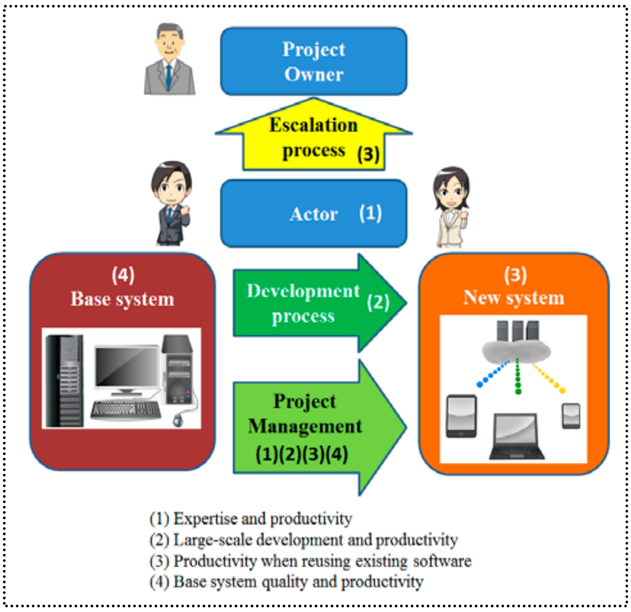

Figure 7 Diagram of correspondence between topic numbers and problematic parts

The following measures are being promoted in a PMO organization that we belong to:

(1) Unify development processes for each specific client and enable reuse
(2) Constantly measure productivity based on unified processes; clarify productivity targets
(3) Clarify business knowledge/know-how that provides competitiveness as a team, for each person responsible, and for each business domain. (See Table 1)

We have discussed approaches to reflecting on and resolving unprofitable projects from the standpoint of a developer or PMO organization, but greater importance is having the client, i.e., the source of the needs, first acquire correct understanding of the system, and then strongly participate in the project. In our previous experiences, clients who experienced a software development project reaching a standstill are significantly less likely to fail in their next project. Efforts to pass on knowledge and expertise, including education of clients, is something the industry should undertake as a whole.

Acknowledgements

We would like to than all the project members on whom, when unprofitability became clear during development, tough operations were imposed, and who nonetheless contributed to and continue to contribute to the completion of the projects. It is our sincere hope that we may repay everyone's hard work by learning from the record of everyone's struggles, and continuing to pass this on as wisdom for the following projects to start.

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Proposal of Evaluation and Improvement Method of Presentation Skills

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Presentations are not only about transmitting information in a way that is easy for audiences to understand, but also about delivering information in manner that is creative enough to keep listeners interested. As a consequence, it is essential to evaluate and improve presentation skills to emphasize these features. However, it is difficult for beginner-level students to identify improvements based on these criteria. This study therefore proposes a method that can be used by beginners to evaluate and improve their presentation skills. The method consists of a questionnaire survey of requirements, an evaluation (multiple regression analysis) of comprehensibility, an audience analysis (factor analysis) to measure their level of interest in the presentation, and guidance for improvement based on the analyses. The effectiveness of this method has been confirmed by applying it to 38 university students and clarifying the aspects of their presentations that could be improved.

Keywords and Phrases: Presentation, Information Provision, Understandability, Listener's Interest, Communication

1. Introduction

The Ministry of Economy, Trade, and Industry (2010) advocates the learning foundation for social workers (Figure 1) as the set of abilities required for students. This skillset is defined as "the ability to work with diverse people in the workplace and community." It consists of three pillars: the ability to show initiative, the ability to think carefully, and ability to work in a team. Of these, the ability to work in a team is considered particularly important, as it enables students to share their opinions with other people, respect the opinions and position of an opponent, and make it possible for the team to achieve good results. Team work contains six sub-elements: the ability to transmit a message, listen, be flexible, understand a situation, demonstrate discipline, and control stress. To practice these sub-elements, it is important for students to communicate with each other and provide information.

One way of communicating is by giving a presentation. Among the fundamental competencies of social workers, the ability to transmit a message is required for working in teams, so presentations are considered very important. Presentation goals can be classified into three groups: 1) providing information, 2) persuading, and 3) making an impression. Among these, 1) providing information is the most general category; this type of presentation is therefore suitable for beginners who aim to improve their presentation skills.

Figure 1 Fundamental Competencies for Social Workers

In order to improve one's presentation skills, it is effective to have listeners point out aspects that could be improved. However, it is difficult for a listener to make accurate recommendations in the case of a beginner's presentation. For this reason, even if the listener is also a beginner, it is necessary to have a mechanism to accurately evaluate the speaker's presentation skills, in order to lead to improvement.

Yamashita and Nakajima (2010) have divided the topic of presentation skills into four parts: presentation content, presentation materials, verbal behavior, and action. They argue that the clarity of a presentation is greatly affected by its content and presentation materials. Kitamura et al. (2005) have noted that the timing of slide changes and the amount of time the presenter gives audience members to think about each slide also helps them understand presentation content.

However, these studies are limited in the sense that they analyze the understandability of presentations without presenting a framework for improving presentation skills. This research therefore proposes an evaluation/improvement method for improving the presentation skills of beginners (college students).

2. Presentation skills

2.1 Importance of presentation skills

This research focuses on the communication skills of university students, as a key indicator of success targeted by corporations and society. According to a survey conducted by Nippon Keidanren (2016), communication skills received the highest ranking (87.0%) as they key factor in the hiring of new graduates (Figure 2). Of the basic skills needed by social workers, communication, which involves the three elements of exercising power, comprehending while listening, and flexibility, is the most important.

A presentation is a tool used to communicate the opinions and ideas of an individual to many people at once. A presentation needs to provide information to others accurately and efficiently. Acquiring presentation skills is necessary to promote smooth communication and information sharing.

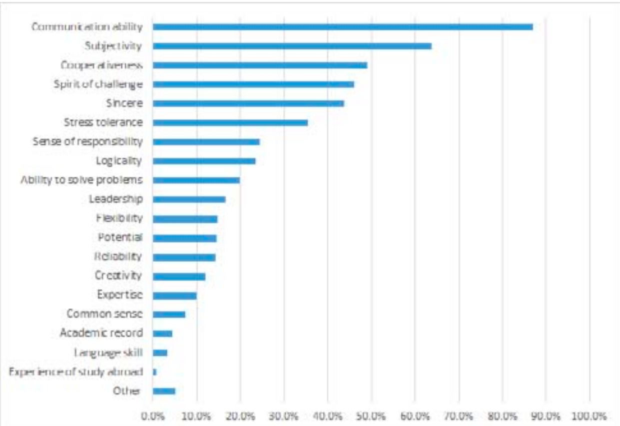

Figure 2 Selection criteria emphasized during new graduate recruitment

2.2 Structure of presentation skills

It is important for a presentation to accurately convey the speaker's intention to the listener within a specified time. In addition, good presentation skills are needed to achieve the purpose of the presentation.

Okabe (2012) has proposed the following three requirements for a good presentation:

1) Transmission with clarity, accuracy, and efficiency
2) Comfortable, with a minimal burden on the audience
3) Impressive to the audience.

This suggests that two elements are important in the presentation: intelligibility (above, 1 and 2) and engaging listeners' attention (above, 3).

Yamashita and Nakajima (2010) have said that two items, presentation content and presentation materials, are required for an easy-to-understand presentation. In the content of the presentation, it is effective to include explanations, and to emphasize consistency and connection in the presentation materials, slide layout, use of pictures, diagrams, tables, and photos.

2.3 Issues related to improving presentation skills

In presentations conducted by university students during exercises, both the presenters and the listeners often have poor presentation skills. In such cases, both presenters and listeners tend to make inappropriate suggestions and to engage in immature discussions of ideas. As these proposals and discussions are not based on the theory of the presentation, they are rarely useful for presenters.

As mentioned in the previous section, in order to enhance the effectiveness of a presentation, it is important not only to understand the presentation, but to be able to make an impression on the listener. To achieve this, it is necessary to analyze the listener's interests and to devise a presentation that matches those interests.

3. Research method

This study proposes methods that can help beginners evaluate their presentations and guide their improvement. The content of this proposal includes: 1) questionnaires that can be used to evaluate even a beginner's presentation; 2) an analysis of the accessibility of the presentation, based on questionnaires, 3) an analysis of listeners' interest in the presentation, 4) an improvement guide drawn from the analysis results.

3.1 Questionnaire survey

(1) Questionnaire preparation

A questionnaire was developed, consisting of indicators deeply related to the presentation (14 items, 13 individual items, and 1 comprehensive evaluation item). Each item consisted of two items (Table 1), evaluating the presenter (7 items) and the presentation materials (6 items).

Since the presentations were spoken, some additional elements were required (a1: voice volume, and a2: a fluent speaking style). To display information on slides, b2 (keyword clarity) and b6 (figure/table clarity) were also important.

It is said that 83% of the information we obtain from our five senses is visual, while 11% is aural. For

Table 1 Questionnaire items

Question item	
a1	Voice volume
a2	Fluency
a3	Gesture
a4	Abundant emotions
a5	Bright facial expressions
a6	Keyword description
a7	Communication effort
b1	Color usage
b2	Keyword clarity
b3	Timing (Change Slide)
b4	Number of slides
b5	Clarity of figure/table
b6	Being animated
c1	Understanding the content

this reason, the information that a person takes in visually tends to make the strongest impression. To create a good presentation that engages the listener, b1 (color usage) and b2 (keyword clarity) create an effective slide.

When it comes to the presenter, a3 (gesture), a4 (abundant emotions), a5 (bright facial expressions), and b6 (being animated) are particularly effective.

According to Kitamura et al. (2010), creating pauses can help a listener understand more of the presentation content. This suggests that b3 (timing of slide changes) and b4 (the number of slides) create pauses between the slides to allow the listener to understand.

According to a study by Yamashita and Nakajima (2012), the presenter's enthusiasm and efforts to communicate have little impact on understandability. However, since the enthusiastic announcement stated that there is an effect that attracts interest of the listener, a7 was set up as a telling effort.

The above items were designed to refer to the presentation points described by Yamashita and Nakajima (2012) and the presentation skills described by Ikeuchi and Takazawa (2013).

(2) Questionnaire survey

In the questionnaire survey, each of the 14 items in Table 1 is rated using a scale of 1–5:

Point 1: Bad
Point 2: Somewhat bad
Point 3: Ordinary
Point 4: Slightly good
Point 5: Good

3.2 Factor analysis of ease of understanding

A good presentation must be easy to understand. To analyze the extent to which a presentation can be easily understood, a multiple regression analysis was carried out, using the 13 items (a1 to b6) in Table 1 as explanatory variables and c1 as an objective variable. This multiple regression analysis made it possible to understand which aspects of the presentation were easiest to understand.

3.3 Factor analysis of listener interest

As mentioned in Section 2.2, the presentation must be interesting to listeners, as well as easy to understand. The previous section focused on the relationship between presentation method and ease of comprehension; this section explores the relationship between the presentation method and listener interest.

To measure listener interest, it is necessary to clarify latent factors behind the questionnaire responses. The items in Table 1 were selected on the assumption that the author could classify the aspects of a good presentation into two categories: presenter and presentation materials. By contrast, listeners may use a different framework. Without including a comprehensive evaluation of c1 in Table 1, it is necessary to include an evaluation index of listener characteristics using only 13 items (a1 to b6).

For these reasons, a factor analysis was used to clarify latent factors behind the responses. These factors are different from the hypotheses established by the authors and reveal the listener's own interests, which can be extracted through a combination of questionnaire items.

3.4 Proposal for an improvement guide

The purpose of this guide is to evaluate each presenter from the two perspectives of understandability and listener interest, explaining which aspects are effective, and which should be improved.

First, the results of the multiple regression analysis are used to assess understandability. Using the partial regression coefficients of the statistically significant items, evaluation points for ease of the presentation are calculated using a product-sum operation with a 5-step ease-of-understanding score. Unlike the aggregated 5-point scale result derived from a simple questionnaire, this numerical value does not depend on variations in the evaluator's judgment.

This numerical value can eliminate the influence of items unrelated to clarity and evaluation, based on the tendency of the whole population. By using this numerical value, it is possible to arrive at an accurate ranking of each presentation in the context of the whole population.

Only items deeply related to understandability are extracted from the multiple regression analysis. The average value of the 5-point scale results are calculated for each item, creating an item score. This makes it possible to determine the evaluation result for each item relating to understandability, something that could not be achieved through an average of all items. This focus on understandability makes it possible to accurately grasp which aspects of a presentation are effective and which should be improved.

In determining how interesting each presentation is to listeners, factors with a high factor contribution rate can be extracted based on the result of the factor analysis. For example, when there are five items with a high factor loading amount that constitutes the first factor, the average value of the five-point scale evaluation can be calculated, revealing a listener's interest score. Evaluating each factor reveals how deeply interested a listener is, something that would be hard to extract from an average of all items. By implementing the above procedures for each factor with a high contribution rate, it is possible to improve factors and generate higher levels of listener interest.

4. Research result

4.1 Experimental conditions

The proposed method was used to assess beginners' presentations, and its feasibility was verified.

The presentations were part of a meeting of college students to announce PBL achievements. Although the participants were studying presentation theory in a lecture course, their opportunities for practice were limited and were effectively beginners. There were 38 participants; 11 groups consisting of 3 to 4 people made a presentation. Each group was allocated ten minutes per presentation, and the content of the presentations related to PBL.

4.2 Questionnaire result

A survey of event participants was carried out to evaluate the items in Table 1 using a five-point scale. The respondents rated and responded to the presentations of ten groups, excluding their own teams. To obtain an evaluation based on intuitive judgment rather a delayed response, the respondents were asked to give their answers during the presentation. Omitted entries and overlapping evaluations were eliminated. The number of collected responses was 369.

4.3 Factor analysis result for understandability

(1) Result

The strength of the relationship between the questionnaire responses and the understandability of each presentation was calculated using a multiple regression analysis.

Table 2 shows the results of the multiple regression analysis. The question item columns in the table are the same as those in Table 1. The partial regression coefficient shows the depth of the relationship between the evaluation result of clarity (c1 in Table 1) and the question items in Table 2—the greater the value, the greater the influence on understandability.

Table 2 Analysis results of understandability factors

Question item	Multiple regression analysis		
	Partial regression coefficient	p-value	t-value
a1	0.047	0.292	1.056
a2	0.159	<u>0.002</u>	3.066
a3	0.007	0.886	0.143
a4	0.002	0.976	0.029
a5	-0.040	0.497	-0.679
a6	0.056	0.345	0.945
a7	0.127	<u>0.012</u>	2.519
b1	0.071	0.204	1.272
b2	0.111	0.059	1.891
b3	0.113	<u>0.030</u>	2.174
b4	0.176	<u>0.001</u>	3.366
b5	0.127	<u>0.013</u>	2.489
b6	0.048	0.338	0.960

The p value represents probabilistic reliability when the question item refers to ease of understanding. Even when an item has no meaning, it represents the probability of exceeding the coefficient.

If the value is less than a certain condition, the item is considered reliable. In this study, only question items with a value less than 0.05 were adopted. The five items adopted on this occasion (a2, a7, b3, b4, and b5) are underlined in Table 2.

The t value supplements probabilistic reliability when the question item explains ease of understanding.

The higher the absolute value, the higher the reliability. As can be seen in Table 2, the values adopted according to the p value all show high t values. This indicates that the result is reliable.

Figure 3 presents the Table 2 results as a graph. The horizontal axis shows the questions used in the survey. The right axis represents the partial regression coefficient shown by the line graph, while the left axis shows the gray bar graph p value and the orange bar chart t value.

(2) Discussion

The results of the analysis of understandability factors are considered below.

Table 2 shows that five factors (a2, a7, b3, b4, and b5) have an impact on understandability. Of these five, the strongest influence, with a large absolute value of t, is the number of slides in b4. This suggests that a presenter’s ability to finish his or her presentation within a set time is important. The next most influential factor is a2, or fluency. By speaking smoothly, listeners make the content of their presentations easier to understand.

Next, we consider a7, the effort to communicate. According to Yamashita and Nakajima (2010), although the correlation between enthusiasm and understandability is low, many people are willing to listen to the opinions of enthusiastic presenters. In this study, a7 also has a high value, indicating that a presenter’s enthusiasm and effort has the effect of attracting listeners.

4.4 Analysis of listener interests

(1) Result

Table 3 shows the results of the factor analysis.

The question item columns in this table are the same as those in Table 1.

The upper row of the table shows the factor load amount of each item, with respect to the extracted three factors. The lower row of the table shows the contribution rates of the three factors. The sum of the factor load amounts is a numerical value indicating how much the factor accounts for the total variance. The factor contribution ratio is a numerical value indicating the ratio of the factor and explaining the total dispersion.

The cumulative contribution rate is a numerical value obtained by adding factor contribution ratios in descending order. As can be seen from the table, the ratio that can explain the total variance of 13 items by 3 factors is 54%.

Figure 4 is a graph showing the results of Table 3. The horizontal axis is the item used in the questionnaire survey, and the vertical axis is the factor load amount. Items with a factor load amount of x> 0.5 were adopted for each factor. The first factor that relates to listener interest (bar graph: blue) includes a6, a7, b1, b2, b3, b4, and b5. The second factor (bar graph: orange) includes a3, a4, a5, and b6. The third factor (bar graph: gray) includes a1 and a2.

(2) Discussion

The result of this analysis of listener interest is considered, beginning with the first factor. The first factor includes items related to all slides except b6 (being animated). In addition, a6 (explanation of keywords) and a7 (efforts to communicate) are included as presenter-related items. These show that the

Table 3 Analysis results of listener interests

Question item	Question item factor analysis result		
	Presentation material	Action	Oral
a1	0.235	0.131	0.602
a2	0.297	0.300	0.610
a3	0.227	0.814	
a4	0.213	0.715	0.340
a5	0.275	0.641	0.402
a6	0.627	0.275	0.207
a7	0.560		0.410
b1	0.638	0.225	0.285
b2	0.723	0.279	0.140
b3	0.601	0.144	0.291
b4	0.586	0.193	0.256
b5	0.626	0.280	0.165
b6	0.458	0.503	
Contribution rate			
SS loadings	3.257	2.295	1.509
Proportion Var	0.251	0.177	0.116
Cumulative Var	0.251	0.427	0.543

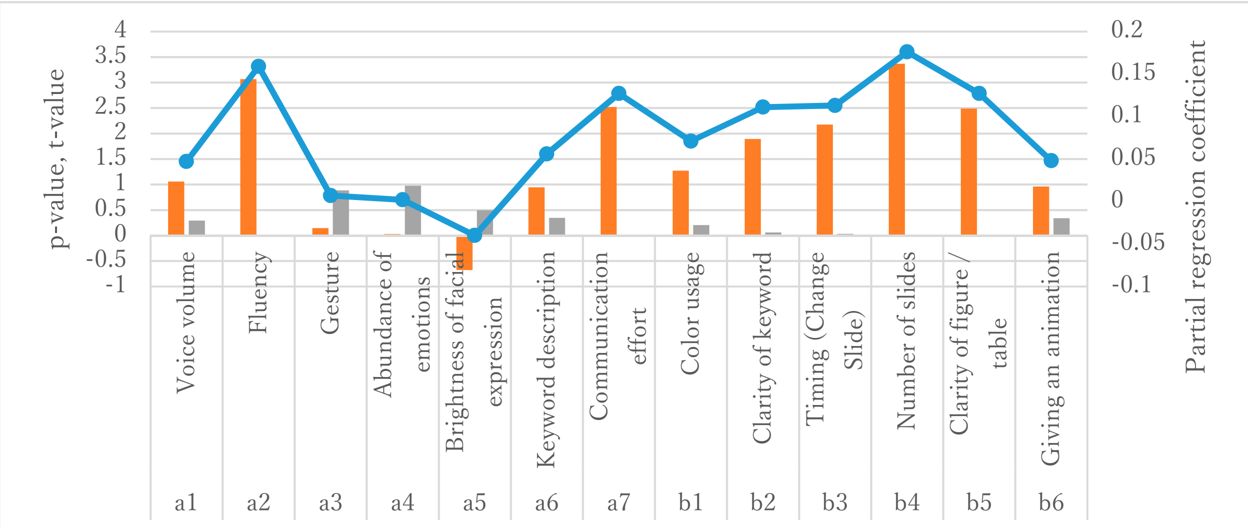

Figure 3 Factor analysis results for understandability

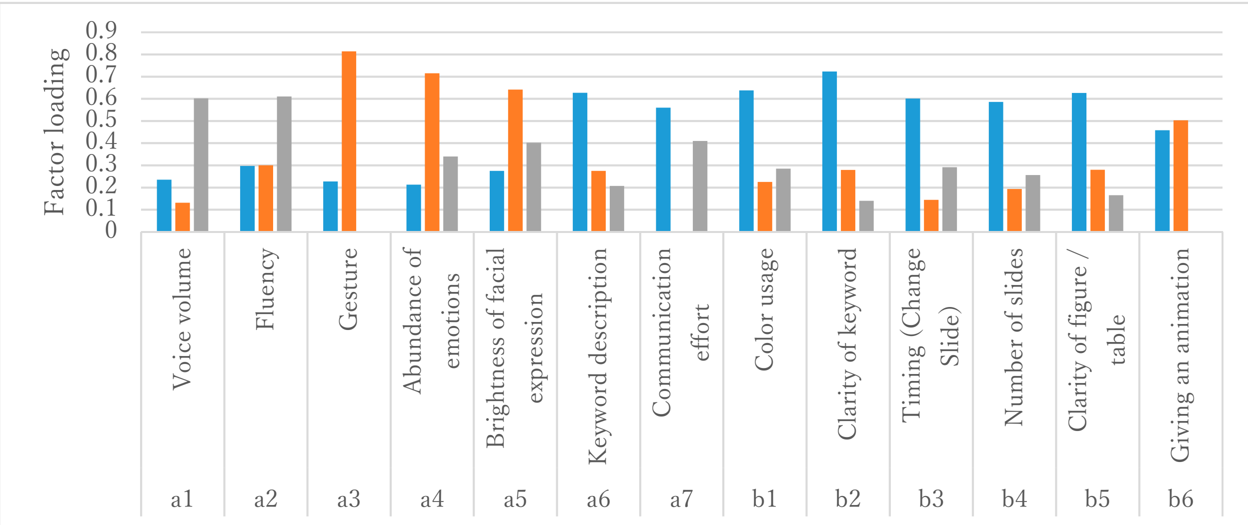

Figure 4 Listener interest analysis results

listener is interested in the completeness of the slide, the explanation and enthusiasm of the slide keywords. Based on the above, the first factor has been called "presentation materials."

The second factor includes items relating to movements during the presentation, such as gestures and emotional ups and downs, facial expressions, and animation. The second factor has been called "action."

Finally, the third factor includes items related to voice volume and fluent speech. Because it is an indispensable item in oral presentation, the third factor has been called "oral presentation skills."

These results are in agreement with Melabian's Law, which emphasizes the importance of nonverbal ability. According to the law, people unconsciously pay attention to facial expressions, lines of sight, gestures, and voice momentum, emphasizing the information obtained from them. This result suggests that presentation material = gaze, movement = gesture, verbal = vocal momentum. The analysis result and the law are in agreement. The law therefore supports the validity of this result.

4.5 Comparative consideration of ease of understanding and listener interest

A comparison of the results in Figs. 3 and 4 reveals whether a presentation can be easily understood, and whether listeners are interested.

Of the three factors shown in Figure 4: presentation materials, action, and oral presentation skills, the factor that has the most impact on understandability is presentation materials, which contains three of the five understandability factors. In other words, the listener answers the questionnaire by deciding whether the presentation materials have been prepared with the listener in mind, or designed to be understood.

This result shows that, in informative presentations, it is important to emphasize presentation materials rather than gestures or speech.

4.6 Trial of the improvement guide

Finally, an improvement guide was made for each presenter using the method described in Section 3.4. As an example, Group A received a high average score for c1 (understanding published content) in Table 1, and Group B had a low average score.

Table 4 shows how the numerical scores received by Group A and Group B were used in the improvement guide. The score in Table 4 is an average of the score of students in that group, resulting from the 5-point scale evaluation of c1 (understanding published content) in the questionnaire described in Section 4.1. The other evaluation items in Table 4 are explained in 3.4.

Significant item scores for understandability are displayed in descending order of the t value, indicating the influence of each on understandability.

First of all, the questionnaire evaluation score and the score for ease of understanding show the same trend. As a result, the five items considered statistically significant in Section 4.3 can represent the whole. Next, the significance score item shows that the Group A has a high score for 2 (fluency), while its score for b5 (clarity of slide) is low. The Group B has a high score for 7 (effort to communicate), but its score for b3 (slide timing) is low. Finally, an analysis of listener interest shows that the Group A scores high on oral skills and low on motion. Likewise, Group B receives a high

Table 4 Numerical examples used in the improvement guide

Group			A	B
Questionnaire evaluation score（c1）			4.09	2.97
Easiness to understand	Evaluation score of		4.00	3.13
	Meaning item score	a2:Fluency	4.14	3.19
		a7:Communication effort	4.11	3.57
		b3:Timing (Change Slide)	3.97	2.84
		b4:Number of slides	3.94	2.86
		b5:Clarity of figure / table	3.83	3.24
listener's interest score		Presentation material	3.95	3.20
		Action	3.71	2.83
		Oral	4.21	3.39

score for oral skills and a low score for motion.

The characteristics and improvement points for each group are reported.

Group A had done enough practice for the presentation, but there was room for improvement when it came to document preparation. They were ready to read the dialog fluently, but did not point out relevant parts of the slide. Thus, they were advised to improve their materials and to practice using them in the presentation.

Group B received lower scores than Group A in all items—it was totally unprepared. In particular, the improvement points suggested by the analysis involved an explanation of how to use and point to slides.

In this improvement guide, the presenter has the listener write an evaluation questionnaire about the presentation, analyzes the result, and extracts improvement points. Beginners can make improvements by evaluating and improving their performance each time they make a presentation, accumulating improvement points to make a checklist, and using the list to prepare for presentations.

5. Conclusion

This research has developed a method for evaluating and improving beginners' presentation skills. Based on the hypothesis that a good presentation is easy to understand and engages the interest of listeners, the proposed method develops an improvement guide by analyzing the results of a questionnaire survey.

The proposed method was tested on a group of college student presentations. The results revealed that understandability was deeply related to the presentation materials, and that listeners were not particularly interested in the presenter's performance. It was clear that it would be better to concentrate on preparing presentation materials when presenting in a similar context in the future. The feasibility of the proposed evaluation and improvement method was confirmed through this process.

On this occasion, the proposed method was applied to university students who had never made presentations before. The results obtained were consistent with the level of the target group. In general, the aspects of a presentation needing improvement will differ, depending on the level of presenter and audience. Using the proposed method, it should be possible to evaluate and improve presentations at any level.

In the future, it will be necessary to apply the proposed method to different context, to verify whether the same effect can be obtained when the presentation conditions change. It may also be necessary to review the questionnaire items based on these results.

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Redesigning Datacenter Business

Considering the Characteristics of the Business Sites for Smooth Nearshoring

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This paper discusses analyzing and optimizing datacenter businesses with the aim of nearshoring them. In this paper, "nearshoring" means the outsourcing of information technology processes to companies in the same country. It is possible for a company to reduce costs if they outsource their business processes to regional companies. Thus, many companies that want to shave costs consider nearshoring. Defining business scope and the work procedures of the nearshoring source is necessary to implementing nearshoring. However, the business scope and work procedures tend to become ambiguous through long years of business. This makes it difficult to judge which business processes are able to be nearshored. To solve this problem, this paper proposes an "analyzing and optimizing" approach that can be used for defining scopes and procedures. It proposes analyzing causal relationship of the issue. Thus, it proposes optimizing the business of the nearshoring source. As an optimization, following four are required: representing operations in procedure manuals, redesigning operations from tacit knowledge to explicit knowledge, redesigning remote operations, and optimizing contracts with customers. It makes possible to judge which business process are able to be nearshored. Therefore, nearshoring is able to be implemented. It is able to reduce office rent, labor costs, and total costs.

Keywords and phrases: Nearshoring, Datacenter, Labor Cost, Analyzing, Optimizing

1. Introduction

It is common knowledge that office rent and labor costs in the capital area are higher than in regional cities. In Japan, office rent and labor costs in Tokyo are particularly high compared with those in regional cities (Table 1). It is therefore possible for a company to reduce costs if they outsource their business processes to regional companies. In this paper, "nearshoring" means the outsourcing of information technology processes to companies in the same country.

Table 1 Usual price of office rent and usual price of labor cost in Tokyo and a regional city

Place	Usual price of office rent (per 3.3 m2 per month)	Usual price of labor costs (hourly minimum wage)
Tokyo metropolitan	24,800yen (Note 1)	932yen (Note 3)
A regional city	7,104yen (When gross floor area is 165-330 m2) (Note 2)	715yen (Note 3)

A defined business scope and work procedures of the nearshoring source are required to implement nearshoring. However, business scopes and work procedures tend to become ambiguous through long years of business. This makes it difficult to judge which business processes are able to be nearshored. To solve this problem, this paper proposes "analyzing and optimizing". It makes possible to judge which business processes are able to be nearshored.

2. Circumstances for Considering Nearshoring

2.1 Our Datacenter Business at Tokyo

We started datacenter business at Tokyo in 2003. Our services provided to our customers are classified under the following two services.

2.1.1 Colocation Services

We rented colocation facilities from datacenter ownership company. Colocation facilities consist of server racks, power supply, air-conditioning equipment, and physical security systems. Thus, we rent out these colocation facilities to our customers. Customers used colocation facilities for the customer's devices. Devices are, for example, servers, storages, and networking devices. The datacenter is in Tokyo. Hereafter, this paper calls the datacenter "Tokyo datacenter".

2.1.2 Monitoring and Operating

We rented an office nearby Tokyo datacenter. Hereafter, this paper calls it "Tokyo office". It takes 1 minute from Tokyo office to Tokyo datacenter. Our operating engineers worked at Tokyo office and Tokyo datacenter. Hereafter, this paper calls them "Tokyo operating engineer".

We provided service to our customers that we monitor customer's devices in Tokyo datacenter.
If central monitoring server detected an error, Tokyo operating engineers noticed that to our customers.

Moreover, we provided services that we carried out following operations.

- Operation with remote control

The network was prepared from the Tokyo office to customer's devices in Tokyo datacenter. Our operating engineers operate customer's device by remote control. For example, it is the following operation.

  - Checking whether particular backup job is completed by remote control at 10:00 daily.
  - Making job rerun at customer's server by remote control by
  - remote control when the job abended.

- Operation on actual devices in Tokyo datacenter

Our operating engineers operate actual customer's devices in Tokyo datacenter. For example, it is the following operation.

  - Checking server's LED at 10:00 daily.
  - Changing LTO tapes in LTO tape drive at 13:00 every Tuesday.

2.2 Organization at Tokyo

Tokyo operating engineers worked 24-hour 365-day. They were shift work. They carried out "monitoring and operating".

We had some "Management System Engineers" at Tokyo office. "Management System Engineer (MSE)" is contact person in charge with customers. MSEs did the following jobs.

- MSEs did requirement definition of customers.
- MSEs contracted to provide our services with customers.
- MSEs contracted to rent colocation facilities from datacenter ownership company.
- MSEs made procedure document of operation for operating engineers.
- MSEs taught operations to operating engineers using procedure documents.

2.3 Changes in Business Environment

In 2003, the number of our customer was several. It increased about 4 times in 2010. Therefore, number of operating engineers increased from 8 to 16. Number of MSEs increased from 2 to 10. Since office rent was too high in Tokyo, we started to consider implementing nearshoring. In addition, as a reason for planning for nearshoring, there is the purpose of contributing to the regional creation policy of the Cabinet Office.

2.4 Nearshoring Plan

Below is our nearshoring plan.

(1) We decided not to nearshore "colocation services" to a regional city. It means that we decided not to move customer's devices to a regional city. There were the following reasons.
  - Some customers who have their devices in Tokyo datacenter have a base office in Tokyo. Thus, they wanted not to move their devices to operate their devices themselves as needed.
  - It takes a lot of time and effort to move their devices. It usually takes 2 to 3 years to prepare and implement.

(2) We decided to nearshore "monitoring and operating" to an IT company at regional city. Network from the IT company's office to customer's devices in Tokyo datacenter was to be prepared. The IT company was determined to supply "monitoring and operating" 24 hours a day, 365 days a year. Hereafter, this paper calls the IT companies engineer "Regional operating engineer".

(3) MSEs were determined to remain on Tokyo office. MSEs were determined to carry out the following operations which regional operating engineers are not able to be carried out.
  - Operation that are not able to be represented in the procedure manual
  - Operation that require flexible judgment

  However, MSEs stay Tokyo office only in weekday's business hour (9:00-17:40).

(4) "Operations on actual devices in Tokyo datacenter" were to be carried out by Tokyo datacenter's ownership company's engineers. Since, regional operating engineers are not able to carry out the operations on Tokyo datacenter physically. Also, the MSEs were to be only at

9:00-17:40 on weekdays in the Tokyo office. Thus MSEs were not able to carry out "Operations on actual devices in Tokyo datacenter".

Table 2 shows the plan.

The reason why we chose particular the regional city is as follows.

- That area has few earthquakes.
- Since that area is far enough from Tokyo, it is hardly possible that the area and Tokyo have a disaster at the same time.

Thus, the scope of the nearshoring is operations that meet to all of the following conditions.

- Operations that are represented in the procedure manual.
- Operations that do not need flexible judgment.
- Operations not on actual devices in Tokyo datacenter.

3. Issue of Nearshoring

It is difficult implementing nearshoring. Conditions of operations that can be nearshored were defined. However, it is difficult to judge whether actual operations meet the conditions. Actual operations are not defined clearly. In Tokyo, There are MSEs and Tokyo operating engineers. Thus, the MSEs and operating engineers flexibly respond to the circumstances at the time together. Moreover, in Tokyo, there are Tokyo office and Tokyo data center together. Thus, In spite of actual operations are not defined clearly, There is no problem to carry them out.

In Tokyo, the roles of MSEs and operating engineers' work are not defined clearly. In other words, the scope of the works of the operating engineers is not clear. Thus MSEs and operating engineers respond flexibly according to customers' occasional demands. Datacenter business in Tokyo is designed in situation that the scope of the works of the operating engineers is not clear.

In Tokyo, It takes one minute from Tokyo office to Tokyo datacenter. Datacenter business in Tokyo is designed in situation that operating engineers are able to come and go between Tokyo office and Tokyo datacenter. A procedure manual mentions operations in

Table 2 Nearshoring plan

Services		Decision to Be nearshored or not	Service personnel before nearshoring	Service personnel after nearshoring
Colocation Services		Not to be nearshored	Datacenter ownership company	Datacenter ownership company
Monitoring and Operating	Monitoring	To be nearshored	Tokyo operating engineers	Regional operating engineers
	Operations that meet all of the following: ➢ Operations that are represented in the procedure manual ➢ Operations that do not need flexible judgment ➢ Operations not on actual devices.	To be nearshored	Tokyo operating engineers	Regional operating engineers
	Operation that is not able to be represented in the procedure manual	Not to be nearshored	Tokyo operating engineers/MSEs	MSEs
	Operation require flexible judgment	Not to be nearshored	Tokyo operating engineers/MSEs	MSEs
	Operation on actual devices in Tokyo datacenter	Not to be nearshored	Tokyo operating engineers	Datacenter ownership company's engineers

Tokyo office and operations in Tokyo datacenter too. Thus, it is difficult to judge which actual operations are able to be nearshored.

4. Analyzing and Optimizing

To solve these issues, it is significant to analyze causal relationship of the issue. Knowing the issue is important. It is required to find root issues, causes, and root causes. After that, it is necessary to solve root issues. A solution of root issues is to optimize datacenter business to circumstance of regional operating engineers and regional locational situation. In the other words, this is redesigning the datacenter business, considering the characteristics of the business sites.

4.1 Analyzing

It is necessary to analyze causal relationship of the issue. Figure 1 is a causal relationship diagram. Followings are root issues of the issue.

(A) There are not enough studies as to whether some operations are could be represented to the procedure manual.
(B) There are not enough studies as to whether some operations need flexible judgment.
(C) There are not enough studies as to whether some operations need actual machine in datacenter in the situation that a procedure manual mentions operations by remote and operations at actual devices too.
(D) Some operations are difficult to be judged as to whether it is the same as the operation defined in the contract.

Following are causes of root issues.

(E) There is a tendency that the rule of preparing the procedure manual is not observed at the operation sites.
(F) Customers' work-addition requests and work-change requests are occasionally accepted without considering whether they are in the contract.

Following are root causes of causes.

(G) Acceptance rules vary from person to person.
(H) "Rules for making changes are not enough." and "Rules for making changes are of shape only."
(I) Collusion with customers
(J) MSEs and operating engineers are not conscious of the importance of change management.

Thus, the causal relation of the issue is analyzed. The analyzing makes it possible to solve the root issues, considering the causes and the root causes.

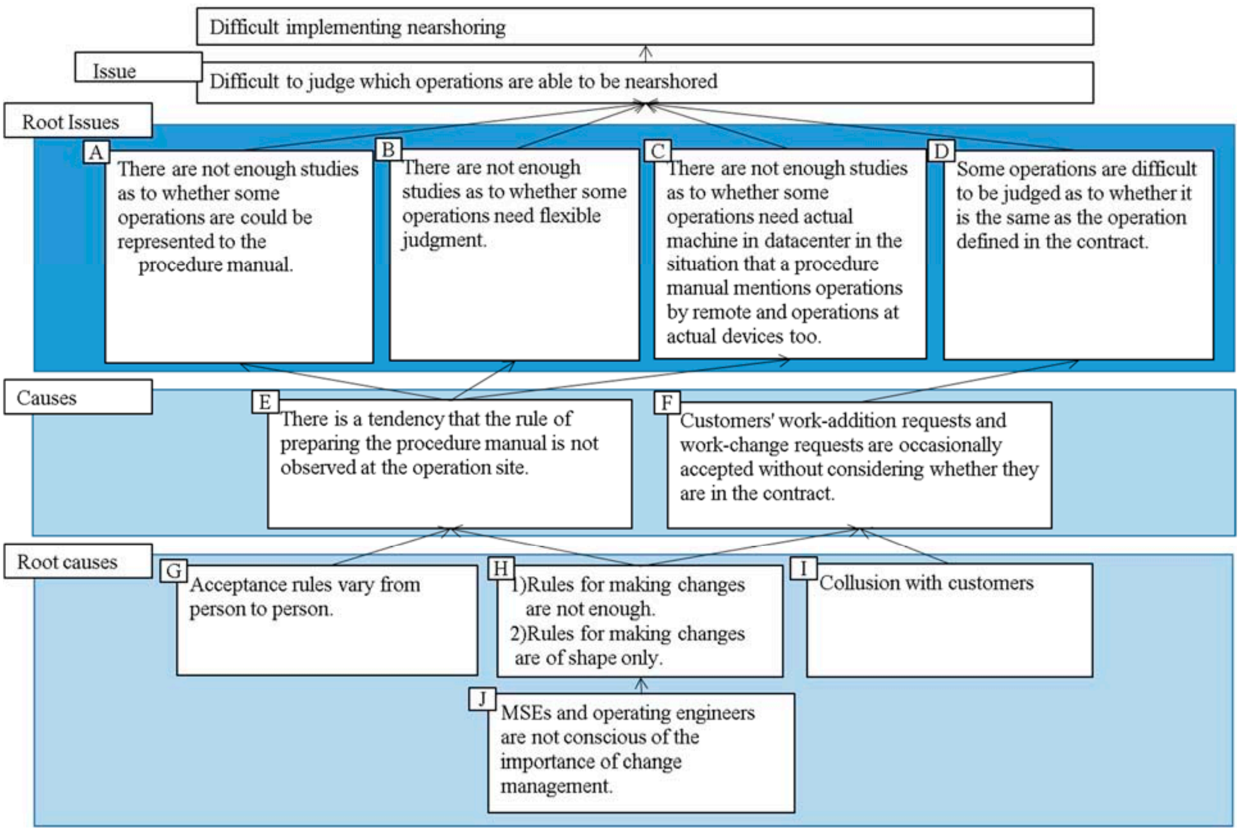

Figure 1 Causal relationship diagram

4.2 Optimizing

The solution is to optimize the datacenter business, considering circumstance of regional operating engineers and regional locational situation. It is redesigning the datacenter business, by following optimizations. These are four: representing operations in procedure manuals, redesigning operations from tacit knowledge to explicit knowledge, redesigning remote operations, and optimizing contracts with customers.

(1) If the operation is not represented in the procedure manual, it is necessary to consider whether it is be able to be represented in the procedure manual and make it. If the operation is instructed by the customer verbally, it is necessary to ask the customer to make procedure manuals. If neither we nor customers are able to make procedure manual, we are not able to nearshore the operation, so that MSEs will be determined to carry out it. As MSEs are at Tokyo office only weekdays from 9: 00 to 17: 40, it is necessary to make the customers understand the operation will be carried out at that time. (Though operations without procedure manuals were carried out even on holidays and at night before nearshoring, it is not a contract that promises to carry out immediately. So that it is possible to get customer's consent that the operation will be carried out by best-effort.)

(2) If the operation that needs flexible judgment, it is necessary to make procedure manuals formalizing tacit knowledge. If it is impossible, MSEs will be determined to carry out it. As MSEs are at Tokyo office only weekdays from 9:00 to 17:40, it is necessary to make the customers understand the operation will be carried out at that time.

(3) If the operation that needs actual devices in datacenter, it is necessary to consider whether it is be able to be carried out by remote. If it is impossible to be carried out by remote, it is necessary to get customer's consent that operation on actual devices will be carried out by datacenter ownership company's engineers. In addition to, it is necessary to give procedure manuals to datacenter ownership company's engineers.

(4) If the operation is judged to be out of contract, it is necessary to confirm with the customer whether or not we will continue to carry it out. If the customer wants the operation to be carried out, it is necessary to decide the contract sum and put the operation into the contract.

Through the analyzing and optimizing, it makes possible to judge which operations are able to be nearshored. Therefore, nearshoring is able to be implemented.

5. Evaluation of Proposed Approach

Through the proposed approach, nearshoring our datacenter business was implemented. In addition to, the following results were obtained.

(1) Since the procedures for each operation were well-defined, it became possible to smoothly explain the operating procedures to the regional operating engineers.

(2) Since we were able to make each operation without formalizing tacit knowledge, the regional operating engineers became able to carry out the operations by looking at the procedure manuals.

(3) It became possible to match the contracts with the actual operation.

In addition, as a result of the nearshoring implementation, the following results were obtained.

(1) Operations judged to be able to be carried out by regional operating engineers became able to be carried out by regional operating engineers. For this reason, it became possible to efficiently use labor forces in both the Tokyo and the regional company.

(2) Before nearshoring, the Tokyo office had been renting two floors of the building. Through nearshoring, it became possible to rent only one floor, despite having to rent in the regional city, the total price of office was reduced.

(3) The number of Tokyo operating engineers was reduced. Despite the number of regional operating engineers increasing, the total labor costs were reduced.

Table 3 shows the effects on cost. Below is a monthly comparison of the costs.

Table 3 Effects on cost

	Effect
Office Rent	37% reduction
Labor Costs	16% reduction
Total Costs	20% reduction

6. Conclusion

In analyzing, it was found that root issues (A), (B), (C), and (D) were caused by (E), (F), (G), (H), (I), and (J). In the future, in order to solve (E), (F), (G), (H), (I), and (J), we would like to continue to develop rules, education, and awareness-raising activities to improve operational quality.

Nearshoring a datacenter business is a special case. However, in other industries as well, some operations may not be the same as the work defined in the contracts, or some operations may not be represented in procedure manuals. In those cases, it might be possible to apply the "analyzing and optimizing" approach. It would be great if this paper will be a point of reference not only for datacenter businesses and IT companies, but also for those managing project.

Notes

Note 1) This number was cited from the website published by Sanko Estate Co., Ltd. (2017-6-12a)

Note 2) This number was cited from the website published by Sanko Estate Co., Ltd. (2017-6-12b)

Note 3) This number was cited from the website published by the Ministry of Health, Labour and Welfare, Japan (2017-6-19)

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Competencies as an Instrument for the Blended Mental Space Management of a Project

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A project successful implementation is carried out by a project manager on the base of the management instruments using that have been lied on the subject area. Nevertheless, the professional proficiency by the management instruments and being the high-level professional in project subject area may be not enough for the project successful implementation. Another professional instrument, that can help to obtain success in projects implementation, is the blended mental space, which is created, developed, and in the frame of it the project is implemented and which is disbanded after the project is finished by the project manager. Space is temporary and the main function of it is interaction and communication support of all participants of the project process during the project life-cycle. Space provides the integrated understanding both the project process and the project product all participants of the project implementation. The knowledge, practices and values sets are the elements of the space. Space life-cycle influence through creation, development, functioning, stability, and disbandment. The problem of the evaluation of the level development of such mental space is appearing at each stage. The level should be enough for the project success implementation at the stage. The authors offer to consider competencies as an instrument for evaluation of the blended mental space development. The competencies set is based on the IPMA Delta and ICB4 standards.

Keywords and phrases: The Blended Mental Space, Project, Competence, Standards, Management

1. Introduction

The success of the project depends on the integrated understanding of the project processes and project product by all participants of the project process. In the practice, the lack of integrated understanding leads to delays in the project implementation or, worst, to early closure of the project. Formation of an integrated understanding of project processes and features of a project product is possible in the temporal mental space that arises during the initialization of the project and disappears according to the results of the project implementation. Such a space is called the Blended Mental Space (hereafter – the BMS). Its elements are the knowledge, practices, and values that come from the mental spaces of the project manager/project team, stakeholders, the movable context and the project during the project implementation, or they are the transformation of the knowledge, practices, and values of these mental spaces (Bushuyev, S. and Verenych, O., 2017a, Verenych, O. and Bushuieva, V., 2017b).

The aim of the BMS is the creation and functioning of a mental space in the process of the project implementation. The BMS's function is the interaction and communication support of all participants in the project process throughout the project lifecycle (Verenych, O. and Bushuieva, V., 2017b).

The BMS creation has five stages. At the any stage, the project manager should create integrated understanding the project and product definitions. For this purposes, the project manager can use both informal approaches (discussions, questionnaires, learning sessions and etc.) and formal approaches (the Analytic Hierarchy Process (Verenych, O., 2016), the Methods of Structural Matrices (Dorosh, M. et al., 2016), cognitive methods and etc). More details the BMS creation has been presented in the methodology of the BMS creation that is presented in (Verenych, O. and Dorosh, M., 2017c).

In most cases, the BMS's life cycle is under the management of the project manager during all time of the project implementation. In fact, the project manager is the person who provides the creation, development, operation, stability, and disbandment of the BMS. However, at some stages, the BMS can only be managed by the implementing organization or be under the double management of the project manager and the implementing organization. Hereafter, under the term "organization" we will understand the owner of the project. The owner of the project can be both a juristic person and an individual (or individuals association).

In most cases, the project manager is responsible for managing of the BMS. For effectively doing this management, he/she needs to have knowledge, practice, and skills.

The whole of knowledge, practices, and skills, according to (IPMA Global Standards, 2015) is the competence of the project manager. On the other hand, the project is implemented in a particular organization. Its success also depends on the level of the organization to the implementation of the project approach.

The article will be devoted to the study and selection of the necessary competencies of the project manager, which enable him/her to create, develop, function, provide stability, and disbandment of the BMS. The list of competencies will be formed based on the standards Individual Competence Baseline, Version 4.0, volume 1 (hereafter - ICB4) and IPMA OCB (hereafter – IPMA Delta). ICB 4 is a standard for evaluation of the individual competencies of the project managers. The IPMA Delta is a standard of an organization evaluation in organizational competence in managing projects.

2. Competence elements that are needed for management of the BMS

Each stage of the BMS needs different project manager's competencies. The research of the required competencies will be carried out in accordance with the stages of the BMS.

2.1 The Creation stage of the BMS

The stage aim is to create the BMS's knowledge and values sets to ensure the implementation of the project initiation phase. To achieve the aim, the following tasks should be done: (i) create integrated definitions base of project management; (ii) create integrated definitions base of the project product; and (iii) define the project, the organization, and the project manager values. The project charter and the list of values are the stage phase results.

2.1.1 Create integrated definitions base of project management

For achieving of the task (i), the project manager should understand whether the organization has the necessary knowledge in project management. A certificate that confirms the competence class of an organization in project management is one way to confirm its competence in it. knowledge of the organization.

1. Availability of the corresponding certificate allows the project manager to uniquely identify the competence of the organization in the project management, as well as understand the trends of its development. The organization can get the certificate using the IPMA OCB standard that is based on the IPMA Delta model. The passage of the certification determines the "weaknesses" or, in other words, the final difference in the measurement of the existing level and the desired level of application of project approaches in the implementation of projects in the organization. The more the competence class of the organization, according to IPMA Delta, the more standardized and regularly applied approaches to project management in the organization, and, consequently, the less "gap" in the conceptual framework of project management between the project manager and organization.

1.a The competence classes "Standardized" (hereinafter - S), "Managed" (hereinafter - M) and "Optimizing" (hereinafter - O) univocally identify the organization's knowledge and practice in the form of the project management internal standards. The project manager only needs to obtain such standards from the organization. He/she uses competence elements "Self-reflexion and Self-management", "Personal communication", "Negotiation" from the field "People". In such situation, the management of the BMS is carried out by the organization, because the project manager "obeys" the project management standards of the organization.

1.b Certification of the organization into the classes "Initial" (hereinafter - I) and "Defined" (hereinafter - D) indicates to the project manager that using the project management in the organization is chaotic and it is necessary to provide the special knowledge for the initialization of the project. The necessary competence elements of the project manager will be "Governance, structures and processes" from the field "Perspective" and "Leadership" from the field "People".

The project manager will manage the BMS with the partial assistance of the organization.

2. Lack of certification indicates (a) nonsystematic approach to project management, (b) accidental implementation of projects, (c) the organization does not intend (from different reasons) to undergo certification or has not yet performed this intention.

2.a In cases (a) and (b), the project manager fully manages by the BMS. He can provide himself/herself initial knowledge from the project management that will be sufficient to implement the project initiation phase. In the other case, he/she can offer the organization to take part/arrange relevant courses on the basics of project management. The necessary competence elements of the project manager will be "Personal communication", "Negotiation" from the field "People". The BMS is under the full control of the project manager.

2.b In case (c) the project manager should evaluate the knowledge level of the organization in project management. The assessment can be made both during negotiations, discussions and based on the project activity analysis of the organization, received by the project manager both from the organization and from open sources. If the project manager evaluates the definitions base level of the organization at the level that is equivalent to the classes S, M or O, then he/she should use competence elements "Personal communication" and "Negotiation" from the field "People". The project manager and the organization carry out management of the BMS.

If the estimated level is equivalent to I or D, then the necessary competence elements of the project manager will be "Personal Communication" and "Negotiation" from the field "People". The project manager with the partial assistance of the organization carries out management of the BMS.

2.1.2 Create integrated definitions base of the project product

For achieving of the task (ii) the organization should understand whether the project manager has the necessary knowledge in the project product. There are two options: (ii_1) the project manager is a specialist in the project product subject, or (ii_2) the project manager is not a specialist in the project product subject.

1. In case (ii_1), if the organization has a certificate of competence classes S, M or O, the project manager applies the competence elements "Results Orientation," "Personal Communication" and "Negotiation" from the field “People”. The organization applies the competence G1 "PP&P Mission, Vision, Strategy" from the O module. The project manager under the direction of the organization carries out management of the BMS.

If the organization has the competency class I or D, then the project manager uses the competence elements "Results Orientation," "Personal Communication," "Negotiation," "Personal Integrity and Reliability," and "Leadership" from the field "People". The project manager with a partial participation of the organization carries out management.

If the competence class of the organization isn’t defined, then there are 3 cases, which are described in item 2 of the clause 2.1.1. For cases (a) and (b) of paragraph 2 of clause 2.1.1, the needed competence elements of the project manager are "Personal Integrity and Reliability", "Leadership", "Personal Communication" and "Results Orientation" from the field "People". The project manager entirely carries out management.

For the case (c) of §2.b, item 2, clause 2.1.1, the necessary competence elements of the project manager are "Personal Communication", "Negotiation" and "Results Orientation" from the field "People" if the assessment of the competence class of the organization is equivalent to S, M or O. The project manager with the organization carry out management. When the competency class is equivalent to I or D, then the necessary competence elements of the project manager are "Personal Communication", "Negotiation", "Personal Integrity and Reliability," "Leadership" and "Results Orientation" from the field “People”. The project manager with the partial assistance of the organization carries out management.

2. In case (ii_2) the dependence on the competence class of the organization will be absent. The project manager needs to know the project product subject area. The project manager applies the competence elements "Self-reflection and Self-management" and "Personal Communication" from the field "People". The organization carries out management.

2.1.3 Define the project, the customer, and the project manager values

Achieving this problem is one of the most important. The project success may depend on incorrectly defined values of all project process participants.

1.a If the organization has competence class S, M, or O, its values are already clearly defined in its strategies, missions, and vision. In this case, the project manager applies the competence elements "Personal Communication" and "Self-reflexion and Self-management" from the field "People". He/she formulates values for this project on the base of the internal project documents of the organization. The project manager under the full control of the organization carries out management.

1.b If the organization has competence class I or D, then this indicates that the organization has a base of the system approach to project implementation, but it doesn't have well-defined own strategies, missions, and vision. The project manager applies the competence elements "Stakeholder" from the field "Practice" and "Personal Communication" from the field "People". The project manager with the partial assistance of the organization carries out management.

2. The competence elements "Stakeholders" competencies from the field "Practice", "Personal Communication" from the field "People" and "Culture and Values" from the field "Perspective" will be needed from the project manager if the organization isn't been certificated.

Our research is presented in Table 1.

2.2 The Development Stage

The stage aim is to create a practice set, expanding the knowledge set and the values set of the BMS to ensure the planning phase implementation. To achieve the aim, the following tasks should be done: (i) expand integrated definitions base from the project management , (ii) create the project product definitions base for stakeholders and movable context and expand the project product definitions base to other project process participants, (iii) determine and to bring in line definitions base of the project management of new stakeholders and (iv) estimate the values set from the standpoint of revising the values of the project, the organization, the project manager, and adding value of the movable context. The project documents and updating of the value core are the stage results.

2.2.1 Expand integrated definitions base from the project management

If the competence class corresponds to S, M or O, then to the competence elements of the project manager, which were described in §1a of item1 of clause 2.1.1, will be added "Governance, structures and processes" and "Compliance, standards and regulations" from the field "Perspectives" and "Negotiation" from the field "People". The project manager and the organization will carry out management.

If the competence class corresponds to I or D, then to the competence elements, which were defined in §1.b of item 1 of clause 2.1.1, will be added "Compliance, standards and regulations" from the field "Perspectives", "Personal Integrity and Reliability", "Personal Communication" and "Negotiation" from the field "People". The project manager with the partial assistance of the organization carries out management.

If the competence class of the organization isn't defined, (non systematic/random project implementation), the project manager uses the competence elements "Personal Integrity and Reliability", "Leadership", "Negotiation" and "Personal Communication" from the field "People" and "Governance, structures and processes" and "Compliance, standards and regulations" from the field "Perspectives". The project manager carries out management.

If competence class of the organization corresponds to I or D, the competence elements of the project manager will be the same when the organization implements the projects nonsystematically or random. The project manager with partial assistance of the organization carries out management.

If the competence class of the organization corresponds to S, M or O, the competence elements of the project manager will be the same when the organization has the competence class S, M, or O except for the competence element "Self-reflection and Self-management". The project manager and the organization carry out management.

2.2.2 Create the project product definitions base for stakeholders and movable context and expand the project product definitions base to other project process participants

At this stage, the integrated and detailed understanding of the project product in all the smallest detail by all project process participants are the most important. Therefore, close cooperation between the customer and the project manager is required. In addition, other stakeholders and the movable context can be involved in project planning. The project product presentation for the stakeholders and the movable context should be sufficiently detailed to obtain the required project support.

The competence class of the organization doesn't have significant influence because the project manager is moving towards full project management, hence he/she must understand the project product (if it doesn't, he/she pays much attention to studying the project product at the Creation Stage). Therefore, the competence elements of the project manager will be "Personal Communication" and "Results Orientation" from the field "People". The project manager carries out management.

Table 1 The management by the BMS at the Creation stage

Task	The competence class (according to the IPMA Delta)	The Project manager's competence elements (according to the ICB4)	Subject of management
(i) create integrated definitions base of project management	S, M, or O	"Self-reflexion and Self-management", "Personal communication", "Negotiation"	Organization
	I or D	"Governance, structures and processes", "Leadership"	Project manager with partial assistance of the organization
	Not determined: Non systematically/random	"Personal communication", "Negotiation"	Project manager
	Not determined: Equivalent S, M or O		Project manager and organization
	Not determined: Equivalent I or D		Project manager with partial assistance of organization
(ii) create integrated definitions base of the project product; the PM is a specialist in the project product subject	S, M, or O	"Results Orientation," "Personal Communication", "Negotiation"	Project manager under the direction of the organization
	I or D	"Results Orientation," "Personal Communication," "Negotiation," "Personal Integrity and Reliability," "Leadership"	Project manager with a partial participation of the organization
	Not determined: Non systematically/random	"Personal Integrity and Reliability", "Leadership", "Personal Communication", "Results Orientation"	Project manager
	Not determined: Equivalent S, M or O	"Personal Communication", "Negotiation", "Results Orientation"	Project manager with the organization
	Not determined: Equivalent I or D	"Personal Communication", "Negotiation", "Personal Integrity and Reliability," "Leadership", "Results Orientation"	Project manager with the partial assistance of the organization
the PM isn't a specialist in the project product subject	Not influence	"Self-reflection and Self-management", "Personal Communication"	Organization
(iii) define the project, the customer, and the project manager values	S, M, O	"Personal Communication", "Self-reflexion and Self-management"	Project manager under the full control of the organization
	I, D	"Stakeholder", "Personal Communication"	Project manager with the partial assistance of the organization
	Not determined	"Stakeholders", "Personal Communication", "Culture and Values"	Project manager

2.2.3 Determine and to bring in line definitions base of the project management of new stakeholders

The task solution requires from the project manager the next competence elements "Leadership" and "Personal Communication" from the field "People" and "Stakeholders" from the field "Practice". The competence class of the organization doesn't be a significant impact since the project manager has been

Table 2 The management by the BMS at the Development Stage

<table>
<tr><th>Task</th><th colspan="2">The competence class (according to the IPMA Delta)</th><th>The Project manager’s competence elements (according to the ICB4)</th><th>Subject of management</th></tr>
<tr><td rowspan="5">(i) expand integrated definitions base from the project management</td><td colspan="2">S, M or O</td><td>"Self-reflexion and Self-management", "Personal communication", "Negotiation", "Governance, structures and processes", "Compliance, standards and regulations", "Negotiation"</td><td>Project manager and organization</td></tr>
<tr><td colspan="2">I or D</td><td>“Governance, structures and processes", “Leadership”, "Compliance, standards and regulations", "Personal Integrity and Reliability", "Personal Communication", "Negotiation"</td><td>Project manager with the partial assistance of the organization</td></tr>
<tr><td rowspan="3">Not determined</td><td>Non systematically/random</td><td>"Personal Integrity and Reliability", "Leadership", "Negotiation", "Personal Communication", "Governance, structures, and processes", "Compliance, standards and regulations"</td><td>Project manager</td></tr>
<tr><td>Equivalent S, M or O</td><td>"Personal communication", "Negotiation", "Governance, structures and processes", "Compliance, standards and regulations", "Negotiation"</td><td>Project manager and organization</td></tr>
<tr><td>Equivalent I or D</td><td>“Governance, structures and processes", “Leadership”, "Compliance, standards and regulations", "Personal Integrity and Reliability", "Personal Communication", "Negotiation"</td><td>Project manager with partial assistance of the organization</td></tr>
<tr><td>(ii) create the project product definitions base for stakeholders and movable context and expand the project product definitions base to other project process participants</td><td colspan="2">Not determined</td><td>"Personal Communication", "Results Orientation"</td><td>Project manager</td></tr>
<tr><td>(iii) determine and to bring in line definitions base of the project management of new stakeholders</td><td colspan="2">Not influence</td><td>"Leadership", "Personal Communication", "Stakeholders"</td><td>Project manager</td></tr>
<tr><td>(iv) estimate the values set from the standpoint of revising the values of the project, the organization, the project manager, and adding the value of the movable context</td><td colspan="2">Not influence</td><td>"Personal Communication", "Culture and Values", "Stakeholders"</td><td>Project manager</td></tr>
</table>

responsible for the integrated understanding of project management approaches in the project process.

2.2.4 Estimate the values set from the standpoint of revising the values of the project, the organization, the project manager and adding value of the movable context

Detailed project planning can make some adjustments to the participants’ values in the project process. The values set can expand or, which happens less often, can narrow. In addition, the movable context is another participant. It has own values, which should be taken into account by the project manager. The influence of the competence class of the organization will be insignificant, so it can be neglected. The competence elements of the project manager will be "Personal Communication" from the field "People",

"Culture and Values" from the field "Perspectives" and "Stakeholders" from the field "Practice". The project manager carries out management.
Our research is presented in Table 2.

2.3 The Functioning Stage

The stage aim is supporting/expanding of the practices and knowledge sets, updating the values set of the BMS to ensure the project implementation phase. To achieve the aim, the following tasks should be done: (i) analyze the project management definitions base of the customer, the stakeholders and the movable context and update it (if necessary) in accordance with the project management standards; (ii) analyze the BMS's values set and update it (for it is necessary) for the project successful implementation. The project reporting and the value core updating are the stage results.

2.3.1 Analyze the project management definitions base of the customer, the stakeholders, and the movable context and update it (if necessary) in accordance with the project management standards

At the functioning stage, the basic concepts of project management are already known. The customer, the movable context, and stakeholders are informed about the project implementation. It is important that they can understand the project reports and be able to "read" them.

The competence class of the organization is essential. Class S, M or O shows that the organization will not only understand and correctly interpret the project reports, but it has its own approach to their presentation. In addition, the informational hierarchy is in it, which clearly regulates information flows during the project implementation. The project manager must demonstrate the competence elements "Organization and Information" from the field "Practice", "Results Orientation", "Negotiation", "Personal Communication" from the field "People". The project manager under the control of the organization carries out management.

If the organization has the competence class I or D, the project manager understand that it has the lack in their own organization approaches to the project implementation and the project reports can be interpreted with certain disadvantages. The required competence elements of the project manager will be the same as for the competency class S, M or O. However, the significant difference will be in management. The project manager carries out management.

The uncertainty of the competence class of the organization, as described above, leads to the full management of the BMS by the project manager. Full management by the project manager can be in the case when the project activities aren't the main activity of the organization, or it deals with this by random. The competence elements required will be the same as described above.

Similar competence elements will be required if the organization's competence class is equivalent to S, M, O, I, or D. Changes will be in the management of the BMS. The project manager and the organization carry out management in the case when the organization has the competence class S, M and O. The project manager with the possible intervention of the organization carries out management if the organization has the competence class I or D. However, this intervention will be more cover the organization's reporting culture and need not coincide with the reporting approaches adopted by the project management.

Stakeholders and the movable context can have or can't have knowledge concerning the project reporting. Sometimes such knowledge is presented in the form of certain templates for the project reporting preparation.

If some context pretenses have been accepted, according to it the stakeholders' and the movable context's knowledge can be equated to the competence classes of the organization. In this case, the competence elements of the project manager will be equivalent those that he/she should use for the corresponding competence class of the organization. The management will be corresponding the competence class of the organization.

2.3.2 Analyze the BMS's values set and update it (for it is necessary) for the project successful implementation

Subcontractors may be included in the list of stakeholders. These organizations/persons have their own values. The project manager needs to identify these values and estimate their possible impact on the project.

The competence class of the organization can be unaccounted. The project manager controls this analysis himself/herself because he/she is responsible for the project implementation. The necessary competence elements are "Personal Communication" from the field "People", "Culture and Values" from the field "Perspectives" and "Stakeholders" from the field "Practice".

Our research is presented in Table 3.

Table 3 The management by the BMS at the Functioning Stage

<table>
<tr><th>Task</th><th colspan="2">The competence class (according to the IPMA Delta)</th><th>The Project manager’s competence elements (according to the ICB4)</th><th>Subject of management</th></tr>
<tr><td rowspan="5">(i) analyze the project management definitions base of the customer, the stakeholders, and the movable context and update it (if necessary) in accordance with the project management standards</td><td colspan="2">S, M or O</td><td rowspan="2">"Organization and Information", "Results Orientation", "Negotiation", "Personal Communication"</td><td>Project manager under the control of the organization</td></tr>
<tr><td colspan="2">I or D</td><td>Project manager</td></tr>
<tr><td rowspan="3">Not determined</td><td>Non systematically/random</td><td rowspan="3">"Organization and Information", "Results Orientation", "Negotiation", "Personal Communication"</td><td>Project manager</td></tr>
<tr><td>Equivalent S, M or O</td><td>Project manager and organization</td></tr>
<tr><td>Equivalent I or D</td><td>Project manager with the possible intervention of the organization</td></tr>
<tr><td>(ii) analyze the BMS’s values set and update it (for it is necessary) for the project successful implementation</td><td colspan="2">Not influence</td><td>"Personal Communication", "Culture and Values", "Stakeholders"</td><td>Project manager</td></tr>
</table>

Table 4 The management by the BMS at the Stability Stage

Task	The competence class (according to the IPMA Delta)	The Project manager’s competence elements (according to the ICB4)	Subject of management
(i) control the understanding of project processes and project product by all participants in the project process	Not influence	“Negotiation", "Results Orientation"	Project manager

2.4 The Stability Stage

The stage aim is to support the BMS’s knowledge set to ensure the Monitoring and Control project phase implementation.

The project manager should control and monitor a clear understanding of the project documents and characteristics of the project product during the project implementation. That is why the elements of the Stability stage will appear on the creation, Development and Functioning stages. The project manager carries out management. The competence elements will be "Negotiation" and "Results Orientation" from the field "People".

Our research is presented in Table 4.

2.5 The Disbandment Stage

The stage aim is transferral the practices and knowledge sets of the BMS from implicit to explicit view (documenting, formalization) for further use in next projects.

To achieve the aim, the following tasks should be done: (i) update or create the knowledge base and best practices of the customer/the stakeholders; (ii) received skills, knowledge, and practices of the project manager/the stakeholders should have everything in black and white. A database creating and updating, and CV and organization portfolio updating are the stage results.

2.5.1 Update or create the knowledge base and best practices of the customer/the stakeholders

The competence class M or O shows that the organization collects the best practices and creates knowledge bases for continuous improvement of its own project management processes and for the improvement of the skills of its own project management staff. In this case, the organization has regulated approaches to the collection and management of knowledge and practice. The project manager uses the competence elements "Compliance, Standards and Regulations" from the field "Perspectives" and "Self-reflexion and Self-management" and "Personal communication" from the field "People". He/she with the organization carries out management.

The competence class S of the organization indicates on the lack the own approach, but it has an understanding of its creation necessity. The project manager applies the competence elements "Personal Communication" from the field "People". The project manager with the partial participation of the organization carries out management.

If the organization has the competence class I or D, the project manager, using the competence elements "Personal Communication" from the field "People", demonstrates the need and importance of storing the knowledge and best practices. The project manager carries out management.

If the organization's competence class isn't defined (non-systematic approach), the project manager applies the same competences as in the case of the competence class I or D.

If the organization didn't undergo certification, the project manager can independently evaluate it making a comparison with the certain competence class. The required competence elements of the project manager and management will coincide with the competence elements of the project manager and management described above for certified organizations.

2.5.2 Received skills, knowledge, and practices of the project manager/the stakeholders should have everything in black and white

The solution to this task lies outside the organization. The result is the visualization of the skills, knowledge, and practices received by the project manager and stakeholders. Solving the task doesn't require from the project manager of certain competence elements that belong to the project management field. Stakeholders also solve this task independently. The project manager carries out management fully himself/herself.

Our research is presented in Table 5.

3. Discussion

Presented detailed analysis of the necessary competence elements of the project manager for the BMS management at the different its stages gives the possibility to present some regularities and next conclusions:

(a) the project manager alone or with the organization carries out the BMS management. The participation of the organization in the management process has a different degree;

(b) the degree of the organization involved in the management process depends on the competence class of the organization. The higher the competence class the more the organization takes part in the management process. The regulated approaches developed adopted in the organization as standards for project management regulate its degree of management process;

(c) the competence class of the organization has an impact on the list of necessary competence elements of the project manager for the BMS management;

(d) generally, the project manager needs in the competence elements from the field "People" for the BMS management. These elements describe the personal and social competencies that the project manager should have. They belong to "soft-skills". The development of soft skills can be shown as one of the keys to the project success;

(e) the competence elements from the field "Perspective" is used by the project manager when the organization's competence class is S, M or O, ie when the project approach implementation in the organization is carried out systematically and purposefully.

4. Conclusions

The BMS is one of the tools to effectively projects implementation. The BMS doesn't exist outside of the project. It exists during the project implementation.

The project manager should know about The BMS existence. He/she will be able to build and manage it. Building and managing of the BMS require skills from the project manager. How can the project manager confirm his/her skills? Complementary to CV and interview the project manager certification is one of confirmation. It identifies the certain competence elements availability. Without the defined competence elements, the project manager will not be able to manage effectively and efficiently by the BMS.

On the other hand, the organization also has an impact on the BMS management. The competence class of the organization indicates to the project manager its preparedness and involvement in project management.

Table 5 The management by the BMS at the Disbandment Stage

<table>
<tr><th>Task</th><th colspan="2">The competence class (according to the IPMA Delta)</th><th>The Project manager’s competence elements (according to the ICB4)</th><th>Subject of management</th></tr>
<tr><td rowspan="7">(i) update or create the knowledge base and best practices of the customer/the stakeholders</td><td colspan="2">M or O</td><td>“Compliance, Standards and Regulations", "Self-reflexion and Self-management", "Personal communication"</td><td>Project manager with the organization</td></tr>
<tr><td colspan="2">S</td><td rowspan="2">"Personal communication"</td><td>Project manager with the partial participation of the organization</td></tr>
<tr><td colspan="2">I or D</td><td>Project manager</td></tr>
<tr><td rowspan="4">Not determined</td><td>Non systematically/random</td><td>"Personal communication"</td><td>Project manager</td></tr>
<tr><td>Equivalent M or O</td><td>“Compliance, Standards and Regulations", "Self-reflexion and Self-management", "Personal communication"</td><td>Project manager with the organization</td></tr>
<tr><td>Equivalent S</td><td rowspan="2">"Personal communication"</td><td>Project manager with the partial participation of the organization</td></tr>
<tr><td>Equivalent I or D</td><td>Project manager</td></tr>
<tr><td>(ii) received skills, knowledge, and practices of the project manager/the stakeholders should have everything in black and white</td><td colspan="2">Not influence</td><td>Not influence</td><td>Project manager</td></tr>
</table>

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Understanding Project Culture and its Implication on Project Management

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According to literature, culture is often described as the way people feel, think and tend to act due to a collective programming of values and beliefs. Various research has been conducted to analyze the correlation between cultural patterns manifested in nations, organizations and groups, and the way projects are managed – resulting in multiple concepts of types, traits, interdependencies and their impact upon project success. Whereas most national and organizational cultures have developed over a significant amount of time, projects offer the opportunity to purposefully enhance certain cultural characteristics in its culture – especially in the initiating phase. Although project culture is impacted by the organization's or nation's culture, it is not identical to it, as it is subject to changing constellations such as stakeholders from varying nationalities. Therefore, it is important for project managers to understand the concept of project culture and adapting it according to the complexity of the project and its environmental requirements. This paper aims to provide valuable insights on the aspects of project cultures and how they might be utilized to support project success by transferring key findings from cultural research.

Keywords and phrases: Project Culture, National Culture, Organizational Culture, Project Management

1. Introduction

Culture is understood by various researchers as the sharing of history, traditions, ideology and language, which translates into the way people feel, think and tend to act due to a collective programming of cognitive schemas (Hofstede 2010; Rodrigues et al. 2014; Alas and Tuulik 2007).

As people are imbued with the cultural settings they belong to, there is a strong linkage between culture and the context individuals are involved in – such as societies, organizations and projects. Bredilet et al. (2010) and Bony (2010) for instance, report a linkage between national culture and project management. Mohammed et al. (2008) further state, that the cultural patterns of organizations, societies and individuals imprint upon the cultural patterns of a project's environment. Projects involving individuals from different cultural settings and/or countries are therefore not only seen as international projects but inter-cultural projects – arising the need to understand the influence of cultural traits upon project management (Chevrier 2003; Rees-Caldwell and Pinnington 2012).

The following paper will therefore focus on the formation of culture and its influence on project management by first summarizing key findings on organizational and national culture and their implication on project management. The second part will then focus on understanding project cultures and provide a detailed view on impact areas.

2. National Culture and its implication on Project Management

Different classification approaches on national culture have been attempted throughout literature, such as Lückmann and Färber (2016) who differentiate between competitive, context related, vertical relationship and philosophical culture traits or Hofstede (2010) who defined four cultural dimensions, which differentiate national traits in terms of power distance, masculinity and femininity, individualism and collectivism, and uncertainty avoidance (see table 1). According to Hofstede (2010) national and organizational culture influences project management work and affect organizational performance. The cultural dimensions can therefore be utilized to describe certain countries nationality as well as to gain insights on organizational and project culture.

According to Miloservic (1999) and Zwikael et al. (2005) National Culture influences how project management practices are understood and projects are managed, thus resulting in similar projects being run differently depending on the cultural background. They explain this by stating that project members develop different project management cognitive schemas depending on the cultural programing.

Literature findings suggest that there are certain cultural traits, which may show a significant influence upon project management such as leadership style, behavior scripts, problem-solving ability, rule compliance, openness and risk taking (Zwikael et al.

2005; Rodrigues et al. 2014; Rees-Caldwell and Pinnington 2012). Depending on the cultural setting, however, the impact upon project execution may vary. Wang, Jiang and Pretorius (2016) for instance, found project communication, negotiation, conflict resolving, contract process and team building to be the key factors of influence, when conducting projects in China or with Chinese counterparts. Rees-Caldwell and Pinnington (2012) researched British and Arab project planning and found planning, scope, time, integration and innovation to be rated higher in the British group, whereas communication was rated higher by the Arab group.

Various studies on international projects found cultural differences to be a key factor to affect project success (Pheng and Leong 2000; Wang et al. 2016). Knowing the culture of the international stakeholders of the project – such as project members, customers, suppliers and partners – and exhibiting competencies that are specific to the culture in which the project is undertaken, is therefore argued to enhance project success (Ramaprasad and Prakashi 2003; Yasin et al. 1997).

On the other hand, disregarding cultural differences may lead to higher uncertainty and ambiguous project planning due to disruptions in the previously identified impact categories (Lückmann and Färber 2016). There are various factors, however, influencing project performance and a direct linkage of culture to project outcome has also been vividly discussed in literature, as there are inconsistencies in terms of definitions, comparability of industries and understanding of project management (Rees-Caldwell and Pim 2012).

Table 1 Hofstede's four Cultural Dimensions and their organizational consequences

The Power Distance Dimension	
Low (e.g. Denmark, Australia) ▪ Less centralization ▪ Low hierarchy	High (e.g. India, Mexico) ▪ Greater centralization ▪ High hierarchy
The Masculinity / Femininity Dimension	
Low (e.g. Finland, Thailand) ▪ Sex roles are minimized ▪ Organizations do not interfere with private life	High (e.g. Japan, Italy) ▪ Sex roles are clearly differentiated ▪ Fewer woman in qualified jobs ▪ Work is valued as a central life interest
The Individualism / Collectivism Dimension	
Low ▪ Involvement of individuals with organization primarily moral ▪ Employees expect organization to defend their interests	High ▪ Involvement of individuals with organization primarily calculative ▪ Employees are expected to defend their own interests
The Uncertainty Avoidance Dimension	
Low (e.g. Great Britain, United States) ▪ Managers are more willing to make individual and risky decisions ▪ Low structure of activities	High (e.g. Japan, France) ▪ Less willingness to take risks ▪ More structuring of activities ▪ Lower Labour turnover

(Adopted from Hofstede 2010)

3. Organizational Culture

According to Ralston et. al (2008) national culture and organizational culture influence each other as there is a process of reciprocal adaptation as well as the influence on individuals' behavior, which shapes and is shaped by the cultural system of values the person is embedded in. It can therefore be assumed, according to Sasaki and Yoshikawa (2013), that competitiveness is not only achieved by a firm's characteristics, but also derives from the industrial system and national culture it is embedded in.

The following section will therefore focus on organizational culture and its inclination on project management.

3.1 Definition

Organizational Culture helps members of an organization to form an identity and increase commitment, provides help to perceive people and organizational events, reinforces the values, and controls and shapes employee's behavior (Robbins and Judge 2014). However, definitions on organizational culture vary. One of the most frequently used definition by researchers was formulated by Schein (1990), who defines organizational culture as:

> "A pattern of basic assumptions that a group has invented, discovered, or developed in learning to cope with its problems of external adaption and internal integration, and that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (p. 111).

3.2 Creating and Maintaining Organizational Culture

An Organization's culture is strongly influenced by the visions of its founders - their concept of what the organization should be like – and the unique circumstance of its growth (Barney 1986).

In the beginnings it is easy to impose the founders vision on every employee, for previous customs or ideologies are non-existent and people with similar values and beliefs are being employed (Robbins and Judge 2014). When the values and visions are continuously embedded into new employees, it is most likely that the company's culture will resemble the personality of its founders who will act as role models for each member.

Maintaining a culture and ensuring that employees share the same values, can be achieved by formalizing the selection process and performing organizational socializing. Organizational Socializing is important to maintain the company's culture and central values and begins with the selection process. By transforming newcomers into effective members of an organization who adopt and live the organization's values and norms, a company can enhance performance, job satisfaction and reduce labor turnover (Nelson and Quick 2013).

The three stages of organizational socializing involve anticipatory socializing, encounter, change and acquisition (Nelson and Quick 2013).

3.3 Analyzing Organizational Culture

Different approaches to analyzing organizational culture have been taken by researchers, such as Schein (1985), Hofstede (2010) as well as Cameron and Quinn (2006).

Schein (1985), for instance, takes a process approach to understanding organizational culture by seeing it as an ongoing recreation of shared meaning (Lim 1995). By analyzing three cultural levels, namely: Artifacts, values and basic assumptions, an organization's culture can be understood.

Artifacts refer to cultural symbols in the physical and social work-environment and include personal enactment, ceremonies and rites, stories, rituals, and symbols (Nelson and Quick 2013).

Values reflect an individual's inherent beliefs of what is right or wrong (Nelson and Quick 2013). A company's value for instance is often stated in its mission statement. A difference can occur when a company's espoused values are not coherent with the members' actual behavior – for instance in case of potential discrepancies between managerial ideology and actual organizational culture (Nelson and Quick 2013; Yesil and Kaya 2013; Alvesson 2013).

The most inherent level are the basic assumptions. Assumptions guide the behavior and tell the members of an organization how to interpret situations and people. They are often unconscious and according to Schein (1985), the essence of culture (Nelson and Quick 2013).

Like Hofstede (2010) and his four cultural dimensions, other models take a classification approach to organizational culture in order to provide a common framework for differentiating and comparing cultures. These types are usually reinforced by two or more variables.

Cameron and Quinn (2006) for instance defined four organizational culture types, which are clan culture, adhocracy culture, market culture and hierarchy culture (see table 2). By asking questions regarding the dominant characteristics of the organization, the leadership style, the management of employees, the mechanism that holds the organization together, the strategic emphasis, and the success criteria a picture is created, which either reflects the company's control orientation or its focus on internal or external functions (Fekete and Böcskei 2011; Tseng 2010; Quinn 1988).

Table 2 Cameron and Quinn's four types of Organizational Culture

Clan Culture	▪ Warm and friendly workplace which encourages knowledge exchange and is characterized by loyalty, morale, commitment, tradition, collaboration, teamwork, participation, consensus, and individual development and common aims
Adhocracy Culture	▪ Dynamic, entrepreneurial and creative workplace which encourages individual initiative, risk-taking and innovation and is characterized by adaptability, growth, change, productivity, efficiency and experimentation
Market Culture	▪ Competitive and result-oriented workplace which encourages winning, outpacing the competition, escalating share price and market leadership
Hierarchy Culture	▪ Formalized and structured workplace which encourages control, stability, predictability and efficiency and is characterized by well-defined processes and a smooth-running organization

(Adopted from Cameron and Quinn 2006; Fekete end Böcskei 2011; Tseng 2010; Yesil and Kaya 2010)

However, Quinn (1988) concedes that those types are merely ideals and it is more likely for organizations to incorporate more than one type.

The Problem with many approaches to analyze organizational culture is, that it is reduced to a tool to increase practicality. Though some organizations might seemingly fit into one category, they still have their distinctive values, which differentiate them (Henri 2006). This makes it hard to oversimplify approaches to organizational culture in order to enable cause-effect statements on how to manage; control and change culture - as many researchers do (Alvesson 2013).

3.4 Organizational Culture in global context

Understanding national differences is even more important for global companies which are not only influenced by their own organizational and national culture but also by the culture of other countries, which again are influenced by factors such as language spoken, legal system, values espoused, extent of education, political system and the dominant religion (Huczynski and Buchanan 2007). Same accounts for project cultures as projects can also be exposed to cross-national activities or multinational project teams.

Merging different cultures and opening branches in different countries, for instance, will lead to interaction with local actors such as suppliers or employees, who most likely embody different cultural values. Sasaki and Yoshikawa (2013) remark, that a strong regional culture will raise the need of adaptation and may influence and even change an organization's unique culture.

In order not to be affected by the problem of centralization and decentralization, developing a global organizational culture with employees supporting the global view is important (Nelson and Quick 2013). However, that does not incline that a global organization shall disregard local culture - considering cultural differences when merging with other countries is crucial for successful performance (Robbins and Judge 2014).

Further, taking national customs into account and weighing them appropriately regarding acceptability and national importance is also vital (Robbins and Judge 2014). Fostering an overarching corporate culture through shared artefacts, values and assumptions prevalent at every settlement around the world, will have a positive impact on competitive performance on the global market (Nelson and Quick 2013).

4. Implication of Organizational Culture on Project management

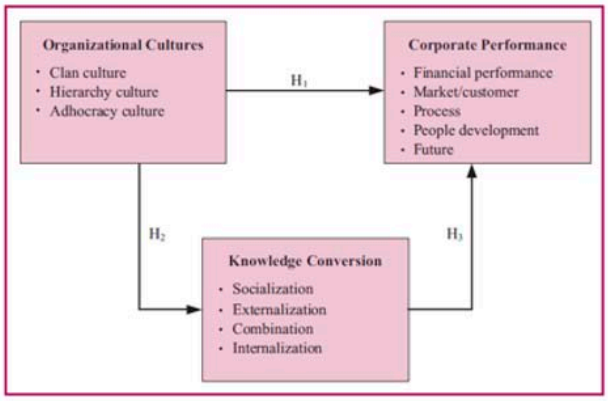
Various research has been conducted on organizational culture and project management, fewer linked organizational culture types to project management.

Best et al. (2012) for instance, defined three categories of project interventions namely controlling, connecting and actuating interventions and analyzed the relation of those interventions to organizational culture types and project management phases. By cross-tabulating the interventions with Cameron and Quinn's (2016) organizational culture types as well as the project phases initiating, executing and closing, they concluded that organizations use interventions differently depending on the culture type.

According to the authors, the findings can be used to determine which intervention type may be used in which project phase. Projects done in a family hierarchy, for instance, showed a greater need for actuating interventions in the initiating phase, such as encouraging ownership, bringing into action and learning by sharing. A hierarchical culture, on the other hand, showed a greater need for controlling interventions in the initiating phase, such as managing the stakeholder, minimizing discussions or establishing structure, to ensure project effectiveness (Best et al. 2012).

Rodrigues et al. (2012) analyzed the relation between project success and the way project managers value and perform project planning and control activities. They found a correlation between these factors and concluded that organizational cultures that foster planning and control activities may increase project success and should be reinforced in cultures that show little to no practice of these activities.

Another approach taken by Tseng (2010) draws a link between organizational culture, knowledge conversion and performance, by suggesting that organizational performance can be enhanced by cultivating a culture that "encourages and provides opportunities for communicating ideas, knowledge, and experiences (p. 279) (see Figure 1). Further, by using Cameron and Quinn's four culture types for their research, they found that an adhocracy culture scores best and hierarchy culture scores worst in terms of knowledge conversion and effect on performance (Tseng 2010).



H1: Cultural differences in an organization will significantly affect corporate performance
H2: Cultural differences in an organization will significantly affect knowledge conversion
H3: Knowledge socialization, externalization, knowledge combination, and knowledge internalization have a significant correlation with corporate performance

(Tseng 2010 p. 270)

Figure 1 Influence of Organizational Culture on Performance through Knowledge Conversion

5. Understanding Project Culture

According to the study of Geraldi and Söderlund (2017) the scholarly interest within the field of project management in the past years has moved from focusing on individual projects to understanding the meso- and macro-levels of projects – one of these fields being the culture in projects or in wider perspective the study of the culture of the project environment (Killen and Kjaer 2012).

Although the general perception in literature is of organizations having *a* culture, it is believed by various authors, such as Van Marrevijk (2007), Van Maanen and Barley (1985) or Bate (1994), that an organization incorporate various cultures – often seen as subcultures with multiple power relations, conflicts and deviations. Projects can thereby be seen as an organization's subculture, which according to Kendra and Taplin (2004) then again consists of multiple fragmented subcultures.

This view is also supported by Wei and Miraglia (2017) who state that projects include several professional cultures and subcultures. As part of their research, they further breached the issue of the dominance of corporate culture over project cultures by suggesting different cultural elements at different organizational levels, which impose an influence on professional cultures and subcultures operating in projects (Ajmal et al. 2009, Wei and Miraglia 2017). Certain core values and beliefs of the parent company and national culture of the project members are thus mirrored and nurtured in projects (Wei and Miraglia 2017).

Throughout literature the establishment of project cultures is therefore closely connected to research on organizational culture and their frameworks are frequently used to analyze and demonstrate the establishment of project cultures.

Van Marrewijk (2007) for instance uses Martin's (2002) three classification of organizational culture, namely content themes, cultural forms and practices to analyze the project culture of a large infrastructural project. Zuo et. al (2009) defined a project culture framework according to five project culture components, namely: Integrative, cooperative, goal oriented, flexible and people oriented. Wiley et al. (2016) refer to Schein's definition of culture and describe project culture as the shared norms, beliefs, values and assumptions of the project team.

A project's culture is further often seen as the manifestation of the defined way of communication, objectives, rules, roles and standards and can be enforced by using symbols, storytelling, rituals etc. (Palmer 2002, Wiley et al. 2016, Schein 1985).

According to a study from Loo (2002) on best practice in project management, project cultures are defined as unstable and are a constantly changing reflection of the environment they are embedded in and the temporary forms of the project organization - thus needing to be managed efficiently throughout the changes (Van Marrewijk 2007). This argument is supported by Hastings (1995) and Van Marrewijk (2007) who stated that projects and thus their culture are defined and shaped by social interaction and transform as changes occur during the project life cycle.

As Rees-Caldwell and Pinnington (2012) further state, the difficulties of understanding Project cultures arise from the variations of national cultures, organizational cultures and individual differences a Project is interacting with. Different stakeholder of different national and/or different organizational cultures make up the project culture. Even if project content may be similar, the cultural traits and thus the project management approach may differ due to the stakeholders' cultural cognitive scheme (Butt et al. 2016).

Problems occur when projects do not adapt to the changes of the environment they are embedded in, such as increasing isolation or loosing innovativeness - thus rising the need for successful project cultures to be adaptive to change (Van Marrewijk 2007; Bate 1994).

It is therefore crucial for project management to understand the concept of project culture and adapting it according to the complexity of the project and its environmental requirements. It is further suggested for project managers to invest in building a project culture. Whereas most national and organizational cultures have developed over a significant amount of time, projects offer the opportunity to purposefully enhance certain cultural characteristics in its culture – especially in the initiating phase (Wiley et al. 2016).

6. Implications of Project Culture on Project Success

There are various studies throughout literature which research the relationship between project success and certain traits prevalent in project cultures. Those insights can be utilized to gain a better understanding on project mechanisms.

According to Lückmann and Färber (2016), for instance, cultural factors within projects impact upon transparency, knowledge transfer, common understanding, motivation and team spirit and may lead to increased stress levels, additional work, frustration, escalations and hostility among project stakeholders if not taken into consideration.

By taking key insight from literature, the following section will focus on knowledge sharing, transparency and communication as project aspects cultural differences may impact upon.

6.1 Knowledge Sharing

Killen and Kjaer (2012) identified a high correlation between successful project performance and project cultures, which foster a culture of trust, openness, collaboration, transparency, knowledge and information sharing - not only within but also between projects.

The concept of trust, for instance may manifest in different ways depending on the hierarchical structure, high and low power distance, physical distance or communication methods - and may cause additional work or misunderstandings if not taken into consideration (Lückmann and Färber 2016). Closely related to trust is the behavior towards sharing knowledge - referring not only to the willingness or unwillingness of sharing information but also in terms of detailedness of the information and may result in misconceptions about the actual project situation and understanding of roles and tasks (Lückmann and Färber 2016).

According to the findings of Killen and Kjaer (2012), cultures and processes that encourage between project communication and knowledge sharing positively influence the understanding of project interdependencies and thus improve project portfolio management performance (Killen and Kjaer 2012). Müller (2014) further states that knowledge-sharing in projects has positive effects upon time, structure, output orientation and openness.

Barriers to organizational success can on the other hand be caused if knowledge is not transferred and shared accordingly in the organization (Killen and Kjaer 2012). This is especially prevalent in projects because of their temporary nature and the tendency of building knowledge silos within projects due to lack of knowledge transfer or knowledge being held by individuals within the project team (Killen and Kjaer 2012; McClory et al. 2017).

Ajmal et al. (2009), however, identified a positive correlation between organizational culture and the extend and way of knowledge sharing is practiced and therefore suggest for project management to harmonize the organizational culture and knowledge sharing practices.

A culture that supports between project communication and learning can be further enforced by project managers who encourage knowledge sharing among project teams as well as through management support for collaboration and information sharing (Killen and Kjaer 2012). The documentation of gained knowledge and lessons-learned is viewed as a key indication for organizational maturity by McClory et al. (2017).

A key suggestion to enable transferred lessons-learned and thus project learning is to establish a learning cycle (Killen and Kjaer 2012). McClory et al. (2017) further provide insights upon knowledge creation within an organization and projects and introduce a triple-loop project learning framework, which can be utilized to create a learning organization by first focusing on personal learning through experience, project learning through processes and organizational learning through setting learning targets and culture.

6.2 Communication

According to Wang et al. (2016) cultural differences mostly influence the project communication, negotiation and conflict-resolving.

Communication barriers for instance, can be encountered in form of differences in language, context or candor and may cause the communication between the stakeholders to slow down, the information to be filtered or to result in different interpretations of information (Wiley et al. 2016). Further, if values and communication style are perceived different by team members and are not being taken into consideration by the project manager, cultural distance may be created. It is therefore crucial for project managers and the project team to interact effectively with the project environment and if necessary adapt its processes accordingly (Ghemawat 2001). One prerequisite for this is understanding the impact of cultural differences on project stakeholders and communication.

As one of the key activities of stakeholder engagement, the way people communicate may vary depending on the cultural setting – resulting in differences between direct vs. indirect; high vs. low-context, “yes-saying” patterns and saving-face principles just to name a few. It therefore rises the need to differentiate the way of communication and requires significant higher amount of stakeholder communication compared to culturally homogeneous stakeholder (Lückmann and Färber 2016).

According to Butt et al. (2016) stakeholder participation can be ensured through effective communication for instance through teamwork and empowerment, whereas lacking communication may lead to cultures focusing on task performance and efficiency instead of shared alignment. They also stress the importance of project change communication during project culture changes in order to ensure stakeholder engagement and therefore suggest implementing and regularly updating a project communication routine, which incorporates change needs throughout the project life cycle (Butt et al. 2016).

6.3 Transparency

Finally, a culture fostering stakeholder participation is also seen in close connection to transparency and sustainability in projects, which in this context refers to the openness about policies, decisions and actions as well as timely, clear and relevant stakeholder information (Gilbert Silvius et al. 2017). The idea of fostering sustainability in project management has taken more and more interest in recent research. According to Gilbert Silvius et al. (2017) who researched the consideration of sustainability in project management decision making, only three sustainability criteria, namely stakeholder orientation, transparency and accountability were taken into consideration by project managers when making decisions. The decision making process is still dominated by time, cost and quality (Gilbert Silvius et al. 2017).

7. Conclusion

In conclusion, as reviewed in this paper, there are various impact factors of culture on project management. A projects culture is strongly influenced by the organizational and national culture it is embedded in as well as the cultural cognitive schemes of the project members and stakeholders.

Further, managing culture depends strongly on how culture is seen – as tool to influence organizational behavior, or as navigation, which has to be taken into consideration in the decision-making process. Moreover, though most authors refer to culture management, it shall not be ignored that according to many definitions, organizational culture is understood as the shared beliefs and values of its members – thus putting emphasis on every single individual. Though culture can be managed to some extent, it cannot be solely changed by management.

Nevertheless, it is important for project management to understand the influence factors on project culture and how they affect project work. This paper provided a detailed view on knowledge sharing, transparency and communication as project components, which may be influenced by cultural factors. However, it has to be noted, that further research has to be undertaken to gain a more comprehensive picture on the implications of Culture on Project Management.

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Operation Method using Evaluation Models of Procurement Specifications

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In this paper, we propose an operation method using a newly developed quality evaluation manual to improve the quality of the information system procurement specification. In the procurement of information systems conducted by the government, it is necessary to maintain the quality of the procurement specifications initially referenced at the time of bidding in order to ensure successful procurement. To maintain the quality of procurement specifications, the quality of the procurement specifications must be evaluated. Quality models are required to evaluate quality. We have developed a quality model for procurement specifications and show the effectiveness of the procurement specification's quality assessment.

Keywords and phrases: Software Requirement Specifications(SRSs), Information System Procurement Specifications(ISPSs), Quality Model

1. Introduction

The purpose of this paper is to clarify the effectiveness by using the quality evaluation manual in the quality inspection of the information system procurement specification. Therefore, we clarified the effectiveness of the quality evaluation manual by conducting experiments using the **I**nformation **S**ystem **P**rocurement **S**pecifications **Q**uality Model (ISPS-Q model) and the quality evaluation manual developed using the inspection method (Nakakita, 2010-11-17)(Nakakita, et al., 2012-08-23) (Nakakita, et al., 2012-10-02).

Public investment for fiscal year 2013 is 5,285 billion JPY[4], which is undoubtedly a huge amount of money. In the bid for information systems, the procurement specifications are clearly defined in the information system procurement specification(ISPS).

If the quality of the text described in the procurement specification is low, for example, it is extremely difficult to construct the same performance and product of the same function, for example, if there is a vague description or description. Made a successful bid company satisfies the function and performance of the request as described in the procurement specifications shall be kept high quality of the procurement specifications.

Definitions of the quality of the procurement specifications, we define in detail in Chapter 2 and Chapter 3. Also, in order to evaluate the quality of procurement specifications, a quality model of the procurement specification which can be used as the standard for quality evaluation is necessary. By evaluating quality using the quality model of procurement specification, it becomes possible to detect any areas in the procurement specifications with quality problems. To indicate such quality models and effectiveness of the quality evaluation method, at first, it is important to know the characteristics of the procurement specifications.

This research shows the results of quality evaluation which newly became apparent by further evaluation the results of experiments to the clarified quality model. Subjects for comparison become necessary to clarify the characteristics and effectiveness of the procurement specification ISPS-Q model. As the first subject for comparison, we used the public comments. In general, before the government releases their ISPSs, it calls for public comments and use these public comments to improve their ISPSs. The ISPSs are reviewed by several companies, and their findings are disclosed as public comments by the government. We classified these public comments by applying the ISPS-Q model. As the other subject of comparison, we used the results of our experiment.

Another comparison, we used the result of the comparison experiment by the 6 subjects. In our experiment, the general engineer detects the defect of the procurement specification by using the ISPS-Q model and the independent inspection method. The ISPS-Q model in this research is the enhanced version of IEEE std. 830-1998(IEEE-830) (IEEE Std.830-1998, 1998). The independent inspection method is a method in which a party unrelated to the procurement applies perspective based on reading(PBR) (Basili, et al., 1995) as the evaluation method. We certify by the results of the two experiments using the ISPS-Q model which were developed, and independent evaluation technique(Nakakita, 2010-11-17)(Nakakita, et al., 2012-08-23) (Nakakita, et al., 2012-10-02).

However, there were many opinions that it is difficult to find defects only by understanding the quality characteristics of the quality model when interviewing after the experiment. In other words, they do not know where in the text described in the procurement specifications we should focus on quality inspection. Then, a newly developed quality evaluation manual is described in what kind of content should be noticed for description of the procurement specifications and quality attributes of ISPS-Q model for procurement specifications.

Quality evaluation manual to define in detail in Chapter 5. Quality evaluation tests of the procurement specifications using the quality evaluation manual was carried out, to confirm the validity of the developed quality evaluation manual.

2. Quality evaluation for specifications

If the evaluator can evaluate the quality of something, it becomes possible to improve its quality. Many quality models have been developed to evaluate software products (Carvallo, et al., 2003) (Finkelstein, et al., 2002). For example, there is a standard for defect types of programs, which is a kind of quality model for evaluating the source codes of programs (Humphrey, 1996) (Fagan, 1976). Within the standard, types of defect of source codes are defined by their ID, name, and description. The defect types are useful for inspection, since they guide us in distinguishing between right codes and wrong codes. In this paper, the quality model of the ISPS is introduced, because the characteristics of the ISPSs is disclosed by experiment. Even now, we cannot say that the quality model of the ISPSs of the government has been discussed enough.

However, we have the quality model of SRSs. Several version have been developed as the quality models for SRSs. The first version of IEEE-830 was published in 1984[11]. Alan Davis (Davis, et al., 1993) proposed a quality model of SRSs with twenty-four quality characteristics based on IEEE std.830-1984. IEEE std.830-1998 (IEEE Std.830-1998, 1998) is the latest version of the quality model of SRSs which has seven quality characteristics. There are several quality characteristics that both SRSs and ISPSs have to satisfy. We refer to the latest IEEE-830 as the common part of the quality characteristics of ISPSs and SRSs.

The government lays out the ways to conduct fair and adequate procurements.

The Ministry of Internal Affairs and Communications(MIC) has published the basic guidelines on the information systems of government procurement (Administrative Management Bureau Ministry of Internal Affairs and Communications}, 2007) (Chief Information Officer(CIO) liaison conference decided, 2007). It provides the standard operations of procurement. The Japanese Ministry of Economy, Trade and Industry(METI) has developed the Technical Reference Model(TRM) (Ministry of Economy, Trade and Industry Commerce and Information Policy Bureau, Information Processing Promotion Division, 2010). TRM consists of numerous technical domains, e.g. network systems, database systems, hard disk drives, printers, etc. The mandatory and optional properties of each technical domain are defined and referred to by officers of the government when they write their ISPSs. For example, when the government procures a database system, they must define the amount of the data, performance of the database system, and the expected data amount as it evolve in the future. The TRM is effective for writers to cover enough properties of expected products. However, strict properties of a product sometimes harm the fairness of the procurement. Fairness is an essential social responsibility of ISPSs of the government.

Inspection is an effective method to detect defects. Basili et al. proposed perspective based reading(PBR) (Basili, et al., 1995).

By applying the perspectives to an inspection, each inspector can inspect a document by focusing on an aspect of the document (Forrest, et al., 2000) (Matsukawa, et al., 2002). Applying PBR to inspect an ISPS, and we disclose the characteristic of the ISPSs by comparing with public comment. Then, we compare the experiment result with written opinion, and clarify the effectiveness of the quality survey by the quality evaluation manual.

3. ISPS-Q model

3.1 ISPS-Q model overview

The purpose of our research is to clarify the

Group No. : Inspecter's Name : Date : / / Inspection Time :

No.	Doc. name	Page No.	Chap. No & Sec. No.	Sentences	Correct				Complete				Unambi-guous	Consis-tent	Ranking	Verifia-ble	Trace-able	Claims
					Ser. correct	Tech. correct	Social correct		Ser. complete	Tech. complete	Social complete							
							Com. correct	Fair			Envi. complete	Com. complete						

Figure 1 Inspection Sheet

effectiveness of the evaluation model of the procurement specifications. The Procurement Specification describes requirements for the government's information systems. The features of such procurement specifications are generally features of requirements specifications. However, there are different parts in the procurement specifications and requirements specifications. The same role as requirement specifications was named "role of service" in the role which procurement specifications have. The role of this service can refer to IEEE -830[5] as part of the ISPS-Q model.

In the procurement specifications, there is a role of technology and society as a quality different from the requirements specification. The role of society is the government's responsibility to the public. In the information system procured by the procurement specification, the social responsibility shall not be violated. As a role of technology, the government is responsible for procurement.

As a government responsibility, the procurement specification is responsible for providing sufficient technical information to the company that intends to bid. Companies wishing to make bids prepare proposals and estimates required for bids from the procurement specifications.

The information required to prepare a proposal and an estimate must be described in the Procurement Specification. The role required for this procurement specification shall be "role of technology." Thus, the ISPS-Q model includes three aspects of quality characteristics: the role of service, the role of society, and the role of technology. For details, please refer to the paper.

4. Independent evaluation using the ISPS-Q model

This chapter describes the independent evaluation method by the ISPS-Q model used in experiments.

4.1 Independent Evaluation Method

The evaluation target is the procurement specification. The evaluator is required to have knowledge of the ISPS-Q model or to obtain an explanation of the ISPS-Q model. The evaluator is expected to be independent from the bidding company (not related to the bidding company). Evaluation is controlled by the perspective of the evaluator. For evaluation, the ISPS-Q model is referenced in the evaluation process. This indicates that evaluators evaluate the quality of the procurement specifications using the ISPS-Q model.

4.2 Perspective

In this experiment, we define perspectives for procurement specifications and apply PBR as a process of inspection techniques. Three perspectives were defined based on the structure of the sentence. As a perspective, the procurement specification is a type of document, so the entire document, text, and word are used.

Perspective 1 : Focus on the entire document in the procurement specification.
Service complete, technical complete, social complete, ranked for importance and/or stability

Perspective 2 : Focus on the statement of the procurement specification.
Service correct, technical correct, social correct, consistent

Perspective 3 : Focus on the word in the procurement specification.
Unambiguous, verifiable, traceable

4.3 Process

In this experiment, three kinds of materials were adopted. The first is the inspection sheet. The inspection sheet is a document that reports defects in the text in the procurement specification. The inspection sheet consists of the inspector's profile (group number, inspector name), the date and time of the inspector, the date and time of the inspection (ID, document name, chapter number, term number, page number, page number), the quality characteristic evaluated, and the defect reason for individual defects.

The inspection sheet is shown in Figure 1. The inspector describes the quality characteristics corresponding to the identified defects. In addition, multiple characteristics may be described. In the column of defect reasons, the inspector discusses and describes the defect. The second is the ISPS-Q model. See Chapter 3 for the ISPS-Q model.

The third is the quality evaluation manual. There is an opinion that it is difficult to extract defects that become problems in the procurement specification in order to perform actual operation only in the description of quality characteristics of the ISPS-Q model. Therefore, we prepared a quality evaluation manual. See Section 5.1 and Section 5.2 for this quality evaluation manual.

4.4 Evaluation

In this experiment, the independent inspection method using PBR is applied. To evaluate the evaluation, we asked evaluators to maintain high levels of concentration. Therefore, we decided to limit the evaluation time every hour (Kong, et al., 2011).

After evaluation, all inspection sheets must be inspected by all evaluators. Two or more evaluators assigned to each perspective to remove subjective evaluations. Thus, the recommended number of inspectors is more than six. Evaluate the procurement specifications by experiments. The following chapter describes the quality evaluation manual used in this experiment.

5. Content and intention of the quality evaluation manual

5.1 Evaluation manual overview

The ISPS-Q model we developed is a quality evaluation model for determining the standards of procurement specifications. This quality evaluation model enables us to evaluate the quality of procurement specifications. However, when the quality evaluation experiment of the procurement specification was carried out in practice, there was an opinion that when quality evaluation was carried out only by quality model and quality evaluation technique, it was not clear how to find defects.

Therefore, we prepared a manual listing how to detect defects by evaluating the description of the procurement specifications for each quality characteristic. To verify the validity of this manual, we conducted a quality evaluation experiment using a manual.

5.2 Quality evaluation manual for procurement specifications

An excerpt of the method for discovering the quality of the procurement specifications described in the quality evaluation manual is described below.

・ISPS-Q Model Quality Characteristics

(1) Complete : An ISPS is complete if, and only if, it all important requirements.
  (1-1) Technical complete An ISPS is technical complete if, and only if, it includes a description concerning the scope of responsibility and the compensation for a failure.
  [Example] The procurement specification must refer to two sentences. The Ministry of Internal Affairs and Communications Administration Office's Basic Guidelines for Government Procurement and Technical Reference Model for Procurement of Information Systems. The technical reference model is used for cooperation between Japan and the EU as an open standard for the procurement of Japanese government. Thus, the procurement specification must include references to the technical reference model.

(2) Ranked for importance and/or stability : An ISPS is ranked for importance and/or stability if each requirement in it has an identifier to indicate either the importance or stability of that particular requirement. For Example, the stability of laws and ordinances should be remarked.
  [Example] Ranking in case of multiple problems.

(3) Unambiguous: An ISPS is unambiguous if, and only if, every description stated therein has only one interpretation. As a minimum, this requires that each characteristic of the procuring product is described by a single unique term.
  (3-1) Word error : the sentence is ambiguous if the following words are used and the scope of the sentence is undefined.
  [Example] "Accuracy," "Proper", "Quick", "Right", "Optimal", "Easy", "Energy Saving", "Energy Conservation," and "Confirming (where? Who?),

"Responsibility", "Principle", "Special", "Attention", "General", "Special", "Stabilization", "Stable", "What is possible," or "to do".

(3-2) Syntax error: If the following words are used and the scope is undefined, the sentence is ambiguous.
[Example] "that" , "this ", "all the ", " etc", "and ", "or ", "however ", "again".

6. Evaluation

6.1 Experiment environment

6.1.1 Experiment environment

In this experiment, the procurement specifications and opinions published by the government were used as experimental subjects. Procurement specifications of the experimental subject for “The design and development work relating to worker’s compensation receipt computer processing system (draft) ” provided by the Ministry of Health, Labor and Welfare(WHLW) " was used. The public comments also covers documents published with the procurement specifications. The ISPS consisted of 16 sections in 78 pages. In this experiment, the scope of evaluation was 30 pages with Section 2 (21 pages), Section 7 (4 pages), and Section 15 (5 pages).

6.1.2 Inspectors

All inspectors have technical experience for ten or more years, and knowledge of the quality model of IEEE Std.830-1998. Though they did not have the domain knowledge on the technical domain of the ISPS, we accepted them as inspectors.

6.1.3 Perspectives

We divided the twelve inspectors into three equal groups to two experiments. Each group was assigned a set of quality characteristics. Basically, we assigned ``complete" to Group1, and ``correct" to Group2. The remaining quality characteristics we assigned to Group 3 with some assigned to Groups 1 and 2.

The relationships between perspectives and inspection groups are shown in Figure 2. The quality characteristics that were assigned to the groups are as follows:

- Group 1 : Service complete, technical complete, social complete, ranked for importance and/or stability
- Group 2 : Service correct, technical correct, social correct, consistent
- Group 3 : Unambiguous, verifiable, traceable

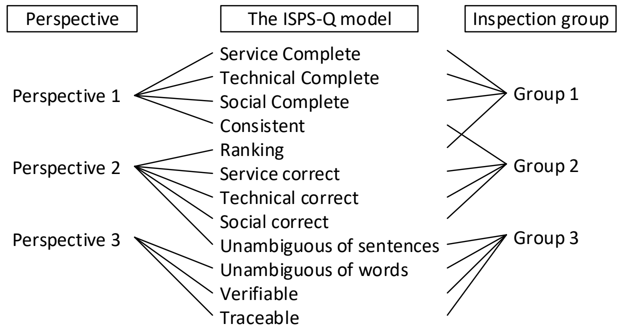

Figure 2 Links between Perspective and Inspection group via The ISPS-Q model

6.1.4 Process

Step 1 : The briefing was held for approximately 60 minutes.

Step 1-1 : The ISPS-Q model and evaluation method and the quality evaluation manual were distributed and explained as reference materials.
The inspectors did not know the ISPS-Q model. However, the inspectors knew the quality model of IEEE-830.

Step 1-2 : It was explained how to enter a defect on the inspection sheet (shown is Figure 1)

Step 1-3 : The defect detection method was explained by showing an example.

Step 1-4 : Then, we had Q&A

Step 2 : The inspection took one hour.

Step 3 : All of the inspection sheets were reviewed by all inspectors. We compared the results of the experiment with the public comments of the ISPS.

6.2 Experimental Result

Table 1 shows the results of the experiment and the public comments.

The columns of the table are the quality characteristics of the ISPS-Q model. The rows consists of the number of defects reported by group and public comment.

Table 1 Results of quality evaluation experiments

Quality characteristics		Expe	Pub. Com.
Complete	Technical complete	16	3
	Service complete	30	31
	Social complete	2	2
Correct	Technical correct	1	2
	Service correct	3	20
	Social correct	2	7
Ranking		0	5
Consistent		1	2
Unanbiguous		36	16
Verifiable		0	17
Traceable		2	0
Total		93	105

6.3 Results of quality evaluation

Many quality characteristics detected by the experimental evaluation group were service complete, service correct, consistent, unambiguous, and traceability. Quality characteristics, which were found to have many public comments, were technical complete, social complete, prioritization, technical correct and social correct. Also, the number of defects found was verified to be verified. Quality characteristics that the evaluator could not find at all were technical completeness, technical correct and prioritization.

The evaluation group could not find defects that would be problematic in the quality characteristics of prioritization. According to an interview with the evaluation group, they considered all sentences in the procurement specification to be the top priority and did not evaluate them. Technological correct could not detect many defects. However, in the completeness and correctness of the service, the evaluation group can detect defects because it detects defects based on the IEEE-830 quality model. Technological correct may be a quality characteristic that can be found only when the system is actually constructed. Therefore, the technical correct is difficult to find in an independent inspector.

In addition, the quality characteristics of a small number of defects detected are social complete and social correct. These quality characteristics are quality related to law. The reason why only a small number could be detected is considered insufficient at the explanatory meeting before the experiment. In other words, the description of social complete and social correct should be described in detail in the quality evaluation manual.

The experimental group discovered a defect that had a problem with most quality characteristics. In particular, we found the quality of many problems especially in completeness and unambiguous.
In technical completeness, the experimental group has discovered a new 30 defects. In addition, 36 new defects are reported in unambiguous. However, the two qualities of ranking and verifiable were not found.

6.4 Discussion

Until now, the quality evaluation of the procurement specifications has not been evaluated using appropriate words because there is no quality model as an evaluation criterion to detect the quality. Therefore, we defined the quality model of the procurement specification and conducted two quality evaluation experiments using this quality model to discuss the effectiveness of the quality model (Nakakita, 2010-11-17)(Nakakita, et al., 2012-08-23) (Nakakita, et al., 2012-10-02).

However, when an interview was conducted on the experimental group, there was a lot of opinion that it was difficult to find out where the quality of the text was in the text described in the procurement specification. In other words, it is necessary to prepare a quality evaluation manual that summarizes where to focus on the text described in the Procurement Specification.

Therefore, we conduct a new quality evaluation manual and conduct an experiment to confirm that the quality of a more problematic product can be found by using the quality evaluation manual. We discuss the effectiveness by using the quality evaluation manual.

6.5 Effectiveness of the evaluation method

As an evaluation method, we allocated the viewpoints (sentences, sentences, words) and quality models of the procurement specifications focusing on each group, and extracted the quality of the procurement specifications. The experimental results showed that the experimental group could not point out the quality characteristics of the services. In other words, it became clear that the viewpoint of the quality of the procurement specification was different between the company and the evaluator who submitted the public comments.

The evaluation method of this paper uses the quality model of the requirements specification by IEEE -830 to evaluate the procurement specification, and the difference in quality characteristics of correctness and completeness is lost. Because the number of points indicated is the sum of the items in Table 1. By defining the quality of correctness and completeness as the characteristics required by the procurement specification, it became clear that the companies that bid are specialized in technology.

Therefore, the quality evaluation of the procurement specification proposed in this paper revealed the difference between the company describing the public comment and the quality evaluation using independent evaluation method.

7. Conclusion

This paper clarifies that the quality of many problems can be discovered by using the quality evaluation manual using the ISPS-Q model. The evaluators of this experiment have detected the same or more problematic defects in many points. However, the number of defects due to the quality of the ISPS-Q model was different from that of the public comment. The social correct was able to detect defects from the viewpoint of the companies in which bidding was carried out, but it was difficult to detect the defects by the evaluator. The reason is that companies that are bidding have an important social perspective. In other words, the information system to be awarded and constructed must be fair and must be provided as a product conforming to the law.

By adding quality evaluation manuals to quality evaluation methods only for quality models so far, we have clarified that we can find more problems. In this experiment, it is also true that the quality is still difficult to evaluate.

In the future, further research and experimentation are planned to improve the discovery rate.

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On-site Quality Improvement at Multiple Parallel Development Projects

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Quality management in project management is one of the most important factor to meet the expectations of customers. In general, the method of quality control in a single project is clearly defined as project management knowledge areas, but it is not mention how to manage quality when multiple development projects are conducted at the same time. Although there is a general definition of quality control, it depends on on-site PM what kind of specific tools should be adopted to the project for the success. In the mission-critical system, the author has led projects that contain multiple parallel development as Project Manager. This system has been repeatedly expanded for more than 10 years, the environment has also changed, and the development team was downsized due to the leaving of experts who had joined in initial construction and the promotion of efficiency improvement. In this circumstance, major troubles have occurred frequently in recent years, so it is the author's responsibility to improve the quality as the rescue PM. In this paper, based on the experience of the author leading the multiple parallel development projects, the author analyzes troubles, measures improvement of quality, evaluates their results, and finally defines the method of quality control as the on-site perspective.

Keywords and phrases: Quality Management, Multiple, Parallel, Improvement, On-site

1. Introduction

Recently, the author was in charge of project manager position in the mission critical and financial project. The project was a system application development and maintenance project that had lasted 10 years ago. During the past 10 years, the project manager has been changed for several times. And also, there were only a few members who had experienced the initial development.

Therefore, it was one of the most important tasks to lead newly multiple young engineers with the few experienced members.

In addition, due to the cost reduction request from inside and outside the company, the project had to delegate development outside of Japan with a low unit price and to reduce the development organization in Japan.

Furthermore, as the system had been repeatedly expanded and complicated and it had several requirements to add functions in various aspects, it had to lead 30 projects in parallel at all times.

In background, there were these three circumstances, and recently the project had several major system troubles. These troubles could not be ignored in both the company and customers, and it was necessary to conduct improvements. Following the mission of this improvement, the author was assigned as the project manager.

In the next session, the background of the proposal is described in detail. In the next session, the background of the proposal is described in detail. In section 3, actions of project issues are proposed. In section 4, the efficiency of these actions is mentioned. Finally, in section 5, the conclusion of this paper is provided with the summary.

2. Preparation for proposal

In the project, the problem of organization aspects was also remarkable, in addition to this, similar troubles which was concerned about by company and customer had occurred in widespread. It was necessary to conduct improvements at the management level of the company. However, it was difficult to reach the cause why the same problem had occurred more than once outside the project and in the previous management organizations, it was also difficult to conduct improvement actions.

Therefore, at first, it was necessary to analyze the cause of the past troubles and consider the improvement plan. In attending this project, the author analyzed the trend of troubles in the past year. At the lists of trouble managements that were voted in the Test Phase of several projects, we divided the cause of the troubles into two types, "Embedding Cause" and "Undiscovered Cause". And analyze again to identify the phase that caused the troubles such as “Requirement Phase”, “Design Phase”, “Program Phase”, and “Test Phase”.

As a result, it was revealed that there were some troubles which were occurred by recognition differences between phases, parallel development, and overseas development, that the part of detailed design contents was not included in the program, the part of the requirement definition contents was not included in the design.

3. Actions of quality improvement

To manage quality, the author carried out some actions. He defined six points as quality improvement at multiple parallel project.

3-1 On-site quality improvement

At first, it was considered what is necessary to improve quality. The similar troubles were occurred, the troubles were not recognized to every members, and the lessons were not made use of. These were the reasons of having no rule to accumulate lessons and learned. Although there was a project check list as a company's quality control indicator, it was too much generalized and there were no material that has been realized to the extent that project troubles can be found in advance. Also, since system application development has unique difficulties and environments to each project and there are trade-off between standardization and concretization, it is difficult to define the definite standard as a company. Normally, projects are defined as periodic, but there are some projects that extend and maintain specific systems in parallel. For this reason, it is necessary to create a standard checklist that incorporates unique elements to the project.

In order to deal with this, a project-specific checklist was created in this project. And it was not the one abstract checklist for the entire project, but it was generalized so as to make it easier to understand the troubles which have been repeatedly failed in cases of Design, Development and Test. Specific troubles were added so that concrete events can be identified from generalized items. In addition, it was created a format that can add links to trouble documents so that trouble causes and actions can be traced from these troubles.

3-2 Consciousness of traceability

If it is a case where all Design, Development and Test tasks can be done by one person, there is no recognition difference.

It is the most desirable organization to manage quality by participating in one project fixedly with one person as in case of carrying out parallel projects.

However, that is not the case if there are 30 parallel development projects. If it was planned to manage 30 projects concurrently, as long as it was owned to one company, it is necessary to seek efficiency on the ordering side. And if it is considered even as a project manager, the time that people need is different in order to have time differences at the project start and project end.

Also, it is the real intention that a fixed member should participate in each project across the long term as possible in the system development.

Then, it is easily occurred to participate as a designer of multiple projects for one person and to

Table 1 Check List (for Design Phase)

Category	No.	Check Items	Trouble No.	Link	Check	Results	PID	Date
Planning	1	There are no issues to affect the development plan.	DD-001	//aaa.bb	■	N/A	John	2016/1/20
Planning	2	There are no corrections which are out of scope.	DD-005	//aaa.br	■	We have one thing to discuss about the schedule.	John	2016/2/3
Review	1	Every deliverables are peer-reviewed.	DD-010	//aaa.cs	■	N/A	Marry	2016/2/10
Review	2	Walk through review have done for multiple members.			■	N/A	Marry	2016/2/15
Review	3	All review points have been closed.			■	N/A	Marry	2016/2/17
Program	1	All change affections are detected.	DD-023	//aaa.dx	□			
Program	2	Existing implementation are confirmed properly.			□			

participate as a developer of multiple projects for another person.

Therefore, it is obvious that the designer and the developer become different people. Moreover, it can always be occurred in the project that designer is in Japan and developer is in overseas.

In that case, another country and another member will exist as designers and developers, so the designer needs to tell the developer or the test executor that the contents of the design is clear.

So two points are needed in this situation.

The one is the traceability check at development. Defining to create a document that contrasts the development source with the design document after completion of the development in order to confirm whether the design source does not include what is not written in the design. As a result, recognition differences are resolved, and a culture was born that confirms at the time of comparison in case there are unclear contents in the design content.

The other is the traceability check with the design document in test design at the beginning of Test Phase. After completing the test design, it is necessary to perform traceability check between the design document and the test design document so that there is no excess or deficiency in the contents included in the test item as the test design.

As a result, it was confirmed that all the test items included in the Design were tested and it contributed to suppressing the occurrence of troubles due to the test omission.

3-3 Library management

If there are 30 development projects in parallel which are one of the huge system, there are many requirements to modify the same program in different projects. In addition, each project does not necessarily end in turn, and it can be fully occurred that later project has been finished which would modify the same program before finishing the previous project. Therefore, in 30 parallel projects, it is essential to implement source and version control about design documents and programs.

For this reason, we have established a method of library management while utilizing tools in the project. In this parallel development project, the meeting to share the state of the library with team members is held for 10 minutes on a daily basis after defining the core library administrator. It was standardized to report

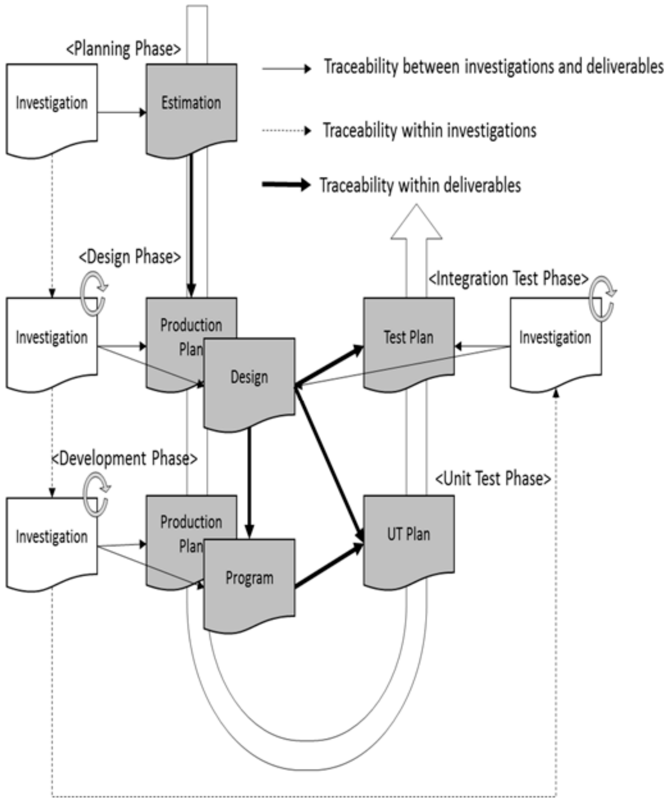

Figure 1 Traceability Image

release time and modification time for each project, so that there is no discrepancy in recognition. The virtual library management members were also defined with library manager, and library management meeting was constantly held to discuss tasks in library management as a virtual team on weekly basis and to measure improvements constantly.

3-4 Investigation to the requirements

In the system development that conducts multiple projects and repeats expansion, it is very important how to precisely identify the requirements of each project in detail. Analysis of the cause of troubles found cases that were issued by insufficient investigation as undiscovered causes. Therefore, as a countermeasure, "Investigation" was defined as a standard process in this project. In addition, in order to thoroughly carry out this process, the investigation guide and Investigation sheet artifacts were created. And all contents of Investigation at the results of Basic Design, Development and Test Phase were described in the same format, stored and managed in one unit, and the past contents were aimed at reuse as knowledge.

The purpose of this process is defined as follows.

- Identify development targets to meet requirements
- Comprehensively grasp specifications of existing applications and prevent miscreation due to

misunderstanding and misrecognition

- Identify the impact of changes in logic and data on existing applications

Through this process, it can be used not only for refining the closed impact study in one project but also for analyzing the impact in parallel projects at the same time. It was contributed to find out useful results for Library management.

Investigation Template			Create Date	Create Member	Review Date	Review Member
Phase		Preparation				
		Conduction				
The purpose of investigation and contents						
The results of investigation						
The scope of investigation						
☐Program ☐Image ☐Properties ☐Design Documents ☐DB Definition ☐Job ☐FrameWork ☐Master Data ☐DB ☐Test Documents						
The way of investigation						

Figure 2 Investigation template

3-5 Standardization of quality evaluation definitions

In the situation where multiple development projects are carried out in parallel, there are some kinds of project size, large and small. The large scale project is required to manage strict quality not only form the company but also from customers. Especially in the area of application development it is important to define the extent to which the results at the completion of the test were achieved. It requires quantitative analysis and qualitative analysis. Until frequent occurrence of troubles, quality evaluation of Test phase was conducted only when it was requested by customers.

However, in order to carry out the same analysis irrespective of the magnitude of the scale, a process was defined in which a specific quality assessment is carried out in every project and a test quality evaluation guide was created.

Test quality was analyzed on the following four points.

- Case density
- Trouble density
- Trouble analysis
- Enhancement measures
- Summary

In terms of density, quality evaluation indicators were predefined based on the past knowledge. Analysis was carried out from the viewpoint of embedded / undiscovered causes and those phases, and summarized all the troubles in the list. In addition, when judging that a certain quality is not maintained after the result of density and analysis, it was essential to formulate quality enhancement measures and raise to a certain quality level. As a result, it contributed to maintaining a certain quality level regardless of the project size.

Test Quality Evaluation Guide

1) Case Density
Actual value of cases is within ±20% of Target Value at this phase.
And so, we could archive enough cases.

Target Value	Actual Value	Conduction Value	Digestibility
1891	1953	1953	100%

2) Trouble Density
Trouble density in all development scope is within ±20% of Target Ratio.
Common Function had more troubles than other functions. Because they related to each other functions and they tend to be higher trouble occurrence.

Function	Step value (kstep)	Trouble Value	Trouble Ratio (value/kstep)	Target Ratio (value/kstep)
Common	3.5	11	3.1	2.9
Others	9.5	22	2.3	2.4
Total	13.0	33	2.3	2.5

3) Trouble Analysis
Among all 33 troubles, 31 troubles should be found at this phase.
We could keep high quality from the previous phase.

Function	Embedding phase		Should be found	
	Design	Development	Unit	Integration
Common	4	7	2	9
Others	7	15	0	22
Total	11	22	2	31

4) Conclusion
As mentioned above, test quality is ensured at this phase.

Figure 3 Test Quality Evaluation Guide

3-6 Quality control at overseas

It was the time to transfer the project tasks to overseas members. It is easy to transfer the simple test task, but it is difficult to transfer the development and the design task. Along with implementation of the transition of development, it has occurred that the content of Design did not convey to the overseas development members or the overseas test design members.

The following points were addressed as this solution.

- Set up a project manager overseas.
- Fix overseas members.
- Implement overseas quality management at the same level as Japan

It is easy to say, but it is not ready to run. It is necessary to arrange overseas manager, communicate weekly, and raise the knowledge level of all overseas members. However, these points were totally contributed to reduce the misunderstanding each other.

Table 2 Trouble List

No.	Category	Phase	Issues	Direct Causes	Embedding Causes	Undiscovered Causes	Apply to others	Actions	Date
1	misunderstanding	Integration							
2	programming	Integration							
3	misunderstanding	Design							
4	misunderstanding	Design							
5	Investigation	Design							

4. Efficiency of these activities

As I have discussed, by analyzing troubles, analyzing trends and examining and implementing countermeasures from the past. The important troubles were reduced to zero due to the fact that more than 20 important troubles occurred in the past one year.

Regarding measures specific to overseas development and parallel development projects, it was applied not only this project but also any other similar projects in which multiple troubles frequently has occurred for lateral deployment feedback. It was also contributed to be used as a standard for these projects.

5. Conclusions

As described in this paper, there are unique problems in overseas development and parallel development projects. It is necessary to respond the troubles in advance. However, because there are several various situation depending on the project, It is difficult to establish the standards that meet all conditions.

Therefore, the risk which would produce the troubles should be analyzed beforehand in each project unit and risk measures should be implemented. This may reduce the probability of trouble occurrence in the future.

We hope that the contents discussed in this paper will be helpful for equivalent project managers who will experience parallel and multiple development projects.

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Redefining Project Management – A Design Thinking Approach

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Project management practices have always been a struggle around the triple constraints (Time – Cost – Quality). The intention still remains the same - to manage the project with limited resources within a defined timeline and achieve a 'reasonable' quality. There has always been a concept of some standard practice which doesn't suffice when it comes to some out of the box issues and it needs to be solved by some innovative and creative execution approach. What is important here is to realize that there will always be some issues beyond the boundaries of the established rules that cannot be solved by standard practices. When there exists no straight forward solution to a consistent problem, the need for creative thinking comes into the picture. A major change in the project management philosophy would be to shift from a requirement based plan and delivery approach to a fresh and new design thinking approach which makes a significant difference. The change is towards exploring the possibilities to improve the deliverables by considering usability, the end result and how customer is benefitted by the deliverables. Sometimes customer doesn't or is not able to explicitly highlight the requirements. So reading between the lines becomes very important. Also, it's crucial to understand the impact that the deliverables have on customer's business. The approach goes like – Explore, Analyze, Ideate, Verify, Execute. The failure of one innovative idea should not impact the implementation of the future ones. That is to say the confidence for implementing ideas in the future should not go down, due to failure of a past idea.

Keywords and phrases: Project Management, Quality Consciousness, Design Thinking, Requirement Evangelism, Agile

1. Introduction

Starting from the advent of the Information Technology business, project management has been a key to deliver the desired result by leveraging the key tools and techniques. The challenge has always been to manage the project with limited resources like Time, Budget, Human Resource, Hardware etc. The project management process has evolved over a period of time to accommodate the changing environment, changing client philosophy, their business goals and the market itself. Needless to mention, it also impacts the way projects need to be executed in the industry.

When we talk about Japan, IT is a bit different compare to the same in other parts of the world. It has never been easy to formulate the way IT project should be executed in Japan in comparison to the rest of the world. The key reason is probably the difference in mindset and the perception about how the IT project is executed. The mind set and the process in ICT area in Japan have evolved mainly from the manufacturing industry. Incidentally there is a philosophical difference in how things work in IT industry as compared to the manufacturing industry.

It becomes obvious that project in Japan will be delivered keeping the customer's need in mind. It's very common that the IT team will think about what customer may need to meet their business needs by leveraging the IT system. On majority of times the explicit demands are not jotted down and it is assumed that the project team will explore such possibilities later. This is an approach which can ensure the best result are being delivered, however, it is not straight forward to deliver the project within constraints.

The gap is magnified specially in offshore – onshore model where the clients are in Japan and the execution mainly happens outside Japan. In the following areas we will try to address the key areas and a probable approach to minimize the gaps and find out a creative way improve the project management in IT.

2. Challenges faced in traditional Project Management approach

If we try to nail down the key challenges in IT project management in Japan, especially in onshore –offshore model, they would be as follows.

2.1 Requirements

Detailed requirements are not always known. It's assumed the team will explore all possibilities to make it better.

2.2 End Product validation

Simply developing what has been asked by the customer, may not solve the business problem. The final goal is to make a positive difference to client business by leveraging the IT product. So it becomes important to validate the project deliverable if it's aligned to business goal.

2.3 Preemptive Approach

It is important to propose what should be done rather asking what needs to be done. Client may not always be able to highlight the explicit requirement. It becomes difficult to deliver as per customer expectation.

2.4 Lack of strong reference

In many cases the project is mostly based on a vague idea, not driven by a strong reference. It becomes difficult to validate the deliverable against any reference data.

2.5 Design Finalization

Freezing design in one go becomes impossible if the requirement is fluid. The design goes through multiple iterations as the requirement get evolved.

2.6 Prototype Driven

It is essential to create a prototype and develop it further to reach the finally acceptable solution.

2.7 Process Design

Predefined process definition for execution becomes difficult. The milestones and its acceptance criteria may not be well defined in advance. Traditional process may not be able to control the fluid development and reach the desired state.

This implies that Traditional project management methodologies may be inadequate to solve many issues which demand further creativity.

3. Change in Quality Consciousness

The term 'Quality' has been a 'myth' in the industry for long. It has never been easy to define an absolute quality benchmark. In layman words, probably the simplest definition is 'to deliver what is expected'.

The 'expectation' and 'meeting the expectation' may be relative and practically there may always be a gap.

For example, 'Japanese Quality' is a benchmark which simply means 'Customer Satisfaction' and there is no perfect way to define a boundary to measure the satisfaction.

There are standard quality matrixes which are being followed in any project management methodology. The execution is planned and each development is measured according to the matrices.

In case there is no concreate execution methodology and it's not possible to bind the development to a well-established methodology, there is always a conflict between a good plan and how to develop what is best for the customer based on that plan, considering the fact that change is inevitable.

4. Understanding The Gap – expected vs reality

It becomes essential to understand the gap before jumping to recommend a more creative approach. If we do an analysis, apparently the most prominent areas which come out are –

- Lack well defined requirements
- Read between lines - always a challenge
- Continuous change in requirements
- Ad-hoc planning
- Gold plating - a norm
- Manage it somehow – philosophy
- Understanding customer is always a challenge (language, mindset, way of working etc.)
- There is always a gap (between key stakeholders) that needs to be bridged
- Distributed model (onshore-offshore) is always a challenge

5. Changing Trend – Away from traditional Approach

The Information technology trend is ever-changing along with the change in technology capabilities and more human centric expectation from a system. If we try to summarize the key changes, those will be as follows –

- During the ideation phase of product or solution, participation of Domain expert is imperative to capture user perspective therefore requirement evangelism is also very important. It becomes essential to understand the user's business and translate the business goal with user's requirement. The idea is to evolve the requirement, rather asking the requirement. This way the deliverable will be more close to what the user may desire. This may give a better chance for meeting the user expectation.
- Unlike services where the exit criteria are known before hand, in case of product development (where new features get added frequently) or

solutions designing ETVX criteria/toll gate/stage gate cannot be applied since requirement is not known. There needs to be upstream quality measures which is important for a comprehensive quality assurance.

- Then addition of any new feature at a later stage can cause regression and degradation issues which can impact the quality. However, it's a common trend and it will happen. So there needs to be a creative approach deduced to address the changes and also ensure the quality adherence.

6. Value proposition – key components

The key value proposition in IT project management will require more than just following the processes. The key components would be as follows.

- Solutioning & consulting for customers
- Enterprise level techno-functional knowledge
- Domain knowledge (Retail, IT, Telecom, Finance etc.)
- Awareness of emerging technologies and industry trend
- Client requirement evangelism techniques

7. Adopting Design Thinking Approach – Way forward

Needless to mention, it is necessary to re-think in a different way to come up with a better way of working. If we try to summarize the approach it will be broadly like -

- Evangelize the requirements/Early Engagement
- Adopt Agile methodology/iterate – work together
- Be flexible to accommodate changes
- Bridge the gap - coordinate key stakeholders toward the common goal
- Collaborate with client, explore, analyze, ideate, verify and execute together

8. A creative thinking approach

When there is no straight forward solution to a consistent problem, the need for creative thinking comes into the picture.

Ideally, there are 3 approaches which prevail. These approaches are –

a) Problem solving approach
The focus here is driven by the problems that occur as opposed to proactive approach. This is the most traditional and most common
b) Out of the box approach
Here problems that occur are solved with an indirect and creative approach. The traditional best practices may not be able to deduce logic from this approach.
c) Design thinking approach
It is an amalgamation of the set practices and imagination and reasoning. Here both the logic and imagination are put to use.

The creative thinking methodologies adopt the flexible approaches to address the changing scenarios and fine-tune the approaches runtime.

8.1 Problem solving approach

The problem solving approach is used when the analysis of the process that is being implemented or the skill set of people implementing the fixes, reveals that while the PM primarily focusses on technical aspect of the project, what he misses most of the times is that the business process being implemented is not revised as per the changing needs.

The application of problem solving approach results in successful projects that include process assessment and organization change management.

The focus changes to achieve the business objective rather than just completing the project.

8.2 Out of the box approach

The out-of-the-box approach is required when vertical thinking has nothing to offer. All the improvements to be made are at the optimum level.

The need of an in-depth research becomes significant in narrowing down an execution approach.

Below are few examples of evangelism

- Product Research
  Scrutinizing, auditing, and understanding existing products, both competitive and adjacent.
- Organizational Research
  Understanding stakeholder goals, assumptions, and values; uncovering potential synergies.
- User Research
  Identifying user needs and pain points, validating hypotheses, discovering new opportunities, and determining priorities.
- Technical Analysis
  Exploring existing or proposed technical dependencies, identifying potential solutions, and providing recommendations.

• Design Exploration
Sketching and prototyping user interface alternatives; exploring aesthetic directions.
• Project Planning
Estimating and strategizing the most efficient delivery plan; including team size and make up, phasing, and release schedules.

8.3 Design Thinking Approach

A major change in the project management philosophy is to shift from a requirement based plan and delivery approach to a fresh, new design thinking approach which makes a significant difference.

The approach goes broadly like this –

Figure 1 Design thinking Approach

a) Explore
Since we do not know business problem and business process, the traditional requirement gathering does not work out.
It is essential to learn about the people and context of the problem from user's view point.

b) Analyze
It is important to synthesize the learning and categorize challenges at hand.
Categorize the problem and translate high end business problems into tangible technical specifications.

c) Ideate
It is almost impossible to create end-to-end solution based on such technical specifications. So we design solution, make ideas real and repeat as needed.

d) Verify
Once we have a prototype, we can test ideas as actual users, we come to know about the gaps between the prototype obtained and actual ideas we had initially.

e) Execute
Continuously improve the prototype based on continuous test results and gap analysis.

9. Adopting Design Thinking Approach – Way forward

The adoption of the approach is critical. It is not just following few steps since it's not guided by any predefined process. It's all about absorbing the philosophy of ideating and delivering. The below image depicts an approach which must be customized for adoption on case to case basis –

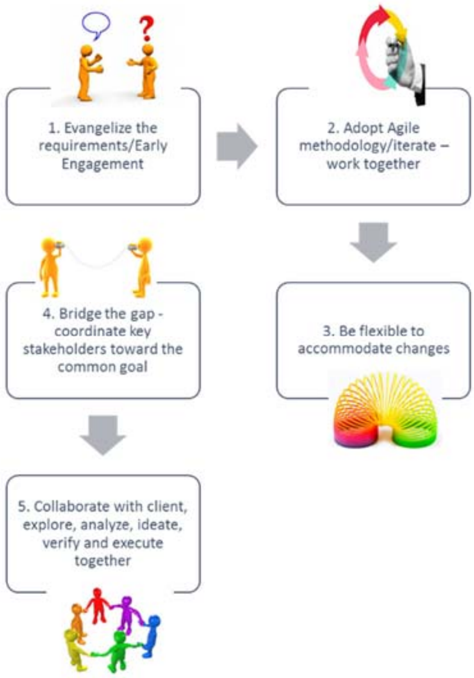

Figure 2 Adoption of Design thinking Approach

10. How it is different from Agile

Eventually the Design thinking approach encompasses agile methodology. We would like to start with the following understanding while trying to differentiate Design Thinking Approach from Agile –

- There is no conflict between Design Thinking approach & Agile methodology
- The key is the mind-set to deliver a creative solution
- Both are built on similar core principles, allowing the two to overlap, intermingle and apply in almost any context
- Design Thinking can be performed in an Agile manner and Agile can be executed using Design Thinking mind set/tactics

Still we are to trying to spot the thin line which must be highlighted here.

Design Thinking is an exploratory approach to uncover the needs and come up with creative solutions to meet those needs.

It advocates to build concepts and test the ideas and roll them out.

On the other hand, once the solution is determined, Agile can be used to build it. Agile is all about delivering solutions. And it overlaps perfectly with the prototyping stage of Design Thinking.

The Key Principles of design thinking would be as following –

- Human-First / People Over Process
- Creativity / Innovation
- Iteration / Prototyping / Adaptation
- Multi-discipline autonomous teams

11. Adoption of Design Thinking is distributed project management

It is a popular belief that Design Thinking is only applicable in innovation project. Design thinking always focuses on creating the product with more user centricity and considering the human factors. It always tries to deliver a solution to solve the business problems in a better manner.

Let us understand the context of distributed project management and why adoption of design thinking approach is critical here.

A typical project can be distributed in multiple geographies consisting of diverse teams. The common problems which occur are –

- Communication – The most critical part is to manage the project in distributed fashion. It is important to bridge the communication gap on what needs to be done, who is going to do that and how to integrate.
- Cultural Gap – It's obvious especially in onshore-offshore model like Japan – India. The way of working itself differs (as we have already mentioned earlier in this paper).
- Integration – There will be integration issues while collating the output from different teams and aligning it towards the common goal.
- Manage team dynamics – This is important since different teams work in different ways and the productivity also varies based on the specific team dynamics.

The impact is obvious when a project is executed in distributed manner resulting in quality degradation, delay in deliverables and overall productivity and tracking issue.

Having discussed the above issues, a typical project delivery which is planned in distributed way, adoption of design thinking always helps to control the iteration and deliver it better.

Let us take a typical distributed agile project (we are ruling out the waterfall model in distribution method) that uses Scrum method. The product backlog is created based on early analysis. It is followed by a pre-defined set of sprints where every sprint starts with sprint planning, execution and retrospection. The project is executed in distributed agile fashion and there are multiple scrum teams that work towards the delivery.

Let us understand how the design thinking approach helps in each phase and gives a better result.

11.1 Creating a product back log

A cross-functional team is involved to evolve the requirement which is best fit in the context. It would be more proactive to re-verify the specification over each iteration to check if the development is aligned to the need of the context which itself may be changing.

11.2 Engage key stakeholders

It is important to engage the key stakeholders as part of the cross-functional team. If it is a distributed project, the best representatives from the teams should be aligned and contribute to the common project goal.

11.3 Verify at the end of each iteration

Ideally Agile advocates to verify the continuous improvement. It is also important to adopt a design thinking approach in each cycle if the progress is aligned with the ultimate goal of the product/service. Also, it is possible that the backlog may be improved along with changing requirement during the project. We should welcome the changes and be flexible to adopt the changes for the betterment of the business goal.

11.4 Focus on domain/technology trend

Agile will become obvious choice of project execution and engineers with no idea of business, latest technology, domain and user perspective would vanish gradually (Hard work by engineers only shall not suffice). Any IT project development will be human centric, customer centric and driven by domain expert.

The technology trend itself is changing so adoption of design thinking approach in driving the project towards the goal becomes more critical.

12. Key Criteria for success of Design Thinking Approach in project management

While we talk about adoption of design thinking approach in project management, we need to understand the challenges of the traditional thought of project management practises. It is not easy to shift from a well-defined process oriented approach to comparatively an open ended, ideation and prototype based approach.

The journey is not going to be easy until and unless there is an adoption of certain critical points.

Precisely, if we try to nail down the key success criteria which would be critical, they would be like –

- Challenge the traditional thought
- Right mind-set to think beyond
- Flexibility to adopt changes
- The attitude to collaborate
- Openness to welcome different opinions
- Be user centric
- Never-settle philosophy

13. Conclusion

It is important for the project managers to understand that not all creative ideas put to use will reap the same successful results.

The confidence for implementing ideas in the future should not go down, due to failure of an old one.

The need is to move over unnecessary data analysis. Organizations are designed for stability and control, and are obsessed with analysis. This culture also gets embedded into project managers. However, there is a limit to logical analysis and project manager should know when to move into intuition and creative thinking instead of endless data crunching.

Also here the sensitization that innovation does not necessarily mean big and complex ideas. Successful implementation of even a trivial idea can fetch big results.

Project managers need to move beyond their accepted comfort level to take up projects that belong to different domains with different technologies, with different teams in different environments. This in turn will stimulate creative thinking.

The KPIs for instance should include the innovation and creativity parameter.

Project managers do not necessarily have to be geniuses to come up with creative solutions to tackle the day to day challenges. The also do not have to be dependent on expensive strategy and innovation consultancy each time they are stuck in a daunting challenge.

Improvement and innovation is a continuous process. We would like to do more research on this topic and take inputs from industry experts to improve our findings.

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Study of Management to Improve R&D Efficiency at the National Level

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Japan possesses scant natural resources, and has maintained and enhanced its global competitiveness by strengthening technological capabilities. From this perspective, continuous implementation of R&D is an indispensable element for maintaining national strength. Through public support institutions and other channels, the government plays a key role in Japan's R&D development. That being the case, the question of how to efficiently conduct R&D as a nation has become critical. Under such circumstances, appropriately promoting management to improve R&D efficiency at the national level by involving public institutions is extremely important. In this paper, research has been made on management at the national level by examining the situations of R&D support by a specific public institution. Selection and concentration is being performed at the national level by way of the involvement of public institutions in the R&D process. This means the effective use of resources related to R&D in Japan, and the function that the public institution fulfills to improve R&D efficiency at the national level has been confirmed.

Keywords and phrases: R&D, Selection, National Eco-System, Innovation, Management

1. Introduction

Japan possesses scant natural resources, and has maintained and enhanced its global competitiveness by increasing its national strength through technological prowess. It enacted the Science and Technology Basic Law, under which the central government is responsible for formulating and implementing comprehensive policies for the promotion of science and technology, and every five years the government formulates a Science and Technology Basic Plan. The five-year plan from 2016 has been prepared as the 5th Science and Technology Basic Plan. Under the plan, the government will promote the enhancement of "science, technology and innovation measures", and encourage a broad spectrum of parties, including the government, academia, industry, and citizens, to work together to lead Japan into "the most innovation-friendly country in the world" according to a Cabinet decision, 2016.

From this perspective, continuous implementation of R&D is an indispensable element for maintaining national strength. Driven by the significant progress in information technology, technological developments are advancing at an unprecedented pace. Amidst this change, a decline in the efficiency of Japan's R&D has been noted by METI (Ministry of Economy, Trade and Industry) and Mizuho Research Institute. Despite the tremendous impact that R&D results have on a country's future, this decline in R&D efficiency has stirred considerable disquietude regarding Japan's future. That being the case, the question of how to efficiently conduct R&D as a nation has become critical (Kubo et al, 2016, Nakamura, 2014, Yamazaki et al, 2006, 2014).

Through public support institutions and other channels, the government plays a key role in Japan's R&D development. It is viewed as performing a vital function from the standpoint of efficient resource allocation as a nation as well, and can be said to create the situations that might be referred to as the National Eco-System. That is, the government selects and concentrates R&D at the national level by identifying and aiding, from among the broad range of R&D, superior projects that show strong promise for the future. Of course, excellent projects are being chosen at the level of individual firms as well, which use their own methods (Cooper, 2011). Such R&D, however, naturally is kept controlled within each firm. As a result, there is a possibility R&D on a similar theme is being pursued concurrently by several firms without any coordination. Moreover, there also is a possibility R&D that compares unfavorably with other companies from a technical or economic efficiency aspect is being conducted as well. From the viewpoint of competition, of course, it is true a situation in which multiple firms are working simultaneously on similar projects is preferable in some respects. There are thought to be many situations, however, in which several firms cooperating to implement R&D, or the most capable firm implementing said R&D and other firms allocating their resources to other themes, would be preferable if viewed from the national level.

In this context, we investigated specifically what position NEDO (New Energy and Industrial Technology Development Organization), Japan's national R&D support institution, should occupy within the National Eco-System. Based on this, the role public institutions fulfill is discussed from the viewpoint of improving R&D efficiency at the national level. Finally, we examined whether management is being provided that enables the National Eco-System to function effectively within the framework of the country as a whole.

2. R&D support from NEDO

NEDO's FY2016 budget is 129.8 billion yen, which shows the rough scale of NEDO's activities in a sense. While Japan's R&D-related government budget is 3.5 trillion yen (FY2015), roughly 70% of this amount, or 2.47 trillion yen flows to universities and national R&D institutions. Then, NEDO and other Funding Agencies use the remaining amount, about 1.0 trillion yen, to assist private sector firms and other organizations (JST, 2016). In that sense, it can be said that NEDO's budget of approximately 130 billion yen, which we examine in this paper, is never small as a share of funding agencies nationwide.

2.1 Representative Funding Agencies in Japan

The following section touches briefly on several representative funding agencies in Japan.

(1) NEDO (New Energy and Industrial Technology Development Organization)

NEDO mobilizes the wisdom of industries, universities, and governments to implement activities that will help solve energy and global environmental problems and enhance the competitiveness of industrial technologies, while taking advantage of international networks. In particular, for important industrial technologies, NEDO develops as national projects common basic technologies, which firms are unable to bring to practical application without public support because of the high risk, and provides competitive funding.

(2) JST (Japan Science and Technology Agency)

As one of the core institutions responsible for implementation of the Science and Technology Basic Plan, JST implements activities to contribute to the creation of innovations in science and technology. Projects that form the core of its funding efforts promote issues-oriented basic research aimed at achieving the strategic targets set by the government, with the goal of creating innovative technology seeds that will lead to innovations in science and technology.

(3) JSPS (The Japan Society for the Promotion of Science)

As the core organization responsible for the promotion of learning in Japan, JSPS provides funds to award academic research grants and train researchers, and implements activities such as the promotion of international learning collaboration. Grants-in-Aid for Scientific Research, which form the core of JSPS's funding, cover the full spectrum of the humanities, social sciences, and natural sciences, and are intended to greatly develop all "academic research", from pure research to applications.

(4) AMED (Japan Agency for Medical Research and Development)

The new Japan Agency for Medical Research and Development was established with several objectives. These include conducting research and development in the field of medicine, establishing and maintaining an environment for this R&D, and providing funding. The agency will promote integrated medical R&D from basic research to practical applications, to smoothly achieve the application of outcomes, and work to comprehensively and effectively establish and maintain an environment for R&D in the medical care sector.

3. Discussion of the functions of a public institution (NEDO)

Support from NEDO for R&D in the industrial sector is broadly divided into two areas as follows.

- National Projects: For national projects, firms or other entities with capabilities for conducting R&D are selected and the players decided through public solicitation.
- Firm-led projects: There are two types of projects, for which firms or other entities are the lead entity: projects for which the issues are set by the government and the players decided by solicitation, and projects for which firms propose the themes and the firms are examined for the eligibility of public support.

Table 1 NEDO's Public Solicitation-type Programs

	Grant period (Years)	Grant ratio	Grant amount (mil. yen)	No. selected	No. of applications	Selection rate
New Energy and Environmental Technologies Guidance Program	1	1	100	66	298	22.10%
Strategic Innovation Program for Energy Conservation Technologies	2~3	1/2~2/3	1000	89	193	46.10%
Support for research and development ventures	2	0.85	70	19	47	40.40%
Development Support Project for Practical Application of Problem-Solving Welfare Equipment, etc.	3	2/3	60	11	67	16.40%
Technology Development Project for Commercialization and Practical Application of Robot	3	2/3	250	21	35	60.00%
New Energy Venture Business Technology Innovation Program	1	2/3	50	38	209	18.20%
Innovation Promotion Activity/Nanotech Advanced Component Utilization Research and Development	5(3+3)	2/3~1	200	78	647	12.10%
Innovation Promotion Activities	2(+1)	1/3~1/2	100	401	1140	35.20%
Water Conservation and Environmentally Harmonized Water Recycling Project	5	1	1120	16	36	44.40%
IT Integration-based New Social System Development and Demonstration Projects	2	2/3	300	16	61	26.20%
Total				755	2733	27.60%

For R&D support from NEDO, projects always go through the process of public solicitation and are selected at the stage when approved for public support by NEDO. The players and target themes eligible for support are narrowed down as a result. After selection, projects receive public support for periods ranging from about one to five years.

The fact NEDO projects have several preferable points has been noted (Kato et al, 2016). One is that when an entity receives NEDO support, it can form a team with other firms, universities, and other organizations with which it normally would have difficulty working as partners. According to the interviews with players for NEDO projects, NEDO management to coordinate among such partners of different backgrounds is highly appreciated.

In recent years, NEDO has been conducting follow-up monitoring of National Projects. These evaluations monitor how projects are being administered at firms after NEDO has ended its support. The continuation or discontinuation status of projects after NEDO has terminated support has been clarified as a result.

Here, we investigate the function of the National Eco-System by examining the selection process by NEDO and the results of publicly supported projects at the later stage. Ideally, for projects in the same project group it would be desirable to examine the status of projects at the stage when they are selected for NEDO support, then confirm the status at a later stage after NEDO's support for the group has ended. Unfortunately, however, such information is not released publicly. Consequently, we have used the project selection rate for the theme solicitation-type programs at the stage when selected for NEDO support, and the National Project follow-up monitoring results at the stage when NEDO support has ended, based on available information open to the public.

Table 1, created by the authours by summarizing information of reports issued by NEDO, shows the programs for which interim appraisals were implemented and the system for which post-project evaluations were implemented as institutional assessments at NEDO from FY2014 to FY2016. These programs solicited themes conforming to certain goals to be achieved in each framework and then, through a selection process conducted by specialists, selected themes to be placed on the short list eligible for support from among the themes submitted. As can be seen in Table 1, the selection rate (=number selected/ number of applications) for each system varied widely between 12.1% and 60.0%; when the results are summarized and averaged, the selection rate came to 27.6%. This means that at the solicitation stage, which is when projects are selected to receive a public institution's support, 27.6% were selected by third-party examination. Of course, the possibility of a theme with future potential not being selected because of budget restrictions or other reasons cannot be dismissed. Still, what is significant is the fact that themes and players with prospects from a technological and economic point of view are selected at this stage. That is, such promising projects will be supported, but on the other hand, other players that had hoped to be involved in these projects will turn their important human capital and financial resources to other themes. For society as a whole, this is both extremely important and desirable.

Ideally, it would be best if information on projects that received support under these systems could be obtained afterwards. However, with certain exceptions, such information is not made public as noted above (In the New Energy Venture Business Technology Innovation Program (2014), the rate of conversion to practical application after NEDO support is 30%; for Innovation Promotion Activities (2014), the rate of conversion to practical application is 32.7%). Consequently, although the groups differ, for National Projects that received NEDO support in a similar way we used the follow-up monitoring results that have been publicly released. These results are shown in Figure 1. According to this, 22% of the projects that received support ultimately discontinued R&D for various reasons, such as no expectations of future results, after NEDO had terminated support. In addition, 5% of the projects were discontinued after five years. That is, 27% of the projects were weeded out after going through the process of receiving NEDO support. This means 73% of the projects that were eligible for support were continuing five years after NEDO terminated support. Thus, it is possible to claim that more efficient R&D for Japan as a whole has been achieved as the result of public institution intervention. Moreover, these circumstances mean it is possible to claim the National Eco-System is functioning effectively. Figure 2 shows these circumstances schematically. Furthermore, the practical application ratio for these National projects after five years is 25% (large enterprises: 24%; small and medium-sized enterprises and venture businesses: 31%), a result that is not vastly different from the

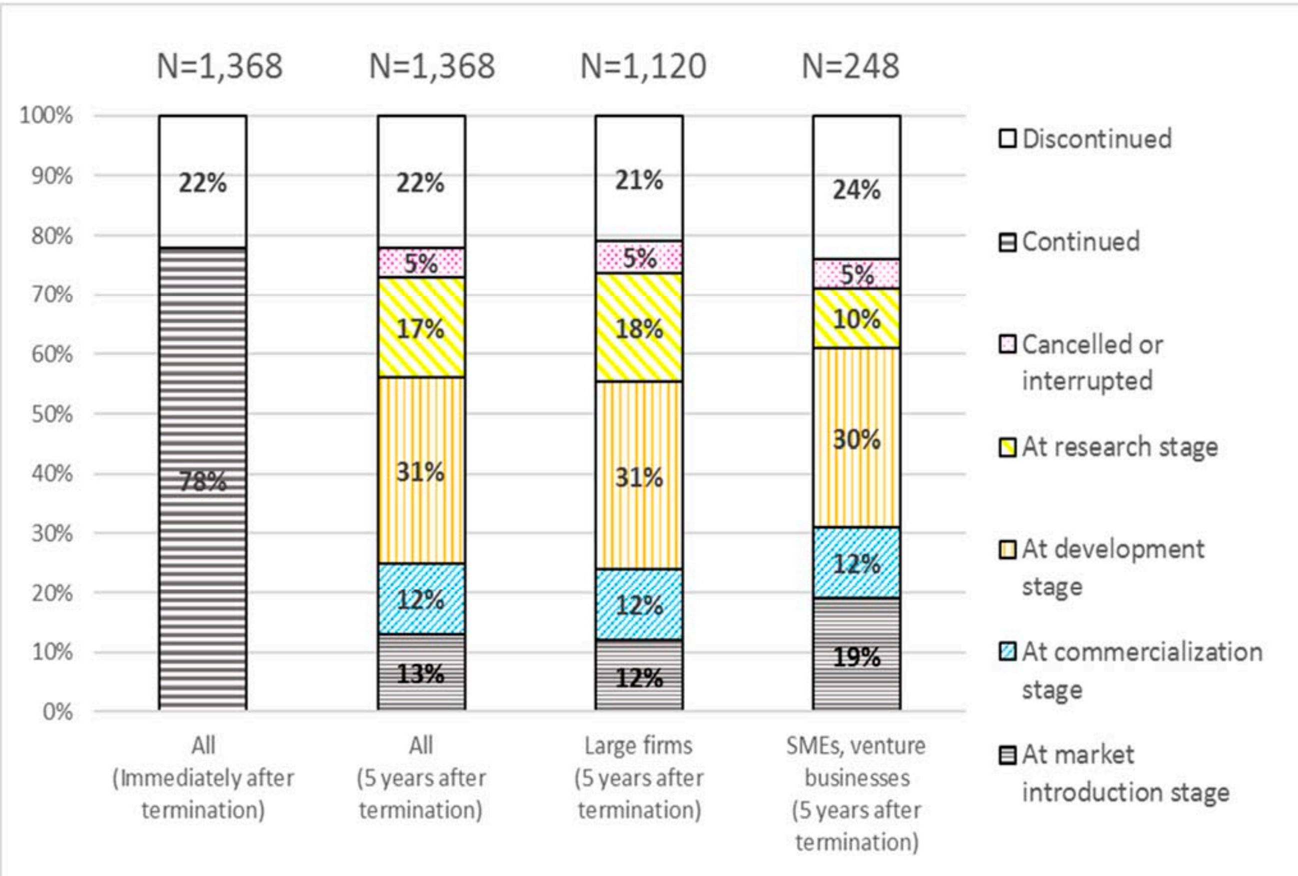

Figure 1 Project status after termination of support (NEDO)

roughly 30% for theme solicitation-type projects.

4. Conclusion

To summarize the above, when an entity receives NEDO support, it can form a team with other firms, universities, and other organizations with which it normally would have difficulty working as partners. As a result, Japan is able to optimize the composition of teams at the National level, and achieve proper use of domestic resources. Furthermore, because of public institution involvement, R&D to be supported is narrowed down to 27.6% of all solicited projects at the stage when selected for public institution support, and then, the selected projects that are further brushed up by receiving the public institution's support are narrowed down to 73% five years after the end of public support, as a result of factors such as obtaining professional advice. While the decision of whether to continue the R&D will be made internally by the firm after the institutional project support is terminated, this decision can be expected to be accelerated because of the previous public institution support.

Therefore, selection and concentration is being performed at the National level because of public institutions being involved in the R&D process. As a result, as described earlier, players such as firms that are not selected for support from a public institution can allocate resources to other projects.

Thus, it has been confirmed that the effective use of resources at the national level and accelerated decision-making can be achieved by involving public institutions, and that the National Eco-System is being managed to function effectively.

5. Future Issues

In this paper, it can be confirmed that the National Eco-System is functioning effectively as the result of public institution involvement. As already noted, however, the same group was not monitored from the stage when selected for NEDO support to the stage when NEDO support ended. Groups of different project types are viewed as being the same. A better approach would be to verify results within the same group, provided the data are available.

Moreover, in this paper we chose the example of NEDO as a public institution. Deeper research on the orientation of active management of R&D efficiency improvement at the national level is desirable in the future. This would be realized by accumulating examples from Ministry of Education, Culture, Sports, Science and Technology-affiliate JST and other institutions. Based on such additional research, the situation of the National Eco-system concerning R&D would be understood in more detail, which would help realize more efficient R&D at the National level.

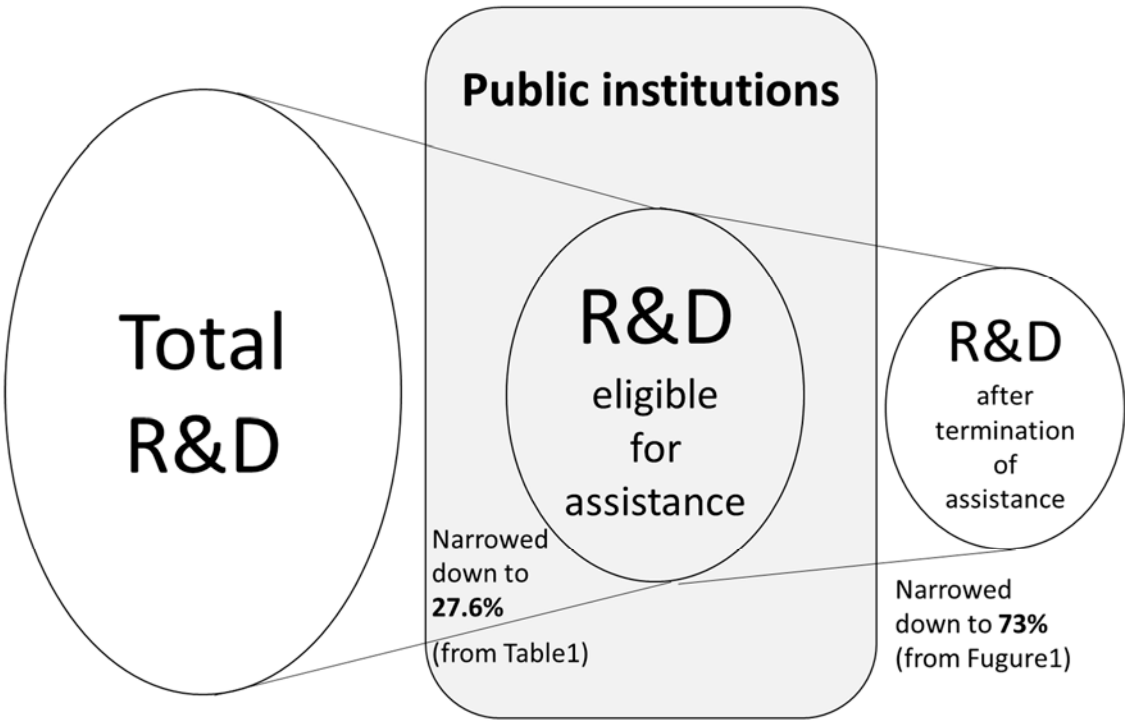

Figure 2 National Eco-System

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Project Monitoring for Detecting the Changing Tide of Baseline to Prevent the Occurrence of Unprofitable Projects

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In the information system construction project, various large and small changes from the baseline occur during project execution due to the increase in sophistication and complication of system requirements. Especially, it is important to capture the changes that are large or difficult to solve such as the foundation of the project and take appropriate measures as soon as possible. These large or difficult changes can be regarded as the turn of the tide in the project. If the detection of the tide or countermeasures are delayed, the adverse effects on the project will increase, then time and cost required for recovery will also increase. We created the check sheet that organizes viewpoints based on signs of past tides to detect the current tide. Additionally, we devised "analysis and resolution map" for reviewing countermeasures against the tide and recording the execution results of countermeasures. The efforts to regularly and systematically monitor events related to tides in the project and efficiently consider measures and carry out implementation and effect confirmation are introduced by this paper. It is possible to solve the problem caused by the change of the tide with the customer even in the high difficulty project and prevent the occurrence of unprofitable projects by these monitoring efforts.

Keywords and phrases: Project Monitoring, Project Baseline Management, Changing Tide, Quantitative Analysis, Qualitative Analysis

1. Introduction

In the information system construction project, it is not easy to make a project success as planned. As the daily project management method, the gap between the project plan and actual work performance is often occurred during processing the upper phase with customer. It is important to capture the problem that has not become obvious yet and the progress of project correctly in order to catch the gap from the plan and the problem that should not be left out (IPA, 2007).

In PMBOK guide, this gap analysis is defined as Monitor and Control Project Work. We check the actual work to make sure that it is indeed going to plan. And if it isn't (i.e. gap exists), it is necessary to either change plan or recover work delay as Figure 1. At this time, the project baselines such as a scope baseline, a schedule baseline and a cost performance baseline are used as criteria of the gap analysis. A lot of technical method and tools exist for this kind of management.

However, even if this monitoring and controlling processes with those multiple baselines are performed correctly, a project is not necessarily certainly successful. This project monitoring and controlling works are able to be realized under the status that the project baseline itself was defined firmly and stable. Conversely, if the project baseline is unstable or changes frequently, this monitoring and controlling processes itself will not be materialized properly.

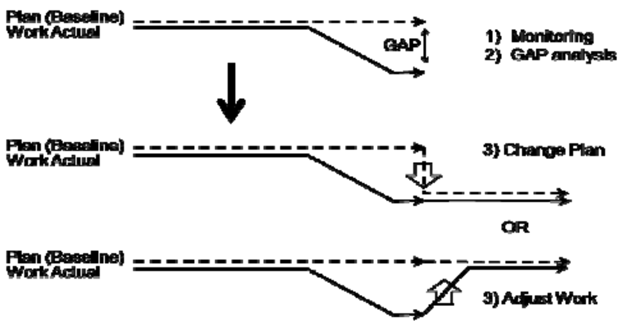

Figure 1 Project monitoring and controlling process

It is very important for the success of the project to catch up the project baseline instability and signs of change and correct them to the proper form. A lot of signs which affect to change the project baseline are existed out of daily project monitoring and controlling process. This paper shows those factor and signs.

We define the sign of turning point which changes the project baseline unstable as the "project tide" and we have considered that the project tide monitoring is effective in preventing failure projects.

In this article, the methodology to monitor and catch up the tide of projects and the countermeasures by organization level are introduced. In addition, some effective tools for monitoring have been developed and this paper introduces them.

2. Project baseline agreement and change management

It should be considered why the baseline of project might be changed or unstable. At first, precondition of project baseline is important. Both project management plan and baselines are existed on some preconditions. Those preconditions consist of two kinds, ones of them are explicit conditions and others are un-explicit conditions. Explicit conditions are functional scope, timeline, cost, human resources headcount, and so on. They are quantifiable and project manager can grasp several changes of them mechanically. On the other hand, un-explicit conditions are human relations, policy, strategy, restriction, cooperative attitude, motivation and so on. They cannot be defined quantitatively and just assumed inside though. Moreover some of them might differ among persons based of them standard of past experience or common sense.

There are quantitative approaches, qualitative approaches, and comprehensive approaches as approaches to realizing project visualization (IPA, 2008). We analyzed the cause of failure of past projects with these approaches. Analysis of past failure IT system project showed that various preconditions of project baseline were changed gradually in most projects and as a result the baseline was collapsing itself. In failure project, many un-explicit preconditions were different from assumptions at the start of the planned project without even noticing and the difference can lead to the collapse of the project baseline.

When the baseline is unstable or collapsed, even if we analyze the GAP between baseline and actual work as daily project monitoring and controlling process, it will not help to success the project because that is meaningless GAP and it differs from the actual project condition as Figure 2.

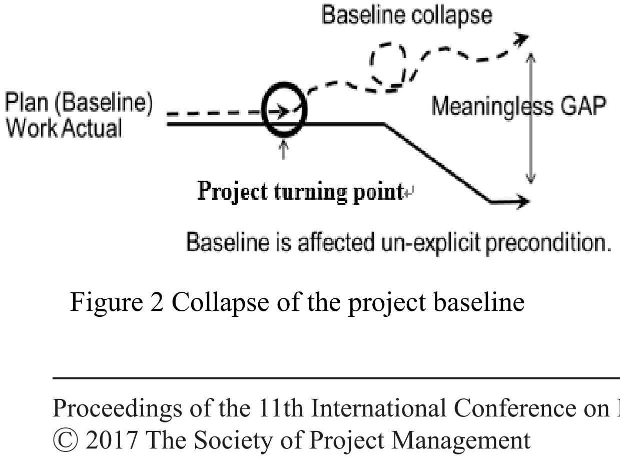

Figure 2 Collapse of the project baseline

Therefore, when the sign of the project turning point (i.e. project tide) occurs, it is necessary to take countermeasures to re-decide and be stable the project baseline. However, since IT system project activities are carrying out by not machinery but human power, it greatly depends on human skills and experience. Especially to catch up the sign to make baseline unstable by changing the un-explicit precondition is difficult from daily monitoring and controlling process. Then it is important to check whether the project changing tide of baseline is coming or not.

We extracted the factors should be caught up that make significant influence to the IT system project from the past failure experience and knowledge as the project tide factor. In order to catch up the project turning point (i.e. signs of tide), it should be consider the following tide factors and conditions.

- Factors: Un-explicit elements and viewpoints required to catch up the project turning point.
- Conditions: When status and matters are monitored, should it regard as signs of significant tide.

These were systematically arranged from the past failure experience and knowledge. Cooperate between project internal members and the cross-sectional PMO which are external organizations from project, it is performed the project tide monitoring, catching up and taking countermeasures methodology.

3. Project tide factors and conditions

By analyzing the past failure project, the following five categories of un-explicit precondition items which have big influence to the project baseline were shown as the project tide factors in upstream phases.

(1) Project Object and Policy
(2) Project Promotion and Management Policy
(3) System Realization Policy
(4) End user Cooperation
(5) Work responsibility compliance

Moreover, condition of communication is also important factor as the degree of top management participation, stable holding of steering meeting to be able to take company or organization level decision making and consensus building with minutes and documentation.

It is needed to monitored and checked what kind of condition has occurred to above factors, and defined as a significant tide condition what change may generate as the precondition which has big influence on a baseline.

3.1 Project Object and Policy

When the corporate or organization management has change and the object or policy of IT system investment and project object and policy change, the realization level of system or function must be change. Moreover, since the priority of project matter changes, it is subject to very big influence to project baseline.

The significant tide condition is found by following factors;

- The officer or project owner who have influence to IT system project changed by staff reassignment.
- The management plan of a company changed to influence to IT investment plan.

In those cases, following countermeasures should be taken.

- Check the project scope to match to new policy or object or not.
- Re-plan the scope baseline to fit to new policy of IT system investment.

3.2 Project Promotion and Management Policy

Headcount and mandate of project management are based on assumption of usual volume of project promotion and management tasks. If it is deeper or more detailed than assumption, it will be lack of mandate and schedule delay and collapse the management itself.

The significant tide condition is found by following factors;

- Customer or project owner require a lot of reports or documents not defined as project deliverables.
- Customer or project owner require a lot of meetings or review sessions.
- Customer or project owner require deeper descriptions for each document.
- Higher rank manager, middle manager or consultants who are not assumed appear and demand their own management of project promotion policy.

In those cases, following countermeasures should be taken.

- Estimate mandate and headcount according to the required level of project management and promotion policy.
- Re-plan the cost and schedule baseline based of new estimation.

3.3 System Realization Policy

The project organization and skill set of human resources are planned based on the realization policy that assumed first. If the realization policy changed by change requirements and requires skillset was also changed,

It shall be must be difficult to continue by current project organization even if enough mandate and headcounts are given.

The significant tide condition is found by following factors;

- System realization policy change from AS-IS based realization to TO-BE based. (or opposite change)
- It required reverse engineering to analyze legacy system program source because of lack of specification document of the legacy function.
- It drastically increases the add-on functions for package SI solution.
- It changed the hardware, middleware, OS or network infrastructures to need special skill set.

In those cases, following countermeasures should be taken.

- Check the proper project organization and skillset for new policy.
- Re-plan the organization and concerned baselines.

3.4 End user Cooperation

Although it assumes that an end user cooperates in each tasks of the project, when the cooperation degree and speed of decision-making, and the physical degree of participation differ from assumption, it not only has influence on progress but there is a bad influence to make consensus with them. At the worst case, a determination matter might be reversed at a later process by other person.

The significant tide condition is found by following factors;

- There are fewer times of meeting or work sessions than planned. Otherwise, attendees don’t have enough skill, knowledge or authority.
- There is any user who performs power harassment utterance.
- There is any user who does not keep his promise or due date.
- There is any user who express a negative opinion to the project.
- Requirements and specification change frequently based of temporary utterances.
- Required documents, such as legacy system specifications are not given or those are insufficient and deficient.
- The end user assignment is changed and

knowledge transfer is not enough.

In those cases, following countermeasures should be taken.

- Point out to an end user management or at steering committee, and request to improve.
- When not improved, re-plan the organization of IT project organization and a schedule baseline according to a situation.

3.5 Work responsibility compliance

Even if the overall scope of project is not changing, a workload increases in fact because work responsibility changes among other parties from assumption. If responsibility becomes the work of an end user or a partner is overdue, or ambiguous, the workload on the IT project side will be expanded in many cases. It is important whether all the parties are observing the work responsibility.

The significant tide condition is found by following factors;

- Work responsibility is not confirmed or made consensus among project concerned parties.
- Some members or teams did not comply the work responsibility and work load of other team is increased.

In those cases, following countermeasures should be taken.

- List up all tasks and assign proper work responsibility again. Then it should be announced officially.
- Re-plan each baseline with new work responsibility.

3.6 Communication condition

Check and share the project status and monitoring results in the steering committee meeting. It should be make final decision according to project and company policy when a serious problem occurs.

The significant tide condition is found by following factors;

- No key person attended to steering committee meeting.
- No decision making done at steering committee meeting.

Also check the making minute activity. The minutes are very important in order to leave the consensus and the circumstances as official stipulated documents.

The significant tide condition is found by following factors;

- The minutes are not described the determination matter and the indetermination matter in minutes.
- The minutes are not described the due date and the person in charge for problem and action item in minutes.
- The minutes are not approved by the responsible person.
- The minutes are not opened to all the project members.

In those cases, following actions should be taken promptly.

- It escalates to a higher rank administrator and requests to have reasonable measures taken.
- Is should be indicated the actual impact for project proceeding by using concrete evidence which shows unexpected communication condition.

4. Operations of project tide monitoring

A check sheet that summarizes the project tide factors and conditions of the previous chapter was created. This check sheet consists of the following three items.

(1) Project tide factors and conditions with several examples

(2) Diagnosis results of monitoring whether each tide factor and condition occurs or not

(3) Rationale and background for diagnosis results

In this check sheet, it is possible to judge the validity of the diagnosis content by describing the rationale and background.

During project execution, project managers correctly organize and grasp the facts occurring within the project based on various materials such as work reports, progress meeting minutes, review record sheets, task and issue lists, and so on. Then, the state of the project is diagnosed using the tide monitoring check sheet, and it is judged whether or not a tide occurs. This judgment is done regularly at the timing (weekly or monthly) at which data in the project can be collected.

Furthermore, not only the project manager but also the members of the cross-sectional PMO are objectively diagnosing the state from the standpoint of a third party for tide monitoring using the check sheet. By diagnosing the project situation from multiple standpoints, we are trying to prevent omission of capture of project tide.

In particularly important projects and large-scale / high difficulty projects, we share results of the project tide monitoring with internal executives, and we systematically grasp and manage the tidal status of projects.

When it is judged that project tide is occurring, we will have weekly or sequential meetings to consider countermeasures and confirm implementation status of countermeasures and verify implementation results. Thus, we will systematically respond to the tide and improve the situation.

The overall operations of project tide monitoring are as follows.

(1) Project manager checks the state of the project (whether project is in the tide or not) using the tide monitoring check sheet.

(2) The cross-sectional PMO member also checks the state of the project as a third party based on reports, various deliverables and individual hearing results.

(3) Compare the check results of both project manager and cross-sectional PMO and analyze the differences.

(4) If there is a possibility of being in the project tide based on the tide monitoring check result, escalate to the senior executive manager. After that, we will consider and implement countermeasures together within the organization.

Many countermeasures to improve the project tide state are also often executed by customers. In that case, it is necessary to make adjustments and negotiations with customers to implement countermeasures. When the influence of countermeasures is large or the difficulty of execution is high, it is often necessary to adjust between the executives of both customers and our company to make a final decision on the countermeasure execution.

We also developed "Project Tide Analysis and Resolution Map" as a tool to be used in the project judged to be in the tide (Figure 3). This map is used to organize and analyze facts and phenomena related to the current tides occurring in the project, to examine the improvement measures and to verify the effect of implementation. It is very important to prevent the deterioration of the project by confirming and implementing improvement measures early with using these maps and tools. In developing this map, we referred to the Postmotem method which is one of the retrospective analysis methods (NIKKEI SYSTEMS, 2014).

The "Project Tide Analysis and Resolution Map" consists of the following three columns.

(1) Left column: Organization of facts and occurrence history of events related to the project tide and deep empirical analysis of causation (root cause analysis of the project tide)

(2) Center column: Organization and analysis of the gap between the project baseline agreed in the past and the facts, phenomena, and root causes related to the latest tide

(3) Right column: Concretization of response policies and countermeasures to solve the gap with the project baseline and verification of the effect of countermeasures implementation

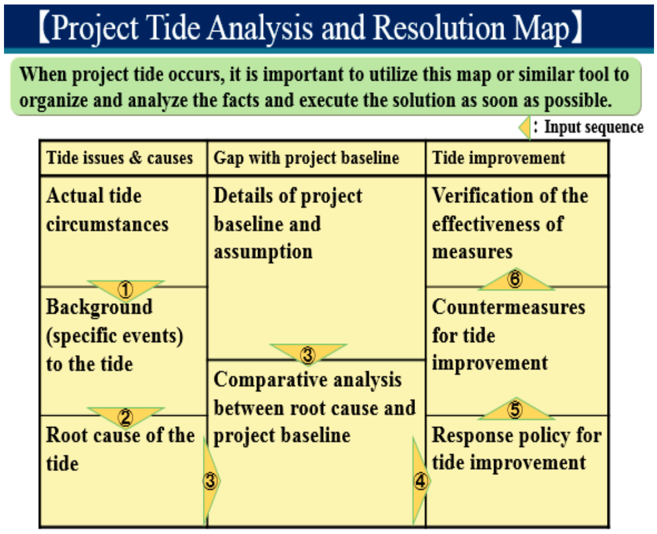

Figure 3 Project Tide Analysis and Resolution Map

This map is a mechanism to decide the actual tide improvement measures and to judge the execution effect while filling in the contents from the left side column sequentially.

(1)Background to the project tide

We look back to the past and organize the events up to the project tide. Specifically, we look back on when / who / what kind of remarks and actions lead to tides. We identify the direct cause of the tide by reconfirmation in the past.

(2)Root cause of the project tide

We analyze the root cause that caused the remarks and actions related to the project tide organized in (1).

(3)Comparative analysis between root cause of tide and project baseline

The root cause of tide is different from the project baseline and assumption assumed and agreed upon stakeholders at the start of the project. We analyze and clarify the gap between the project baseline/assumption and root cause of tide.

(4)Response policy for the tide improvement

We decide the response policy to resolve the tide by eliminating the gap with the project baseline.

(5)Countermeasures for the tide improvement

We decide the specific countermeasures for tide improvement based on the response policy in (4).

(6)Verification of the effectiveness of measures

We verify the effectiveness of the decided countermeasure. As a result of the verification, if the solution is still insufficient, further improvement measures will be considered again.

5. Actual cases of project tide factors and countermeasures

In 2 project cases, project tide condition which has possibility to make big influence to the project baseline was detected. Then, cross-sectional PMO performed warning to the project and escalated to the higher level management. Because of this tide monitoring methodology, suitable corrective action can be taken before the problem become larger.

5.1 Case 1

Found the tide condition “3.3 System Realization Policy”.

The number of the external interface increased as twice or several times by change requirements. It required some special skill set to realize interface system. But in this time, not enough project members who have such skillset has assigned. Moreover increasing of external interface needs not only human resources but also huge terms of test phase exponentially especially integration test with external systems to assure the sufficient system quality. Then is must affect the cost and schedule timeline. Additionally, cross-sectional PMO suggest that it should be examined to decrease the interface functions or re-plan especially test schedule.

5.2 Case 2

Found the tide conditions “3.2. Project Promotion and Management Policy” and “3.4. End user Cooperation”.

Demand to change the specification examination method and directivity from end user project promotion leader has come out after work session finished and some consensus made. Workload of some project members increased by re-examination, and delay has also occurred. No project inside member can oppose the leader's remark. It considered that if it was neglecting, it should influence great impact through all project activities. Then cross-sectional PMO suggest taking countermeasure via top management from outside of project. And when the demand from a leader was appropriate, it should be included in project plan and baselines.

6. Evaluation of effects

The probability of IT system / software development project success in Japan is said to be about 67 to 70% (NIKKEI COMPUTER, 2014). On the other hand, we have applied the project tide monitoring of this paper and implementation of countermeasures by the tide analysis and resolution map to about 50 projects so that there were no unprofitable projects and all projects were completed successfully (Some project are ongoing). Therefore, we conclude that the effect of these measures is sufficiently large from the current achievement. In addition, the effect of these measures (i.e. the number of unprofitable projects is 0) has been highly appreciated not only within NEC but also within each company of the NEC group and we also receive consultation on realization of project tide monitoring operation from each company.

7. Conclusions

In the future, we would like to develop the project management by tide monitoring to the level that will become the NEC group internal standard. Also, I would like to make use of tools for tide monitoring in order to ensure consistent project management at all times regardless of project manager's skills and project characteristics. We will continue to make further improvements in the future when new problems for monitoring process and tools are found with hearing to each project manager.

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Project Management Utilizing CMMI(R)

-An Example of Applying Tailoring for Productivity Improvement-

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This paper describes the organizational application of project management based on CMMI(R) (Capability Maturity Model Integration, henceforth, CMMI), which is the international de facto standard framework for process improvement. When defining management processes in project management, it is necessary to identify and implement necessary processes with consideration of the characteristics of the project, but to achieve the objective of "improving the project management capability of the entire organization", it is necessary to define a certain standard development process within the organization. On the other hand, trying to apply a uniform standard process regardless of individual project characteristics may cause their productivity to be reduced. For this kind of issue, we think that the project management practices(especially organizational application method) defined in CMMI are effective. Specifically, organization sets the tailoring criteria, and each project defines their own processes to be implemented for meeting the project's characteristics from the organization's standard process in accordance with the tailoring criteria. Below, we describe countermeasures that contribute to "improving the project management capability of the entire organization" using the improvement model defined in each process area of CMMI, and introduce concrete examples of our company actually utilizing this method.

Keywords and phrases: CMMI, Organizational Application of Standard Development Process, Tailoring, Continuous Improvement

1. Introduction

This paper describes the organizational application of project management based on CMMI, which is the international de facto standard framework for process improvement.

CMMI is the model to measure the capability and maturity of organizations implementing IT project and defines that continuous improvement activities should be implemented in the four areas of “Process Management”, “Project Management”, “Engineering” and “Support”.

In this model, there are five maturity levels measured 1 through 5.

At level 2, the attainment criteria are "to implement fundamental process management and project management by individual project". And at level 3, the attainment criteria is "to implement the project's defined process which is tailored from organization's standard process in accordance with the tailoring* criteria".

In other words, in the Level 3 organization, "Implementation of an optimum process organizationally" has been realized from the viewpoint of project crossing rather than optimization when viewed individually.

Therefore, to "improve the project management capability of the entire organization" as the issue point, we must implement practices equivalent to Level 3.

*Details of tailoring will be described later in Section 4.

2. What is CMMI

2.1 CMMI’s basic concept and appraisal

The model of CMMI gathers best practices that help organizations improve their processes, and for each of 22 process areas, "a series of goals considered to be important for improvement" is specified.

For CMMI appraisal, the processes required to be fully implemented are defined for each level. 22 process areas are mapped as shown in Table 1.

When applying CMMI in organization, processes should be implemented according to the level to be attained.

2.2 Project management in CMMI

Among the 22 process areas described in 2.1, we describe the points of achievement for the following two areas that are largely related to "improving the project management capability of the entire organization".

2.2.1 Organizational Process Definition (henceforth, OPD)

This is the process area at level 3.

The purpose of the OPD is "to establish and maintain a usable set of organizationa’s process assets, work environment standards, and rules and guidelines for teams”. (Carnegie Mellon University, 2010)

Table 1 The 22 process areas in CMMI

	Process Management	Project Management	Engineering	Support
LEVEL5	Organizational Performance Management (OPM)			
LEVEL4	Organizational Process Performance (OPP)	Quantitative Project Management (QPM)		
LEVEL3	Organizational Process Definition (OPD) Organizational Process Focus (OPF) Organizational Training (OT)	Integrated Project Management (IPM) Risk Management (RSKM)	Omitted	
LEVEL2		Project Monitoring and Control (PMC) Project Planning (PP) Requirements Management (REQM) Supplier Agreement Management (SAM)		

In Specific Practice 1.1, requirements to establish organization's standard processes are defined.

For example, when establishing a standard process for project planning, following processes should be defined.

- Establish WBS
- Establish Budget and schedule
- Identify Project risk and plan risk management
- Plan Data management
- Plan Resource (Effort, Equipment, Materials, Methods)
- Plan Personnel training
- Plan Communication with stakeholders
- Obtain commitment to the plan

In Specific Practice 1.2, requirements to establish tailoring criteria and guidelines are defined.

When defining the tailoring criteria, followings should be considered. (Carnegie Mellon University, 2010)

- Requirements that must be satisfied by defined processes
- Options that can be exercised and criteria for selecting among options
- Procedures that must be followed in performing tailoring

2.2.2 Integrated Project Management (henceforth, IPM)

This is the process area at level 3.

The objective of IPM is "to establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes". (Carnegie Mellon University, 2010)

Managing the project's effort, cost, schedule, staffing, risks, and other factors is tied to the tasks of the tailored process from the "set of organization's standard processes".

In other words, in the various management tasks of the project, the processes are implemented according to the characteristics of the project, selecting from the organization's standard processes.

3. The issue in organizational application of project management

To "improve the project management capability of the entire organization", it is essential to standardize the processes to be implemented in the projects in the organization. Project management is standardized by using guidelines and standard templates defined by the organization, and as a result, improvements of productivity and quality can be expected.

On the other hand, if we try to apply the same standard rule uniformly to projects without consideration of their own characteristics, there are risks that cause productivity to be reduced since tasks that are not essentially required or wasteful review processes may be implemented.

In other words, implementing uniform management of projects within the organization and improving the productivity of individual projects are in conflict in a sense, and it's an issue to annoy many organization managers.

4. Issue solving by using CMMI model

As a measure to deal with this issue, it becomes possible to define the process to meet project characteristics by utilizing "tailoring" defined in the CMMI.

Regarding the definition in CMMI about "establishing the organization's standard process" and "utilizing in the project", the outline of each process area is as follows.

- OPD (Level 3) : Define the standard development processes and set the tailoring criteria for applying to each project.

- IPM (Level 3) : Based on the tailoring criteria defined by the organization, projects compose their own process.

4.1 What is Tailoring

Tailoring means an activity to modify standard processes provided by the organization so that they can be applied in the project (Anma,Y. et al, 2007). For example, in each project or work group, by tailoring the "set of organization's standard processes", we can establish "defined processes" to meet its goals, constraints, and environment. (Carnegie Mellon University, 2010)

4.2 Specific examples of tailoring standards

As for tailoring in project management, first of all, we identified all processes to be standardly implemented, and then, we decided either "process to be applied mandatory" or "process to be applied optionally" for each process.

Table 2 shows samples of tailoring criteria.

The specific procedures and points to be noted in setting the tailoring criteria are described in detail in Section 5.

< Supplementary explanation of Table 2>

Processes to be implemented:

All organization's standard processes to be implemented

Tailoring axis:

Criteria for classifying projects according to their characteristics (Example: Development effort, Risk Rate**)

** Risk Rate: Value calculated by weighting in consideration of importance of risk factors as described below, for the purpose of objectively judging the risk possessed by the project not only on the development size but also from the various viewpoint.

- Development size
- Influence range when problems occur
- Clarity of business requirements
- Validity of development period
- Satisfaction level of personnel / organization
- Difficulty of system configuration

5. Example for setting procedure of the tailoring criteria

5.1 Features of Sompo Systems Inc.

Sompo Systems Inc. is an IT subsidiary of an insurance company, and undertakes development and operation from the parent company. In development, various projects ranging from large-size projects to small-size enhancements are being implemented. As shown in Table 3, most of the total effort is spent on large-size projects with high risk rates, and many employees are engaged in large-size projects. As for number of projects, the ratio of small-size projects with low risk rates is high, and there are characteristics that we perform numerous projects with a little effort. Also, most of the development projects are small enhancement of existing systems.

Regarding to the status of the organization's standard processes, as the parent company repeated the merger, IT subsidiaries also merged with each other, and the standard processes of each organization were not maintained and were in a state of muddling. As a result, the organization's standard processes referenced by the subsystems were different, and it causes low quality, low productivity and a barrier of personnel rotation. The CMMI model is utilized for process improvement to solve the issues above.

Table 2 Samples of tailoring criteria

	Tailoring axis		
Processes to be implemented	Group A	Group B	Group C
Process A	Mandatory	Mandatory	Mandatory
Process B	Mandatory	Mandatory	Optional
Process C	Mandatory	Optional	Optional
Process D	Mandatory	Optional	Optional
:			

Table 3 Composition ratio of effort and number of projects by Risk Rate in our company

Risk Rate	Effort	No. of Projects	Impact
Very High	43.5%	3.1%	Customer
High	23.2%	11.3%	Agency
Medium	16.0%	18.4%	Agency
Low	10.1%	27.7%	In-house
Very Low	7.2%	39.5%	In-house

5.2 Key Points when setting tailoring criteria and implementation examples (As for quality management department)

Following activities were implemented with reference to OPD of CMMI.

One of the points when setting tailoring criteria for the organization's standard processes is the balance with the organizational governance on projects. If the tailoring tolerance is too tight, some projects will implement excessive processes to forcibly comply with the organization's standard process, which brings risks of a decline in productivity. Conversely, if we relax the criteria too much, there is a risk that it will negatively affect the business of the parent company, such as an increase in trouble occurrence rate due to degradation.

Below, we introduce the case of our company which sets tailoring criteria of the organization's standard process, considering the balance between strengthening organizational governance on projects and expanding discretion of projects.

5.2.1 Tailoring criteria setting policy

In establishing tailoring criteria, we decided the following policy based on our characteristics.

- Ensure compliance with the organization's standard processes for relatively large projects to meet the requirements for quality, cost, and delivery time
- Ensure high productivity by reducing the burden of complying with the organization's standard processes as much as possible for relatively small projects to respond to more functional improvement requests

In accordance with these policies, we describe in detail the procedure when we set up tailoring criteria for the organization's processes below.

5.2.2 Determination of tailoring axis

We should set, as the tailoring axis, what can uniquely and objectively express the characteristics of the project. We decided to adopt the Risk Rate, which is derived from various risks including project size and impact range (end users) for each project.

5.2.3 Determination of threshold

We used the tailoring axis to clarify the boundary that identifies the cases of thorough compliance with organization's standard processes and the ones that minimizes compliance with them. Therefore, referring to the distribution of actual results of projects against the Risk Rate (Table 4), we considered the threshold considering the balance between governance and load reduction.

As a result, we judged it valid to set the threshold value between Medium and Low at the Risk Rate, because it became clear that the governance will be effective against approximately 83% of the total effort, and the load can be reduced in approximately 67% of the total number of projects.

Table 4 Component ratio when threshold value is set between Medium and Low at the Risk Rate

<table>
<tr><th>Risk Rate</th><th colspan="2">Effort</th><th colspan="2">No. of Projects</th><th>Impact</th></tr>
<tr><td>Very High</td><td>43.5%</td><td rowspan="3">82.7%</td><td>3.1%</td><td rowspan="3">32.8%</td><td>Customer</td></tr>
<tr><td>High</td><td>23.2%</td><td>11.3%</td><td>Agency</td></tr>
<tr><td>Medium</td><td>16.0%</td><td>18.4%</td><td>Agency</td></tr>
<tr><td>Low</td><td>10.1%</td><td rowspan="2">17.3%</td><td>27.7%</td><td rowspan="2">67.2%</td><td>In-house</td></tr>
<tr><td>Very Low</td><td>7.2%</td><td>39.5%</td><td>In-house</td></tr>
</table>

5.2.4 Determination of target process of tailoring

For each area delimited by the threshold, we selected "process to be applied mandatory" or "process to be applied optionally" from the organizationa’s standard processes.

As “processes to be applied mandatory”, which do not allow tailoring in projects, we should select important ones to ensure the integrity of the project.

As "process to be applied optionally", which permits tailoring in projects without departing from the aim of the organization’s standard processes, we should select the processes of which the project itself should decide the optimization of the standard process, necessity of application, alternative means according to its characteristics.

This time, as for the projects risk rated medium or higher, we defined all processes as “mandatory”. As for the other projects, we defined the processes related to measuring productivity as "mandatory", and defined other processes as "optional". (Table 5). This is because we decided that it was important to monitor the degree of achievement against the target value of productivity improvement set as the organization's business goal.

5.2.5 Continuous improvement of tailoring

Tailoring criteria need to be reviewed periodically. The quality management department regularly monitors the status of failure occurrence after release, status of compliance with delivery date and budget, productivity etc. across the project and reviews the validity of the tailoring criteria. It is important to identify the tailoring axis, the threshold value, the problem related to the tailoring process and continuously improve it.

5.3 Main points when applying tailoring criteria in projects (Development department)

Following activities were implemented with reference to IPM of CMMI.

Using the tailoring criteria set by the organization, each project selects the processes to apply from the organization’s standard processes, considering the characteristics of the project~~s~~ and subsystems.

In this section, the major points when each project selects or review the processes to implement and quality management department objectively validate the projects' activities are described.

5.3.1 Determining the processes to execute

In deciding process, it is a point to what extent governance needs to be effective based on the characteristics of the projects such as the development size and the Risk Rate.

If this selection is wrong, work load will be generated more than necessary, which is a factor of lowering the productivity.

<Key points to consider when determining processes>

We explain main notes on process decision below.

Table 5 Tailoring standard (excerpt)

Organization’s Process	Risk Rate	
	VH / H / M	L / VL
Measurement Data Collection		
Size (SLOC: Source Lines of Code)	Mandatory	Mandatory
Effort	Mandatory	Mandatory
Test defect	Mandatory	Optional
Test case	Mandatory	Optional
Test defect density	Mandatory	Optional
Development Productivity	Mandatory	Mandatory
:	:	:

1) Development size, Risk Rate of subsystems

In our development projects, there are many cases which have variations in the development size and the Risk Rate when looking down at each subsystem, regardless of those of the entire projects. This is largely related to our characteristics that most of the projects are maintenance of existing systems.

We show an example in Figure 1. In this case there are subsystems with a large development size and a high Risk Rate, while the others do not develop at all just including no-effect-check-test or implement small development with low Risk Rate.

We must consider whether it is necessary to apply the same process to all subsystems.

Unless this is taken into consideration, the management effort (the man-hour required for each management activity and various reviews) may become larger than the development effort, which is one factor of lowering productivity.

It is possible to reduce the workloads and improve productivity, when a project manager identifies the processes to be applied essentially for all subsystems and those which match development size and Risk Rate for each subsystem.

2) Validation by a third party

Generally, when deciding the processes to be applied, the project manager frequently emphasizes productivity and decides not to implement them even if they should be originally performed in view of the project characteristics. On the contrary, there may be cases where judgment is made to carry out a richer process than necessary. In order to avoid such a variation of governance by the discretion of project managers, we conduct activities to ensure the productivity of the whole organization by validating them as a third party (quality management department, etc.).

With reference to the results of analysis based on past development, we take into consideration the characteristics of the project to be confirmed, and confirms that the processes selected by the project manager are valid. On this occasion, quantitative data and checklists etc. are effectively utilized so that the subjectivity as a third party is not interposed as much as possible.

5.3.2 Review the processes to be executed

In the execution phase, the environment surrounding the projects changes frequently. Therefore, it is necessary to respond flexibly by appropriately changing the processes defined in the initiation phase.

Also, reviewing the processes should focus not only on strengthening governance more than the current situation, but also on considering to prevent the increase of effort checking whether there is anything to be weakened.

<Main factors that cause projects to review the processes>

1) Changes in development size and Risk Rate

2) Changes of project organization due to personnel changes etc.

3) Deviation between quality target value and actual value

We will explain them in detail below.

1) Changes in development size and risk rate

There are many cases that subsystems which had a small development risk and Risk Rate at the stage of the initiation phase become greater in size or risk along with changes in requirements and scopes as the process progresses.

Therefore, even while the project is ongoing, the development team must recheck the development size and Risk Rate at appropriately scheduled checkpoints and reexamine the application of the process accordingly.

In addition, it is useful to share with development team and stakeholders in advance how to re-estimate the development size and Risk Rate and judge the process review, so that the resistance accompanying the reconsideration will be constantly reduced.

2) Changes of project organization due to personnel changes etc.

During the project period, the organization and personnel are often forced to change due to external factors. Especially when main members of

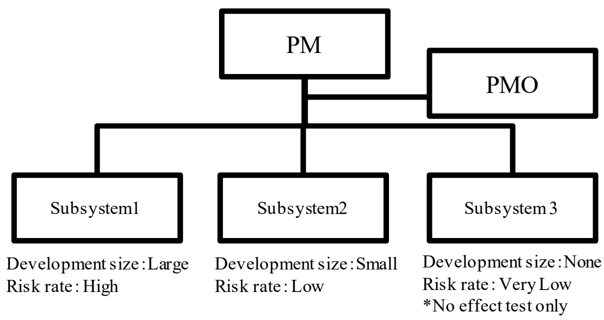

Figure 1 Project structure image

each development teams and stakeholder are obliged to leave the project, it is necessary to grasp the gap of skills and capabilities between predecessor and successor and reconsider the processes appropriately.

In order to grasp the gap, it is useful to enrich communications. In addition, reviewing the process immediately after organizational or personnel change is a factor of lowering the motivation of successors, so it is important to consider gradually changing the process while convincing successors.

3) Deviation between quality target value and actual value

When deviating from the range of target values initially set in the quality management plan (defect density, review efficiency, etc.), it is possible that there is a cause in the process that was implemented, so we must reconfirm the balance between quality and productivity, and review the processes.

5.4 Effect of applying tailoring criteria

As mentioned above, we have a lot of projects with small development size and Risk Rate. We calculated the extent to which productivity will improve assuming tailoring criteria that are relaxed considerably are applied to those projects. As a result, it was found that as shown in Table 6 the effort related to project management can be reduced to 1/3 ***.

Therefore, taking into consideration notes and others mentioned above, we judged that productivity can be improved by defining and applying appropriate tailoring criteria.

***We estimated work hours for each process in the total amount of processes to be performed, and accumulated the efforts for both cases when it was mandatory (Before) and optional (After).

6. Conclusions

At our company, since the organization's standard processes to which each project should comply were not sufficiently developed initially, we began to develop them. After that, company-wide application is started including tailoring criteria for applying standard process to each project.

The point in establishing the tailoring criteria this time was to build a scheme in which project managers can determine the processes to be implemented for each subsystem among the projects. In projects that develop complete new systems, we think that it is difficult to decide the standard for each subsystem like this. But our company has the feature that most of development is maintenance of the existing systems. In such an organization, we think that the setting of the tailoring criteria described in this paper is effective for securing the productivity of the entire project because the development size and risk rate vary greatly for each subsystem.

Actual effect is enormous as described in the previous section.

In the future, continuous improvement is necessary, and while referring to trends in quality indicators, productivity indexes, failure rate, etc., we will constantly search for the optimum process for the whole organization.

At the present time, we are implementing processes equivalent to CMMI Level 3, but at Levels 4 and 5, we will be able to collect, grasp and analyze project performance data systematically, and utilize them and predict results in future projects as well. In the case where maturity has increased to this level, more accurate result prediction can be made even in improving the tailoring criteria.

Table 6 Assumed result by applying tailoring criteria that are relaxed considerably in small maintenance project

	Average man-hours	
	management	development
Before	34	45
After	11	15

Reference

Anma,Y. et al (2007). *CMMI Basic and Practice -All of the improvements that the projects change-*

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Leadership styles of project management on megaprojects

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This paper explores megaproject management in a behavioral economics perspective. There is no doubt about importance of competent management in the upper echelon level of megaprojects. Problematic of leadership have been increased interest of academic circles and also practitioners in last decades. Leadership is found to be significantly related to project management success, although there is no such a research within the field of megaproject management. Despite the lack of academic literature and research in the behavioral aspect of megaprojects, execution of megaprojects not seems to deliver expected results. In this context, there is requisite to understand what upper echelon of megaproject do and why. Aim of this article is to answer on a research question: what elements of leadership styles are the most significant do push the megaproject forward? This paper aimed to clear up behavioral aspect of megaproject management success. Literature review showed that by today, most scientific discussion was related to megaproject as entity, analyzed trough one aspect, and, that is megaproject itself. Other important aspects like politics and finances were often analyzed separately. The paper delivers literature review on leadership stiles in megaprojects and methodologies that were used in this context. It highlights two main findings which put in into question traditional observation of project success. Main findings are: 1) three leadership styles that occur on megaprojects, 2) challenges of megaproject owner who wants to maximize its profits and 3) process of megaprojects realization trough state level (the conditions that are created by the state to support the megaproject). Paper concludes with new perspective of megaproject management, based on mathematical two-phase modeling.

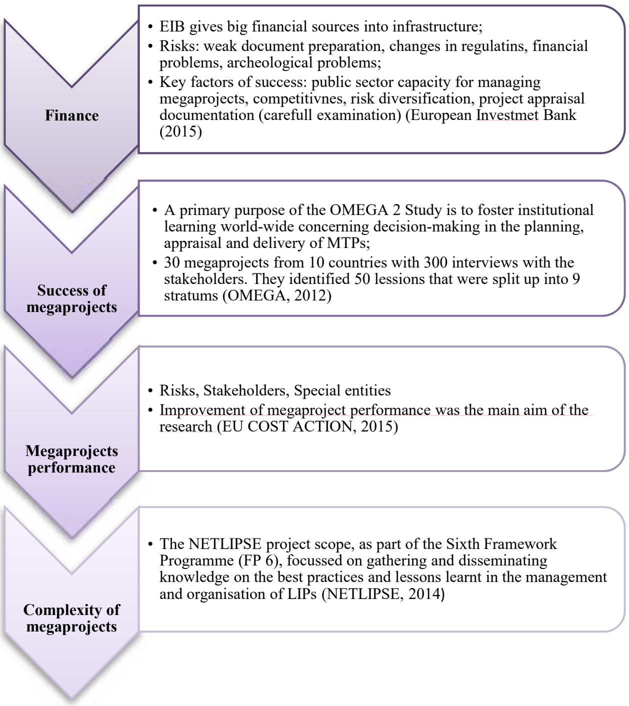
Key words: megaproject management, leadership, competences, project management success

1. Introduction

Without megaprojects, we would not have business and society we do have today. From the historical perspective, we know that megaprojects were key driver of a development of a various technologies for moving business to the next level, so as trigger for many researches conducted while seeking for a totally new management approaches and practices. However, megaprojects were also one of a main drivers and contributors in the society development. Following such perspective, it can be noticed that communities, which in the past accepted challenges of that time, took initiatives, so developed and implemented successful megaprojects moved such community ahead comparing to other. Cost overruns and delays in execution are the most famous concerns in the world of megaprojects. By their definition, megaproject hold the power to change the face of the community – on the short run often for the worse. Therefore, impact of megaproject performance is a matter of concern in the scientific community of the megaproject arena. Previous studies and literature review confirm the assumption that there is a space for research when it comes to managing megaprojects. The purpose of this paper is to analyze leadership types that occur within upper echelon of the megaprojects.

2. Introduction: the power of megaprojects

Last three decades academic community was interested in the outcomes (Merrow, 2011), complexity (Hertogh and Westerveld, 2010), success (OMEGA, 2012), performance (Brookes, 2016), and inceptions (Flyvbjerg, 1997) of megaprojects. But, even under the best of circumstances, it is difficult to find valid and reliable data on the performance of infrastructure investments (Ansar et al., 2016). Recently, profession of project management became interested in the benefits that large infrastructure projects bring. Although the success of a megaproject may be classified during the project close-out phase when deliverables are accepted, stakeholders' lingering perception of success and the associated benefits are arguably more influenced by the longer term impacts and outcomes resulting from a project (Fahri et al., 2015).



Source: authors collection

Figure 1. Main themes in megaproject research today

Figure 1 shows world′s prominent research done in the field of megaprojects. The overarching research question posed by the OMEGA 2 Study is related to a success of mega transport projects in light of the aims of such projects and the anticipated challenges presented by the 21st Century. Result of this research are key lessons about the practice of international MTP planning, appraisal and delivery. The lessons are grouped under the following headings: MTPs as ‘agents of change; MTPs as ‘open systems’; MTPs as ‘organic’ phenomena; the need for proper framing of MTPs; the power of context; the role of sustainable development visions; engaging with MTP stakeholders; institutional, policy and legislative support and the last one: the importance of lesson-learning and sharing (OMEGA, 2012). MEGAPROJECT COST Action conducted analysis of megaprojects performance, with the main aim to find out what are the key drivers of megaprojects performance. MEGAPROJECT"s analysis identified three key drivers for improving megaproject delivery performance in Europe: engaging external stakeholders, designing good governance and learning across megaprojects (Brookes, 2015).

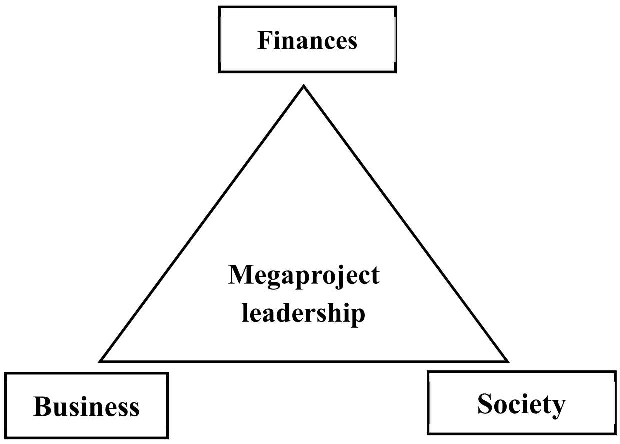
MEGAPROJECT indicates that the success or failure of a mega-project is determined by factors that lie in its external context particularly in terms of the regulatory environment in which it operates and the way in which it interacts with external stakeholders (those actors who are influenced by or can exert influence on the mega-project but have no formal or legal relationship with the mega-project (Brookes, 2015). The NETLIPSE research was aimed at gathering, analysing and disseminating information on experiences (lessons learned) and best practices in the management and organisation of 15 large infrastructure projects (LIPs) in Europe in order to develop an Infra Maturity Tool (Hertogh et al., 2010). On the other side, using primarily public sources Merrow (Merrow et al., 1988) developed a database with which certain questions on outcomes, factors, cost, schedule and performance were addressed. His research gave three steps recommendation to make megaprojects less risky: broad the scope of the project definition phase to systematically developed factors, train project managers, question whether the introduction of proposed new technology is essential to the mission of the project. Flyvbjerg′s (Flyvbjerg et al., 2003; Flyvbjerg, 2007) research is based on the rationality-power relations in modern politics, administration and planning of the infrastructure megaprojects. Flvbjerg (2003) explains that poor performance in mega-projects is due to those involved in decision-making for mega-projects significantly over-estimating the benefits of the mega-project whilst simultaneously significant under-estimating the resources required to implement the mega-project. He sees “optimism bias” or strategic misrepresentation as reasons behind megaprojects that were failures. He suggest that “reference class forecasting” (a technique that constructs a reference sample of previous similar projects) could be a way of avoiding this type of misrepresentation. On the other hand, EY′s comprehensive research into the performance of 365 megaprojects shows that despite the importance of project performance as it relates to enterprise value and share price, a high percentage of projects fail to deliver on time or meet approved budgets. The high number of overruns in oil and gas megaprojects which was identified in the research is not particular to the industry and also has been identified in other sectors, including government, real estate construction, mining, and power and utilities (EY, 2014). PwC research from 2014 shows that worldwide, infrastructure spending will grow to more than $9 trillion per year by 2025. Overall, close to $78 trillion is expected to be spent globally between 2014 and 2025. Growing urbanization in emerging markets such as China, Indonesia, and Nigeria should boost spending for such vital infrastructure sectors as water, power, and transportation (PwC, 2014). The Asia-Pacific market, driven by China's growth, will represent nearly 60% of global infrastructure spending by 2025. In contrast, Western Europe's share will shrink to less than 10% from twice as much just a few years ago. Increasing prosperity in emerging markets will impel infrastructure financing toward consumer sectors, including transportation and manufacturing sectors that provide and distribute raw materials for consumer goods (PwC, 2016). For every one billion dollars of investment in infrastructure, as much as 20,000 new jobs can be created (Miller, 2013).

3. Literature review on leadership

Jalava and Virtanen (2000) stress the project manager's role in project leadership. They explain the different roles the project manager may have: visionary, integrator, organiser, and agent, and their meaning to project management. They consider that the main problem is the leadership problem and they try to figure out how to cope with it. They present 10 core elements in project management: developing a clear vision, seeing the whole project, co-operating continuously together with the project participants, intervening in deviations, preventing personal interests interrupting the project, being careful with recruiting, and developing competence, taking care of project atmosphere, taking care of information needed, evaluating, and taking a leader's role. The most important elements in succeeding in project management according to Jalava and Virtanen (2000) are commitment, capability, recruiting, quality and competence. One of the most important project manager's competences is the leadership skill and the ability to influence practices creating conditions for a learning organisation. It would be accurate to say that while Morris and Hough (1987) identify that major projects severely challenge the leadership qualities of those who undertake them but they do not explore in detail the ways in which leadership challenges are qualitatively different, or whether the difference is solely a matter of degree. It remains unclear whether sponsorship, as with leadership issues on major projects, is a fundamentally different phenomenon in megaprojects to the issues encountered on smaller projects. Project management competence consists of understanding the project management knowledge areas, leadership skills, and business environment. Leadership skills include understanding the project management process, self management, leading people: direction, motivating and inspiring, communicating, negotiating, problem solving, and influencing the organisation. On the other hand, business environment understanding means understanding of global markets, internationalisation, regulation and laws, technology and applications; also in cultural, political, economical and ethical context (Suikkia, Tromstedta and Haapasalob, 2006). Obviously most important factor in the overall composition of the team is the project manager or project leader who plays a vital role in overall project management (Tor and Ogulana, 2008). He keeps the team together with synergy, and directs the team toward project goals and makes sure that the team is performing according to expectations. Therefore, researchers have also emphasized that leadership capabilities of project manager can greatly influence the project outcomes (Toor and Ogunlana, 2006; Odusami, 2002; Toor and Ofori, 2006). If the project manager is experienced, knowledgeable, and well conversed with overall project chemistry (Westerveld, 2003), there is high likelihood of successful completion of the project (Dulaimi, 2005; Munns and Bjeirmi, 1996). Leadership involves developing and communicating mission, vision, and values to the members of an organization. A successful leadership is expected to create an environment for empowerment, innovation, learning, and support (Shirazi et al., 1996). Researchers have examined the links between leadership styles and performance (Bycio et al., 1995; Howell and Avolio, 1993). Fiedler (1996) has emphasized the effectiveness of a leader as a major determinant in success or failure of a group, organization, or even an entire country. It is argued that the negative effects of external factors in a project environment can be reduced by the training end equipping of leaders with different skills (Darcy and Kleiner, 1991; Hennessey, 1998; Saari et al., 1988). Organizations require leadership for any of their decisions or actions (Beatham et al., 2004). Due in part to dissatisfaction with the inconsistent results from leader–trait research and, more directly, as a response to purely economic perspectives on organizational strategy (Hambrick, 2002), TMT researchers have largely moved away from the study of the leader to a focus on the team of top executives in an organization.

4. Challanges of upper echelon of megaprojects

World′s prominent infrastructure statistics gives evidences that there is a raising need for investing in infrastructure. In 2015, global flows of foreign direct investment rose by about 40 per cent, to $1.8 trillion, the highest level since the global economic and financial crisis began in 2008 (United Nations, 2016). The global demand for infrastructure investment is huge and estimated at about US$ 3.7 trillion annually. In developing countries, it is driven by growing population, economic growth, urbanization and industrialization. In the developed world, a particular concern is that so much legacy infrastructure needs maintenance and rehabilitation, owing to the ageing of assets, stricter environmental regulations and the globalization of supply chains (World Economic Forum, 2014). One of the main challenges in the delivery of infrastructure services is the need to ensure enough financing to reimburse the loans obtained by the poorest countries to finance the investments needed to deliver those services (Estache, 2010). In the research of Merrow the average cost growth of megaprojects, measured from the beginning of detailed engineering (a fairly late point in project evolution), was 88 percent. The data on cost growth, schedule slippage, and performance shortfalls of megaprojects are certainly sobering, but the most chilling statistic is that only about one in three of these projects is meeting its profit goals (Merrow, 1988). IMEC study found that it is that close to 40 percent of megaprojects perform very badly; by any account, many are failures (Miller i Lessard, 2000). Data from more than 300 global megaprojects show that 65 percent of industrial projects with budget larger than 1 billion in 2010 U.S. dollars failed to meet business objectives (Merrow, 2011). European megaprojects across all sectors are uniformly delivered late and over-budget. It does, however, demonstrate significant variations across the sectors in that performance. Megaprojects EU COST Action report concludes that European megaprojects fail to meet their delivery targets across all sectors (Brookes, 2015). Infrastructure megaprojects have great potential and active work in the field lowering cost overrun is essential. This can be done trough developing profession trough tolls and methods for improvement, such as identifying risk management practices, front end planning and impact evaluation. Implementing project management tools and best practices, including interlinked work breakdown structures with real-time data input, at the outset of a project can improve performance and reduce risk of cost overruns and schedule delays (EY, 2014). While improving project performance it is important to consider factors leading to the achievement of desired benefits, unexpected outcomes or effects, and the impact of the project. These can only be assessed by conducting a post-project evaluation (Fahri et al., 2016). Following on our assumption, Merrow (Merrow, 1988) recommends that the sponsors of megaprojects take the following steps to make their projects less risky: significantly broaden the scope of the project definition phase, train project managers to be geared to the project's institutional environment and internal project organization and investigate the need of innovation in megaproject. Impact evaluation has now essentially become a sub-field of development economics (Estache, 2010). But, those seeking to enact policy through mega-projects need to be very aware of the regulatory environment in which they are placing their mega-projects (often this will be a regulatory environment over which they will have substantive influence) (Ansar et al., 2016). European Investment Bank (2006) invests a lot in infrastructure. Attention to environmental and social outcomes is critical during implementation. Weak field-based supervision can result in adverse environmental and social impacts. While large, complex projects are generally well supervised, medium and smaller projects often have inadequate supervision. Strong field-based supervision is essential, to adjust project design using an "adaptive approach" based on implementation experience and consultations with local communities and other stakeholders.



Source: authors

Figure 2: Relation of megaprojects leadership

Clearly, a successful mega-project is one that delivers its outputs and significantly contributes to the fulfilment of agreed objectives. Moreover, it should have only minor negative effects, its objectives should be consistent with needs and priorities in society, and it should be viable in the sense that the intended long-term benefits resulting from the mega-project are produced (Samset, 2016). But, where the funding needs to go outside the public sector to involve private finance, either independently or through some form of public–private partnership, identifying the beneficiaries may be critical to making the finance available (Vickerman, 2007). The UK Department for Transport (UK Department for transport, 2016) has outlined the steps for appraisal of wider benefits in large-scale transport investment improvements. Apart from the usual appraisal of user benefits in terms of journey-time savings, four wider effects are identified:

- productivity effects (measure the way in which journey-time savings and increased reliability for business travel affect productivity and GDP),
- agglomeration effects (productivity among firms increases because of an increasing concentration of firms or increasing density of employment),
- competition effects (pro-competitive effects of increased competition and, under imperfect competition, the impacts of increasing returns to scale) and
- labour-market effects (improved transport, higher working hours, relocations).

Infrastructure megaprojects have great potential and active work in the field lowering cost overrun is essential. This can be done trough developing profession trough tolls and methods for improvement, such as identifying risk management practices, front end planning and impact evaluation. Implementing project management tools and best practices, including interlinked work breakdown structures with real-time data input, at the outset of a project can improve performance and reduce risk of cost overruns and schedule delays (EY, 2014). While improving project performance it is important to consider factors leading to the achievement of desired benefits, unexpected outcomes or effects, and the impact of the project. These can only be assessed by conducting a post-project evaluation (Fahri et al., 2015).

5. Conclusion

Megaprojects are always large scale with many "?" across all characteristics and always with some kind of a society participation. In a megaproject everything is mega, which makes them different and specific for management. While some of them have more commercial foundation and expectations (i.e. industrial megaprojects), the other have more community focused expectations (i.e. particular infrastructures). In the both cases, elements of a strong leadership expectations are present, with interaction of financial and social criteria of megaprojects success. None of success criteria is easy to program and determine while dealing with a megaproject, but seems financial aspect is more represented in a feasibility and post project analyses. Investment from a society and benefits for a society are always more demanding part of analysis, since society is investing its future, not only in terms of value of the money, but also in terms of many resources (i.e. natural resource like land, water, …). So it mostly goes that society participate in a megaproject by some critical resource which define today and tomorrow of the whole society. The typical example are infrastructure megaprojects where society invest unique natural resources, and there will be no possible to reshape or change such usage for years and years. Megaprojects are not only about the generation which live today, but also about the future generations, where current generation by acting in good faith, influence life of future generation without previous debate and consensus. Therefore, clear leadership is what brings together all mentioned elements to success. Although leadership topic is covered in management science in general, there is lack of research on this topic specifically on megaprojects. Therefore, for future research it is recommended to observe few aspects when discussion leadership: element of business and society should be covered per se. Two phase mathematical model seems like the appropriate and precise method for further research on this topic.

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Is it possible to prevent behavioural complexity in the project?

- A study on prevention of behavioural complexity by authentic leadership approach in creative projects. –

Fahri Akdemir PhD.

Project leadership is accepted one of the key success factors for any project by academicians, practitioners and there are great bodies of works in the field. Even though the numbers of the articles and books are numerous, but the works regarding project leadership in projects where creative personalities work are limited. This article aims to focus on the leadership of project managers, specifically where the project team members are creative personalities. In this article, we will first focus on the creative personalities, their characteristic traits and try to create a better understanding of why they are perceived and named as “complex personalities”. After having a better understanding of creative personalities and their complexity, then the focus will move to the possible complex situations in the project which has roots in behavioural complexity and finally as project managers what kind of leadership approaches would be helpful to prevent such complex situations in our projects. This study also argues the impact of authentic leadership on prevention potential behavioural complexities in such projects. To fulfil our aim, we will look into two specific art creation projects where all parties in the projects are known as creative personalities included the project leader him/herself.

Keywords and phrases: creative personality, leadership, authentic leadership, project complexity, behavioural complexity,

1. Introduction

If we look through the history, it is visible that humankind carried out studies and research about leadership from different perspectives and in different disciplines over the years. Basic scholar search with the keyword “leadership” provides us with 4,000,000 results of books, articles and scholarly works. These works focus different aspects of leadership or provide a different perspective about the topics from different disciplines like sociology, psychology, military, politics and management. These works and the number of studies on this subject clearly highlights the importance of the leadership topic for the humankind. Also, the vitality and the importance of leadership is also accepted as common (Antonakis et al., 2004) Also it is claimed that specific leadership styles are needed for different projects (Müller and Turner, 2005).Even though the number of works from the academic and practitioner perspectives has great magnitudes in numbers, there are still several untouched areas which carry the answers to some of our questions. One of this field is the authentic leadership approach used to lead creative personalities, specifically about prevention of behavioural complexities which are generated from the characteristic traits of creative personalities in contemporary dance performance creation projects.

This research aims to illuminate leadership in behaviourally complex projects and propose a better understanding of preventing possible complex situations. Having this aim in mind, it argues the impact of authentic leadership on project success and preventing possible behavioural complexities in complex projects of creative personalities.

2. Case of action

In this research, the researcher went beyond the academic traditions and presented the case of action through “personas”. This is a method used in product design stage in different industries. In product design or marketing, professionals create “personas” (Lidwell, Holden, Butler, and Elam, 2010), fictional characters to represent the different user types for whom the product might be useful. For this research, the personas are created to emphasize the need for such research in different industries. Six personas created to emphasize the need for such work. These six personas are people from six different industries. And only first five of them is fictional. The first persona is a curator from Germany who is having difficulty in working creative personalities because she is defining them as unpredictable and sometimes much disciplined and sometimes very irresponsible. The second persona is a senior business consultant from the UK who recently got a new client from game development, IT industry and his main client the CEO of the IT Company is asking the consultant to help him to develop a certain leadership approach to be able to lead the highly creative and complex game development employees. The third persona is a young event manager from Turkey. She is responsible managing and organizing national and international dance festivals. She has never worked with the artist or such creative people. She is having difficulty in keeping them active and motivated. She realised that their motivation is directly affecting their performance on stage. Forth persona is an executive manager in a very prestigious luxury leather goods company from Italy. As their company is working in luxury goods, the designers of the company are very well known and famous designers. They are known because of their creativity and quality of their works. He wants them to work as a team, but he finds them very individualistic and sees a resistance in them towards any leadership. They don't want to lead, but they do not want to follow as well. The fifth persona is also an executive manager but from a famous advertisement company. He just gets this job, and it is his first year. As an executive manager he wants to develop his employees' creativity and at the same time be able to work with them effectively. The researcher defined himself as the last persona. A business trainer who had worked for clients from different industries and would like to work more in creative industries. He sees a great potential for these people and their work and would like to create a leadership model which could be effective in creative industries. As it is seen, the personas are from different industries, but their problem or need is similar. They all want to understand the creative personalities better and find an approach to leading them or working with them effectively. These six people are just examples; creative people are everywhere and almost in any industry leaders need to develop their skills in reaching them and keeping them motivated to be able to get good quality work.

3. Literature review

This research is a multidisciplinary research. Main disciplines which the research is working on are; leadership (particularly authentic leadership), project management, creative personality, complexity (particularly behavioural complexity caused by creative personality) and cultural studies discipline is selected as the scientific frame of this work which connects all these disciplines.

3.1 Leadership and authentic leadership

Waren Bennis (1985) defines leadership by mentioning its similarities to beauty or love and claims that we can recognize it when we see it, but it is not easy to define it. Like in the story called "Elephant in the dark" (Rumi and Barks, 2004, p252), when different people get into one dark room and touch and define the elephant inside very differently from each other based on which part of the elephant they contacted, everyone has their own limits and perspectives on defining the reality and this case defining leadership. Not only the definition of leadership but the theories of leadership is also varied. For the sake of this research, the researcher limited his perspective on authentic leadership style. This decision was not based on gut feelings but based on the development of the leadership theories. The importance of human side of the leader and the ethics started to grow and showed itself in one of the recent leadership theories, being authentic leader, which is utterly dependent on the characteristic traits of the leader since they are considered as main leadership multipliers (Giessner, van Knippenberg and Sleebos, 2009 and Reave, 2005)

As authenticity has the roots from ancient Greek and can be understood as "being true to yourself" it has several components like self-awareness, transparency and ethics (Avolio et al., 2004) When it came to authentic leadership scholars defended that there should be more than just being true to yourself (Ilies, Morgeson and Nahrgang, 2005; Shamir and Eilam, 2005) like accountability. For this research, the researcher also needed to define some components of authentic leadership which he can use as lenses while he is collecting his data. Several people proposed different component models for authentic leadership. Bill George (2003) who is known as the first person who used the work "authentic leadership" in his book described a five-component model. (1) Pursuing purpose with passion; (2) acting with solid values; (3) leading with heart; (4) establishing enduring relationships; (5) practising self-discipline. Bhindi and Duignan (1997) also came with another component model with 4 elements but the researcher decided to use the most practical and most efficient component model which is based on Stanislavski method from the theatre and created by Donna Ladkin and Steve S. Taylor. According to them authentic leadership has three important components as steps. These steps are self-exposure, relating and making leaderly choices. When a leader acts based on these the leader can be perceived as authentic leader.

To have self-exposure, the person should be aware of the somatic markers and emotional memories in his/her body and chose a way to express them. In other words, it is all about being self-aware and accepting what you feel. When we have an impulse from outside, that creates a feeling based on our emotional memories and this emotion does not come alone. It generally come with a particular reaction to that impulse. The first step of authentic leadership propose to recognize this, being aware of it but do not accept that reaction as the authentic response to the impulse. In this stage, it propose to start relating. Which is more about being "here and now", that is the step to relate the situation to the environment, people, surrounding and the context that you are in. When this is done, this step will bring more response alternatives than just what your body proposed. After relating, the last step is to make a leaderly choice. After having self- exposure and relating steps now, the person makes a choice in between response or action alternatives based on the identity of the group, the team. The choice should not be from the own identity of the leader but the identity of the team. Of course this one is only possible if the leader has already know or defined his team's identity. These three components for leaders to develop authenticity are proposed by Ladkin and Taylor (2010) On the other hand, Steve Taylor underlined that, a person is accepted as authentic if it is perceived authentic, on their interview with the researcher. That tells us that one person can be authentic and unauthentic leader at the same time because it is all about the perception of the follower.

3.2 Project management

The understanding of project management and project can be considered young but the practice of it actually ancient. The definition project management which is mainly accepted comes from Project Management Institute:

"A project is a temporary endeavour designed to produce a unique product, service or results with a defined beginning and end (usually time-constrained, and often constrained by funding or deliverables), undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value." (PMI, 2014. p.4) For this study, the researcher accepted contemporary dance performance works as projects even though even the people who are doing that work is not considering or defining them as a project. It has all the elements of projects. The result is always unique; the process is not repetitive. The dancers may repeat the performance, but the dance creation process never repeated for one project. Like in every project, to be able to reach your unique goal, you need to have funds, people, equipment. Even though any creation of dance performance or theatre play is a perfect example of project management, the project management literature hardly consider them as significant cases. With this research, it is also aimed to remind this of the project management world and highlight it, especially for academics.

3.3 Creative personality and behavioural complexity

Creative people are not only in art houses or in creative industries; they are everywhere. We are all creative at different levels. They are the different thinker who also acts differently and moves differently. They are the ones who push the boundaries. (Harris, 2009). The complexity which is focused in this research has its roots from creative personalities. There were several scholars who are trying to define the differences of creative personalities by highlighting their personality traits, but the psychologist and creativity researcher Mihaly Csikszentmihalyi is the first person define creative personalities as complex personalities (Csikszentmihalyi, 2010; Thomas, 2008; Selby et al. 2005). Csikszentmihalyi names these ten characteristic traits of creative personalities as "paradoxical traits". Some of these traits are; 1.Creative individuals have a great deal of energy, but they are also often quiet and at rest. 2. Creative individuals tend to be smart, yet also naive at the same time. 3. Creative individuals have a combination of playfulness and discipline, or responsibility and irresponsibility…Still, it is not known that if these traits are making them creative or their creativity are generating those paradoxical traits and complexity in behaviour. As you can also see these traits are the issues which our personas were mentioning as a difficulty, challenge on their management related needs.

Another important point about this research is the understanding of the complexity of the projects. If you look at the works of academics or practitioners and ask them about complexity, generally they talk about the technical complexities. It is very difficult to find any work related to behavioural complexity.

3.4 Cultural studies

If a person is doing research about any living organism, s/he should consider the culture as a factor. For this research, the perception of culture is limited by where the research is conducted, which nationalities involved, what kind of personality group is researched, what disciplines and sub-disciplines selected for the research and also the type of organisations which have the influence of setting the cultural context and so the result of the research. Culture is the key to this research because all these disciplines create their own cultural perspectives and actually cultural studies are the only discipline which we can use to connect all these different disciplines. As it was described in the authentic leadership components, authentic leaders should relate to the culture, and furthermore, we can perceive the group identity and explain it by group culture as well.

4. Methodology

A Sufi proverb says that " There as many paths to the God, as there is souls on earth" research is like creating a picture of the researched topic and make it as clear as possible and to be able to do that different person may try different ways. For this research as the whole research is about leadership, the researcher decided to go directly by qualitative research. This is done because the leadership approach that which is analysed is a behavioural aspect. When we look at the literature, people who want to do research about a behaviour like this research they all choose ethnographic research methods (Sandelowski, M., 2000; Bryman, A., 2012). Getting his inspiration and support from other scholars, the researcher decided to collect his data by participated observation and support this data by doing semi-structured interviews. After deciding how the data will be collected the other question was from where it will be collected. The researcher found two projects from contemporary dance performance creation and choose them as case studies for his research. As a participated observer, he was involved in both projects as a documenter and non-artistic choreographer assistant. This role created the perfect environment for the researcher. He was with the team from the first moment till the last. As mentioned above he supported his observation and limited his personal subjectivity he interviewed with dancers and choreographers. As a researcher, he chose to use a method called Design Epistemology on especially analysis of the data. Design Epistemology is a method proposed by Dr Dino Karabeg (2012). From design epistemology, the researcher decided to look for the polyscopy in the data. When we are trying to define the reality to be able to minimize the personal subjectivity we need to use several perspectives. So the researcher defined and explains all his data from three different perspectives. As the participant observer firstly his own perception related to the issue, then the perception of the dancers and then the perception of the choreographer via semi-structured interviews. So every issue which is collected and recorded as data had three different perspectives to create a better and less biased data.

5. Findings

To be able to see the effects of authentic leadership the researcher used three components of authentic leadership as three lenses to identify if the choreographers were using authentic leadership or not. The researcher, looked at the issues which are caused by behavioural complexities of personalities and also the behaviours and leadership of choreographers when there is no issue and again by the inspiration from the design epistemology, the researcher also checked and compared two choreographers to see if they have any behavioural common patterns. Later in the analysis each issue, choreographers leadership behaviours and the common patterns were analysed by three lenses of authentic leadership and tried to define if the choreographers' responses to the issues, their normal behaviours and the patterns shows any presence of authentic leadership. Then the researcher also marked for each issue if it is solved or not solved and for the patterns, if those patterns were supportive or not. The results of six issues which were observed from two different cases highlighted that there is a positive correlation between the authentic leadership and resolving the issue. The results also highlight that when the leader behave in opposite direction of authentic leadership, then this creates an issue in work. So authentic leadership is not only a leadership approach to resolve the issues but also an approach to prevent such issues.

When the researcher looked at the common behavioural patterns between the choreographers he mainly defined four different patterns: Warm-ups, acknowledgement, physical contact and Favourism. First three patterns had positive effects on people and the work, but the last pattern had very negative effect on people and so their work. When the researcher looked at these behavioural patterns from an authentic leadership perspective, he realized that the first three patters align with authentic leadership understanding but the last one does not align at all. This also proved that authentic leadership aligned behaviour has a positive effect on the people and if the behaviour is not aligned with authentic leadership or if it is against the understanding of authentic leadership, it has a negative impact on the people and the work.

Furthermore, as it is also mentioned above it is also seen that these positive behavioural patterns also help the choreographer to prevent issues during the project time. For example, if the choreographer does a warm up properly not only to prepare the bodies of the people but also to bring them to the same state then those days they have fewer issues. On the other hand, if the choreographer does do a warm-up only to warm them up physically then that they the people became more separate from each other and more space for issues.

6. Conclusion

Analysing the practitioner's world and usability of the research results, we can go back to the personas devised for the sake of the thesis. The research reached its aim of satisfying the needs of each persona. To elaborate this conclusion, here the researcher commented, not as the researcher of this study but as one of the personas, who would benefit from this research. Now as a business trainer, whose focus is creative industries and leadership, he knows that what kind of leadership approach would be helpful to prevent issues related to behavioural complexity and also to resolve such issues when they appear. He now can develop a training model for his clients from creative industries who are looking forward to leading creative personalities in the most effective way. It is also believed that the research findings could be helpful to many more people from different industries. This study provides light into the dark corners of leading creative people and complex projects for both the practitioners' and academic worlds. It may be accepted as a complementary work to various academic publications from different disciplines such as leadership, behavioural complexity, project management, creative personality, management, and managing creative personalities. Moreover, considering contemporary dance projects as "projects" and focusing on the behavioural complexity of the projects are only two of the many novelties of this research.

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Study on Applicability of Project-Behavior Simulation System as a Research Platform for Project Management

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Research on project management inherently has difficulties compared to research on routine operations such as production management. Because projects as a subject of study have the nature such as uniqueness, long-term, few cases, trial-difficulties and so forth. Therefore, the project-behavior simulation system as a research platform for project management has been prototyped by the authors. In this article, the author discusses applicability of it and addresses that it could be applicable for three types of its applications as follows: (1) Applications as impact estimation system, which can compare the impacts of different conditions or policies/countermeasures. (2) Applications as virtual case-data generation system, which may generate virtual project case data as benchmarking dataset. (3) Applications as controlled system of project management, which can combined with computer agents to compare the impacts of different agents' project management logic. Moreover, the author shows the potential of applications to combine project-behavior simulation system as controlled system of project management with autonomously learning AI (Artificial Intelligence) agents in order to study the impacts of project objectives or rewarding criteria on project performance.

Keywords and phrases: Project-Behavior Simulation, Constructive Approach, System Dynamics

1. Introduction

It is difficult to conduct controlled experiments in the research on social science and/or industrial engineering, in contrast to the study on natural science. Because entities of human intelligence (as autonomous decision-making) are essentially involved and they mutually interact in the study on social science and/or industrial engineering. Constructive approach, in which virtual experiments are conducted with artificial society implemented based upon computer simulation, has been applied in the research on social science (e.g. Yamakage 2007, Izumi & Ikeda 2013). In the research on industrial engineering, approach of experimental science with computer simulation also has attracted much attention (e.g. Terano 2016, Kurahashi 2016).

Research on project management inherently has difficulties compared to research on routine operations such as production management, inventory management, and so forth. Because projects as a subject of study have the nature such as uniqueness, long-term (duration from project start to appraising the project outcome is long), few cases (there are few samples in a population), trial-difficulties (failure is not tolerated then it is impossible to try in extreme conditions) and so forth. Therefore, one of the research domains, where the constitutive approach or experimental science approach with computer simulation is most expected, would be project management. However, there have been only a few studies based on the approach.

Okada & Oshima (2017) had prototyped the project-behavior simulation system (Probes-SD0: Project-Behavior Simulation System Based upon System Dynamics, version 0) as a research platform for project management, which is able to simulate project behavior for various purposes. Moreover, Oshima & Okada (2017) applied Probes-SD0 to estimate effects of project risk countermeasures. In this article, applicability of project-behavior simulation system is discussed, after Probes-SD0 is briefly introduced.

2. Overview of Project-Behaviour Simulation System

2.1 Overview of System Architecture

Probes-SD0 is composed of four simulation models, which are "Process Model", "Human Resources Model", "Project Progress Monitoring Model" and "Mutual Interactions Model" (Figure 1). All these models are implemented on generic system-dynamics-simulator (Vensim PLE) as a COTS (Commercial off-the-shelf) software. (Note that implementing some applications which are discussed in this article, requires advanced features provided by Vensim DSS)

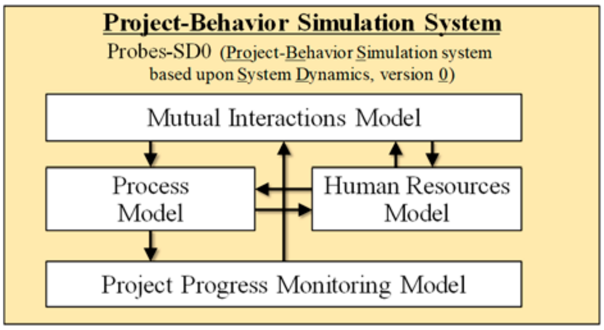

Figure 1 System Architecture Overview of Probes-SD0

Process Model addresses seven project phases, which are Requirements Definition (RD), Conceptual Design (CD), Detailed Design (DD), Implementation (IM), Unit Test (UT), Integration Test (IT), and System Test (ST), based upon V-model. Then migration of the amount of work in each phase is modeled. Moreover, occurrence of rework and propagation of rework across phases is also modeled. Human Resources Model assigns effort for each profession category (systems engineers or programmers) in each activity category (producing, testing, reviewing, communicating or improving activities) in each phase, from the number of human resources with overtime work and the amount of required work. Project Progress Monitoring Model calculates the progress of project with rework, by comparing against the progress of ideal project without rework. Mutual Interactions Model addresses the well-known effects as follows:

(1) Capability levels of human resources are improved by learning effects
(2) Schedule pressure makes overtime work increase
(3) Motivation levels of human resources are decreased by too much overtime work and tiredness
(4) Efficiency of communication is affected by the number of human resources as communication overhead
(5) Productivity is affected by capability and motivation levels of human resources
(6) Quality is affected by capabilities and motivation levels of human resources, and also communication error rate

2.2 Parameters of Simulation Conditions

Parameters of simulation conditions in Probes-SD0 are classified into two categories, such as (1) attributes of project and (2) policy of organization and/or project, as follows:

(1) Attributes of project
- the amount of work in each phase
- the number of human resources planned for each profession category in each phase
- the initial capability level of human resources for each profession category
- the initial motivation level of human resources for each profession category
- the baseline of communication error rate
- the baseline of communication efficiency
- the baseline of defects injection rate in each phase
- the baseline of defects detection rate by review in each phase
- the baseline of defects detection rate by testing in each phase

(2) Policy of organization and/or project
- the review effort rate in each phase
- the communication effort rate in each phase
- the improving activity effort rate in each phase
- the allowable overtime work in each profession category
- the criterion to open the phase-gate in each phase
- safety factor for initial estimation of planed work in each phase

It is able to simulate the project-behaviors in various conditions by setting those parameters for the purpose.

3. Overview of Types of Its Applications

The applicability of Probes-SD0 is discussed. The applications of it could be classified into three types as follows:

(1) Applications as impact estimation system
(2) Applications as virtual case-data generation system
(3) Applications as controlled system of project management

These three types of applications are mentioned in section 4, 5 and 6.

4. Applications as impact estimation system

Application to estimate the impacts of different conditions by setting different values to parameters of simulation conditions, belongs to "applications as impact estimation system." These are most simple and basic applications of project-behavior simulation system.

4.1 Estimating and comparing the impacts of project attributes

The impacts on project performance are estimated and compared, by setting various values to parameters of project attributes such as project size, initial capability level of project members, communication error rate, and so forth (Figure 2).

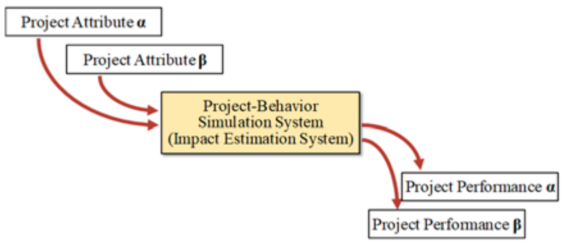

Figure 2 Estimating and Comparing the Impacts of Project Attributes

Li & Mizuno (2004) estimated the impacts of project risk factors by using system dynamics simulation model which developed by themselves. It is an example of this type of applications.

4.2 Estimating and comparing the impacts of countermeasures

The impacts on project performance are estimated and compared, by setting various values to parameters of specific countermeasures (i.e. changes of organization and/or project policy) on baseline conditions (Figure 3). The specific countermeasures might include project risk countermeasures, process improvement actions, and so forth.

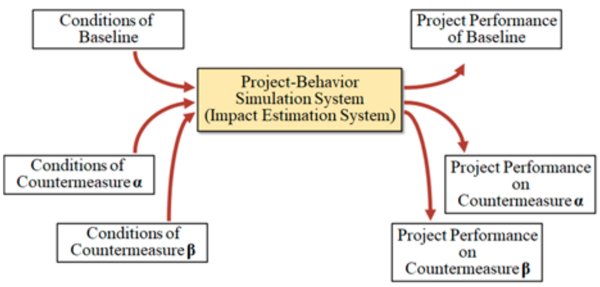

Figure 3 Estimating and Comparing the Impacts of Countermeasures

Oshima & Okada (2017) estimated the impacts of project risk countermeasures, for example, the impacts of increasing communication effort (i.e. increasing value of communication effort rate) as project risk countermeasures against baseline project conditions where communication difficulty risk is higher. It is an example of this type of applications.

5. Applications as virtual case-data generation system

Application to automatically generate large amount of case-data of virtual projects by setting various values to parameters of simulation conditions, belongs to "applications as virtual case-data generation system" (Figure 4). A set of project attributes $A_i = [a_{1,i}, a_{2,i}, \cdots, a_{m,i}]$ and a set of project performance $P_i = [p_{1,i}, p_{2,i}, \cdots, p_{k,i}]$ which are result of simulation on the project attributes are paired, then a pair is recorded as the case-date of one virtual project. By generating value of each project attribute $a_{j,i}$ according to the assumed probability distribution (i.e. Monte Carlo simulation), dataset of virtual projects case-data are able to be generated.

The generated dataset of virtual projects case-data might use as benchmarking dataset to compare the competing methods to build estimation models.

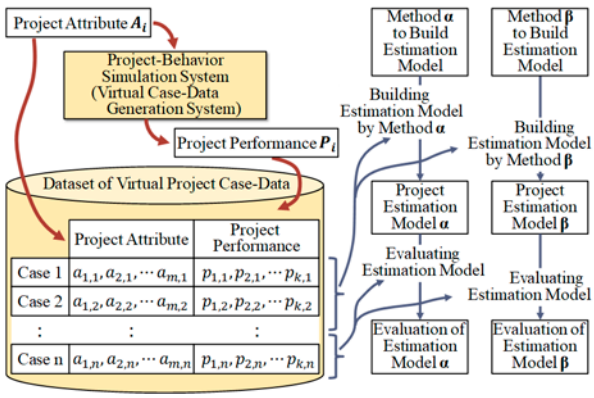

Figure 4 Applications as Virtual Case-Data Generation System

5.1 Comparing methods to build estimation models for approximate effort

Estimate of project gradually get accurate through ROM (Rough Order of Magnitude) estimate, budget estimate and definitive estimate. In approximate estimation of project effort, parametric models for estimation are usually applied (Hatsuda, Harada & Ohno 2002). These parametric models are typically built by using some sort of statistical analysis method to historical project case-data recorded within specific organization. Even though various methods to build estimation models (e.g. Kaneko 2011) were proposed and the accuracy of estimation model which was built by each method was clearly shown, it is difficult to compare the advantage of each method which was proposed by different researcher. Because the impacts from various differences (e.g. organizational processes, data measurement procedures/criteria, and so forth) inherently had mixed into the dataset within each organization, and which were not considered to build the estimation model for approximate effort. Comparing the advantage of each method to build estimation model, requires common and shared benchmarking dataset.

There is little study where estimation model was built by using common and shared benchmarking dataset (e.g. Tsunoda, Amasaki & Monden 2012). However, case-data in the benchmarking dataset are also collected from various organizations. Then, the case-data from different organizational processes, data measurement procedures/criteria, and so forth, are mixed.

For this issue, the applications as virtual case-data generation system have potential to provide homogeneous common benchmarking datasets.

5.2 Comparing methods to build estimation models to forecast project success or failure

Recently, it is ordinary that PMO (Project Management Office) supports projects organizationally (e.g. Okada, Miyazaki, et.al. 2014). In order to identify risky projects which should be supported by PMO, it is essential to forecast success or failure of ongoing projects objectively. Therefore, various studies on the estimation models to forecast project success or failure, had been conducted. For instance, both Mori, Kakui, et.al. (2014) and Kusano, Yokoyama, et.al. (2017) proposed the estimation models based upon naive Bayes classifier. Kawana & Yokoyama (2016) also proposed the estimation model based upon logistic regression. Moreover, Oba, Kono, et.al (2016) proposed the estimation model based upon deep neural network. Even though the accuracy of estimation model which was built by each method was clearly shown, it is also difficult to compare the advantage of each method which was proposed by different researcher, as same as the estimation models for approximate effort mentioned above. Because the impacts from various differences (e.g. organizational processes, data measurement procedures/criteria, and so forth) inherently had mixed into the dataset within each organization, and which were not considered to build the estimation model to forecast the project success or failure.

For this issue, the applications as virtual case-data generation system have potential to provide homogeneous common benchmarking datasets, again.

6. Applications as controlled system of project management

Project management could be modeled as "a series of project management actions which are decided based upon observed project conditions and are directed as control operations, in order to get closer to the planned target condition." In such model, project could be considered as a controlled system of project management. Application to derive the insights about decision-making and direction of project management actions by using simulation, belongs to "applications as controlled system of project management."

6.1 Estimating and comparing the impacts of project management (decision-making) logic

In this application, computer agents are implemented and added to simulation system. The computer agent observes the state of ongoing project on Probes-SD0, and makes decisions according to the observed project state, and directs project management actions to the project on Probes-SD0. By creating various computer agents with different project management (decision-making) logic, the impacts on project performance are estimated with simulation (Figure 5).

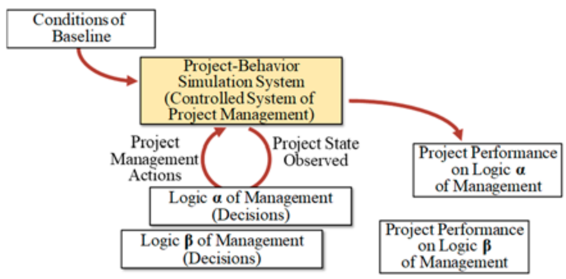

Figure 5 Estimating and Comparing Impacts of Project Management (Decision-Making) Logic

In order to improve the reality of simulation, it is important to explicitly express the different project management logic and to add them into simulation system. Moreover, potential of applications might expand by adding variety of project management logic which are explicitly expressed. For instance, Kusano, Yokoyama, et.al. (2017) considered experience years of project managers to build the estimation model to forecast project success or failure, because the decisions and actions of project managers would affect significant impacts to project success or failure. In order to generate the benchmarking dataset which reflected the experiences of project managers, it would be required to add project management logic which are explicitly expressed into the simulation system.

6.2 Estimating and comparing impacts of project objectives and rewarding criteria

In this application, computer agents are implemented as autonomous learning AI (Artificial Intelligence) agents rather than agents with explicitly expressed logic.

Recently, progress of AI (especially machine learning technologies) is remarkable, and AI agents had obtained the capability which surpass the human intelligence in Shogi and Go games (Ministry of Internal Affairs and Communications, Japan. 2016). Machine learning technologies are generally divided into two types. One is to learn estimation rules from dataset preliminary recorded. The other is to learn decision rules through dynamic interactions such as Shogi and/or Go games, which is called "reinforcement learning." By applying reinforcement learning, computer agents, which are able to autonomously learn the semi-optimal project management logic or decision rules, were able to be implemented (Okada 2017).

By combining the autonomous learning agent with Probes-SD0 as controlled system of project management, it is able to automatically perform iterative learning processes. To give the different project objectives or rewarding criteria, the impacts on learning results would be compared. Therefore, it has the potential to grow to theoretically studies, which explore the impacts of setting project objective and/or rewarding criteria on project performance.

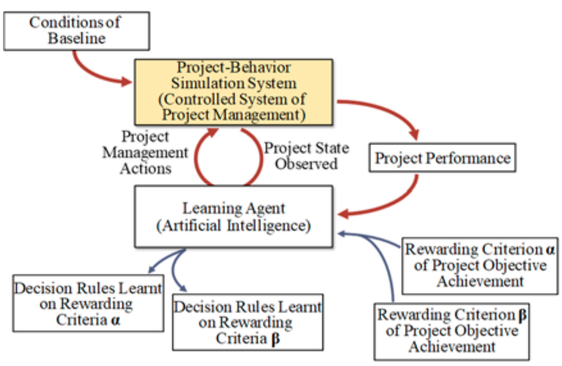

Figure 6 Estimating and Comparing Impacts of Project Objectives and Rewarding Criteria

As preliminary study, Okada (2017) had implemented the computer agent that autonomously learns the semi-optimal project management logic or decision rules with combining the very primitive project-behavior simulator which is much simpler than Probes-SD0, by applying Q-learning which is one of the reinforcement learning algorisms. Then, it was confirmed that the difference of project objectives and/or rewarding criteria (i.e. focus on minimizing schedule delay versus minimizing cost overrun) affects the project management logic which the agents learnt and the final project performance (Figure 7). This study might obtain much reality by applying Probes-SD0.

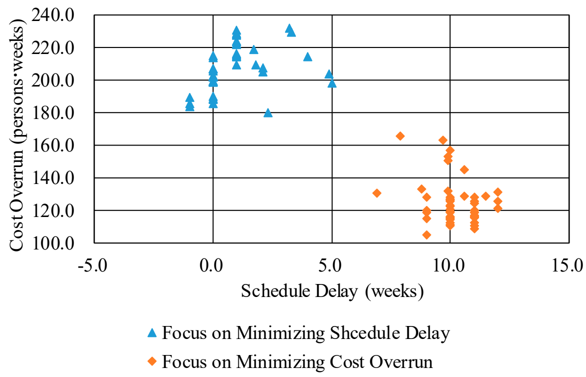

Figure 7 Impacts of project objectives and/or rewarding criteria

7. Conclusions

Research on project management inherently has difficulties, compared to research on routine operations such as production management, inventory management, and so forth. Because projects as a subject of study have the nature such as uniqueness, long-term (duration from project start to appraising the project outcome is long), few cases (there are few samples in a population), trial-difficulties (failure is not tolerated then it is impossible to try in extreme conditions) and so forth. Therefore, the project-behavior simulation system as a research platform for project management has been prototyped by the authors. In this article, the author discussed applicability of it and addressed that it could be applicable for three types of its applications as follows: (1) Applications as impact estimation system, which can compare the impacts of different conditions or policies/countermeasures. (2) Applications as virtual case-data generation system, which may generate virtual project case data as benchmarking dataset. (3) Applications as controlled system of project management, which can combine with computer agents to compare the impacts of different agents' project management logic. Moreover, the author showed the potential of applications to combine project-behavior simulation system as controlled system of project management with autonomously learning AI agents in order to study the impacts of project objectives and/or rewarding criteria on project performance.

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Case Study of Structure of Development System and Operation to Meet a Request of Cost Reduction by 30%

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We, NST (NTT DATA System Technologies) have been engaged in system operation and maintenance of a specific client for a quarter of a century. In recent years at system operation and maintenance, it has been required to keep high qualities and reduce more costs of development system. In order to achieve the substantial cost reduction, we considered an introduction of offshoring development and nearshoring development as a basic policy. Then, we decided to apply the development system called "Kashiwa Nearshore", it actively promotes Diversity and Inclusion -adapting differences of each skill and working time- and the off-site base is located at 5 minutes on foot from an on-site base. The purpose of introduction is to improve several problems of offshoring development and nearshoring development caused by communication and relax some restrictions of the work scope. That introduction led to reduce the cost by 30%, compared to on-site development although they had been responsible for the most part of the work scope and kept the quality level. We will introduce the case study of structure of development system and operation, "Kashiwa Nearshore".

Keywords and phrases: Offshoring, Nearshoring, Communication, Work Scope, Cost Reduction

1. Introduction

For a long time, we have been involved in system operation and maintenance for a specific client. In recent years, in order to correspond to some changes in this business, client's management is spurring management of an attack on. Therefore, systematization projects have been rapidly increased. To realize more systematization projects in the limited budget, it is required to build the development system the unit cost of personnel is suppressed.

To establish the development system, we started to consider whether introducing new nearshoring development, or expanding the offshoring development which was under operation at present. However, at conventional offshoring development, it becomes more difficult to reduce the cost like the decade front because there are some problems, soaring of personnel expenses of foreigner programmers (mainly, Chinese and Indian) and risk by exchange. As a common problem of conventional offshoring development and nearshoring development, when the quality and the productivity are aggravated by lack of communication, the recovery cost occurs and there is risk by offsetting the merit of inexpensive unit price. Moreover, development at distant place was something more difficult because it is required for the work scope as the on-site standard from a client.

Accordingly, we decided to consider new system development dispensation = introduction of "Kashiwa Nearshore" to plan for compatibility of the cost reduction and the work scope of the off-site standard. When client's requirement is put in order, the following will be 5 points.

(1) The cancellation lack of communication
(2) Covering the work scope as the on-site standard
(3) Cost reduction to the conventional nearshoring development standard
(4) Observance of the security requirements and a development environment of the nearshoring clients established
(5) Keeping productivity and quality standard of the conventional offshoring and nearshoring development

To settle (1) and (2), it was necessary to be based in an on-site or in close range of on-site. Therefore, we started to consider whether it's possible to build a new development system and an off-site base which was within the walking range from an on-site base.

It will generate some new problems to establish an off-site base in a downtown suburb against a cost reduction and the supply of human resources. To solve the problem of a cost reduction, we focused on diversity management and adopted it. It makes a cost reduction as the conventional nearshoring development standard possible to include members limited by working at on-site by the restrictions of a skill and members who have restriction in working full-time at on-site though they have skills required to develop primarily.

Now, we introduce the structure of "Kashiwa

Nearshore" = new system development dispensation which make it possible to satisfy client's request mostly and has established as main off-site base at present, application cases and their evaluations. In addition, we also introduce the applied condition and the operation rules from a case.

2. Approach to task

We dug client's requirement up from the characteristic of the project. Then, we sort out the problem which should be settled and formulate the solve policy to satisfy a requirement.

2.1 Characteristics of project

This project is the feature that there are many chances of presentation of conditions because the systematization project is the small lot production of many products. Requirements are shown intermittently, and we need more time to adjust their requirements. In addition, it frequently occurs to rework by lack of understanding of a requirement and a change request, then it takes the cost unexpectedly. When introducing offshoring and nearshoring development, it's necessary to satisfy a requirement of the security and the development environment a client established.

Summarizing the feature of our project, although it isn't difficult to respond to the requirement of a development environment because it has no degree of freedom and is clear. However, it is important to communicate in real time as far as it's possible because projects have to respond to the client's request flexibly to execute it appropriately.

2.2 Organization of customer's requirements

Gathering requirements from a client, including consideration of the characteristic of the project, it's necessary to build the environment and a system the following are filled.

- Development system that it can correspond flexibly to a change request and the small lot production of many products
- Bringing the scope of the development process close to on-site
- The operation cost of the off-site standard
- Preparation of the development environment a client shows
- Observance of the security requirements a client shows
- The quality of the off-site standard which is under operation at present

2.3 Arrangement of issues for realization

In order to meet client's requirement, we organized issues to be solved.

(1) Communication

In the conventional offshoring development, it often occurs difference of the interpretations of word and understanding of a specification because they work between the engineers whose mother tongue is different. As a result, it causes a delay in work and an influence on quality of deliverables. Problems with language don't occur in nearshoring development in the country. However, it's a distant place from on-site, then it is difficult to explain the small specification by communication by a mail and the telephone. Therefore rework isn't uncommon and it is one of a factor of cost increase of a project. A conference call, a television meeting and the internet meeting are often employed as a communication tool between the bases. Though, compared to meeting, it isn't possible to communicate enough by connection sharpness of a line and sound and disorder of a picture. In addition, these communication tool have also problems which is the restrictions by a place, an equipment cost of a circuit between the bases, and anxiety in a security.

Frequent presentations of requirements that is the project feature occasionally occurs differences in recognition by difficulties of communication at the on-site side. It is difficult to solve the communication problem in the off-site development where there is no communication tool of meeting. In the offshoring development which is operated previously, the same problem was held.

(2) Work scope

Members at offshoring development and nearshoring development often play the role of the range of detailed design process to testing process due to communication problem and skill problem.

The work scope is also limited from a physical reason by security requirements. For example, it's given that an audit trail can't be submitted to the on-site side for the restriction which can't take printed matter out. Moreover, it is impossible to implement an ST with execution of a process for which execution authority is not given.

It'll be a general problem that offshoring and nearshoring development are impossible to settle work by the physical restrictions.

Although the physical workable range was proportional and expanding in the following period at the antecedent offshoring development, there are similar problems about impossible work in the physical restrictions.

(3) Cost

The most part of the production cost in the system development is the personnel expenses. One of the ways to suppress the personnel expenses is utilization of offshoring and nearshoring.

The expectation of cost reduction tends to decrease because the personnel expenses of the Chinese vender which is a major country of Japanese offshoring are even going up to the standard beyond 2 times in several years. Therefore, the number of Japanese companies which succeeded in offshoring development keeps decreasing. The number of enterprises which keeps offshoring development away is also increasing because an additional cost occurs by an exchange risk of production cost soaring by fall in the yen and a country risk.

There are also problems that the unit price has no great differences compared to metropolitan area and engineer's securement is difficult in nearshoring development.

As described above, There are several problems with a change in the environment that offshoring is surrounded and in utilizing nearshoring. However, when placing the simple average unit price per 1 man-month in inexpensive order, it is offshoring, nearshoring and on-site. Therefore, utilization of nearshoring is still the strong means to lose the unit price.

In the antecedent offshoring development, there is an advantage of cost in the possible work scope, but we couldn't increase the requested work by problems of communication and operational scope.

(4) Security / Development environment

There is a possibility that becomes a risk to system development in offshoring development because security consciousness is lower than in Japan, depending on the country and region.

It is required to satisfy the client's request of the security and the development environment at the off-site base. It also costs a lot of money for the equipment to obey a security requirement, education and preparations of a development environment.

In preparing infrastructures that satisfy client's requirements in security and development environments, it was able to exclude it from the task because it can take advantage of the experience of building offshoring development system.

(5) Quality / Productivity

Because of lack of understanding of a vender to the quality and progress at offshoring development and nearshoring development, the quality and the productivity are not stable easily. It increases in the cost by the quality because it takes measures of prevention risk from quality trouble beforehand in recent years. There is also a problem caused by person concerned consciousness, such as low consciousness to obstacle correspondence and noncompliance of a project rule and the development standard, and it strongly influences the quality of the deliverables.

The requested work rate in the antecedent offshoring development system is small, so the quality and the productivity are stable. However, it have taken several years to be stable, and it was necessary to correspond the occurrence risk by compound problems about the quality and the productivity, communication, and operational scope to expand sharply.

2.4 Formulation of resolution policy

The development system to satisfy a requirement from client and a present development system (on-site, offshoring and nearshoring) were summarized in an evaluation table (Table 1) about the problem put in order.

It was necessary to settle problems (1) communication and (2) work scope while keeping a cost reduction of the present offshoring standard to satisfy client's requirements more. At a general off-site base, it is impossible to settle (1) Communication and (2) work scope.

Therefore, we decided to advance consideration about a possibility of building the development system based on nearshoring at the place very close to on-site.

- Off-site location

To settle problems of communication and work scope, it was necessary to establish an off-site base near the on-site base from the following reasons.

[The communication density is raised.]

> It becomes possible to go back and forth between the on-site and exchange in face to face by bringing an off-site base closer. There are a lot of chances of presentations of requirements and specification confirmation on characteristic of the project, but it expect prevention of rework and improvement of working efficiency by exchanging in face to face.

Table 1 Evaluation table for project application

Category			Current on-site		Current Offshoring		General Nearshoring		Ideal Nearshoring	
Communication	Language	to on-site	-		Japanese		Japanese		Japanese	
		off-site	-		Foreign language		Japanese		Japanese	
	Means of communication with on-site	Face to Face	-		NG		NG		NG	
		Mail	-		OK		OK		OK	
		Phone	-		OK		OK		OK	
		Video conference *1	-		NG		NG		NG	
Work scope			(Environment)	(Skill)	(Environment)	(Skill)	(Environment)	(Skill)	(Environment)	(Skill)
	Requirement Definition		✓	✓	✓	*2	✓	*2	✓	✓
	Foundation Design		✓	✓	✓	*2	✓	*2	✓	✓
	Make		✓	✓	✓	✓	✓	✓	✓	✓
	Unit Test		✓	✓	✓	✓	✓	✓	✓	✓
	Integration Test		✓	✓	*2	*2	*2	*2	✓	✓
	System Test		✓	✓	×	×	×	×	✓	✓
	User Acceptance Test		✓	✓	×	×	×	×	✓	✓
	Risk of low working rate		-		High risk		High risk		Low risk	
Cost	Personnel expenses		1.0		0.5		0.6		0.5〜0.6	
	Currency risk		No risk		Risky		No risk		No risk	
Security	Customer requirement		-		Compliance		Compliance		Compliance	
Quality / Productivity			Achieve the standard		Achieve the standard		Achieve the standard		Achieve the standard	

*1 Unusable due to on-site side circumstances
*2 Some work is executable

> Face to face communication makes it possible to reduce risk of recognition difference when the request from the on-site side is suddenly changed.

[Physically impossible work is lost.]

> By enabling work at on-site, work that was impossible to implement due to security requirements could be possible. For example, an audit trail can't be submitted to the on-site side for the restriction which can't take printed matter out, and they are unable to implement ST with the execution of the process without execution authority. It is possible to carry out such work which has been limited in the conventional offshoring and nearshoring

In addition, by locating off-site base within walking distance, it is possible to reduce the cost and time involved in moving on-site and off-site.

- A new problem about cost

A new problem about engineer's supply occurred because an on-site base was a downtown suburb. The talent of the downtown suburb has a high average unit price per hour more than offshoring and nearshoring.

Therefore, we also considered whether it was possible to build a development system by the engineer with the low cost at a downtown suburb and utilize it. As a result, we thought they might be able to achieve it by applying the diversity management.

We thought it might be possible to secure the quality and the productivity of the nearshoring and offshoring standard by including in a development system to engineers limited in working on full time (including the emergency response of trouble) and young programmers restricted by applying their skills as engineers in the on-site.

From these results of consideration, we decided to apply new system development system = "Kashiwa Nearshore" as solution policy of the problem to satisfy client's requirements.

To achieve "Kashiwa Nearshore", we decided to do the feasibility study which is the next step.

3. Feasibility study

We started to implement feasibility study about the following 2 problems which weren't existed in the antecedent offshoring system.

(1) Secure the base

To secure the off-site base which is located very close to on-site to settle communication problem and work scope problem.

(2) Structure building

To build system which is secured the quality and the productivity of offshoring and nearshoring standard, though it's in a city suburb.

3.1 Secure the off-site base

We verified whether it secure a property as an off-site base which satisfies the following requirements.

- The security equipment which stops entry in night at the entrance of the building sharing part is installed.
- There is a floor area where necessary capacity can accommodate
- The rental is in the reach of the budget.

The property settled within the target budget could be found easily because an on-site base is located in downtown where rental price is lower than central city. However, there aren't a lot of properties that can secure security of entrance to be shared section. Also, there aren't also a lot of properties that can accommodate about one hundred people together.

We judged that it wasn't numerous, but it can be secured.

3.2 Structure building

A new development system of nearshoring has to supply an engineer from a downtown suburb. The member's average unit price per hour of the downtown suburb is higher than offshoring and nearshoring's one. However, we noticed that it's just an average and decided to consider what kind of restrictions existed in engineers with low unit price per hour. After that, it turned out to be engineers belonging to the green area in Figure 1.

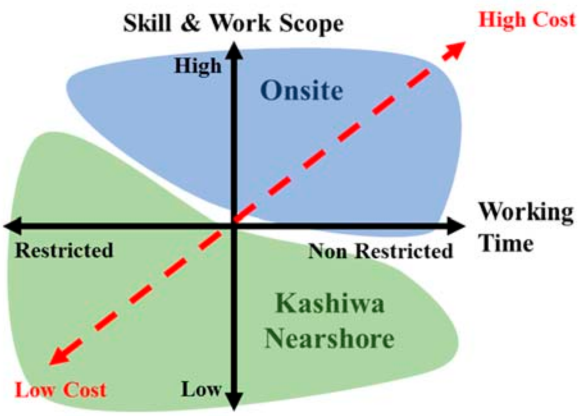

Figure 1 Relationship between skill variance and cost

- The engineer who has a problem in office hours

  Engineers who have the restrictions (child care, nursing and their health) in cutback of working hours and in planned attendance, although they have no problems of skill.
- The engineer who has a problem in the productivity and the quality

  The engineers who retired. (They have rich development experience but it takes time to remember new things or they tend to make some mistakes.)
- The engineer who has a problem in the available work scope

  A skill is insufficient or biased for the on-site correspondence where a skill balance is emphasized. (The young engineers who are expected growth are included.)

Therefore, the new development system of nearshoring decided to resolve systematic problems by incorporating the concept of diversity management. Although it permitted variation of possessing skills and restriction of a lifestyle, we judged that it could establish the average outcome of the whole operation system as well as the preceding offshoring by the advantage of location within the walking range from on-site.

We could also forecast that the necessary number of people for building a development system can be secured because it was good locational condition as a city suburb.

Based on these verification results, it was possible to propose introduction of the new nearshoring development based on conventional nearshoring development to a client and it was accepted. We started new nearshoring development = "Kashiwa Nearshore" where the off-site base is established in the location of 5 minutes on foot from an on-site base and which is introduced diversity management.

4. Management of Kashiwa Nearshore

Kashiwa Nearshore development basically manage quality control and progress as well as present offshoring development.

Characteristic of Kashiwa Nearshore will be the following 2 points.
- Operation of the development system that diversity management was taken in
- Operational implementation at on-site

4.1 Adopting diversity management

It's necessary to make an outcome as the whole system keep stable while accepting that the possessing skills and work schedules have variations by adopting diversity management. At the same time of accepting, development system managed to eliminate variations that can be resolved.

(1) System that accepts variations

When approving variations, important things are to grasp kinds of variations and to share work according to the variations.

Engineers at the on-site do the effort to achieve the work scope, degree of difficulty and a work plan. On the other hand, on diversity management, it is important to take work apart and arrange it thinking for engineers.

Basic management pattern is to grasp the variations of member's possessing skill by a skill map and of the member's working pattern by the pattern table of work, and plan and execute rolling responsibilities and work plan of request work according to the variations.

(2) Efforts towards elimination of variability

It'll be a way of thinking inconsistent with approval of variations, but it is also important way of thinking for diversity management to improve improvable variations. We make effort to pick the improvable skill item out from a skill map and train, improve degree of difficulty of work and increase new work item.

We positively incorporate young engineers with little development experience into the system, prepare tasks using past projects and train them to increase in effectiveness. This aim is to expand the engineers who can work full time. By improving to suppress such variations, we continuously do efforts to reduce operational burdens.

4.2 Work at on-site

At Kashiwa Nearshore, work that cannot be carried out in conventional offshoring became possible because there was an on-site base in location of 5 minutes on foot from an off-site base.

(1) Available work at only on-site

Even work that can be carried out only at the on-site due to security restrictions is incorporated into the work plan and implemented at the on-site as long as the off-site members have the skill of the work.

(2) Meeting in face to face

When a change of requirement and an operational adjustment occurred, a leader on the off-site side goes to an on-site base, has the explanation and confirms the work. The meeting in face to face leads to solute problems by mutual cooperation as well as prevention of the recognition difference.

5. Evaluation and verification of Kashiwa Nearshore

5.1 Kashiwa Nearshore achievements

Firstly, we show comparison with results in Kashiwa Nearshore and conventional offshoring development and nearshoring development in following table 2-table 8.

5.2 Evaluation and knowledge

Secondly, based on the actual value, the result of meeting the customer's requirements is summarized in the evaluation table (Table 9)

Table 2 Travel time from on-site

Offshoring	8 hours
Nearshoring	5 hours
Kashiwa Nearshore	Walking area

Table 3 Development experience

	Start Date	Duration *
Offshoring	December 2013	43 months
Nearshoring	November 2015	20 months
Kashiwa Nearshore	August 2015	22 months

* As of the end of June 2017

Table 4 Relative unit price compared to on-site

	Relative unit price	Reduction rate
on-site	1.00	-
Offshoring	0.49	-51%
Nearshoring	0.60	-40%
Kashiwa Nearshore	0.66	-34%

Table 5 Ratio of utilization by site

Year	2014	2015	2016
Offshoring	100%	60%	23%
Nearshoring	-	10%	17%
Kashiwa Nearshore	-	31%	60%
Host	-	19%	50%
Open	-	12%	10%

Table 6 Ratio of man-hours by process

Process	Design	Make	Test
Offshoring	25%	33%	42%
Nearshoring	0%	42%	58%
Kashiwa Nearshore	21%	50%	29%
Host	20%	56%	24%
Open	30%	23%	47%

Table 7 Coding production per man-month

Region	Host	Open
Offshoring	3,732	-
Nearshoring	-	608
Kashiwa Nearshore	5,086	1,859

Table 8 Number of indicated matters per man-month

Region	Host	Open
Offshoring	0.07	-
Nearshoring	-	0.56
Kashiwa Nearshore	0.10	3.14

Table 9 Evaluation list of correspondence result

Category			Ideal Nearshoring		Kashiwa Nearshore		Evaluation / Comment
Communication	Language	to on-site	Japanese		Japanese		
		off-site	Japanese		Japanese		
	Means of communication with on-site	Face to Face	NG		OK		Possible because it is within walking distance
		Mail	OK		OK		
		Phone	OK		OK		
		Video conference *1	NG		-		Unnecessary because on-site is within walking distance
Work scope			(Environment)	(Skill)	(Environment)	(Skill)	
	Requirement Definition		✓	✓	✓	*2	Although environmental problems were solved, there are problems with skills
	Foundation Design		✓	✓	✓	*2	
	Make		✓	✓	✓	✓	
	Unit Test		✓	✓	✓	✓	
	Integration Test		✓	✓	✓	*2	
	System Test		✓	✓	✓	*2	
	User Acceptance Test		✓	✓	✓	*2	
	Risk of low working rate		Low risk		Low risk		
Cost	Personnel expenses		0.5〜0.6		0.7		Nearshoring achievement level achieved
	Currency risk		No risk		No risk		
Security	Customer requirement		Compliance		Compliance		
Quality / Productivity			Achieve the standard		Achieve the standard		

*1 Unusable due to on-site side circumstances
*2 Some work is executable

(1) Communication

Compared to nearshoring and offshoring from table 2, travel time at Kashiwa Nearshore is overwhelmingly short. Therefore it became easy to hold the meeting in face to face. As a result, it made possible to settle the problem which is caused by lack of communication at Kashiwa Nearshore.

- The effect by being possible face-to-face meeting

> Efficiency of the early stage explanation of request tasks

Face-to-face meeting of the early stage explanations for request tasks led to make understand the tasks efficiently and prevent recognition differences because they can efficiently explain specifications that are hard to convey in terms of words and sentences and confirm questions immediately.

> Efficiency of QA and a change of specifications during correspondence of project

Face-to-face meeting of explanations for the confirmation matter and the change contents which is difficult to convey by words and sentences, such as complicated processing way, screen and forms requirement led to implement confirmation tasks efficiently and prevent recognition differences.

> Efficiency of solution problems of progress and quality

Face-to-face meeting of explanations about change of the schedule and the operational process caused by a problem of progress or quality led to solve several problems efficiently and prevent recognition differences.

(2) Work scope

From Table 2, because Kashiwa Nearshore has no location restrictions and no security restrictions, it is possible to work in wider range of processes from the 2nd year of the start of Kashiwa Nearshore system operation. In addition, as shown in Table 6, although the conventional offshoring regime carries out work in a wide range of processes, there are constraints on the work that can be requested, because it is impossible to do work with location restrictions and security restrictions.

- Eliminate physical work restrictions

  Kashiwa Nearshore development were able to solve the problem of work restriction and realize expansion of working scope by going to the off-site base directly.

- Improvement of operation ratio

  In conventional offshoring development and nearshoring development, standby man-hour in a quiet period was an issue. Due to the expansion of working scope, the prosperity gap narrowed and the operating ratio improved.

(3) Cost

- Cost of nearshoring level

  From Table 4, when the unit price of on-site is set to 1, the unit price of Kashiwa Nearshore is 0.66 and the cost reduction rate is about 34%. The unit price of offshoring is 0.49, and the cost reduction rate is 51%. The unit price of nearshoring is 0.60, and the cost reduction rate is 40%. We could approximately bring it up to the nearshoring level. If it is possible to regard the fact that the work scope is wider than offshoring development or nearshoring development and the problem of restraint is suppressed as the cost difference with offshoring, we are able to judge that the cost has been reduced to offshoring level.

- Non required travel costs

  Moreover, from Table 2, it was possible to reduce the traveling time and transportation expenses by having Kashiwa Nearshore located within walking distance.

(4) Security

Since the requirements for building security and development environment were based on the experience of offshoring launch, we were able to prepare the security and development environment which satisfy the client's requirements without problems.

(5) Quality / Productivity

From Table 7, the coding productivity is higher for Kashiwa Nearshore than offshoring.

- Achieved the target value of Kashiwa Nearshore productivity

  Since the nature of the request item (relation between the correction number per the request number and the number of correction steps per 1 item) in Kashiwa Nearshore is different from offshoring, it can't be compared simply. The coding productivity of Kashiwa Nearshore set the target value as the 5,000 steps per month, and it was achieved.

- Achieved the quality level of Kashiwa Nearshore

  From Table 8, with respect to quality, host development of the Kashiwa Nearshore achieved a quality level close to the targeted offshoring quality level. The open system in Kashiwa Nearshore has a poor result compared to the host by having the programming process of the new project correspond to the beginner programmer's OJT under the consent of the client, but it is not treated as an essential quality problem.

(6) Overall evaluation

- No.1 shared in project

  When estimating each system, result value of the cost, the productivity and the quality is an important point of view. However, rather than comparing the result values of cost, productivity, and quality, the results shown in the transition of the share of Table 5 are considered to indicate the most obvious results as a comprehensive evaluation from clients.

  In the second year since Kashiwa Nearshore was launched, we are reversing the share of offshoring. It seems that we got an evaluation that just fills the cost difference.

(7) Knowledge

[The importance of the closeness of physical distance]

There is the idea of collocation by collecting team members in the same place to enhance their response skills, but it is thought that this approach and outcome can be regarded as application examples of collocation on the geographical scale.

[Non evaluation of the result with the low cost]

If the difference in unit price per person is about this degree, it is considered that collecting engineers as much as possible in the same area and enhancing their response skills of development leads to an increase in overall evaluation.

In addition, regarding the gap of recognition with clients on the amount of results per man-month, which is easy to be treated as an off-site problem, there is no occurrence in Kashiwa Nearshore. By keeping the working rate (the time actually engaged in business per working hours) to the acceptance level, it is considered that it is effective that having located in the walking distance. Moreover, regarding the communication, the relationship among on-site distance, risk and cost is shown in Figure 2.

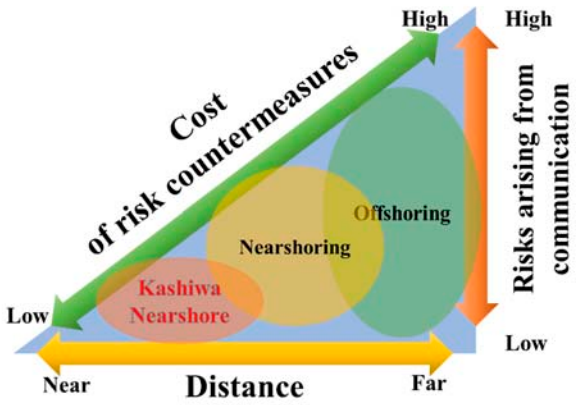

Figure 2 Effect of distance

5.3 Organizing remaining problems

(1) Reduction of variation of skill

Diversity management have established a system with a reduced cost, and because the physical limitations are eliminated, the range of available work is expanded, and there seems to be no problem as a result. However, due to variations in skills, the quality of available work is not sufficient. For example, in the testing process, few engineers are able to create test cases, many engineers focus mainly on possible tests in a simple procedure. Although the physical restrictions of the work scope are canceled due to the superiority of the location, skill constraints that can be improved remain more than in the offshoring area. It means that the effect of cost reduction can be further enhanced. It is the most important issues to do efforts to suppress variations in skills through training for maintaining and developing the Kashiwa Nearshore regime.

(2) Transfer to on-site

There are engineers who leave the project or transfer the project to the on-site due to the improvement of technical skills by training. It is an important element to motivate engineers working in Kashiwa Nearshore. However, immediately after the transfer, the average skill of the Kashiwa Nearshore will decline and it will be a dilemma that the variance in skill balance will not be resolved.

Problems related to relief of variation due to training, transfer to the on-site, and leaving the project must be recognized as issues that must be face from time to time if you operate a similar structure to the Kashiwa Nearshore.

6. Application conditions and operational rules

Based on the experience of Kashiwa Nearshore which has been operating for about 2 years, the application conditions and operation rules for introducing a near shoring development system similar to this application case are summarized as follows.

(1) Application period

When applying the diversity management system for the first time, apply it to maintenance system of medium to long term maintenance projects. Since it is possible to carry out the same kind of projects repeatedly, it is possible to improve the efficiency of the system operation method and to improve the quality and productivity of engineers.

(2) Location

As a location, within walking distance from the on-site base. If off-site base is located outside the range of walking, it might be similar to the usual nearshoring operation. Also, in the case of on-site city center, it is necessary to consider the rent cost.

(3) Scope of application

The application of diversity management needs to be operated at a scale larger than a certain level that is effective for diversity. If it is small, it will be biased towards members with specific constraints, so it will become a structure with characteristic constraints.

(4) Experience of applying offshoring and nearshoring development

Building an off-site structure by diversity management needs the experience of general offshoring or nearshoring development. Since the operation process for diversity management is applied in addition to the operation of the off-site system, the difficulty level of operation increases.

(5) Preparation for applying diversity management

Maintain training program to apply diversity management.

(6) Rotation issues

Problems relating to transfer of engineers with improved technical capability to the on-site system and leaving projects must be addressed as a difficult problem to be solved.

7. Conclusion

This time, we have established a system that responds to cost reduction demands and have operated by Kashiwa Nearshore system we introduced.

Although it is a system that requires sophisticated management such as diversity management, attempts to build and operate a development system with a cost reduction of 30% in the suburbs in our country are few cases.

Does the low unit price of man-month of offshoring and nearshoring lead to the effect of reducing the total cost of system development? This is one of the examples of trying to solve this problem of the balance among the cost, the productivity and the quality in offshoring and nearshoring with different approaches from other managements.

The results of Kashiwa nearshoring system operation will be summarized as follows.

[Results of Kashiwa nearshoring system]

- Construction of a system with a unit price reduced by 30%
- Solve various problems caused by communication
- Relaxation of work scope restrictions
- Achieve productivity / quality level of deliverables

Moreover, what we did to achieve this result is to bring the offsite development base closer to onsite. Therefore, the distance between teams is an important factor. From the application example of this time, points to be considered for distances between each team at the time of project plan are summarized as follows.

[Considerations on distance between teams]

- Increasing the distance of multiple teams within a single project leads to an increase in communication risk and risk correspondence cost (Figure 2)
- Utilization of long-distance off-site should be utilized in off-site and work that does not require communication
- In the case where it is necessary to utilize off-site for the purpose of cost reduction in work where communication occurs frequently, it should be considered including a pattern to construct a structure as close as possible from onsite

As a future prospect, we would like to further standardize the operation process of diversity management and increase cases of development system utilizing engineers in the suburbs similar to the Kashiwa Nearshore.

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Risk Management for Long Term Off-shore Outsourcing IT Projects

--- Introducing the Risk Control Process with Risk Classification ---

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It has become more essential for IT projects' outsourced partners utilizing offshore resources, to consider program management as well as individual project management. Especially in the risk management arena, however, it is getting essential to systematically manage challenges, such as unexpected, misinterpreted or varied risk factors (Complexity, Uncertainty, or Ambiguity) in long term outsourcing contracts. In this paper I have classified the risk management approach and determined the management process to comprehensively control the unexpected, misinterpreted and varied risk factors in the long term using the approach applied in the environmental risk management. Furthermore, I would like to show that the proposed risk control process is effective to visualize in time-series through case studies, using the risk evaluation criteria of agreement level between principal and agent.

Keyword and phrases: Risk Classification, Risk Evaluation, Off-Shore, Outsourcing, Agency Theory

1. Introduction

The risks of offshore outsourcing projects have been discussed in various papers (Herbsleb, 2001, Prikladnicki, 2003, Quélin, 2003). However, most of them have not really quantified their risks, considered unexpected, misinterpreted or varied risk factors in long-term contracts. It is insufficient for risk management of a single project to articulate risks in the long-term contract that neither covers unexpected, misinterpreted nor varied risk factor from time to time.

In accordance with the agency theory, principal do not possess the same objective or goal as that of agent (Karake, 1992). However, to effectively control the risk factors that these papers have identified, it is essential for both principal and agent to establish mutual understandings and agreement on such risks, based on comprehensive classification and structure of risk factors. There is a need for more comprehensive evaluation approach for risk factors, which are unexpected or non-quantifiable, for long-term outsourcing projects.

In this paper, Section 2 defines the classification structure of risk for outsourcing projects with focus on the agreement level, based on the relationship nature of principal and agent; or based on the classification structure of risks (Hanayama, 2016). Section 3 discusses the classification of risk approach and risk management process to consider unexpected, misinterpreted or varied risk factors in long term outsourcing contracts. Section 4 shows how this risk management process works through the cases. Finally, Section 5 discusses the benefits and challenges of this risk management process.

2. Classification Structure of Risk Factors

It is essential to recognize the structure of risk factors, which are identified in the various papers, as they influence one another. The HHM (Hierarchical Holographic Model) is introduced to define the framework of major risk factors for outsourcing projects in order to classify them structurally and comprehensively (Figure 1), (Haimes, 2002, Lambert, 2001, Hanayama, 2008).

The itemised risks (risk scenarios), classified based on this framework, are shown in Appendix-A. These risks are classified with five primary factors such as Strategy, Transition, Operation, Environment and Contracts. Each primary factor is detailed into secondary factors. The structure of relationship among this classification is defined as a risk management framework for the outsourcing project (Hanayama, 2016).

The next section discusses [I] Business Management Area, as defined in the master agreement, [II] Operation Management Area, as defined in the scope of work, and [III] Contract Management Area, as defined in contractual conditions in documents (Figure 1).

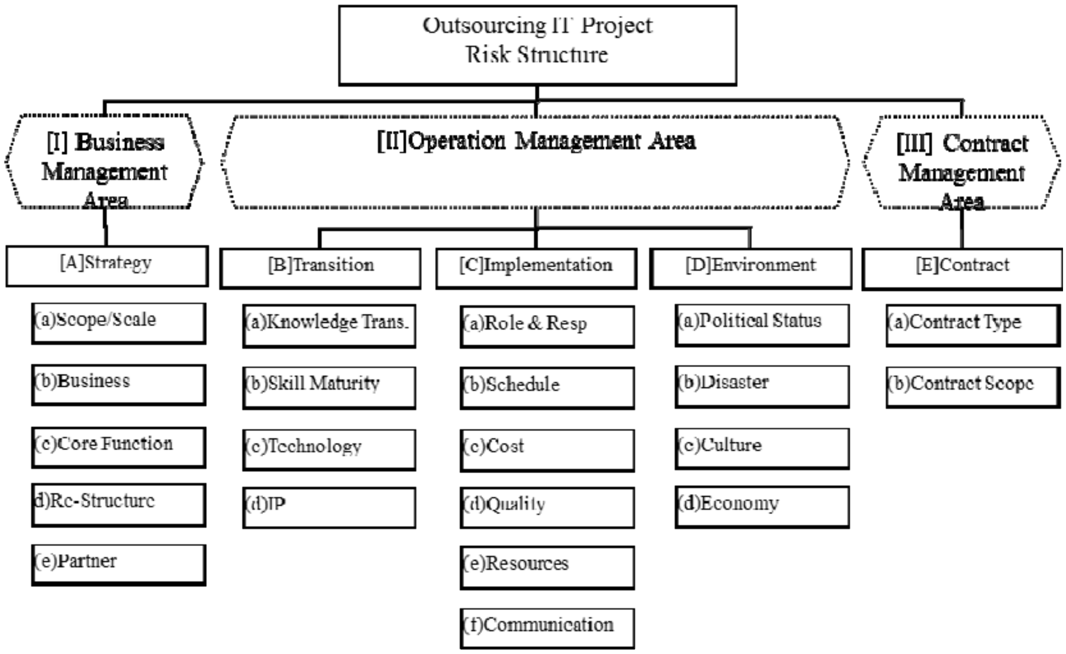

Figure 1 Classification and Structure of Risk Factors

2.1 Business Management Area

[A] Strategy:

Strategic long-term Business Plan should be well defined, to effectively introduce outsourcing scheme. The factors like "Scope, Scale, Continuity", "Business Strategy", "Core-Competency" and "Business Restructuring, Strategic Partnership" should be considered (Aubert, 1999, Heikkilae, 2002, Quélin, 2003). Table 1 shows the definition of the agreement level between principal and agent as its risk criteria (Score); the extent both principal and agent needs to agree on in terms of strategy (Hanayama, 2016).

Table 1 Risk Criteria for Business Management

Agreement Level Definition	Risk Criteria Score
Create joint long term plan with master agreement	**1**
Continuous discussion and sharing of long term plan	**2**
Regularly sharing of business plan	**3**
Inquire information only when necessary	**4**

2.2 Operation Management Area

[B] Transition:

The papers have indicated "Operation know-how & skill transfer", "Technical know-how transfer" and "Protection of Intellectual Property Right" as essential factors to utilize outsourcing partners (Aubert, 1998, Beulen, 2005, Prikladnicki, 2003).

[C] Implementation:

The risks, identified in the various papers (Aubert, 1998, Beulen, 2005, Prikladnicki, 2003) are basically classified into secondary categories, based on the PMBOK such as, Role & Responsibility, Process, Schedule, Cost, Quality, Resource and Communication.

[D] Environment (Country Risk):

Utilizing off-shore resources, National System (law & regulation), Natural Disaster (earthquake, typhoon, epidemic disease), Culture Gap (education, religion, custom, calendar) and Economic System (tax, merger, exchange rate); should be carefully considered (Aubert, 1998, Beulen, 2005, Prikladnicki, 2003). The risk criteria (Score), in the operation management area are defined in the Table 2.

Table 2 Risk criteria for Operation Management

Agreement Level Definition	Risk Criteria Score
SLA/KPI metrics clearly defined and agreed in the document (minimal gaps in expectation)	**1**
SLA/KPI metrics clearly defined but some gaps in expectation	**2**
SLA/KPI metrics not clearly defined and obvious gaps in expectation	**3**
No metrics defined or critical disruptions in operation	**4**

2.3 Contract Management Area

[E] Contract:

Finally, it is essential that the factors above are discussed, clearly documented and agreed as an SLA (Service Level Agreement) or KPI (Key Performance Indicator) in the contract or the memorandum (Gellings, 2007).

Clearly documented contract enables control of probability of risks and limit impacts from risks between principal and agent (Aubert, 1999). It can work out to be a challenge to document everything on contract, however this is crucial for the principal and agent to at best, detail, in document, the related KPIs or SLAs to monitor and avoid potential risks for long-term contracts (Aubert, 2003). Furthermore, there are multiple types of contracts (PMI, 2000, ITPA, 2004). Matching the characteristics of outsourcing work and type of contract is also an important factor to minimize project risks. Figure 2 shows a categorization of the type of contracts based on the nature of outsourcing work, considering the correlation between 'Flux of Scope/Volume of work' versus 'Flux of Quality or Productivity'

The agreement level (risk criteria score) between principal and agent in terms of coverage of scope in contract and its consistency to type of contract with nature of work; is defined in Table 3.

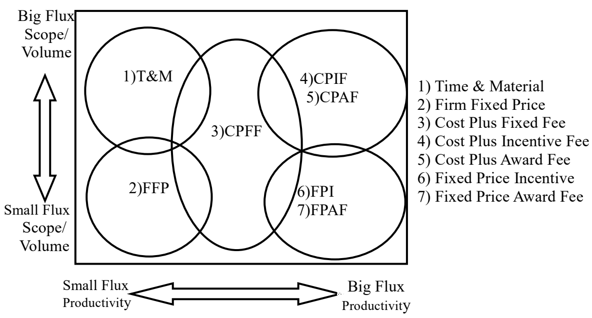

Figure 2 Type of contract vs Type of work

Table 3 Risk Criteria for Contract Management

Agreement Level Definition	Risk Criteria Score
Contract Type is consistent with the nature of work. Additionally KPIs/SLAs are agreed in the contract.	**1**
Contract Type is consistent with the nature of work. However KPIs/SLAs are not agreed in the contract	**2**
Contract Type is not consistent with the nature of work. Additionally KPIs/SLAs are not agreed in the contract.	**3**
Contract Type is not consistent with the nature of work. Additionally even scope is not clearly agreed in the contract.	**4**

3. Risk Management Approach and Control Process

In a long-term outsourcing project, it may not be possible to mitigate every risk due to unexpected, misinterpreted or varied risk factors. It is important to continually bring them into under provisional control. To realize this 'under control' situation, it is essential to narrow down risk approaches in accordance with nature of risk factor.

This section discusses the classification approach for risks and the risk management process in order for comprehensive and effective management.

3.1 Classification of Risk Management

Andreas Klinke et al (Klinke, 2002) discussed their definition of risk management with Complexity, Uncertainty and Ambiguity (Table 4) in order to manage social environmental issues or risks. In addition, they show the effectiveness of combination approaches with Risk Based, Precaution Based and Discourse Based (Table 5) for these risks as well.

Table 4 Classification of Challenges

Complexity	The difficulty of identifying and quantifying casual links between a multitude of potential candidates and specific adverse effects.
Uncertainty	Reduce the strength of confidence in the estimated cause and effect chain by the statistical variation, measurement errors, and ignorance.
Ambiguity	Come from differences in interpreting factual statement or differences in applying normative rules to evaluate.

Table 5 Risk Management Approaches

Risk Based	Quantitative Safety Goals, Exposure Limits, Standard Process
Precaution Based	ALARA(As Low As Reasonably Achievable) BACT(Best Available Control Technology) Containment in Time and Space, Monitoring of potential side effects. Irreversibility, Vulnerability, Robustness
Discourse Based	Deliberative Rules-Making, Consensus-Building, Mediation

In an outsourcing project with long-term contract, it may not be easy to prepare appropriate counter measures for unexpected, misinterpreted or varied risk factors. Therefore, it becomes more effective for risk management to narrow down the approaches based on these classification and approaches. Table 6 shows an example of major risk counter-measures based on the classification of challenges (Table 4) and risk management approaches (Table 5). Of course in a complex case, the combination of approaches should be considered.

The complexity, clarification of requirement and scope, standardization of process, or definition of index to monitor risks, should be improved for the visualization of risk. In addition, appropriate KPIs, monitoring approaches should be discussed and authorized among the experts or stakeholders.

The uncertainty, best practices or lessons & learnt should be applied, although cause-effect relationship is unclear. When anticipating huge impacts, the prevention action should be taken in order to limit size of impact or minimize continuous impact.

As for the ambiguity, it should be of more importance for principal and agent to discuss and agree if they are able to tolerate risks or take appropriate countermeasures. Additionally, it is also effective to have independent experts prove the appropriateness of approach.

Table 6 Challenges and Example of Approach

Challenge	Approach	Example of Approach
Complexity	Risk Based	Clarification of the Scope of Work Clarification of Requirements Definition of Criteria/KPIs (Quality, Productivities) Measuring, Monitoring, Analysing KPIs Standardization of work process Risk Quantitative Analysis(Impact x Probability)
Uncertainty	Precaution Based	Introducing Lessons & Learnt, Best Practices Backup Facilities or Resources Considering Changes of circumstances or Technology Considering Variation, Flexibility Cost-Benefit Analysis Cross-Cultural Training
Ambiguity	Discourse Based	Verified by Experts/PMOs (Validity) Certified by External Experts (Formality) Principal/Agent Discussion (Tolerance) Define Escalation Rule (Escalation Process) Stakeholders Discussion(Consensus Building) Define the Independent Body (Settlement).

It is necessary for both principal and agent to comprehensively improve their risk approach in terms of not only single project but also for long term program. For example, both principal and agent must establish agreement through the processes that principal show agent clear requirement and scope, and agent show principal what they have understood on scope and requirement as well as how they are going to deliver to principal at the same time. For diversity or flexibility, it is important for both principal and agent to agree on how much they would consider on risk impact in advance as well. Additionally, it is crucial that they define and agree on clear escalation process, in the event of discrepancy of scope and requirement. In any event, unless both principal and agent reach mutual and concrete agreement, it is not recognized as an effective risk mitigation.

With this approach, it is necessary for principal and agent to visualize and evaluate the level of agreement in accordance with the risk structure in Section 2.

3.2 Long term Risk Control Process

For the long term outsourcing projects, the risk factors, including unexpected, misinterpreted or varied factors, should be continually monitored during the contract period. In this paper, the risk management approach, which Andreas Klinke et al. (Klinke, 2002) proposed in social environmental issues, is customized for the long-term outsourcing project in order to monitor its risks and challenges. The three primary steps are proposed as follow (Figure 3).

[I] Build knowledge base of risk characteristics such as root cause, probability and impact size, based on the experienced challenges or predictive information.

[II] Define the criteria of tolerable or acceptable level, or the mitigation plan for the risks based on the knowledge base of risk characteristics. Monitor if these criteria of risks are within the assumption for the predefined countermeasure.

[III] In case the criteria of risks are exceeded due to the unexpected, misinterpreted or varied factors, the 6 secondary processes, based on the classification of challenges and risk management approaches, should be proceeded;
<1> Improving precaution (precaution based)
<2> Providing substitution (precaution based)
<3> Ascertaining probability (risk based)
<4> Reducing potential Impact (risk based)
<5> Strengthen responsibility (discourse based)
<6> Building confidence (discourse based)

Iterating these steps and processes until specific mitigation plan or countermeasure, enable principal and agent to build the knowledge base including unexpected, misinterpreted or varied risk factors, and maintain the high level agreement between them. As a result, even provisional level of risk control could be put in place to enable us to comprehensively and consciously monitor and improve risk factors including the unexpected, misinterpreted or varied factors.

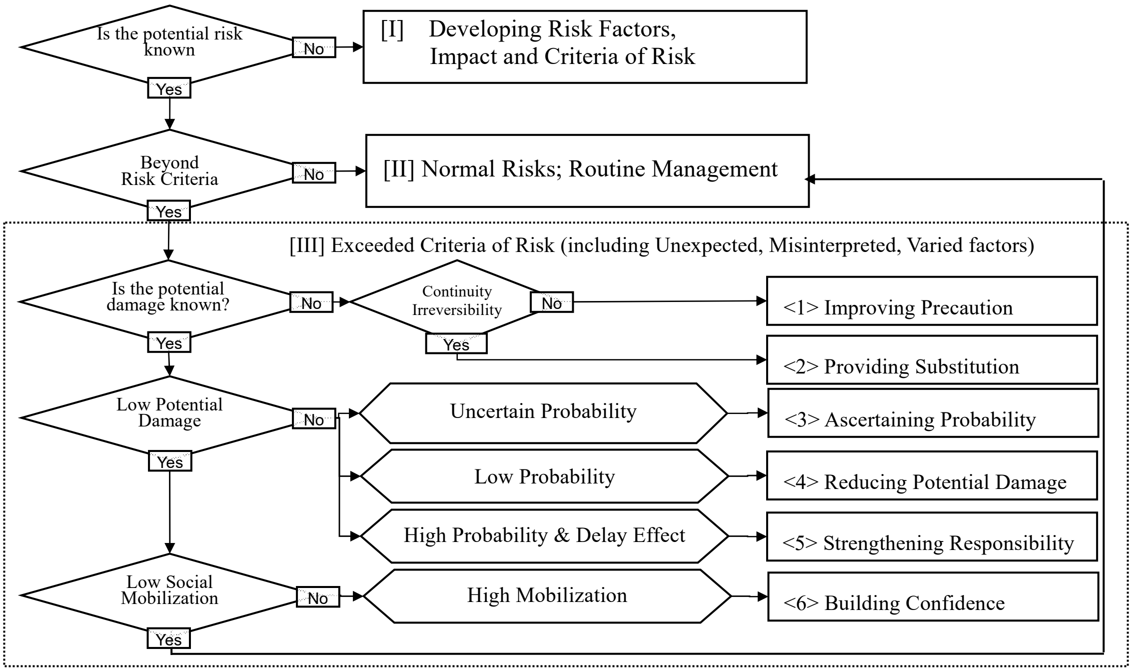

Figure 3 Risk Management Control Process for Long Term Outsourcing Project

Table 7 Cases of Project Outline

Project	Scale	Scope	Contract Type
Case 1 Customer: USA	Annual Ave. 500 Man month	Software Development, Maintenance, Testing CMMI3, ISMS	Firm Fixed Price Time & Material 7 year Contract
Case 2 Customer USA	Annual Ave. 650 Man month	Software Development, Maintenance, Testing Customer's Standard	Cost Plus & Incentive Yearly Contract

4. Case Studies of Proposed Risk Management Control Process

This section shows effectiveness of the proposed risk management control process in Section 3 with the agreement level risk criteria in Section 2, being applied for the cases of software development and maintenance projects to chronologically monitor and control their risks level.

Major risk scenarios are classified into the structure that is defined in Section 2 in order to evaluate risk in each primary risk factor. These scenarios are evaluated by following the risk criteria, which are defined in the Section 3. To simplify the assessment of the risks, the simple mean value of each secondary item is used for the primary risk evaluation (refer to Attachment-A: e.g. Case-1 Risk Evaluation).

For example, Strategy is broken down into five secondary items. The risk scenario related with scope or size, are explained with 4 majors risk items, scope of work (3.0), scale (4.0), duration (4.0), and change management or scope creep (3.0) based on the risk level of table 1. Each risk item is scored using the definition of the criteria in Table 1 in Section 3 and the mean value of those score for four items (3.5) will be the secondary item (scope and size) risk's score. This approach is applied for other secondary items such as business strategy, Core/Non-Core etc., which has been taken to obtain the risk score for primary risk item (Strategy: 3.4). The other four primary risk items such as transition, implementation, environment and contract, are scored using the same method, using the risk criteria (Table 2, Table 3) defined in Section 3.

In accordance with the proposed risk management control process, the trend of risk level in each category has been chronologically evaluated and analysed annually.

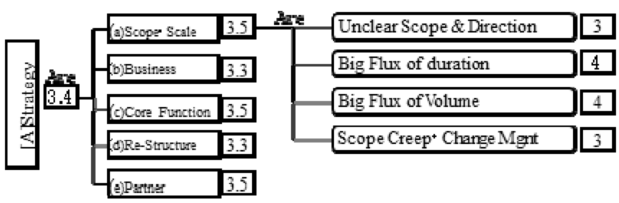

Figure 4 Calculation of Risk Level

4.1 Case-1

Table 8 shows the list of major actions of case-1 for the unexpected, misinterpreted or varied risk factors in each risk category. Approaches of actions follow with the process explained in Figure

3. Thereafter, Figure 5 shows the trend of risk level in accordance with the agreement level from start of contract.

The unexpected and varied risk factors in the transition and operation area is considered to have been controlled at the higher level of agreement between principal and agent, although it has taken a long time. For example, ISMS was introduced into security standard as a best practice in this project, however principal was concerned about validation against their security requirement after that. As a result of prolonged discussion with principal, independent expert was assigned to validate and certify the security system against the requirement. In this case, combination approach of precaution based, risk based and discourse based had to be necessary to control this risk.

On the other hand, this project faced huge challenges in the Strategy area and Contract area in the third year of contract due to the principal's merger and replacement of the person responsible for the contract. Items marked * in Table 8 show key negotiation actions failed to reach agreement with principal in the Strategy area. Therefore, risk level could not be improved and was retained at high, especially the agreement level in the 4th year dropped; and risk level significantly surged to 3.4 score (Figure 5). As a result, it became too big a gap in strategy and contract condition for both principal and agent to continue this outsourcing project, and finally causing the early termination of contract.

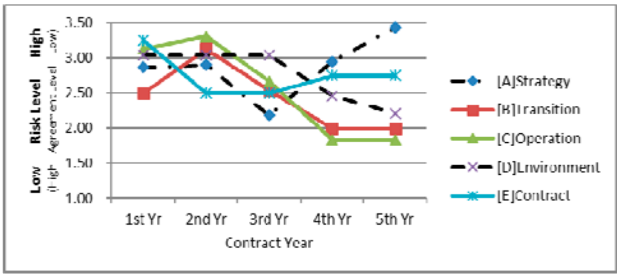

Figure 5 Trend of Risk level of Case-1

Table 8 Case-1 Actions for Risks (*Failed to agree)

	Main Actions for Risks	Approach	Timing
[A]	1) Risks of changes of strategy due to customer's M&A		
	a)Negotiation to maintain the original scope/volume(*)	<1>	3rd Year
	b)Negotiation of role & responsibility(*)	<5>	3rd Year
[B]	1) Risks of immature business skill/knowledge		
	a) Additional Training by Principal key resources	<1>	1st Year
	b) Regular on-site training for Agent key resources	<1>	2nd Year
	2) Risk of key Legacy-Tech Resources Key retirement		
	a) Training for replacement of resources in agent side	<5>	2nd Year
	b) Skill-transfer planning by principal side	<6>	2nd Year
[C]	1) Risks for Delivery Quality		
	a) Introduce CMMI-3 process (Standard Process)	<1>	1st Year
	b) Setting target KPIs and Inceptives for achievement	<3>	3rd Year
	2) Concerns on Security Level and Validation		
	a) Execute Standard process such as ISMS	<1>	1st Year
	b) Validate both Principal's and Agent's execution	<5>	2nd Year
	c) Regular Validation by Independent Auditors	<6>	3rd Year
[D]	1) Risks for business continuity by natural disaster		
	a) Install backup Network to Customer's Onsite	<2><4>	1st Year
	b) Install Alternative Support Site in Agent side	<2>	3rd Year
	2) Risks of misalignment operation due to cross culture		
	a) Exchanges cultures between Principals and Agent	<1>	1st Year
	b) Team building between Principals and Agent	<6>	2nd Year
[E]	1) Risks in contracts due to the M&A		
	a) Review the ambiguous condition in contract (*)	<1>	3rd Year
	b) Minimize Gaps in contract and current operation (*)	<3>	3rd Year

[A] Strategy, [B] Transition, [C] Operation, [D] Environment, [E] Contract
<1>Improving Precaution, <2> Providing Substitution, <3> Ascertaining Probability,
<4> Reducing Potential Impact, <5> Strengthen Responsibility, <6> Building Confidence

4.2 Case-2

Table 9 shows the list of major actions of the Case-2 for the unexpected, misinterpreted or varied risk factors in each risk category. Approaches of actions are followed with the process explained in the Figure 3. Thereafter, Figure 6 shows the trend of risk level in accordance with the agreement level from start of contract.

At the beginning of contract, there were no agreement on the Strategy, however the discussion on the entire outsourcing Strategy area and Contract area began intensively in the second year between principal and agent. As a result, entire agreement level improved significantly and risk level was considered to have been kept significantly low from third year (Figure 6).

Table 9 Case-2 Actions for Risks

	Main Actions for Risks	Approach	Timing
[A]	1) Concerns on various strategy (Scope/Volume)		
	a) Limit scope and Resource training plan	<1><5>	2nd Year
	b) Alignment of Pipeline and Resource-Plan	<1><5>	2nd Year
[B]	1) Risks for Surge of Volume		
	a) Additional Training by Principal Key Resources	<1>	1st Year
	b) Regular on-site training for Agent key resources	<1>	2nd Year
[C]	1) Risks for Delivery Quality		
	a) Introduce CMMI-3 process(Standard Process)	<1>	1st year
	b) Set & Monitor Quality	<3><5>	2nd Year
	c) Setting target KPIs and Inceptives for achievement	<3><5>	2nd Year
[D]	1) Risk of Exchange Rate		
	a) Renegotiation condition against greater than+-5% variation	<2>	3rd Year
	2) Risk of Attrition of Key Resources		
	a) Provide incentives for skill-set/ achievement	<3>	2nd Year
	b) Provide Continuous resources training program	<1>	3rd Year
	c) Team building by Principal and agent	<6>	3rd Year
[E]	1) Risks in contractual conditions		
	a) Switch contract type(Cost Plus, Incentive) (Open Book Cost Management, Risk Sharing)	<1><6>	3rd Year
	b) Regular Validation of Scope of Work	<1><5><6>	3rd Year

[A] Strategy, [B] Transition, [C] Operation, [D] Environment, [E] Contract
<1>Improving Precaution, <2> Providing Substitution, <3> Ascertaining Probability,
<4> Reducing Potential Impact, <5> Strengthen Responsibility, <6> Building Confidence

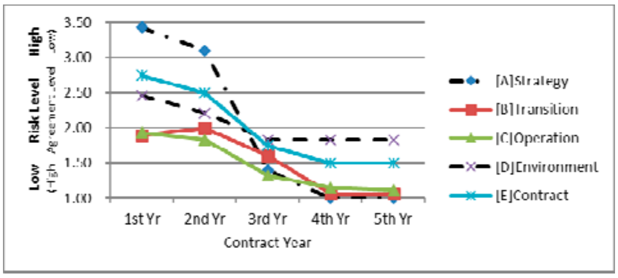

Figure 6 Trend of Risk level of Case-2

Originally both principal and agent were concerned about cost variation risk against work volume. Therefore, agent agreed to introduce the open book management for agent's project cost to provide reasonable price, on the other hand, principal agreed to commit minimum volume for agent to be able to keep reasonable profit. As a result, although agent's margin rate has fallen to low, work volume became four time the beginning of contract. This contract became significantly stable and a win-win situation from 3rd year.

This project has faced high risk of attrition rate in the environment area during early stage. Both agent and principal had jointly introduced incentive and team building programs to retain the existing resources, and had additional training program to introduce new resources as well. As a result, both principal and agent were able to forge mutual trusts and confidence.

In addition, when scope and volume rose four times, principal and agent prepared the recruiting plan, training plan for knowledge transfer in the transition area; and clearly agreed on their evaluation approach and responsibilities (Figure 6).

4.3 Observation

It is more important for principal and agent to reach clear agreement in order to even provisionally control unexpected, misinterpreted or varied risk factors. However, as observed in Case-1, once discrepancy on the agreement of Strategy or Contract area in 4th year of contract appeared, entire agreement level became limited, as a result, risk control retained limited effect across entire area in 4th and 5th year (Figure 5).

On the other hand, as observed in Case-2, agreement level in Strategy area has been kept high. As a result, entire risk level has consistently retained at significant low. As indicated in Figure 6, it is essential on the agreement of Strategy and the clear documented agreement in the Contract to realize comprehensive, effective risk control for long-term outsourcing project.

5. Conclusion

The risk management control process, proposed in this paper, is considered effective with the following points;

(1) It enables objective and chronological visualization of weak areas in project risks across other projects.
(2) It enables visualization of the trend of risks in a simplified manner using agreement level between principal and agent, even for risk factors which are unable to quantitatively indicate probability or impact.
(3) It enables to comprehensively and chronologically visualize and control, including even the unexpected, misinterpreted or varied risk factors.
(4) It enables both principal and agent to use a common framework of risk to discuss the project risks.

According to researches from other papers or case studies from this paper, it is relatively important for principal and agent to agree on the strategical approach and master agreement for outsourcing projects. This visualization of agreement level enables us to control the risks in every long-term outsourcing project. Furthermore, it is also important that both parties mutually understand the characteristics of each classified risk and agrees on appropriate approaches such as control of the probability of risk or control of the impact of risk.

Additionally, it is considered more useful for wider area of risk management in the long-term project since the proposed approach allows chronological analysis on the trend of highlighted risk area periodically.

However, the proposed evaluation criteria, indicates not the absolute, but the relative risk level at present. The quantitative analysis of the inter-relation among primary factors needs to be evaluated as well.

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Appendix A Case-1 Example of Risk Evaluation (simple average)

Primary		Score		Secondary	Score		Risk Scenario	Score
[A]	Strategy	3.43	a)	Scope & Scale	3.5	1)	Outsourcing scope and direction are unclear	3
						2)	Outsourcing duration is unclear (could be shorter)	4
						3)	Fluctuated work volume and no minimum commitmer	4
						4)	Encountering scope creep and unplanned scope	3
			b)	Business	3.3	1)	Outsourcing objectives and target are unclear	3
						2)	Outsourcing structure (On/Off shore, Partners) is uncl	4
						3)	Definition of Business Model (Procurement, Investme	3
			c)	Core/non Core	3.5	1)	Principal; lack of Business/Technology competence	3
						2)	Agent; lack of Business/Technology competence	4
			d)	Restructuring	3.3	1)	Unclear re-structure plan for long-term outsourcing	4
						2)	Unclear structure/function transition plan	3
						3)	Unclear resources transition plan	3
			e)	Partners	3.5	1)	Strategy plan/change plan are not shared with Partners	4
						2)	Pipeline of work/business are not shared with Partners	3
[B]	Transition	2.00	a)	Knowledge Transf	2.0	1)	Insufficient business know-how transfer	2
						2)	Insufficient system know-how transfer	2
						3)	Insufficient technical know-how transfer	2
			b)	Skill level	2.0	1)	Inappropriate business skill level	2
						2)	Inappropriate technical skill level	2
						3)	Inappropriate management skill level	2
						4)	Inappropriate definition of SLA/KPI for skill level	2
			c)	Tech life cycle	2.0	1)	New technology doesn't fit with the business requirem	2
						2)	Difficult to replace with new technology	2
						3)	End of life of product or technology	2
			d)	IPR	2.0	1)	Core business-model know-how is contained	2
						2)	Core technology know-how is contained	2
[C]	Implementation	1.83	a)	Role & Process	2.0	1)	Role and responsibility is unclear	2
						2)	WBS and Tasks is unclear	2
						3)	Scope Change Management is unclear	2
						4)	Security Information management is not in place	2
						5)	Work process management is unclear	2
						6)	KPI management is unclear	2
						7)	Deliverables is unclear	2
			b)	Schedule	2.0	1)	Major milestones are unclear	2
						2)	Big impact of work time period/gap of time	2
						3)	Calendar impact on important milestones	2
						4)	Work duration is unclear	2
						5)	Progress KPI is unclear	2
			c)	Cost	2.0	1)	Estimated cost structure is unclear	2
						2)	Cost management is not in place	2
						3)	Cost management KPI is not clear	2
						4)	Productivity KPI is not clear	2
			d)	Quality	2.0	1)	SLA or Quality KPI is not clear	2
						2)	Quality management process is not clear	2
						3)	Quality KPI/SLA monitoring is inadequate	2
			e)	Resources	2.0	1)	Not hold required basic skills	2
						2)	Shortage or inappropriate resources or team structure	2
						3)	Shortage or inappropriate skill/training	2
			f)	Communication	1.0	1)	Meeting structure or report line are unclear	1
						2)	Communication infrastructure is inadequate	1
						3)	Stakeholder management is not in place	1
						4)	Inappropriate information sharing	1
[D]	Environment	2.21	a	National Circumstances	2.5	1)	Impact from national circumstances (government, poli	2
						2)	Impact from gap in the law, custom, religion	3
			b	Disease & disaster	2.0	1)	Facilities don't perform due to weather or disaster	1
						2)	Resources don't perform due to disease or disaster	3
			c	Cross Culture	1.3	1)	Impact from gap of education level	2
						2)	Impact from gap in custom or calendar	1
						3)	Impact from gap in the social environment	1
			d	Economy status	3.0	1)	Impact from exchange rate/tax	3
						2)	Concerns about attrition rate and Salary increment	3
[E]	Contract	2.75	a)	Contract type	3.0	1)	Type of MSA doesn’t fit with nature of outsourcing	3
						2)	Type of detailed contract doesn’t fit with nature of SC	3
			b)	Contract scope	2.5	1)	Scope of MSA doesn’t cover risk area	3
						2)	Scope of detailed contract doesn’t cover risk area	2

Program/Project Management in Higher Education Considering the Self-Management Behaviors of Team Members

- Observations from an Educational Approach with a University Student Team -

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A balanced scorecard-based model can be applied to program/project management to align project management with organizational strategies. Learning and growth perspectives in the balanced scorecard show the importance of members' skills and motivations in an enterprise, which make a large contribution to consecutive organizational transformations. The foregoing target-oriented and heteronomous human relations approach is vital to the field of program/project management. Concurrently, in recent years, the importance of autonomous and independent-minded "self-management" by project team members is also attracting attention in the field of organizational management. In this paper, we conduct a search of self-management support examples in the field of nursing, medical, and sports physiology with extensive library research, and we investigate the ideal situation of self-management strategies for project management. This paper contributes a framework for dealing with self-management along with the conventional balanced scorecard-based model. We add a self-managing perspective as an additional measure for the balanced scorecard, and introduce new key performance indicators (KPIs), focusing on the personal level such as self-awareness, relationships with others, and behavior control. This paper offers a framework of strategic program/project management tools through the perspective of the members, leaders, and managers on their respective roles. In this study, we apply the proposed framework to an education approach with a university student team, which includes project-based learning curriculums with psychology tests and behavior observations, as a case study to examine its applicability and also discuss future directions.

Keywords and Phrases: Self-management, Program/Project Management, Balanced Scorecard

1. Introduction

Much research has been done in various regions and fields on the importance of human factors in project management (Vučković, Mihić, and Petrović, 2014) (Karaman and Kurt, 2015) (Pasian, Feldbrugge, and Sankaran, 2015). Discussions on organizational project management, which deals with managing a host of projects in line with an organizational mission, include the importance of a human approach in harmonizing the organizational mission and individual intentions (Hossenlopp, 2010).

Ohara *et al.*, who have systematized the project balanced scorecard as a framework for project management that organically integrates multiple projects and aligns them with an organization's strategy, have encouraged the use of the balanced scorecard concept (Ohara *et al.*, 2009). The balanced scorecard is a management tool that categorizes organizational strategies into four groups (finance perspective, customer perspective, internal processes perspective, and learning and growth perspective), in addition to the traditional management perspective based primarily on financial metrics (Kaplan and Norton, 2010). Relevant strategies and management metrics are assigned for each of these perspectives. This method is widely used by corporations, government agencies, and educational institutions, specifically to cover human factors from the "learning and growth" perspective in the context of long-term organizational management.

In regards to organizational management, Ninomiya explained how uniform and rigid control in human resources management differs from autonomous and independent self-management, asserting that the latter is one of the critical factors for an organization's sustained growth in the face of unexpected changes (Ninomiya, 1998). In examining the human aspects of project management, we seek effective methods to encourage proactive behavior by project members as part of the "learning and growth" perspective in the balanced scorecard concept.

In the fields of nursing, medicine, and sports, numerous studies and practices have been conducted on "self-management," which is synonymous with autonomous and independent self-management mentioned by Ninomiya. Many of them demonstrate participants' attempts to monitor and conduct their self-management. In such cases, self-management is explained as the appropriate control and management of oneself in order to advance one's work (Kajitani, Uchida, and Tsumoto, 2012).

As stated earlier, the existing project management methods use various tools to respond to various human factors. However, we have not found many reports of program management practices that consider more developed changes in human factors that reach into the realm of autonomous, independent self-management.

Therefore, using the concept of the balanced scorecard, we will attempt to propose a way to improve an organization's handling of human factors by introducing the perspective of self-management into program management. Moreover, we will apply our proposed framework to the students in our research lab who are studying project-based learning (PBL) and examine the issues and significance of such a framework. This paper presents the results of a survey of the existing literature regarding self-management in Chapter 2 and the balanced scorecard concept in Chapter 3 with a strategy map based on the balanced scorecard concept and the notion of self-management. Chapter 4 presents a trial case where the proposed approach was applied to the curriculum for third-year university students. Chapter 5 summarizes the current issues and future outlook.

2. Studies on Self-Management

2.1 Self-Management in the Field of Nursing

Kajitani *et al.* studied self-management capabilities among mid-level nurses, along with related factors (Kajitani, 2012). They suggested that self-management capabilities are critical in reducing the high rate of turnover due to harsh working conditions among hospital nursing team leaders. Accordingly, they put emphasis in their research on soliciting suggestions for effective support that may result in high-quality nursing practices by stable teams, and not just on the importance of maintaining mental health of the mid-level nursing staff. In this context, their study indicates a strong connection with the learning and growth perspective in program management. Kajitani *et al.* define self-management as "the ability to know oneself and intentionally and independently manage and control one's emotions and behavior for their growth and development." The research by Nakamura *et al.* analyzed the processes of self-management by nursing students, and identified the following seven factors that relate to decision-making: knowing oneself; awareness of one's role; fulfilling one's role; conducting reality checks and reconciling one's own ideas with it; a view on human nature; motivation; and a sense of responsibility (Nakamura, 2004).

2.2 Self-Management in the Field of Sports

Takemura *et al.* define the capability of a team athlete to manage him/herself as "the self-activation capability that enables the individual to think and act independently, thus positively impacting on the performance of the entire team," calling it a self-management skill (Takemura *et al.*, 2013). In addition, they argue that by obtaining this skill, a player can have a positive impact on the team's cohesiveness and its sense of efficiency. They also surveyed 126 students playing on five teams at three universities and identified the following categories of factors based on their analysis: contribution to the team; striving for achievement; self-reflection; thinking skills; and problem-solving.

2.3 Self-Management in the Field of Medicine

Moriyama *et al.* created a comprehensive heart rehabilitation program that was designed to change the lifestyle of heart disease patients and remove risk factors through the introduction of self-management and evaluated its effectiveness (Moriyama *et al.*, 2008). The authors' definition of self-management is "to make decisions and choices on your own with the help and advice of professionals in managing your own health." The goal setting and monitoring metrics listed in this program include biological data (body weight, blood pressure, cholesterol levels, etc.), the WHO/QOL-26 (a quality of life assessment chart for measuring the rate of individual satisfaction), the state of mental readiness, goal achievement rate, sense of self-efficacy (awareness of how effectively one may be able to act as required under certain circumstances), and depression. Upon implementation of this program, the researchers concluded that the acquisition of self-management capabilities led to the reduction of risk factors and improvement in quality of life, thus confirming the efficacy of the program.

2.4 Self-Management in Secondary Education

Watanabe *et al.* reported case examples of social skill training with a self-management strategy for junior high school students (Watanabe and Hoshi, 2009). In doing homework at the student's home, "setting a target for the number of times to apply a target skill," "self-recording the number of times," and "visualization of results for self-feedback" will lead to self-reinforcement.

2.5 Self-Management in Program Management

Thus far, we have provided an overview of the self-management approaches practiced in the fields of nursing, sports, and medicine, including the definition of self-management in each of these fields and confirmation of the linkage between self-management and human factor management in the context of program management. In addition, we have categorized the major key factors identified in each of these fields into three groups as shown in Table 1: self-awareness, interpersonal, and behavior control. While there are factors specific to each of the fields, we believe that these three categories should be considered as

Table 1 Self-management research

	Nursing (nurse)	**Sports** (athlete)	**Medical** (patient)	**Secondary education** (student)	**Program Management**
Self-awareness	- realize who one is - recognize own role - the view of human	- introspection on myself	- physiological data - the satisfaction in the life（WHO・QOL-26） - self-efficacy	- input self-check sheet	- personality, disposition - change in feelings - mental health - recognize own role in the project
Interpersonal	- collate own thoughts and reality, and accept - recognize division of roles	- team contribution	- partnership with medical person and family	- cooperation of parents	- recognize project progress - understand members' and stakeholders' situation
Behavior control	- fulfill a role - driving force - responsibility	- achievement effort - problem improvment - thinking power	- psychological preparation state - goal achievement rate - control depressed state	- set target of usage frequency of applicable skills - results visialization for self feedbak	- set a personal goal - recognize difference between present condition and target - emotional control

common to all the fields and therefore be included as part of the balanced scorecard concept (specifically for the learning and growth perspective) in terms of program management.

3. Balanced Scorecard Concept

The balanced scorecard is a management tool that categories organizational strategies into four perspectives in addition to the traditional management perspective that is primarily based on financial metrics. Relevant strategies and management metrics are assigned to each of these perspectives. This chapter summarizes the balanced scorecard concept practiced in business, medical and higher education environments through an analysis of the existing literature. Based on the research conducted to date, we will consider new methods of utilizing the balanced scorecard concept to improve the way of handling the human aspects of program management, in addition to “self-management” discussed earlier.

First, we examine the strategy map used by Rockwater Ltd. as an example of the balanced scorecard concept practiced in business environments (Kaplan and Norton, 2010). This company specializes in underwater construction, and its strategy is to improve return on investment through cost reduction and customer management. Its financial strategic goals are: developing new sources of profit, improving cash flow, and improving project profitability, and its goals from the customer perspective are improving the added value of strategic business partners and achieving the lowest price. The strategic objectives from the internal process perspective include achieving product and service innovation, enhancing customer value, and improving the efficiency in operation significantly. The company’s goals from the learning and growth perspective, designed to assist in achieving these objectives, are: building strategic skills, increasing morale and empowerment, and acquiring strategic skills.

Second, we consider the strategy map of a medical institution. This institution has an organizational mission of improving the productivity of the overall medical practice. Toward the achievement of this mission, it employs four perspectives: financial, patient satisfaction, the patient treatment process, and human resources. Each of these perspectives has a corresponding strategic objective: improving profitability; improving patient satisfaction in their treatment; maximizing the efficiency of treatment; and training medical staff (Lovaglio, 2010).

Finally, a strategy map used by a university to improve its curriculum is analyzed. It lists the perspectives of stakeholders, students, internal processes, and learning and growth, and it lists the strategic objective assigned to each perspective as: social contributions by the alumni, strengthening of competency and leadership, improvement and integration of education programs, and promotion of student-led learning, respectively (Pennanen, 2015).

Table 2 summaries the four perspectives and their strategic objectives, taken from the strategy maps as explained above. Using it as a point of reference in addition to the self-management concept discussed earlier, we provide a basic framework of program management, under which the handling of the human aspect is stressed throughout the four perspectives and the corresponding strategic goals. As the table shows, the proposed framework divides the learning and growth perspective into controlled management and self-management and presents in the most straightforward manner a method to encourage a project member’s proactive

Table 2 Balanced scorecard concept applications

	Corporate Management	Medical Institution Management	Higher Education Carriculum	Program Management
Financial	**Financial perspective** - discover the source of new revenue - improve cashflow - improve profitability	**Finantial perspective** - improve profitability	**Stakeholder perspective** - social contribution by graduates	**Finantial perspective** - satisfy program goal
Customer	**Customer perspective** - Value add for strategic partners - realize lowest price	**Patient satisfaction perspective** - satisfy patients by medical treatment	**Student perspective** - competency and leadership enhancement	**Customer perspective** - satisfy stakeholders and the organization
Internal Process	**Internal process perspective** - innovative products/service - Customer value improvement - improve operational efficiency significantly	**Medical process perspective** - Maximize medical treatment effect	**Internal process perspective** - improvement and integration of education curriculum	**Internal process perspective** - program/project management practice
Learning & Growth	**Learing and growth perspective** - Strategic skill acquisition plan - improve morale and empowerment	**Medical human capital perspective** - Medical staff training	**Learing and growth perspective** - Strategic skill acquisition plan - promote student-centered learning	**Learing and growth perspective** "controlled management" - education - trainig "self-management" - self-awareness - interpersonal - behavior control

approach more efficiently.

4. Trial Case in the Curriculum for 3rd-Year University Students

4.1 Education Curriculum and Strategy Map

This chapter presents the trial case where the strategic mapping and balanced scorecard for program/project management, as discussed in the previous chapter, have been applied to the curriculum for 3rd-year students in the Faculty of Social Systems Science at the Chiba Institute of Technology. The objective of the trial case is to see the significance of "self-management" as newly defined to the learning and growth perspective, with self-monitoring metrics such as self-awareness and interpersonal and behavior control. Through the application of the proposed method in the actual PBL curriculum, we would like to confirm whether a new approach to promote autonomous and subjective self-management yields new knowledge, compared to the conventional balanced scorecard mainly focusing on the heteronomous human resource management.

As shown in Figure 1, the research lab-based 3rd-year curriculum consists of PBL classes in the first term and the research curriculum consists of PBL classes in the first term and research activities for the graduation project in the second term, in conjunction with the PBL teaching assistance activities for 1st- and 2nd-year students.

Figure 2 and Table 3 shows the strategy mapping and balanced scorecard for this curriculum. This is the trial case where the basic framework of the four perspectives and strategic goals proposed in the previous chapter are applied to the ongoing curriculum. As the figure indicates in the "self-management" column, the learning and growth perspective appears at the bottom of the balanced scorecard, with the self-monitoring metrics such as self-awareness, interpersonal, and behavior control. In this example, with regard to the "self-awareness" and "interpersonal" metrics, a personality tests based on the Profile of Mood States—Brief (POMS) (a psychological rating scale to measure changes in mood and emotions), the Subjective Well-Being Inventory (SUBI), and the Five Factors & Stress (FFS) theory are prescribed so that the student may access his or her mental conditions and the status of their surroundings at any given time. Metrics corresponding with strategic objectives are also provided for the internal process perspective.

4.2 Six-Month Observations

We set up an experimental plan to confirm the influence of setting new KPIs as shown in Table 4. In this paper, we report only on the part marked with an * which includes result from the experiment conducted for less than half a year. As explained in the previous section, we added a

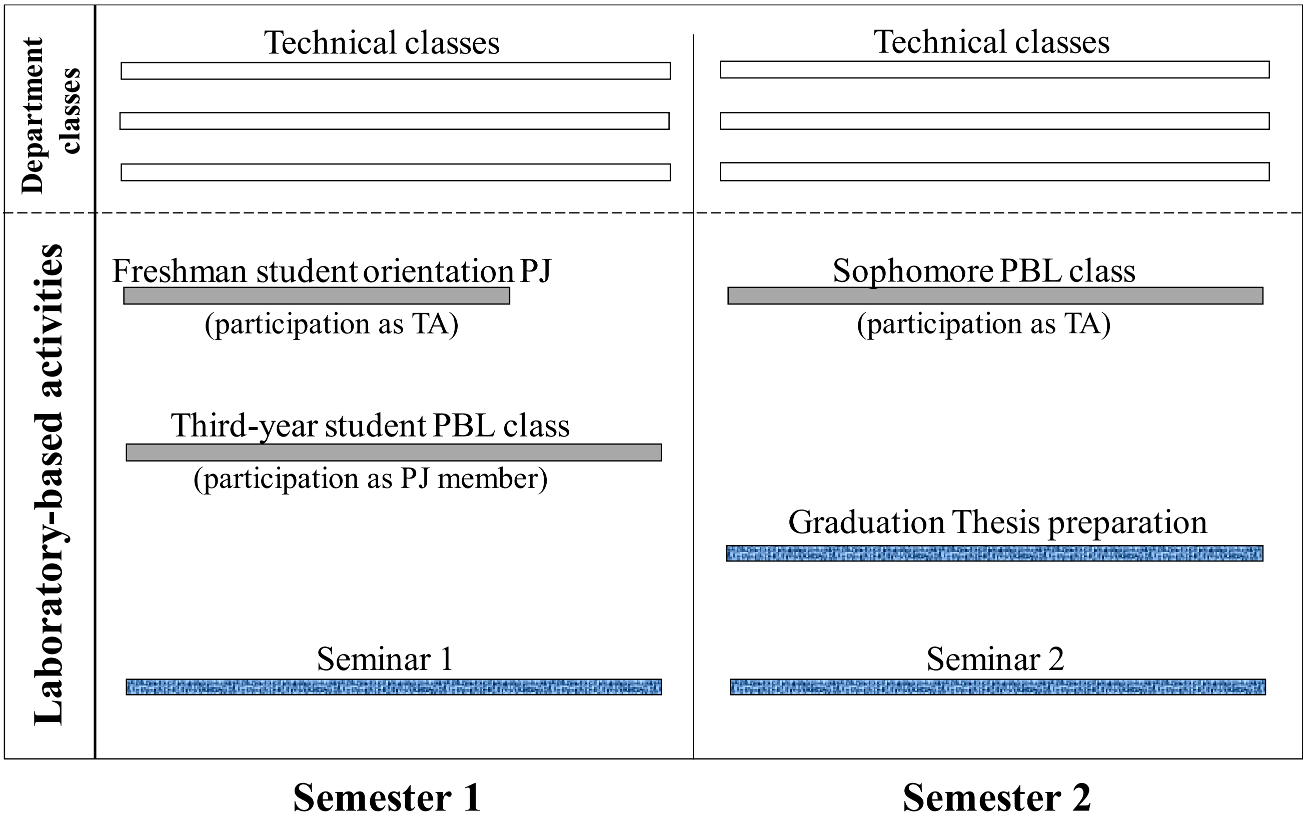

Figure 1 Third-year student's education curriculum

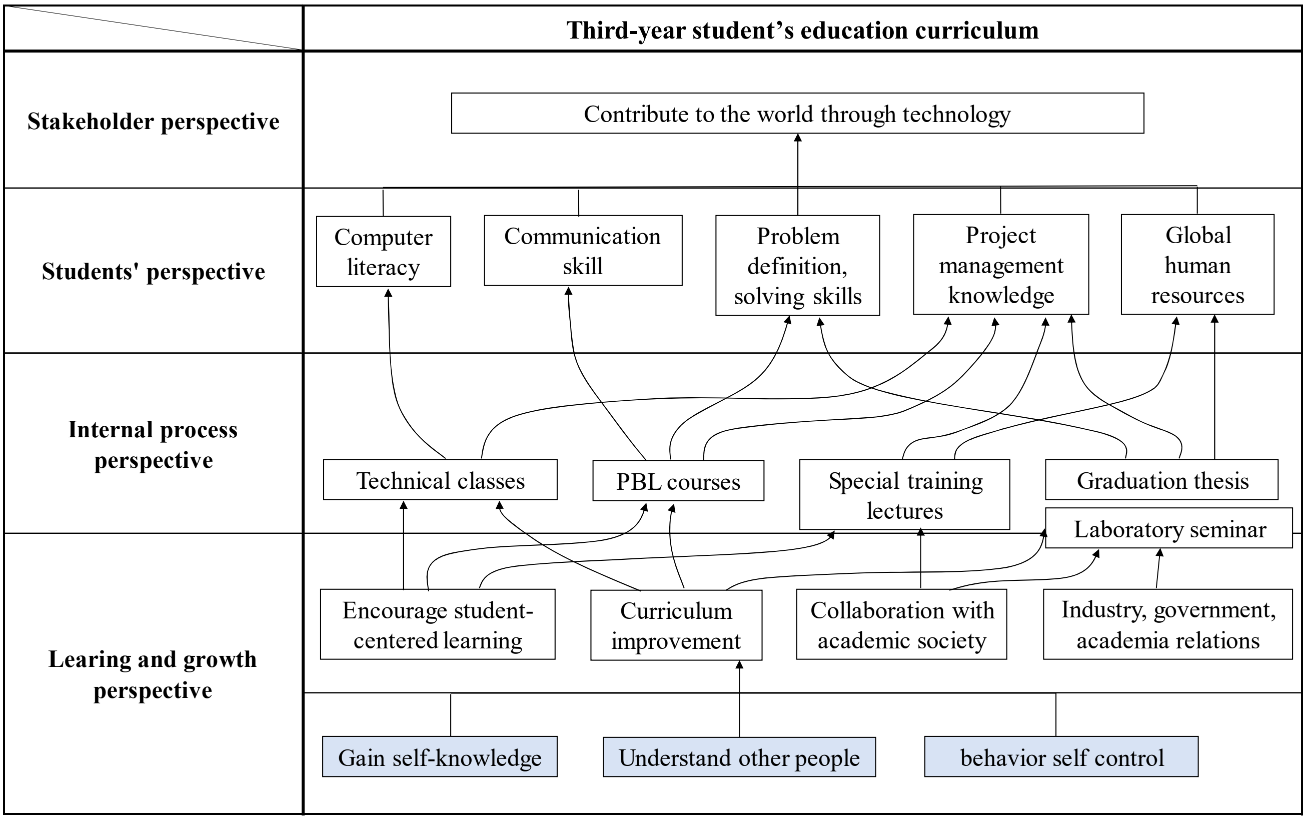

Figure 2 Strategy Mapping

Table 3 Education curriculum BSC

	Program Management	Education Curriculum BSC
Financial	**Financial perspective** - satisfy program goal	**Stakeholder perspective** Number of graduates Number of patents Number of entrepreneurs
Customer	**Customer perspective** - satisfy stakeholders and the organization	**Student perspective** Promotion ratio GPA score TOEIC, TOELF score
Internal Process	**Internal process perspective** - program/project management practice	**Internal process perspective** PBL course academic result Number of special training course Number of conference presentation, paper
Learning & Growth	**Learing and growth perspective** "controlled management" - education - trainig	**Learing and growth perspective** Number of review meetings Number of specific lectures Number of successful applicants (qualifying test) Number of collaboration company/academic societies
	"self-management" - self-awareness - interpersonal - behavior control	POMS score (capturing current feelings) SUBI score (capturing mental health condition) FFS test results (personality assessment)

self-managing perspective as an additional measure for the balanced scorecard, and introduce new KPIs, focusing on the personal level, such as self-awareness, relationships with others, and behavior control. In the experiment, through the perspectives of the members, leaders, and faculty members on their respective roles, we decided to grant the viewing authority of KPIs as shown in Table 4.

Figure 3 focuses on the perspectives of internal processes and learning and growth, and it shows the relationship between each process and personal-level monitoring metrics observed during the six-month period starting in April 2017. Using the test results, it plots out the changes in the average value of the “TMD score,” a comprehensive index of negative mood, and a “V score,” which expresses vigor for all of the participating students.

The two teams that participated in the third-year student PBL class had a member structure with defense and thoroughness type for Team 1 and scouting and leadership type for Team 2 in terms of character diagnosis, using FSS theory.

As shown in Fig. 3, when comparing the transition of the member’s average value of the monitoring indexes, Team 1 has a high "TMD score"; meanwhile, Team 2’s "V score" dominates during Semester 1. By using the indexes of BSC considering self-management, the characteristics of each team as a group can be grasped.

Meanwhile, looking at SUBI indicators showing mental fatigue and health, Team 2, whose department's evaluation score of the course was the top position at the time of the intermediate report, continues to increase its mental fatigue index. We could not make appropriate feedback until Team 2 dropped the ranking at the final presentation, but this suggests the possibility of appropriate collaboration between learning and growth and the internal process.

As a viewpoint of learning and growth, we set monitoring indicators at the personal level, and in the present situation, each individual could only view his or her own data. From the observation of the half year, in the late PBL class in Semester 2, we are planning to arrange the authority of each team member, leader, and teacher so that they can grasp the situation of the team. We would like to continue studying the feedback between learning and growth and internal processes.

Table 4 Self-management KPIs and the browsing authority

Self-Management Category	KPIs	Browsing Authority		
		Student	Leader	Faculty
Self-awareness*	POMS score (feelings) SUBI score (mental health) FFS test results (personality)	Own score*	Individual score*	Individual score*
Interpersonal*	POMS score SUBI score FFS test results	Team Average score		
Behavior control	Learning time after class Personal goal attainment level	Own score	Individual score	Team Average score

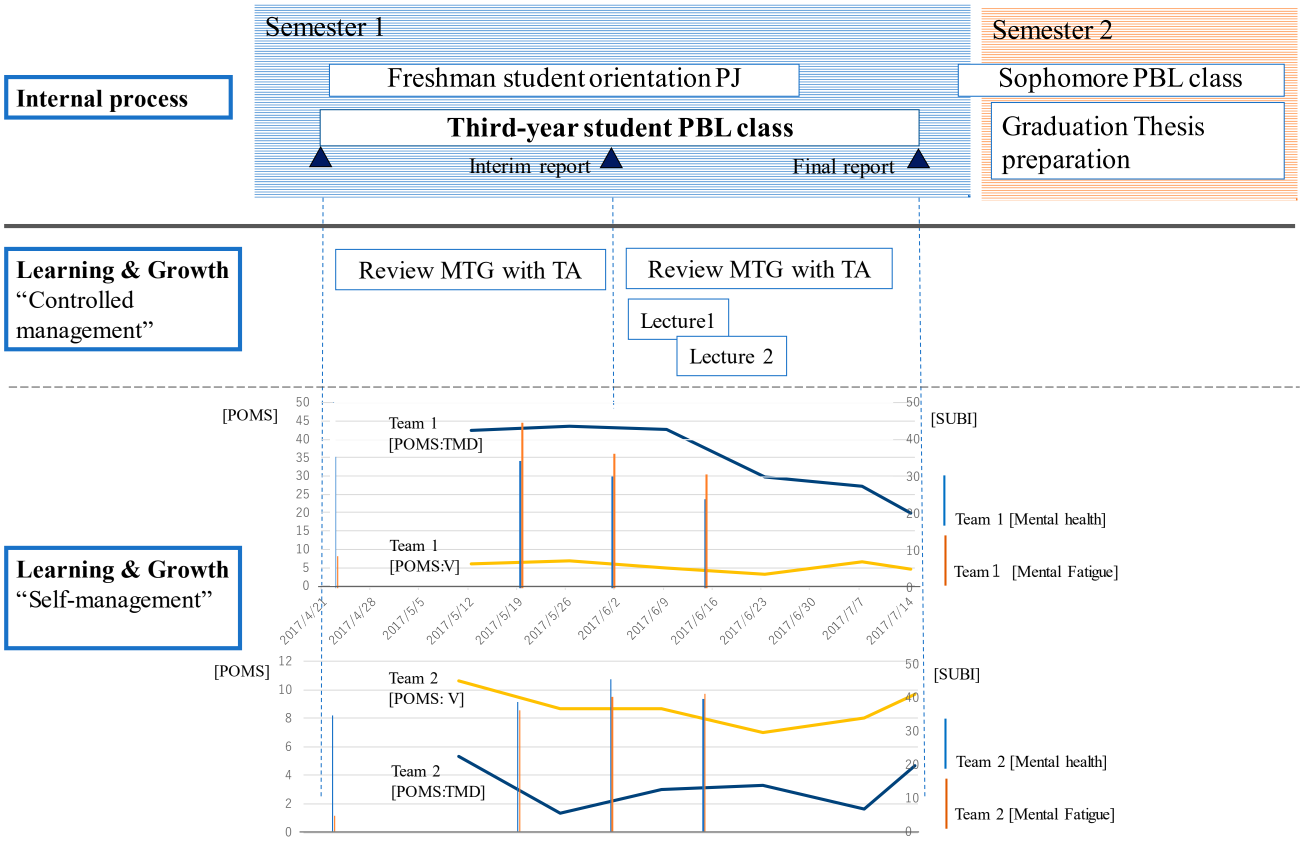

Figure 3 Personal KPIs Observation

5. Conclusions

With an understanding of the importance of human factors in project management, we have expanded the learning and growth perspective in the balanced scorecard concept in order to guide a project member's proactive approach more efficiently.

In doing so, we focused on the dual aspects of controlled, heteronomous human management and autonomous and proactive self-management, and we have concluded that the latter is a critical factor when an organization tries to organize itself toward sustained growth in response to unexpected changes. We then examined the existing literature regarding self-management in order to incorporate that concept into program management.

Furthermore, we attempted to consider the aspect of changes in human factors one step further into the realm of autonomous and proactive self-management and introduce the self-management aspect (based on the balanced scorecard concept) to the existing program management method. This led to our proposal of the strategy map and balanced scorecard as a tool to better respond to ever-changing human factors.

The proposed framework was applied to the education program for students at our university lab, and we examined the issues and significance of such a framework. By explicitly defining the elements of self-management in the learning and growth perspective of the conventional balanced scorecard concept, it was possible to see a certain level of effects on internal processes and on students' perspectives in program management in higher education. In the future, we will continue to monitor KPI comprehensively and improve our method.

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Effective Resource Planning Method to Mitigate Risk at Project

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In recent years, with the complexity of projects, there are many problems that shortage of system / person resources occurs when the project is implemented. As a result, it is necessary to cancel the project or to implement further procurement, resulting in a great adverse effect on the success of the project. The cause of the problem is that procurement content cannot be sufficiently planned from the constraints such as schedule at the time of procurement planning. This paper introduces a method for defining the project type from the scale and complexity of the project, and by following the contents of the procurement resource defined for each level, this method mitigates the risks that occur at the time of procurement. For this time, this method aimed to define the project type for each element, define the resources necessary for procurement for each project type, achieve the standardization of the procurement work, mitigate the risk of greatly adversely affecting the project. As a result of this effort, since the effectiveness was confirmed in multiple projects, this paper report the results.

Keywords and phrases : Project Type, Procurement Management, Procurement Risk, Procurement Role

1. Introduction

Generally, procurement costs account for 60% to 70% of the total cost of a company. Although procurement work greatly affects earnings, it is seen to be lower than research, development and sales. However, the degree of contribution to profit is very large, and the amount of reduction is directly profitable. (Noda, 2014). In recent years, the importance of estimation at the procurement stage is increasing from the viewpoint of the complexity of the project. The risk of procurement has a great influence on the ordering company, the ordered company, the project. Therefore, procurement risk management is also important. It contributes to more efficient utilization of resources and contributes to wasteful work reduction (The Scottish Government, 2016). In addition, the amount of investment in system-related activities has been increasing year by year (Gartner, 2017), the need to improve the quality of procurement work is increasing. But the development method required for the system is increasing and complicated year by year, such as agile.

As a result, procurement based on past experience rules leads to project failure without properly clarifying and responding to risks. As system development becomes more complex, the past procurement method has a risk of having a huge negative impact on the project. As a countermeasure, the definition of new projects and the definition of procurement work are required.

At the procurement stage, the procurement resources are limited due to constraints of procurement staff and the shortage of procurement resources due to lack of system requirements. As a result, resource shortage / lack of function is discovered after actual project implementation and production service. But additional procurement during project execution may be a major cause of delayed service or cancellation of the project.

It is considered effective to formulate a procurement plan that takes into consideration project cost / schedule / complexity and resource estimation necessary for implementing risk reduction at the procurement stage.

In this paper, we propose to define projects and procurement resources as a set as risk reduction at the procurement stage. Procurement is greatly affected by the complexity of the project. Therefore, we adopt indices of complexity in the definition of project and stylize it.

2. Procurement resources according to project type Resource contents

In this section, as an example of procurement resource estimation, necessary procurement resources are defined for each project type. We standardized projects by classifying them by element and formulated estimates of resources and periods necessary for procurement that had been dependent on knowledge and knowledge of experts so far. It aims to reduce the risk of system resource shortage and insufficient number of personnel man-hours occurring in the procurement plan by standardization.

2.1 Definition of project type

For project type, we adopted Table 1 defined in reference document (Youker, 1999).

Table 1 Project Type

#	Project Type
1	Stability of scope
2	Degree of uncertainty or risk
3	Type of worker
4	Importance of time (Pace)
5	Importance of cost
6	Level of new technology
7	Series of projects or one of a kind
8	Form of commitment
9	Level of detail in plans

This project type was defined based on the project outcome (Table 2) and was adopted because it is effective as a general project type to define procurement resources. Moreover, in order to aim for a framework applicable to a wide variety of projects, a general project type is adopted.

Table 2 Project Outcome

Type of Project	Product of Project(Examples)
Administrative	installing a new accounting system
Construction	a building or road
Computer Software Development	a new computer program
Design of Plans	architectural or engineering plans
Equipment or System Installation	a telephone system or IT system
Event or Relocation	Olympiads or a move into a new building
Maintenance of Process Industries	petro-chemical plant or electric generating station
New Product Development	a new drug or aerospace/defense product
Research	a feasibility study or investigating a chemical
Other	-

In addition, as a factor of influencing procurement, it was defined as shown in the following table 3 with reference to references (Youker, 1999), (Adachi, 2012) separately from the project type.

Here, the characteristics of the project are defined, which is difficult to define in the project type. Since project characteristics affect the degree of difficulty concerning procurement, it is defined as a secondary element of the project type.

Table 3 Factor of Influencing Procurement

#	factors
1	Size
2	Duration (Length of project time)
3	Industrial sector
4	Geographic location
5	Number of workers involved
6	Cost (large, medium or small)
7	Complexity
8	Urgency
9	Organizational design
10	originality

2.2 Definition of Procurement Resources

In this section, this paper defines the procurement resource type.

The processes necessary for procurement are defined in PMBOK in 4 processes: "Plan Procurement Management", " Conduct Procurements", " Control Procurements", " Close Procurements".

Procurement is often carried out by a person in charge who is actually in charge of the project. As a result, the quality of procurement execution declines, and many risks cannot be clarified, entering the project implementation stage. Therefore, a big problem becomes obvious, and it becomes very difficult to solve the problem. This paper also make new recommendations for the division of roles and make improvements. Specifically, it is to clarify the role and responsibility in procurement. By doing this, responsibility becomes clearer and we increase the probability of procurement success rate and risk clarification. Here, considering each process, resources required for procurement are uniquely defined as follows.

The following resource definitions are not restricted to organization types but have defined roles in terms of procurement. Especially in view of the existence of experience, the role of advisers is clearly set up to supplement the experience of procurement.

a) Chief procurement officer (CPO):

This role responsible for reporting the situation on procurement to the management based on reports from procurement staff. Person with responsibility for organization management such as department manager, who has the personnel authority within the organization is eligible. Also, it is desirable that the procurement affairs have long experience and those who can properly grasp the situation of procurement affairs.

b) Procurement advisor (PA):

At the stage of procurement planning, confirmation of work, schedule and milestones necessary for planning by own procurement experts is inevitable. Person who has experience of procurement for many years and who can appropriately grasp the situation of procurement affairs is desirable. In addition, it is desirable for those who have experienced properly supporting the inexperienced part of the procurement manager.

c) 1st Procurement Staff (1stPS):

Procure as the primary manager. In addition, in the future, this role also has experiences towards responsibilities as a CPO and PA. The appointment is made by the procurement manager. As a skill, it is desirable to have project implementation experience of the corresponding procurement part. In addition, it is more desirable for a person who is certified for project management ability (PMP etc.).

d) 2nd Procurement Staff (2ndPS):

Procure as a deputy supervisor. In addition, in the future, this role also has experiences towards responsibilities as a 1stPS. The appointment is made by the procurement manager, but also referring to the opinion of the procurement manager in charge at that time as to whether the procurement master can be followed. As a skill, it is desirable to have project implementation experience of the corresponding procurement part. In addition, it is more desirable for a person who is certified for project management ability (PMP etc.).

Since CPO and PA have many supportive aspects, they will be supported as resources during other work. Depending on procurement scale and complexity, it is desirable for the 1stPS and 2ndPS to be assigned full-time positions. The Organization chart is shown in Fig. 1.

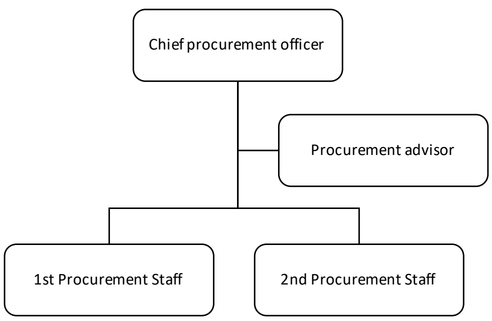

Figure 1 Organization Chart

2.3 Definition of procurement resources for project type

In this section, we define resources for each project type.

In this paper, Table 1 and Table 3 have been defined as elements affecting project type and project. In this section, we present a method to decide resources necessary for procurement. First, score each item in Table 1 and Table 3. We assign weights 3, 2, and 1 as scores in three stages of H (High), M (Middle), and L (Low) in order from the risk level related to procurement of the project type that has been defined. Secondly, we define the degree of difficulty of the project according to the score. Finally, we decide the procurement resource according to the degree of difficulty.

The definition of the project for each score was carried out as shown in Table 4. In this case, in order to distinguish the definition of resources necessary for procurement, definition was made for each degree of difficulty of the project. The feature is that the definitions were classified based on the degree of influence of possible risks. The thing to be particularly conscious of at the procurement stage is to clarify the risk and to take countermeasures against the risk.

Table 4 Description of Score

#	score	description
1	51-60	very difficult to procure
2	41-50	involves risks and procurement is difficult
3	31-40	involve minor risks but are relatively easy to procure
4	20-30	relatively easy to procure

Next, the resources required for procurement for each project definition are defined in Table 5.

Regarding the role of procurement defined in 2.2, for each project difficulty level, we defined whether it is full-time or concurrent. The feature is to arrange many responsibilities for the project definition with a high degree of difficulty, which is greatly affected by risk. On the other hand, project definitions with small risk impact are fewer in charge and saving waste.

3. Results of application to actual project

Figure 2 shows the flow up to the procurement resource definition described in the previous proposal.

We applied procurement resources according to project type to actual project.

Table 5 Score of Project Types

Score	Role	Number of member
51-60	CPO	2- (full-time)
	PA	2- (Concurrent)
	1stPS	2- (full-time)
	2ndPS	2- (full-time)
41-50	CPO	1 (Concurrent)
	PA	2- (Concurrent)
	1stPS	1 (full-time)
	2ndPS	1 (full-time)
31-40	CPO	1 (Concurrent)
	PA	1 (Concurrent)
	1stPS	1 (Concurrent)
	2ndPS	1 (Concurrent)
20-30	CPO	1 (Concurrent)
	PA	0
	1stPS	1 (Concurrent)
	2ndPS	1 (Concurrent)

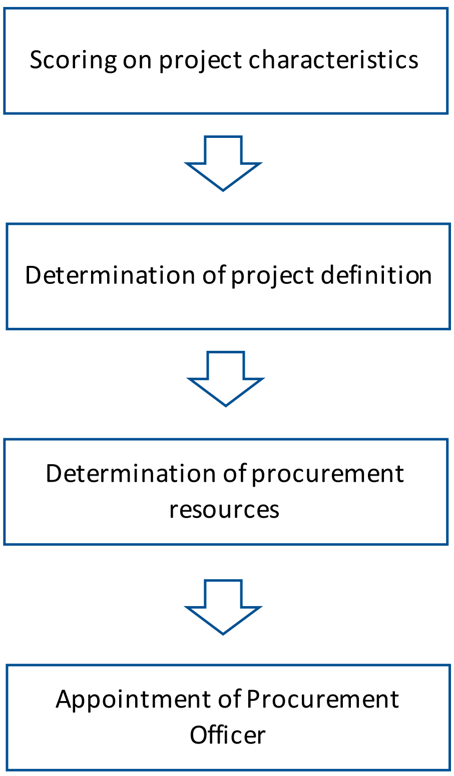

Figure 2 Flow of Procurement Resource Definition

3.1 Project #1

The features of the applicable project are as follows.

feature 1) The system resource enhancement caused by shortage of resources of the system during production operation.

feature 2) The system shutdown due to lack of system resources occurred multiple times, so the period from procurement to system application is the shortest required.

feature 3) In parallel with procurement, provisional countermeasures for production trouble are necessary.

feature 4) Stakeholders are divided into several companies, procurement, so project implementation is necessary while observing each company's schedule.

feature 5) This Project is positioned as the most important task, and failure is not allowed.

As a result of scoring for each item for this project as Table 6, we decided to classify project as project type #3 which includes minor risks but is easy to procure. We placed procurement personnel for the project type and procured it.

In this project, the necessary resources from obstacles were known as features 2). Therefore, the contents of the system enhancement became clear, and even if the procurement resources are somewhat lower like the project type # 3, the risk is judged to be low. As a result, it was a successful project from procurement.

Table 6 Score of Project#1

Project Type and factors	Risk	Score
Stability of scope	Low	1
Degree of uncertainty or risk	Low	1
Type of worker	Low	1
Importance of time (Pace)	High	3
Importance of cost	High	3
Level of new technology	Low	1
Series of projects or one of a kind	Low	1
Form of commitment	High	3
Level of detail in plans	Low	1
Size	High	3
Duration (Length of project time)	Middle	2
Industrial sector	Low	1
Geographic location	Low	1
Number of workers involved	Low	1
Cost (large, medium or small)	High	3
Complexity	Low	1
Urgency	High	3
Organizational design	Low	1
originality	Low	1
Total score		32

3.2 Project #2

The features of the project that was applied next are as follows.

feature 1) We will strengthen system resources by adding business requirements to the current system.

feature 2) The timing to start adding services is already decided. However, as procurement work has

already been delayed, no further delay is allowed.
feature 3) Procurement of system resources for test environment and production environment is divided into two. But the procurement manager is different.
feature 4) The procurement manager is different on the application side and the infrastructure side.

Based on these basic conditions, the score was determined with each index as Table 7, and from the one defined in 2-4 it became # 2 as the type. This project has high risk at scope compared with Project#1.

This project regularly held meetings with application side from feature 4), aimed at promoting the procurement of requirements sharing and procurement, but communication became more burdensome than anticipated. However, we were able to minimize the impact on procurement by following the fact that both 1stPS and 2ndPS were defined as full-time definitions in the procurement definition. Also, we shared work with 1stPS and 2nd PS, we were able to keep the schedule because each was full-time.

Table 7 Score of Project#2

Project Type and factors	Risk	Score
Stability of scope	High	3
Degree of uncertainty or risk	Low	1
Type of worker	Low	1
Importance of time (Pace)	High	3
Importance of cost	High	3
Level of new technology	Middle	2
Series of projects or one of a kind	Low	1
Form of commitment	High	3
Level of detail in plans	Middle	2
Size	High	3
Duration (Length of project time)	Middle	2
Industrial sector	Middle	2
Geographic location	Low	1
Number of workers involved	High	3
Cost (large, medium or small)	High	3
Complexity	High	3
Urgency	High	3
Organizational design	Low	1
originality	High	3
Total score		43

3.3 Project#3

The project features applied as Project # 3 are as follows.
feature 1) It is a software update project involving the loss of support of data conversion software of database software used in production environment.
feature 2) Software failure does not occur for many years, and it is necessary to explain the necessity of procurement to executives.
feature 3) It is necessary to prepare a countermeasure method of a failure that occurred when not procuring.

Based on these basic conditions, the score was determined with each indicator, and from the one defined as Table 8, it became # 4 as the type. This project is Low risk at cost and duration compared with Project#1.

In this project, the size and amount of procurement are determined as specified in feature 1). However, workaround measures are sought as in spot colors feature 2) and feature 3). As a result of this procurement, procurement did not occur because the feature 3) became clear and it was found that the procurement amount of that means fits within the existing contract. In this procurement, it was possible to predict the occurrence risk beforehand as feature 1), so it was possible to show the procurement results convinced by the management even if the resource related to procurement is suppressed.

Table 8 Score of Project#3

Project Type and factors	Risk	Score
Stability of scope	Low	1
Degree of uncertainty or risk	Low	1
Type of worker	Low	1
Importance of time (Pace)	Low	1
Importance of cost	High	3
Level of new technology	Low	1
Series of projects or one of a kind	Low	1
Form of commitment	Middle	2
Level of detail in plans	Low	1
Size	Middle	2
Duration (Length of project time)	Middle	2
Industrial sector	Low	1
Geographic location	Low	1
Number of workers involved	Low	1
Cost (large, medium or small)	Middle	2
Complexity	Low	1
Urgency	Low	1
Organizational design	Low	1
originality	Low	1
Total score		25

3.4 Results of applying to the project

This effort was highly risky because there were many scoring and experimental places, procurement deadlines were limited and procurement staff were first experience. However, by defining procurement resources according to the project type in advance, it was possible to implement projects with appropriate cost, schedule and quality.

In particular, by applying to the project type, we were able to estimate procurement resources on a certain basis. It also made it easier to organize the project procurement team and contributed greatly to facilitate procurement work.

Also, by applying multiple project definitions in different cases, the flow of defining procurement resources from the project definition became smooth. As a result, the timing of the procurement started faster than usual, and in that respect also the risks related to procurement could be reduced.

In addition, we were able to prove the effectiveness of this definition in project # 3 with few procurement resources. This will serve as a great reference for reducing resources related to future procurement.

4. Conclusions

Attempts to identify procurement resources by project type were proved effective as a result of application to the actual project this time. Particularly, it was a great effect to shorten the period until the start of procurement by standardizing resource allocation work. Until now, procurement resources have been decided based on the rule of thumb, which sometimes had a lot of risks.

In addition, the complexity was stylized in the project definition and scored. In some cases, risks that occurred during procurement were clarified, and the project definition could contribute to reducing risk.

However, the following were revealed as improvement points.

a) The conference with stakeholders was not routine and there was some communication discrepancy, such as sudden milestone discovery. Communication with stakeholders should also be included in project elements.

b) Depending on the project, people who did not have procurement experience were in charge. It was necessary to grasp the skill level of procurement by personnel in charge of each company. This further reduces the risks associated with the schedule.

c) There was a problem that resources for procurement were insufficient due to problems during the process. It was necessary to check procurement resources on a regular basis. This prevents risks such as schedule delay and quality degradation.

In addition, I would like to define the following as indicators by accumulating examples as follows.

a) How much procurement resources are required depending on the scale of the procurement case. We want to subdivide the roles related to procurement work and to further reduce risks when applying projects.

b) Refinement of scores to define procurement resources from project type. We would like to further classify project definitions and make corresponding scores more reliable through examples.

c) It is necessary to diversify the role of procurement staff. In this attempt, we have defined four roles, but we will consider setting up new roles through application to future projects.

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Challenges for Projects and Project Management in Agrifood Sector

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Today, the agrifood sector faces major environmental and social challenges that pose a challenge to the competitiveness of SMEs and small farmers, while representing an opportunity to add value to the agricultural sector and improve livelihoods. These are circumstances that urgently require a system of governance that provides effective, fair and legitimate institutional responses that pave the way to the sustainability of the entire Agrifood System. For this to happen, innovations must be not only genetic, agronomic and technological, but also organizational, social and institutional. In this context, the need arises to plan and execute numerous projects simultaneously, which in turn increases the complexity of its direction. In this sense, the objective of this paper is to show the challenges faced by the agrifood sector in the 21st century, in order to highlight the importance of projects and Project Management for the transition process towards sustainability. The results highlight the need for new forms of governance, a path towards a higher level of organizational maturity, where the project and its direction should contribute to achieving the strategic objectives of the Organizations.

Keywords and phrases: projects, project management, agrifood sector

1. Introduction

The agricultural sector is moving into an era of rapid market changes, technological, social and environmental circumstances are often developing unpredictably (Hall, 2007). The need to produce more food with guaranteed safety and respect for the environment poses a major challenge for the agrifood sector and agribusiness (Dennis et al., 2013). However, it also offers unprecedented opportunities for diversification and added value in the sector, owing to the nature and scope of the changing structure of agrifood demand (Da Silva and Baker, 2013).

Galanakis (2016) believes that such circumstances require a sustainable Agrifood System (AS) and innovative approaches to infrastructure, organization, production, distribution and product supply. Always keeping in mind that organizations will only be sustainable if they are competitive in terms of costs, prices, operational efficiency, product offer and other associated parameters, and only if the remuneration that the farmers receive is profitable; which is a particular challenge for SMEs in the sector and for small farmers who, in order to maintain their competitiveness, must be able to deliver more and better quality products (Da Silva and Baker, 2013).

In this context, there is a need to increase the number of projects that must be carried out simultaneously throughout the AS. This, as Fernez-Walch and Triomphe (2004) argues, will in turn lead to an increase in the complexity of its management. It is a scenario in which innovation assumes an important role for the organizations of the sector, since the organizational structures designed for the operations are insufficient to deliver the results of the projects that the new circumstances demand (Turner and Keegan, 2001). Therefore, to achieve AS sustainability, organizations need innovative and more flexible ways of organizing (Pettigrew, 2003), where projects are strategically more important (Jamieson and Morris, 2004).

The objective of this paper is to show the challenges faced by the agrifood sector in the 21st century, in order to highlight the important role played by projects and the Project Management (PM) in the process of transition towards sustainability of the system. For these purposes, the methodology consisted of a wide bibliographical revision.

The paper is organized as follows: Section 2 presents the literature on the situation and challenges of the agrifood sector in the 21st Century; in section 3, the literature on the sustainability of the AS is developed; followed by the Management by Projects as an innovative organizational strategy in section 4. Finally, section 5 presents the conclusions.

2. Situation and Challenges of the Agrifood Sector in the 21st Century

Few industries have the potential to contribute to the development of a country in the same proportion as the agrifood industry. In countries where agriculture is a major source of GDP growth, this sector is of vital importance in combating poverty and achieving the Millennium Development Goals. Their value chains include millions of people, from agricultural inputs suppliers to consumers, and many of them come from developing countries (Genier et al., 2013). But the sector today faces major environmental and social challenges. By 2050, world food demand will double, driven by projected growth in population and the economy that will lift low-income consumers out of poverty.

Given that agriculture is not only the largest consumer of water (about 70% fresh water), it is also the sector that has more water wasted, global farmers should double food production using less water. Likewise, the limitations on the availability of arable land demand environmentally sustainable alternatives that allow to increase, at least to double, the yield of the fertile and non-erodible soils that are already destined to the production (Dennis et al., 2013).

The fact is that current practices and ASs not only produce insufficient food, are also economically and environmentally unsustainable, are not resilient and equitable and are a risk to human health (Horton et al., 2016). This represents a major challenge for the AS, as population growth and climate change are conditions that aggravate widespread food insecurity (IPCC, 2014). For this reason, some research suggests that the "holy grail" for future agriculture is sustainable intensification achieved through new agricultural technologies (Royal Society, 2009; Garnett et al., 2013).

On the other hand, today, food production not only responds to a basic need, but also to a large number of social, cultural and ethical needs and desires (Notarnicola et al., 2017). It is therefore not only a question of producing more food, henceforth actions should focus on improving agricultural practices, optimizing resource efficiency across the whole of the AS, both in terms of food production and consumption; and paying attention to post-harvest conservation technologies (Dennis et al., 2013; Horton et al., 2016). In general, these are factors that emphasize food security as an alternative vision of the system, a concept that implies the notion of sustainability (Horton et al., 2016); as it not only implies high productivity of nutritious foods, it also represents stability in the face of changes in climate and markets, and fosters resilience and equity in supply (Conway, 2012).

2.1 About Technologies and Innovation

The agrifood sector has shifted from an offer-based approach to a demand-driven approach (Boland, 2008; Bigliardi and Galati, 2013). Increased demand for food, as well as changes in the supply of the food chain and increasing competition, make innovation a vital activity for the overall profitability of agribusiness. However, as current ASs causes severe damage to the ecosystem and human health (Baroni et al., 2007), innovations are needed to contribute to sustainability (Tilman and Clark, 2015). Galanakis (2016) believes that innovation must be perceived not only as an opportunity but also as a prerequisite for success, in order to meet the new challenges and fulfill the responsibilities of food safety and respect for the environment, since it is identified as a basic requirement to ensure the sustainability and competitiveness of the sector.

In general, the agrifood industry, although it is a highly relevant sector in socioeconomic and territorial terms, is less intensive in innovation than other industrial sectors. But the food sector in particular is more technology intensive than the primary agricultural sector and other industrial sectors (Fearne et al., 2013). In agriculture, innovations are needed to save energy resources, strengthen biodiversity, improve soils and water quality, and reduce pesticide applications (Wilson and Tisdell, 2001). In the food industry, technological development plays a key role in the future of food production, conservation and supply; in addition to the means of delivery to global consumers (Dennis et al., 2013). On the other hand, in order to prevent nutritional deficiencies and obesity, and to adapt food to the particular needs of the population (Meynard et al., 2017), improvements in terms of consumption are also needed; prioritizing, as suggested by Soussana (2014), the identification of the determinants of a healthy diet that includes physical activity, the development of healthy, high quality, safe and sustainable foods; and, the fight against chronic diseases related to diet.

Another element to be considered relates to the challenges that the growing sensitivity to the classic concepts of Corporate Social Responsibility and environmental sustainability impose on the technologies in the food chain, since consumers condition the response of the industry in the use (Dennis et al., 2013; Galanakis, 2016). The point is that, according to Galanakis (2016), the response of consumers to new foods depends on how they perceive the relationship between benefits, risks and cost. Therefore, it is necessary to be able to reliably measure their perceptions (Reinders et al., 2013) and include them from the beginning in the innovation process (Van Kleef et al., 2005).

The scenario presented requires innovative approaches that lead to changes in infrastructure, organization, production, distribution or retail sales and product supply (Galanakis, 2016). Always considering that sustainability must be present at every stage of the system, from production to consumption and waste disposal (Galanakis and Schieber, 2014), in order to achieve a holistic concept of sustainability that combines socio-technical systems and encompasses the environmental, social and economic dimensions (Betoret et al., 2016; Galanakis, 2016). In this respect, and in line with Vauterin's (2012), a better understanding of the roles between the academic world and the industry could help lessen the perceived uncertainty about market demand. The reason is that the link between business and academia offers a unique opportunity for all stakeholders, especially SMEs, to proactively participate in the achievement of future challenges and opportunities (Galanakis, 2016); since there is a relationship between research needs and strategies to improve food quality and safety, as well as those dedicated to reducing environmental impact (Notarnicola et al., 2017).

On the basis of these opportunities, Galanakis (2016) suggests adopting an open innovation model, which facilitates synergies and alleviates constraints related to limited resources, R & D expertise, skills, etc.; thus, contributing to improve the internal development of ideas in the food industry, through the use of external knowledge and access routes to the market. Finally, this same author affirms that well-formulated actions on innovation policy can accelerate the transition towards a sustainable agrifood model, since as Dennis et al. (2013) argue that the ability of agrifood industries to continue to respond to increasing demand will depend, to a large extent, on increasing the application of existing technologies and the exploitation of new and innovative technologies. However, given that technologies are not applied in isolation, these same authors highlight the importance of private sector commitment and investment in a policy environment in which public policies stimulate entrepreneurship. This requires a competent workforce, tax incentives for R & D & I and international regulations that do not represent a barrier to trade; which also represents another challenge for the sector.

2.2 About Supply Chain Management

In the last decade, the agrifood industry has begun to adopt Supply Chain Management as a key concept for competitiveness, given the set of unique characteristics that differentiate supply chain (SC) from the agrifood sector from the classic supply networks, which increase the need for special management capabilities (Tsolakis et al., 2014). These authors state that, in order to keep pace with the changes that are constantly occurring in the sector, agrifood SCs are evolving in a dynamic way. However, they believe that in the next few years they will have to cope with rapid urbanization, growth and liberalization of national and global factors and markets, declining public sector financing, the emergence of globalized SC, concern for food quality and safety, changes in technology and agriculture, the weakness of regional rural populations to meet the demands of dominant enterprises, the effects of climate change on agriculture, and the establishment of accountability practices Social Business. In addition to being exposed to government regulations and the difficulty of identifying unsafe or illegal practices of second and third order providers (Dauvergne and Lister, 2012).

To manage complex SCs, ensuring their efficiency and sustainability, Tsolakis et al. (2014) argue that it is necessary to recognize in advance the most critical issues that must be addressed by all stakeholders for an integrated decision-making process. A process that is considered complex, since it encompasses strategic, tactical and operational decisions at all levels of the chain, and because of the need to link environmental sustainability and human health together (Tilman and Clark, 2014). However, Horton et al. (2016) consider that organizations throughout the AS are not integrated into their decision-making because the market does not work that way and the limits of the SC encourage sub-optimization. They point out that the absence of integrated decision-making is the biggest obstacle to global food security and they say that overcoming it is perhaps the biggest challenge, since it requires an integrated evaluation of all those involved. That is to say, that the change in agricultural practices does not depend only on the way the SCs are organized, but also on the functioning of the whole AS (Bui et al., 2016). Therefore, a profound reconfiguration of the whole system is required, including changes in the practices and modes of coordination of all actors, from farmers, processors, distributors and consumers, to public policies and research and extension services (Lamine et al., 2012).

In this regard, some researchers consider it necessary to jointly assess issues related to the environment and human health (e.g. Adams and Demmig-Adams, 2013; Horton et al., 2016; Tukker et al., 2011). This is why Horton et al. (2016) and Soussana (2014) propose the Lifecycle approach to assess the sustainability of ASs, who consider the integration and exchange of resulting data for sustainable food security to be essential. The reason is that this integrated approach requires the collaboration of multiple communities in the research and exchange of information within the business and its SC, with governments, agricultural research centers and farmers. Although the most important aspect of the evaluation is that the results are accessible to consumers, so that agrifood organizations have the opportunity to address the needs of their customers and provide individualized and personal service (Horton et al., 2016).

The point is that the integrated assessment approach also addresses the challenges that arise from the complexity inherent in AS (Notarnicola et al., 2017). Despite generating benefits, in terms of greater resource efficiency, reduction of environmental and health impacts, and reduction of costs; the path from data analysis to sustainable AS is plagued by problems arising from its fragmented and disparate nature. Therefore, new government policies of regulation, incentives and sanctions, formulated through the same type of evidence-based integrated analysis are needed in the transition to the sustainability of the system (Horton et al., 2016).

3. Towards the Sustainability of Agrifood System (AS)

Although all phases of AS are strongly interconnected, innovation processes to improve their sustainability are still managed separately (Meynard et al., 2017). As Horton et al. (2016), "farmers grow, manufacturers make food, retailers sell it, users consume it and society and the planet pays the consequences". Because environmental impacts arise from activities at all stages of the system, to address the challenges that affect both agriculture and food, it is necessary to act in an integral way (Lamprinopoulou et al., 2014; Meynard et al., 2017). In order for innovations at different levels to be compatible with one another, and in order to promote sustainable innovations throughout the system, their compatibility must be taken into account jointly from the design stage, considering both production and processing, as well as distribution and consumption (Meynard et al., 2017). Because of this there is an urgent need for consensus throughout the AS to establish broadly applicable environmental impact indicators in the agrifood SC in particular (Hellweg and Canals, 2014; O'Rourke, 2014) and to develop sustainability indicators related to consumption food, human health and nutrition (Horton et al., 2016).

Despite the challenges of the sector, as the growth of agrifood demand increases the possibilities of agriculture and food production for diversification and to capture value, the circumstances also represent an opportunity for small farmers to improve their livelihoods. However, for this to happen, there is a need for an equitable share of the value generated by AS at the producer level (Da Silva and Baker, 2013; Genier et al., 2013). In other words, given the predictions of future food demand and the imminent question of who gets what and why, the issue of justice must go beyond a fundamental political concern in agrifood governance (Forman and Mackie, 2013). Consequently, in the pursuit of sustainable agrifood development, there is a pressing need for effective, fair and legitimate institutional responses by the governance system (Fuchs and Kalfagianni, 2014). Although this situation finds a system in which the implications for equity and justice of private governance institutions appear to have received little attention (Kalfagianni, 2015).

From the previous scenario the need to consider the dynamics of innovation in the transition to AS sustainability, not only in terms of genetic, agronomic and technological innovations, but also at the organizational, social and institutional level (Lachman, 2013; Meynard et al., 2017). But to be successful in the process of transition to sustainability, the organizations that make up the whole system must seek to benefit from the challenges presented in this complex context, as proposed by Wagner (2012), making intelligent adjustments to the new conditions and creating competitive advantage through projects.

4. Management by Projects: an organizational strategy for an agrifood organization

Given the dependence of the agrifood sector on natural, human and physical resources, companies in the sector are increasingly thinking about responsible innovation as a corporate and strategic need to ensure long-term sustainability, since it offers a competitive advantage in terms of expanding their market share and create more favorable conditions for the business (Genier et al., 2013; Rueda et al., 2016). However, in order to take advantage of this condition and create a competitive advantage through socially responsible innovations, agrifood organizations must integrate strategies whose purpose is to produce a change in the way in which they lead and to improve the context in which they offer such innovations (Genier et al. al., 2013). To that end, the PM, which includes Projects, Programs and Portfolios (PP & P), is considered a means to carry out the organizational strategy (Aubry et al., 2007). Therefore, in order to generate value in this aspect, it is necessary to align the PM with the overall strategy of the organization (Cooke-Davies et al., 2009). That is, based on market conditions and the environment, the organization's management must develop an appropriate strategy and align the business project accordingly objectives (Rietiker et al., 2011).

As projects act as a means of adapting to change, competition for project management gains increasing attention, not only at the individual level but also at the organizational level (Wagner, 2012). Therefore, it is not until the need for PM development becomes critical that organizations begin to pay attention to improving their skills in this regard (Crawford, 2014). And the reality is that there are studies that demonstrate that, with greater maturity in projects, they can achieve substantial savings, increase sales growth, show better competitiveness compared to their competitors and establish best practices in their industry or industry. service (Yazici, 2009).

Unfortunately, in the search for literature on PM in the field of agrifood, no information was found on the current situation and trends. Which may be because it has not been documented, or because the PM at a professional level in the sector is scarce. In this sense, an organization interested in integrating project culture needs to define objectives to develop PM organizational competences and manage the individual PM competences of its people. Subsequently, must identify the current level of its competences and reflect on the level want to achieve, according to the needs of the business and the competitive environment in which it operates, to then execute the processes of alignment of the PM with the key elements of the organization (IPMA OCB, 2016).

Currently, the main author of the present paper is doing her doctoral thesis (PhD) about the implementation of a governance model to guide the projectification process of an agri-food cooperative. In order to achieve this aim, a qualitative research has been designed, to identify those elements that are present and related to the projects and strategies that, prioritizing context and people, contribute to the organization sustainability inside an agrifood cooperative that does not work for projects but it works with them in an informally way.

Moving on the investigation, these results indicate which fundamental elements of the model must be:

- A governance system, with strong leadership. That includes: values and code of ethics; the organization mission, vision and strategy; as well as the performance objectives with their respective Key Performance Indicators (KPIs). In this system, communication does means the critical element of leadership.
- Strategic initiatives with technical value, and the most outstanding elements such as innovation and technology as well as quality.
- Strategic initiatives with environmental and social value, highlighting those that integrate actions for a sustainable agriculture and university-company link.
- Actions that generate social learning, especially those that create an advantageous scenario for information and experiences exchange and mutual aid.
- A clearly established PM system.
- Management of people's competencies, beginning with organizing the Human Resources management.
- Organizational alignment, to link the PM with the organization values and culture.

Organizational processes and structures, as well as a project-oriented culture, should enable them to achieve their strategic objectives (Rietiker et al., 2011). Therefore, organizations that want to be successful in PM must meet certain standards and practices (Golini et al., 2015), since the success of the projects depends on the proper use of these specific methodologies and tools (Ika et al., 2010; Papke-Shields et al., 2010).

In this sense, an organization interested in integrating project culture needs to define objectives to develop PM organizational competences and manage the individual PM competences of its people. Subsequently, must identify the current level of its competences and reflect on the level want to achieve, according to the needs of the business and the competitive environment in which it operates, to then execute the processes of alignment of the PM with the key elements of the organization (IPMA OCB, 2016).

Since it is the continuous adaptation that characterizes organizational resilience (Volberda and Lewin, 2003), in order to meet all requirements, an organization that works by projects must prioritize the continuous development of its PM competences, which must be renewed to adapt to the constantly changing business environment (Wagner, 2012) and to be able to respond to such conditions, demonstrating an adequate professional level to achieve new business (IPMA OCB, 2016). In this scenario, the important role of senior executives in the PP & P context is highlighted, and training and competency development of project managers are identified as crucial elements for their success (Bushuyev and Wagner, 2014).

5. Conclusion

Due to the environmental and social problems that threaten the agrifood sector, we are living in an Era that demands sustainable AS, in which are urgent the integration of business strategies that allow organizations in the sector to take competitive advantage of the challenges of the context and optimize the situation.

In the last decades, Agriculture as primary sector isn't longer just food production providing food supplies to more than 7 billion people on the path of challenging 9 billion people population for 2050. Agriculture sector means *Agribusiness* Sector in the 21st Century, involving many actors from farmer to retail, biotechnology, food security, climate change and rural development as well. Food and agribusiness form a $5 trillion global industry that is only getting bigger. If current trends continue, by 2050, meeting demand for human consumption and animal feed demand won't be easy.

This is why it is urgent to integrate business strategies that allow organizations in the sector to take competitive advantage of the challenges of the context and optimize the situation.

Each challenge facing the sector at all levels of the system represents a project need and, consequently, a potential project or projects programme. In this sense, Management by Projects represents an innovative organizational strategy whose importance lies in the fact that it offers a form of strategic governance so that agrifood organizations can cope with the changing conditions of the context, through PP & P that contribute to achieving the strategic objectives of the organization. In order to integrate a project culture and achieve its sustained success, the organizations that make up the AS should be interested in developing in a structured and sustainable way their competences in PM, both individually (individuals) and organizational (IPMA OCB, 2016). This involves a process in which social learning will play a significant role, as it will be necessary to work in teams, exchange information and experiences, learning by doing and mutually assisting each other; which will lead to joint learning.

The increasing competitiveness of the market and the environmental and social factors involved lead to reflection. Agribusinesses should reflect and ask themselves if they are prepared to respond to an increasingly competitive market and the rapid changes that take place.

We cannot find out many references about applied PP & P management across the Sector, some citations can be found about the importance and Project Management Office (PMO) potentiality as issue looking to implement project management in the Agribusiness (Nagy et al., 2009). But if the decision is taken to integrate the culture of the projects and orientate itself to the Management by Projects, this Paper suggests that a practical option could be to establish a PMO. Or, depending on the complexity of the organization, hire at least one person, a kind of Chief Programme Officer (CPO), who support the transformation process and, subsequently, the PM System on a permanent basis. As Wagner (2017 says, a CPO should have sound competences in managing projects, programmes and portfolios. However, more important is experience and a strong network as Senior Executive in order to be accepted in the role. The role of a CPO should also be aligned with all other roles in the Executive Board. In this respect, and according to the suggestion of Hobbs et al. (2008), these actions should be seen as a rational effort to implement new management techniques and Organizacional Competences shaping the organization governance.

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Improving the Quality of the Installation of New Client Computers Utilizing the 'front-loading' Approach.

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To the installation of new client computers often occurred an unexpected error or failed to that in time. While the system must be transformed in a limited time and go live with no problem. The cause of the failed projects are the lack of consideration for the important things to that project at the design process. For example, the client computers status must change depends on the server process is running or the previous client status. Therefore, I apply a front-loading way of thinking to the project installation of new client computers. Front-loading means thoroughly consider a task in downstream process at upstream process. As a result, improve the quality of the design process for preventing occur problems in the test process. In this paper to create the test specification that is find out all tasks by matrix table at design processes. The effect of applying this method to the project, solve the two important things. Moreover, it became easier to manage quality and progress. Further studies are needed in order to highly effect of this method. Accordingly, I also try to apply this method to other projects in the case with there are not all processes that this paper defined as well.

Keywords and phrases: Front-loading, Quality Improvement, Upstream Process, Installation of Client

1. Introduction

Many client computers which include personal computers and point of sale system and credit terminals are set in retail stores.

There is a growing need for introducing computer systems which complying with laws such as a consumption tax increase and the credit security enhanced lately in Japan. Along with introducing new computer systems setting new client computers were highly needed in shops.

It is necessary to install client computers without stopping their business in shops.We carried out work in order to satisfy this demand, but to the installation of new client computers were often occurred an unexpected error. As the result, projects were failed to achieve goals on schedule.

Therefore I decided to improve the quality of the work using a front-loading way of thinking to get rid of these problems.

Front-loading means to prevent fatal problems by the down stream processes such as tests and to prevent the go back to the upstream processes at down stream process by carrying out that we perform it at upper reaches process as much as possible.

Duke(1975) suggested the way of carrying out the test is similar to front-loading thinking in the software development. Moreover, in recent years Ikeda(2007) conducted for improving the design process capabilities in the upper process by using front-loading.

In this paper, I applied a front-loading way of thinking to the project that the installation of new client computers to create the test specification that is found out all tasks by matrix table at design processes.

2. The installation of new client computer project

To the installation of new client computers is set client computers or point of sale system or credit terminal to shops or their office as the state that they can use immediately.

Figure 1 is general flow of the installation of new client computers(NEC Fielding,2012)

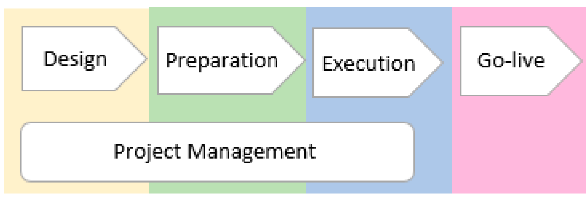

Figure 1 general flow of the installation of new client computers

2.1 The processes of the installation

The processes of the installation of new client computers is consist of following four processes such as figure 1.

(1) Desgin process

(2) Preparation process
(3) Execution process
(4) Go-live process

2.2 The details of each work

The processes of 2.1 are the following contents.

(1) Design process

Design process is following three contents.

(a) To obvious that restriction and environmental condition to the installation of new client computers such as the number of client computers or a length of time to work.

(b) To obvious that the time required and status of setting for the installation of new client computers such as the environment of the shop or client computers.

(c) To obvious that setting and status for the construction of new client computers.

(2) Preparation process

Preparation process is following three contents.

(a) It is construction work on the kitting and the setting of the client computers necessary to set in shops.

(b) The test confirms that the system constructed have no problem.

(c) The making of the operation manual and the education documents.

(3) Execution process

Execution process is following three contents.

(a) To teach the system operation.

(b) To set of the client computers.

(c) To check the operation after the set of the client computers.

(4) Go-live process

Go-live process is following two contents.

(a) To use the new client computers.

(b) To use the new system.

3. Problems with the installation of the new client computers.

It is the pattern of following two to have a big effect on schedule and cost when problems occur in an installation of new client computers project.

One is problems occur in execution process and cannot set of new client computers on schedule. The other make progress until execution process on schedule but the unexpected error occurs after an installation of new client computers.

About in the case of two above, The following shows problems and the influence.

3.1 Problems and influence in execution process

In the execution process, we confirm whether the value of the new client computers set in the previous process is right. If the previous process such as construction is wrong to value set problems often come to light in the execution process.

In the case of problems have occurred in the execution process it is necessary to return to the preparation process and the design process again. Depending on contents of the problem it is necessary to reconstruct of all new client computers. Nevertheless, there is no time to reconstruct of all new client computers at this process. Therefore we cannot stop postponing the installation of new client computers.In addition, it takes more costs to reconstruct of new client computers.

In other words, if problems have occurred in the execution process the project cannot complete on schedule and the cost increases more.

3.2 Problems and influence in go-live process

Even if the practice process makes progress without problems, problems have often occurred in the go-live process. This is why an operation procedure was wrong and the points we shuld confirm were not written in procedure manuls.

Owing to new client computers have been already set in shops when problems have occurred in the go-live process, it is necessary to set the status for new client computers again which we installed depending on the contents of the problem, and cost almost increases. When it is the worst, it is necessary to replace the previous client computers and to work on the project from the design process that is the initial process of the project.

If problems occur in the go-live process the project cannot complete on schedule and the cost increases more is a matter of course, it is necessary to the loss filling to a customer.

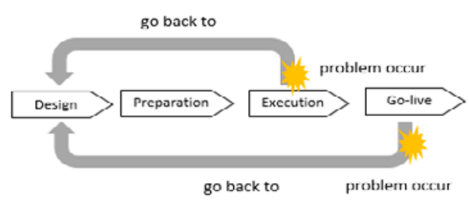

Figure 2 Image of going back to the previous process

3.3 Cause of problems

After analyzing the problem that this paper said in 3.1 and 3.2 occurred in the project the installation of new client computers the result turned out as follows. In addition, the subject of analysis is the project that problems occurred at the execution process and the go-live process in the past three years in the installation of new client computers.

Table 1 Process that Problems occurred and the causing process

Cause \ Problem occur	3.1 Execution	3.2 Go-live
Design	95%	85%
Preparation	0%	5%
Execution	5%	10%
Go-live	0%	0%

According to Table1, in both of 3.1 and 3.2 processes, a lot of problems in the design process occurred.

3.4 Specific example of problems

The specific example of problems that occurred in 3.3 is shown by each process following.

(1) A cause is problems in the design process

(a) The lack of the consideration for when project members work.

In part of the system almost occurred error while the project member set it to client system during server program was running. Generally, We often the installation of new client computers at midnight. Nevertheless, we make test specifications and review it in the daytime.

Therefore there was the lack of consideration to server processing at midnight sometimes.

(b) The lack of consideration for the status transformed of the previous client computers.

To replace the client computers it was necessary to change the state of new clients depending on the state of the previous clients. However, the project was the lack of the consideration for status changed previous client computers all client computers set the same status so that several client computers were set the wrong status.

(2) A cause is problems in the preparation process

(a)The mistake of the construction

The value such as a computer name and an IP address to set each client computers took the wrong value set in the preparation process.

(3)A cause is problems in the practice process

(a)An error of the work procedure

The project members did their work based on a procedure manual but the problem occurred by switching off client computers that was not listed in a procedure manual.

The client computers downloaded data automatically. However, the reason why the problem occurred the project member did not recognize that system and then they switched it off.

(b)A procedure manual is not clear.

Although it was necessary to change the date when the project member should change they set the wrong date.

A procedure manual was written by " a date", but the client computers had two kinds of days such as "a business date" and " a system date". Therefore, the problem occurred in the part of client computers because of the date was a judgment were divided by the project members.

(4)Address to problems

Every time problems occurred, we changed the design specification and a procedure manual.

Nevertheless, about the problems in the design process that this paper said in 3.4(1), another problems occurred in the design process and the project in the installation of new client computers did not reach the basic solution.

4. Solutions of problems

Due to the lack of the consideration of the important things to the installation of new client computers in the design process problems occurred has a significant impact the schedule and the cost.

Therefore, We decided to use front-loading way of thinking to improve the quality of the design process.

Problems occurred the more find out in the down stream processes the more influence to the schedule and the cost. For this reason, this paper decided to aim at finding out by upper stream processes as possible.

In the software development,Spillner(2002) suggests V-model that improve the quality of the design.

Although this paper tried to apply to the project that the installation of new client computers by the same way, that project was not a clear processes definition such as the software deployment.

Therefore, this paper decided to define the processes at first.

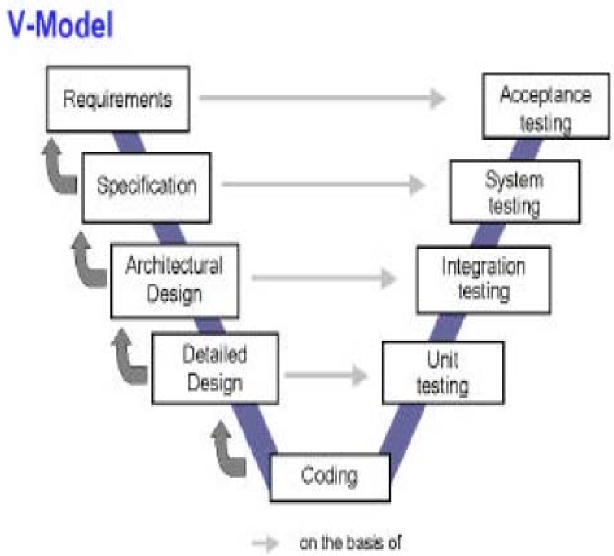

Figure 3 V-model(Spillner,2002)

4.1 The definition of processes

This paper defined eight processes in the installation of new client computers project.

The eight processes above in detail is following.

(a) The definition of requirements is the process to obvious that restriction and environmental condition to the installation of new client computers such as the number of client computers or a length of time to do.The document including them above is the definition of requirements documents.The operation test specification made based on the definithion of requirements document.

(b) The introduction design is the process to clear that the time and setting status necessary for work including the environment of the shop and the installation of client computers.The introduction design makes based on the definition of requirements documents.The document including them above is the introduction design documents. The introduction test specification made based on the introduction design documents.

(c) The construction design is the process to clear that software necessary for the construction of the client computers including status setting in detail.The construction design makes based on the construction design documents.The documents including them above is the construction design documents. The construction test specification made based on the construction design documents.

(d) The construction is the process to build the new client computers based on the construction design which process above(c). The product is the structures such as new client computers.

(e) The construction test is the process that does test to confirm whether the status setting as designed in the construction design process which process above (c). This process does the test based on the construction test specification above (c). The report including construction test result is the report of the construction test result.

(f) The introduction test is the process that does test to confirm whether the design is right in the introduction design process above (b) before setting the new clients in shops. This process does the test based on the introduction test specification above (b). The report including introduction test result is the report of the introduction test result.

(g) The operation test is the process that does test to confirm based on the design in the definition of requirements process above (a) after setting the new clients in shops. This process does the test based on the operation test specification above (a). The report including operation test result is the report of the operation test result.

(h) Go-live process is they use the new client computers after setting the new client computers in shops or office.

Table 2 The process and the base and the product this paper defined

Process		Base	Product
Design	(a) Definition of requirements.	(Proposal)	1. Document of the definition of requirements. 2. Operation test specification.

	(b) Introduction design	Document of the definition of requirements.	1. Introduction design document. 2. Introduction test specification.
	(c) Construction design	Introduction design document.	1. Construction design document. 2. Construction test specification.
Preparation	(d) Construction	Construction design document.	Structures.
Execution	(e) Construction test	Construction test specification.	Report of construction test result.
	(f) Introduction test	Introduction test specification.	Report of introduction test result.
	(g) Operation test	Operation test specification.	Report of operation test result.
Go-live	(h) Go-live	—	—

4.2 Application to front-loading

Afer applying the process that this paper defined above 4.1 to V-model this paper shows next Figure 4.

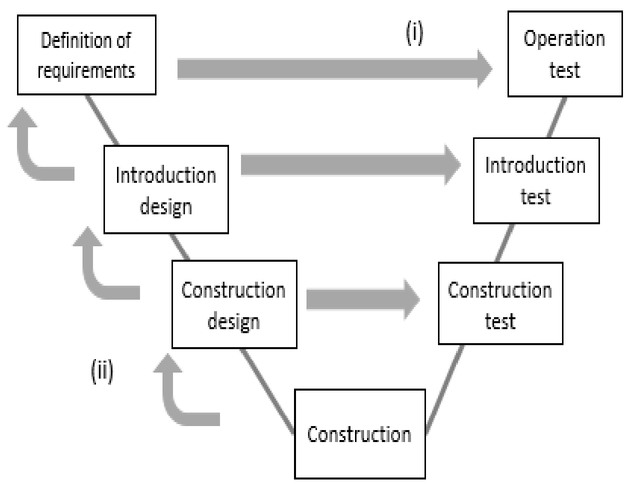

Figure 4 Applying V-Model to the project in this paper

This paper used two front-loading way of thinking.

One is we make the test specification in the design process for find out problems in the design process.The operation test specification is made in the definition of requirements process. The introduction test specification is made in the introduction design process.The construction test specification is made in the construction design process.(Figure 4 (i))

The other is that we make the design documents while considering the later design contents in detail so that problems find out at the upper process as possible.

Although, each part of the system design is written in detail in the construction design they do not often consistency in the whole systems. Therefore We decided to make the design documents in detail while keeping overall consistency by the definition of requirements process and the introduction design process. Moreover, we wrote the construction design documents if we address problems occurred in the construction process and wrote construction test specification too.We wrote the introduction design documents if we address problems occurred in the construction design process and wrote introduction test specification too.We wrote the definition of requirements design documents if we address problems occurred in the introduction design process and wrote the operation test specification too.(Figure 4 (ii))

4.3 Inflection of the matrix table

It is difficult to confirm whether thoroughly consider a task to the design documents and the test specification for the reviewer. Therefore, by using the matrix table which displayed with a listed of which function and test case make easy to confirm it.

The matrix table such as table3 made based on design documents while we made the test specification. In this matrix table test case number in the test specification is listed in each case to confirm whether the points that consideration of pattern of shops and the functions are covered all.

Table 3 Matrix table

System target		System1					
Time		Time1			Time2		
Display target		Display1	Display2	Display3	Display1	Display2	Display3
Confirm the function1 <Personal:ABC>							
1	IP adress	2.2			3.2		
2	Shop Code			2.3			3.3
Confirm the function2 <Personal:DEF>							
3	Drawer	2.5			3.5		
4	Keybord		2.6			3.6	
5	Customer Display		2.7			3.7	
6	Printer		2.8			3.8	
7	Barcode Reader		2.9			3.9	
8	Credit Terminal		2.1			3.10	
Confirm the setting1 <Personal:OPQ>							
10	Netowork	2.15			3.17		
11	LAN Cable	2.16			3.18		
Confirm the setting2 <Personal:XYZ>							
12	Shop Code in Server			2.19			4.21

5. Result of using the front-loading approach

By using the way of this paper shows the situation of problems occurred in the project is following.

5.1 About the project that I applied

This paper applied that method to the project that installs of new client computers in shops or the office for the customer whom problems had occurred in the past.

The project member must set the client computers and test the operation during approximately five hours from closing shops to opening of shops. The target client computers are personal computers or point of sales system. The project is similar although the number of the client computers and the term of work depend on projects.

5.2 As a result of having applied it

As a result of applying that method that showed with 4 above to the project, this paper shows the ratio of the process that the problem occurred before applying and after applying is following table4.

Table 4 Problem occurrence process after applying and before applying

Process	Before applying	After applying
Definition of requirements		4.5%
Introduction design	5.2%	13.7%
Construction design		9.1%
Operation test specification		31.8%
Introduction test specification	12.2%	13.7%
Construction test specification		9.1%
Construction	17.4%	9.1%
Construction test		4.5%
Introduction test	28.8%	4.5%
Operation test		0%
Go-live	36.4%	0%

It became easy to apply a front-loading way of thinking by having defined processes that this paper show 4.1 above and the project member realized they should do in each process.

According to Table4, problems occurrence ratio by the requirements/introduction design/construction design process rises after an application by 22.1% in comparison with before an application.This can consider test environment and contents we should do at the time of a design in detail by having applied the front-loading that this paper showed 4.2 above, and it is said that this method was able to list a condition to test it more concretely.

In addition, problems occurrence ratio by the operative test design/introduction test design/construction test design process rises after applying by 42.4% in comparison with before applying. This considers that the review pointed out of test specifications rose by the Matrix table which this paper showed 4.3 above.

5.3 Evaluation of the result

As this paper showed table4 above this method was able to solve two problems that prevent from occurring the unexpected error and being behind schedule. Consequently, it is effective to thoroughly consider the task at design process using a way of thinking of front-loading not only in the software development but also in the installation of new client computers.

Despite we guarantee the quality of the product in each process problems were found out by the later process. Therefore it was difficult to manage progress in projects and was not able to objectively judge whether projects have some problems about the quality or not.

For this reason, using matrix table such as table 3 was easy to confirm the specification by the person responsible also who does not know the project in detail. Furthermore, to make clear processes became easy to confirm projects progress.

5.4 Challenges for the future

There are several similar projects but some projects have not applied this method. As for the reason, the project period is short. To apply this method to projects are necessary to enough time in the design process. However, the biggest reason is there is not much benefit for projects which problems had not occurred in the past. They think rather the cost high in the design process by tasks increased.

Nevertheless, there is some possibility that problems are occured at the go-live process even if we carry on projects by the same way so far in the installation of the new client computers when projects do not thoroughly consider tasks in the design process. It is assumed that to apply this method to projects which continue effect appears in the long term even if do not appear in the short term.

6. Conclusion

This paper showed the way of front-loading prevent from occuring fatal problems by the down stream process. It became for us to thoroughly consider tasks by the upstream process.

The project that I applied this time carried on all processes that this paper defined as 4 above. Although, processes changes depending on the scale or term in projects that installation of new client computers. Thus sometimes projects have not all processes that this paper defined. In such projects, it is assumed that to think detail deeply at the design process is a similar effect to projects.

I will try to apply this method to projects easier and raise the effectiveness in the future.

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COMPETENCY BREAKDOWN STRUCTURE FOR MANAGING INTERCULTURAL ISSUES IN INTERNATIONAL PROJECT TEAMS

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Project teams that work in an international scope cannot avoid dealing with communication issues caused by differences in cultural background of project team members. Detection of communications issues, as well as preparation of methods for dealing with them is an important part of managing project teams in an multicultural environment. The analysis of the literature on the key competences of international project managers shows that it is necessary to ensure a progress of team members in development of their intercultural awareness. Development of intercultural awareness is a crucial factor as it assumes the abilities to see from others' perspective, engage in authentic intercultural dialogue, etc. It has to be developed or trained in frame of team development for each project. In this paper, the author represents summary of cultural and linguistic issues that are common for international project teams, as well as provides a list of intercultural competencies in relation with managing international projects. Furthermore, a competency breakdown structure is presented as a method to plan, discuss and update intercultural competencies of team members and anticipate linguistic and cultural misunderstandings. Finally, an approach for training intercultural awareness in teams is described and some results of its introduction in multicultural student project teams are discussed.

Keywords and phrases: Intercultural Competence, Multicultural Project Teams, Cultural Issues

1. Introduction

The amount of intercultural interactions and cross border projects has been dramatically increased due to the development of informational technologies and globalization. Cross border projects imply intercultural communication, which is obstructed by misunderstandings and misinterpretations based on differences in beliefs, values, technologies, etc. (Arent, 2009) (Kerzner, 2013) (Rothlauf, 2015) (Mead, 2009). Giving the complexity of cross border projects, team building and conflict resolution strategies have to be developed with consideration of different cultures. In other words, if the cross border project consists of team members from different cultural background, it becomes necessary that the differences and related issues are addressed in a unique way in order to ensure the project success. It means that basically every international project with a multicultural team assumes changes for individuals who are part of a project team. These changes imply the process of development of intercultural competence.

Intercultural competence includes competent communication as an effective interaction in respect of rewarding objectives and appropriate to the context in which the interaction occurs (Lustig, 2003).

On the one hand, intercultural development is a one-time endeavour connected to a unique multicultural environment of the cross border project. On the other hand, it is an ongoing process, due to the fact that team members and/or cultural context change from a project to a project. Therefore, methods and approaches are needed in order to provide multicultural project teams with solutions how to develop intercultural competence and ensure effective and appropriate communication anticipating misunderstandings and misinterpretations.

2. Cultural and linguistic issues in managing multicultural projects

Issues related to managing multicultural projects is a topic that has just started to receive a proper attention in the project management related literature and researches. On the one hand, globalization and possibility to manage projects virtually have occurred not long time ago; on the other hand, the variety of possible cross border connections is infinite and creates unique issues and complications depending on the type and amount of cultures involved. Thus globalization and culture are strongly interconnected factors that constantly change (Nederveen Pieterse, 2015).

Communication issues caused by differences in culture have been studies by scholars who represent such areas as international management, intercultural management, international communication, etc. The analysis of the literature and researches allows defining a few categories of intercultural communication issues, such as cultural, linguistic, technology and personal perception issues. In the given article, only linguistic and cultural issues are presented in order to shed the light on the area of managing intercultural issues in international project teams.

Linguistic issues are reported as those that occur the most in international projects (Rothlauf, 2015). In cross border projects, often a foreign language is used and language skills of the project team members vary. Issues in communication may appear due to the following reasons (Kerzner, 2013; PMBOK 5, 2013; Rothlauf, 2015):

– Difficult accent;
– Difficult pronunciation;
– Insufficient skills in language;
– Poor choice of vocabulary;
– Not self-explaining abbreviations and slang words;
– Terminology;
– Metaphors;
– Grammar mistakes;
– Typos.

Cultural issues are caused by the fact that messages are composed or 'coded' in one cultural context, sent, and then received or 'decoded' in another cultural context (Rothlauf, 2015). Cultural beliefs and rules lead to differences in behaviour, for example, in some countries the following patterns are considered to be an expression of politeness, while in others simply another way around (Gray, 2014; Stawnicza, 2015): yes-saying pattern, tendency to please, saving-face principle. Different cultural perceptions exist also regarding the informal communication during working hours. Some cultures tend to exclude informal communication and some cultures consider informal communication as a part of the business code. Different dimensions of behaviour, such a space, touch and eye behaviour form another cluster of cultural patterns that may cause friction and misunderstanding.

The issues and challenges mentioned above demand some specific qualities from the international project manager. In other words, not every individual is capable to work abroad successfully and with satisfaction. The literature analysis shows that soft skills or behavioural competencies are of the most importance for the international project manager.

3. Key competences of international project managers

The mostly mentioned competencies of the international project manager in the literature are as following (Mikhieieva, 2017):

– Cross-cultural sensitivity
– Problem solving
– Adaptability and flexibility
– Seek commitment of a wide range of stakeholders
– Empowerment of local population
– Sustainable development
– Dynamic leadership
– Respectfulness and patience
– Cultural open-mindedness
– Managing virtual teams and projects
– Active listening

Professional project management standards also represent to some extent competencies that can be used for intercultural development and presented in (ICB 4, 2015) (PMI, 2007), however, mentioning them mostly as generic elements.

International management literature offers a wider set of such competencies. For example, Romani offers three the following competencies needed in intercultural interactions (Romani L., 2016):

– Identifying of cultural differences and similarities and explaining those;
– Ability to see things from the point of view of other people;
– Using one's own views of the world to describe others' points of view in an acceptable way;
– Ensuring participation of each actor;
– Building new levels of solutions or creativity on differences;
– Focusing on a common stake to address potential conflicts and find integrative solutions.

Amster (2016) offers the following meta-levels that provide a logical framework facilitating a better understanding of culture-based behavioral differences that affect the success of cross-cultural management strategies (Amster, 2016):

– Culture-based patterns and protocols for communication;
– Culture-based approaches for developing appropriate business relationships;
– Culture-based ways to show respect/disrespect;
– Culture-based definitions of 'good work'.

These meta-levels correlate with intercultural competencies that are mentioned in various sources.

4. Intercultural competency profile and competency

breakdown structure

In this chapter, the author describes two methods that have been developed and tested based on intercultural issues and key competencies mentioned above, namely: an intercultural competency profile and a competency breakdown structure. Both methods are aimed to shape cultural awareness and interpersonal interactions in multicultural project teams.

The intercultural competency profile, in other words an individual's competency set, is a profile that contains specific intercultural competencies. It is developed within pre-defined personal and organizational goals and takes a unique form in each international project team. At Fig. 1 the intercultural competency profile represents objectives of the project team development in a goal-oriented way, motivating team members to change their behaviour, attitudes and develop self-concept and motives, which are more difficult to train (see Fig. 1).

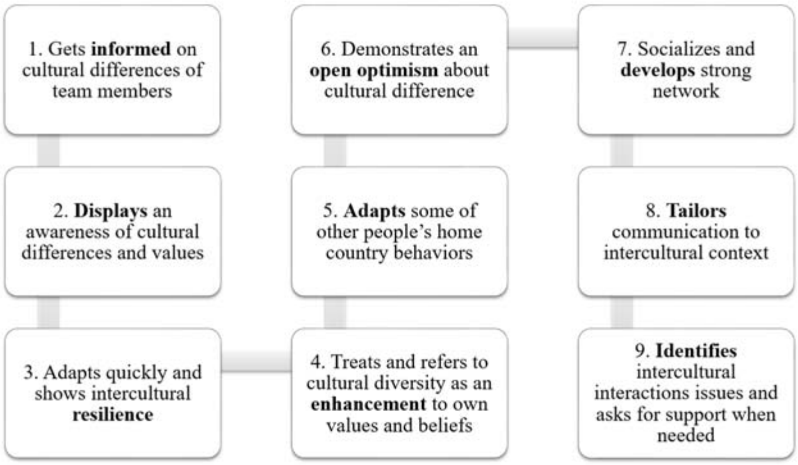

Figure 1 Example of the intercultural competency profile

The competency breakdown structure (CBS) is based on a common project management approach to structure a complex system into manageable elements. CBS approach allows to elaborate a notion of competence bridging its different usages.

There are two distinctive approaches to explain and use the competency notion. Spencer (1993) identify competency as the characteristics, distinguishing 'superior' performing managers from their 'average' counterparts (Spencer, 1993). Competency thus is described in terms of generic underlying characteristics, namely 'behavioural competencies'. Another approach is to consider competency as a work-related concept, defined through a range of functional criteria against which managers are rated as competent in one or more job tasks (Heffernan, 2000). Heffernan summarizes two meanings of the term "competency". The first one refers to the outputs, or results of the training (i.e. a competency "to promote continuous improvement through team learning and development"). It is also called "job-task competencies". The other definition refers to the inputs, required of a person to achieve competent performance, namely "behavioural competencies" (i.e. a "team leadership" competency).

CBS introduces a method that disintegrates the notion of intercultural competence into smaller elements in an output form. In other words, competencies related to intercultural development are broken into sub-competencies down being enriched with specific findings formalized during interactive discussions in the intercultural training. It helps to visualize competencies that are to be developed by the project teams during the introductory phase of the project (intercultural training). In such a way, the competency breakdown structure provides a basis for self-reflection and goal-oriented development. The competency breakdown structure is also a tool to visualize issues and suggestions at the social collaboration platform. The method of competency breakdown structure offers a communication strategy for project team members based on their own personal trait and contributions and aimed to mitigate conflicts.

As an example, let us consider CBS developed at the intercultural trainings conducted for student project teams in frame of English-speaking master programmes of the Dortmund University of Applied Sciences and Arts "Fachhochschule Dortmund" (see Fig. 2).

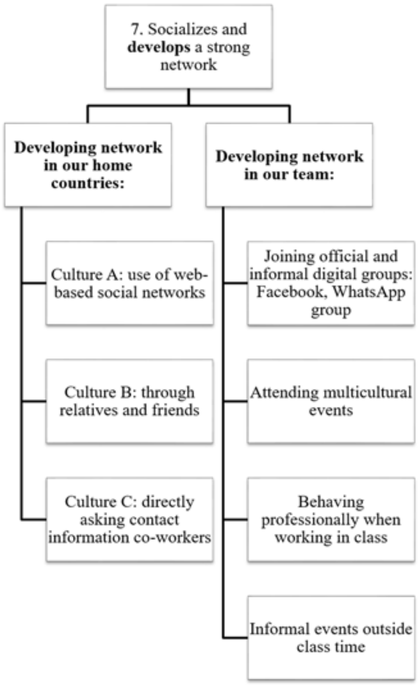

Figure 2 Example of the competency breakdown structure

The European Master in Project Management (EuroMPM) was started in 2007 by a consortium of European universities located in Germany, Spain, Norway, and Lithuania. In 2015, two Ukrainian universities joint the EuroMPM consortium, as well as the associated members from Ukraine and Kazakhstan. The EuroMPM uses the concept of the cross-border Master School in order to meet some typical competence requirements for international project managers: intercultural teamwork & communication, interdisciplinary & international cooperation, proficiency in English language & understanding different accents (Wolff, 2017). Within this Master programme in project management, it is important to deliver the experience of working in an international project team. Each cohort of one of the EuroMPM Master programmes serves as such a team for the international students. They stay together during the two or three semesters and work jointly on assignments, case studies and projects. The composition of such a class with international students from different countries and different scientific domains is the key to the unique learning experience in EuroMPM. Studying in a multi-cultural group in English as a non-native language allows students to train competences needed to address the most common issues in international communication such as differences in language and culture (Wolff, 2017).

In the example presented at Fig. 2, CBS was developed for the competency element “Socializes and develops a strong network”. The aim of this CBS was to illustrate competencies of the student project team, which are to be developed based on three specific cultures of the involved team members. The second CBS includes both competencies that are related to particular cultures of the team members in general and competencies that have been discussed and agreed upon by the team members.

Overall, implementation of the intercultural competency profile and the competency breakdown structure during intercultural trainings offer the following advantages:

- Common language;
- Basis for self-reflection and self-improvement;
- Provides the point of references for team building;
- Managing trust;
- Anticipating intercultural misunderstandings;
- Motivating for personal development of intercultural competencies.

In the following chapter, the author describes an approach for intercultural trainings where both methods are used.

5. Competency-based intercultural training

A variety of methods has been developed to provide training on intercultural development. Amster (2016) argues that training or development programmes to improve intercultural competency have to contain behaviours and values and beliefs (Amster, 2016).

The eight steps approach for the intercultural training is based on the intercultural competency profile and the competency breakdown structure (see Fig. 3) and described in details below.

Step 1. Agreement on the goals of the team building and training is done in advance according to the articulated needs of the training. These needs are described in terms of duration, cost and scope and have to be planned and agreed upon with the following project stakeholders: project manager/director, project sponsor, project team leader, managers of involved departments, HR manager. Involvement of the key stakeholders and justification of the need for intercultural training itself are crucial conditions to ensure the success and a recognized added value of the training. The outcome of the Step 1 is a unique intercultural competency profile that consists of competencies and sub-competencies which are most valid for the cultures involved in a project team.

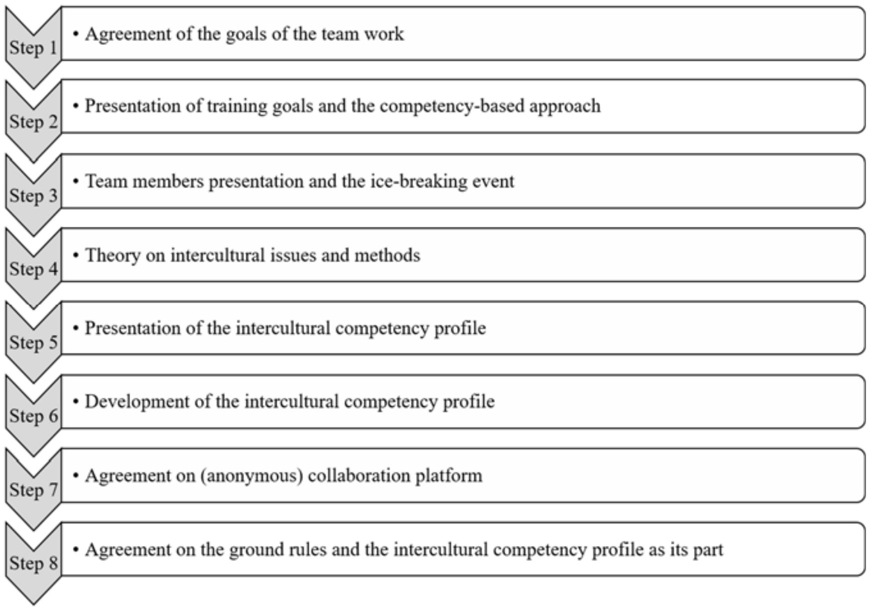

Figure 3 Steps of the intercultural training

Step 2. Presentation of the training goals and a competency-based approach is done in a short form. However, it is an important step as it sets common goals of the training in a competency-based form. Initially, outputs of the training are presented as a set of competencies, i.e. soft skills in the area of intercultural competence. As such soft skills are more difficult to assess and develop (Alam, Gale, Brown, & Kidd, 2008), their presentation in an output form helps to set a goal for an individual's development.

An additional factor that enhances trust and engagement of the project team members is increasing communication effectiveness through a shared vision (Lee, Park, & Lee, 2015). The statement of strategical goals and/or project mission clearly connected with international or global perspectives of a company and recognition of harmonization diverse cultural values and beliefs is a method to is a method to engage project stakeholders and team members (Mikhieieva, 2017).

Step 3. Project team members' presentation and an ice-breaking event have to be aligned with events that are planned in frame of an initial face-to-face (kick-off) meeting in order not to overlap with similar events and measures as getting to know other, etc. Due to the lack of time, the duration of the intercultural training is also mostly limited (Amster, 2016). However, in case of the intercultural training such ice-breaking event has to contain specific training elements that introduce project team members to differences and commonalities inherited in cultures involved in the project team.

Step 4. Theory on intercultural issues and methods to deal with them includes the following topics:

1) Main issues and challenges in international project management and intercultural communication based on scientific researches, the project team specific, previous surveys' results and lessons learn, as well as on the information from the key stakeholders and experts (see Step 1);
2) Discussion of the presented problems and challenges (Bhawuk, 2000) related to international project management and intercultural communication in general and formation of those which are relevant for the project team;
3) Presentation of methods and approaches to deal with problems and challenges related to international project management and intercultural communication based on scientific researches, the project team specific, previous surveys' results and lessons learn, as well as on the information from the key stakeholders and experts (see Step 1);
4) Discussion of methods and approaches to deal with problems and challenges related to international project management and intercultural communication based on scientific researches, the project team specific, previous surveys' results and lessons learn, as well as on the information from the key stakeholders and experts.

Step 5. Presentation of the intercultural competency profile concept is done based on the intercultural competency profile, which was developed at Step 1. This step has to be connected with Step 4, in other words, the set of competencies presented at this stage in the form of the intercultural competency profile has to lead the project team members to the solutions how to embed the discussed issues and methods into the intercultural competency profile of the team itself.

Step 6. Development of the intercultural competency profile is done in the form of interactive exercise with facilitation of experienced moderator. Results have to be documented and presented or delivered to the key stakeholder who participated in Step 1.

Step 7. Agreement on (anonymous) collaboration platform is an important step where the social communication platform is developed in order to reflect intercultural misunderstandings. The visualization of such misunderstandings can be done based on the competency breakdown structure.

Step 8. Agreement on the ground rules of the project team on how intercultural issues and misunderstandings are registered and added to the social collaboration platform.

6. Conclusions

Cultural and linguistic issues in cross border projects require specific team oriented approaches that take into account different cultural backgrounds of project team members. Project team members who work in multicultural environment have to possess a specific set of competencies to be able to work successfully as a team. Competencies that reflect different facets of intercultural development can be represented and visualized by the project team itself, using such methods as intercultural competency profile and competency breakdown structure. Intercultural development is an ongoing endeavour, which can be facilitated through such competency-based methods in frame of intercultural trainings.

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Comparative Study of Description Method for Business Process Visualization

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There are various description methods which are utilized for business process visualization. For example, the flow chart type description methods like DFD are used widely. G-RD (Global Relations Diagram of Function and Demarcation) is the matrix type description method focusing on information relationship between functions. The omissions of stakeholders or information relationships will cause serious requirements defects when business processes are defined and visualized. However, there are few reported cases of comparative studies of description methods about the difference in the requirement omissions of stakeholders or information relationships until now. Therefore, to compare and inspect the difference in omissions between G-RD and DFD, the experiment to define and draw simple business processes for university students who are not familiar with understanding business processes was conducted. The evaluation index of this experiment is the number of (1) Stakeholder's function or role and (2) Information relationship between stakeholders. As the results of this experiment, the number of stakeholders drawn by both G-RD and DFD did not have the significant deference. However, there was more number of information relationships between stakeholders drawn by G-RD than it drawn by DFD. Therefore, it is effective for beginners like university students to understand and visualize business processes by utilizing G-RD.

Keywords and phrases: Stakeholder, Requirement Definition, BPR (Business Process Reengineering), REBOK (Requirements Engineering Body Of Knowledge), IPO (Input Process Output)

1. Introduction

In recent years, many enterprises execute Business Process Reengineering (BPR) project and restructure entire business processes for business innovation (Hammer and Champy, 1993). In this case, it is difficult to describe business processes after restructuring without preparation. Therefore, business processes which are being conducted practically are analyzed as Business Processes-As-Is and some problems are pointed out at first. Next, new business processes solving these problems are designed as Business Processes-To-Be. This design process is referred to as requirements definition process in REBOK (Requirements Engineering Body Of Knowledge) (JISA, 2011). In this design process, the method called modeling or diagraming is used widely to visualize business process. The first process of requirement definition is Requirements Elicitation. In this process, an interview to stakeholders or a brainstorming with stakeholders is carried out to understand current business processes and their problems. And stakeholder's requirements are elicited. Next process is Requirements Analysis. In this process, the requirements which are elicited in Requirements Elicitation process are checked and adjusted to keep consistency. At this stage, business processes and requirements are described by natural language. Next, current business processes which were checked and adjusted are confirmed by stakeholders. And the consensus about current business processes is built among stakeholders. At this time, modeling or diagraming is used so that stakeholders easily understand business processes. Modeling or diagraming is also used to confirm and build consensus to stakeholders about new business processes.

Various description methods are used to visualize business processes. These description methods have to be able to describe business processes easily and understand described business processes easily. On the other hand, it is necessary to distinguish stakeholder's function and role, and grasp information relationship between stakeholders to design business processes without defects.

REBOK refers to Omission, Contradiction, Inadequacy, Ambiguity and so on, as main Requirement Defects. When these Requirement Defects are classified from the perspective of visualization of business processes, Contradiction, Inadequacy, Ambiguity and so on are relatively easy to be pointed out because requirements are already written. However, Omission is difficult to be pointed out because requirements are not written. Therefore, omissions of business processes are often pointed out at the test phase with end users. In this case, it is necessary to return to requirements definition phase and re-design business processes. As a result, a large man-hour is necessary to rework. This reworking also has a significant influence on quality, cost and schedule. Therefore, these description methods have to be able to describe stakeholder's function and role, and information relationship between stakeholders without omissions.

This paper compares and studies the differences of DFD (Data Flow Diagram) (DeMarco, 1978) which is one of flow chart type diagrams and widely used for drawing business processes and G-RD (Global Relations Diagram of Function and Demarcation) (Saito et al.,2011,2012,2013a,2013b,2014a,2014b,2016) about the requirement omissions of stakeholders and information relationships. There are few reported cases of comparative studies of description methods about the difference in the requirement omissions of stakeholders or information relationships until now. To compare difference between G-RD and DFD, the experiment to define and draw simple business processes for university students who are not familiar with understanding business processes. The experiment by university students removes the deference of business knowledge and business experience necessary to define and draw business processes, and be able to compare the description methods purely.

The evaluation index of this experiment is the number of (1) Stakeholder's function or role and (2) Information relationship between stakeholders. The question is if these requirements can be defined and drawn without omissions. As the results of this experiment, the number of stakeholders drawn by both G-RD and DFD did not have the significant deference. However, there was more number of information relationships between stakeholders drawn by G-RD than it drawn by DFD. Therefore, it is effective for beginners like university students to understand and visualize business processes by utilizing G-RD.

2. Visualization of business processes utilizing conventional description methods

Almost all of description methods that are used to visualize business processes define and visualize function and information relation. In this case, information relation is defined as input information and output information toward function. For example, DFD (Data Flow Diagram) or IDEF (Integration DEFinition) is able to describe function and information relation. Figure 1 shows general description rule of DFD. These description methods express a function with a circle or a box, and an information relation between functions with an arrow or a line.

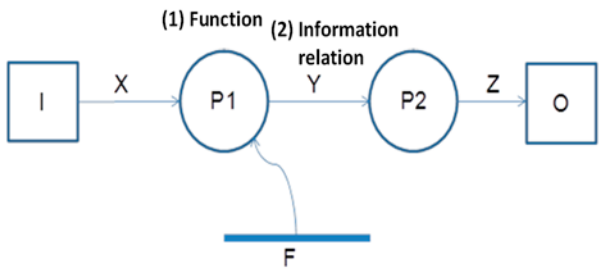


Figure 1 General description rule of DFD

Decomposition and integration of function is expressed by utilizing levels. Figure 2 shows sample DFD of decomposition and integration of functions utilizing levels.

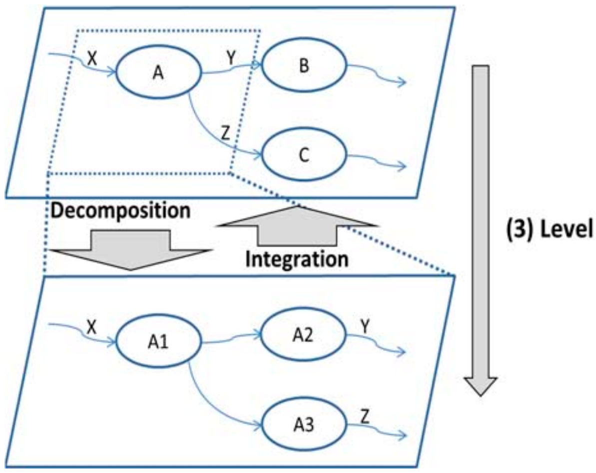


Figure 2 Decomposition and integration of function

And there are description methods which are able to define and visualize management unit. In this case, the management unit means organizations or roles which execute a part of business processes with responsibility. These description methods are also able to define and visualize the responsibility demarcation or boundary of management units. For example, UML (Unified Modeling Language) Activity Diagram (OMG, 2005), WFA (Work Flow Architecture) or BPMN (Business Process Modeling and Notation) (OMG, 2011) is able to define and visualize the management unit and the responsibility demarcation or boundary of management units. Figure 3 shows sample UML Activity Diagram Swim Lane of the responsibility demarcation or boundary of management units (Kobayashi, 2005).

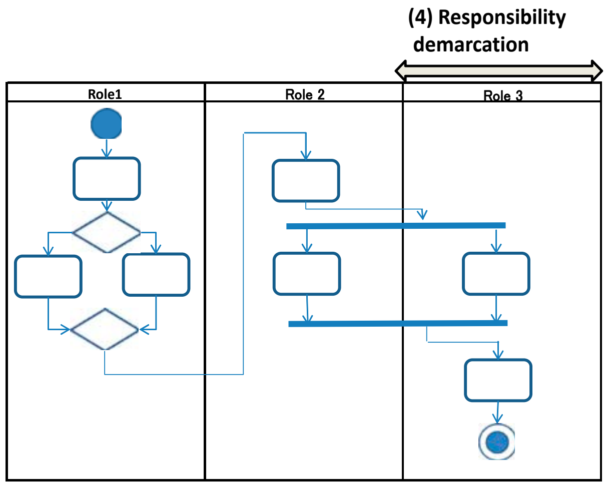


Figure 3 UML Activity Diagram Swim Lane

To summarize the characteristics that these description methods have, these description methods should define four requirements such as (1) function, (2) information relation, (3) levels, (4) responsibility demarcation. To apply these description methods to the visualization of business processes, these four requirements are (1) Stakeholder's function or role, (2) Information relationship between stakeholders, (3) Decomposition and integration of stakeholder's functions utilizing level, (4) Responsibility demarcation of stakeholders.

3. Visualization of business processes utilizing G-RD

3.1 Concept of G-RD

G-RD is a design method that defines Element as the object which sends or receives the information and defines Relation as the information relationship among Elements. Element corresponds to Process and Relation corresponds Input or Output of IPO (Saito et el.,2014a).

When Elements are plotted in the diagonal of square matrix, Relations are described at the intersections of the column and the row of two Elements. As a result, the position of intersection expresses the in-element and out-element at the same time.

Focusing on Elements, outbound from one Element is expressed in vertical direction and inbound is in horizontal direction as Figure 4, thus the direction of Relation is determined. In other words, the column number of Relation expresses in-Element and the row number of Relation expresses out-Element.

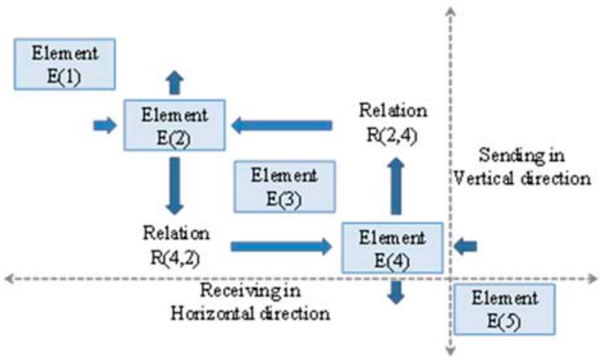


Figure 4 Description rule of G-RD

3.2 Decomposition/Integration utilizing Level

Elements are able to decompose and integrate by decomposition and integration method utilizing Level of G-RD (Saito et el.,2014a).

Figure 5 illustrates the procedure to decompose one level of Element C. First, add rows and columns as the number of decomposed Elements C1, C2 behind Element C. In Figure 5, two rows and columns are added. Then next, add Elements C1 and C2 along diagonal line. Fill in Relations that Element C receives in each row in expanded Matrix, in Figure 5, R (2), R (3) and R (4) are added. For this example, R (2), R (3) are added in C1 row and R (4) is added in C2 row. As well as this, fill in Relations that Element C sends toward expanded Matrix. For this example, R (1) is added in C2 column.

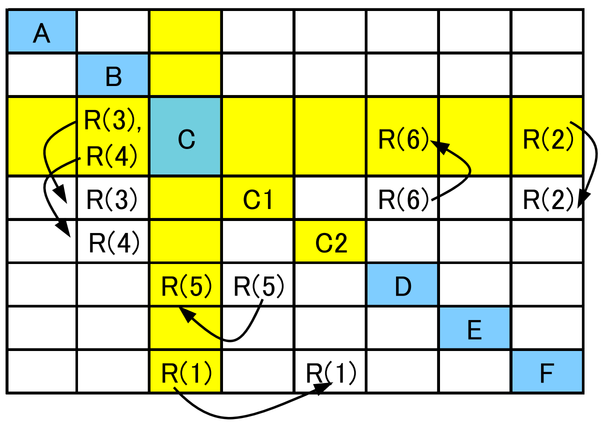


Figure 5 Sample of decomposition utilizing G-RD

When any new Relation was found through decomposition of Elements, add the new Relation, at the same time of expanding the Matrix. In Figure 5, R (5) that Element C1is sending to Element D is added, and this R (5) is also copied to column of Element C. R (6) that Element D is sending to Element C1 is copied to row of Element C as well.

Through this procedure, it is possible to decompose Elements and Relations in simultaneous by capturing whole Relations (Saito et el.,2013a). Therefore, it is able to reduce omissions of Elements and Relations. Business processes are able to decompose to stakeholder's functions or roles and information relationships between stakeholders by utilizing Levels of G-RD.

Moreover, Elements and Relations which are decomposed are able to integrate by utilizing Level of G-RD. Figure 6 shows that Elements C1 and C2 shown in Figure 5 are integrated to Element C. Focusing on Relations, new Relations R (5) and R (6) which were found through decomposition of Element C are added as Relations between Element C and Element D.

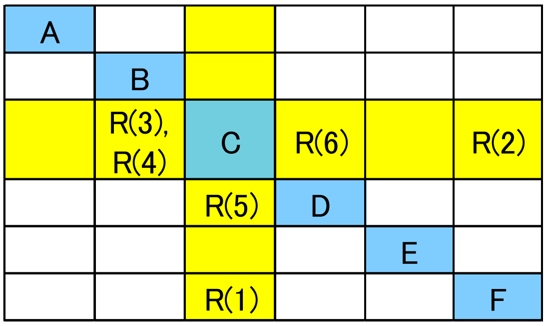


Figure 6 Sample of integration utilizing G-RD

3.3 Clarification of management units
It is able to define the functions or roles of stakeholders as management units by utilizing clarification of management units of G-RD (Saito et el.,2014a). It is able to define the responsibility demarcation or boundary of a management unit between stakeholders.

The functions or roles of stakeholders are able to be treated as a set of Elements and expressed as one management unit by utilizing decomposition method utilizing Level shown in Section 3.2. And the domain (row x column) of two or more Elements which compose one management unit is explicitly surrounded by a frame. This frame will show the demarcation or boundary of a management unit.

For example, if Elements C, D, and E of Elements are surrounded by a frame as shown in Figure 7, this domain can be defined as one management unit. Similarly, Elements F, G, and H, and Elements I, J, K and L can be defined as management units. Moreover, Relations to the inside of the domain (row x column) of a management unit surrounded by the frame are defined under the responsibility for this management unit. On the other hand, Relations to the outside of the domain (row x column) of a management unit surrounded by the frame are defined as Relations to another management unit. For example, Element L receives Relation R (8) which Element D sends. This Relation is a Relation between two management units. Similarly, Relation R (9) and Relation R (10) are Relations between two management units.

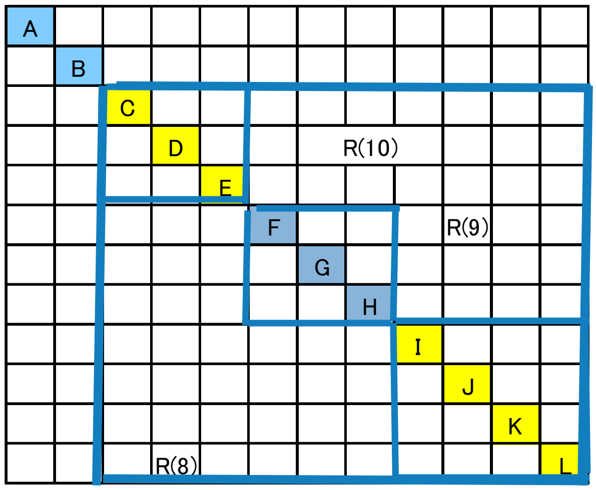


Figure 7 Sample of demarcation utilizing G-RD

If business processes/operations which have the relationships between two or more management units are completed, the power needs to be authorized to the large management unit of the domain from Element C to Element L surrounded by a frame in order to advance cooperation between management units smoothly. And it is necessary to clarify the relationships and rules between management units.

Thus, since G-RD defines the responsibility demarcation or boundary of a management unit focusing on the relationships, it becomes possible to design the relationships of responsibilities between power assignments, or the relationships of information between functional assignments.

It is easy to rearrange Elements because Elements are arranged on the diagonal of a square matrix. By utilizing this characteristic of G-RD, it comes to be able to design reassignment of Elements and Relations in management units (Saito et el.,2014a).

4. Business process drawing experiment

4.1 Requirements for the experiment
In order to compare the omissions of stakeholders or

information relationships between different description methods, the experiment to draw business processes by utilizing DFD and G-RD, and compare the results was conducted. DFD is a proven, widely known business process visualization method. Furthermore, since DFD is presented in a flow format (which is different from the matrix form of G-RD), it is easy to compare the differences between the two methods.

Participants in the exercise should have little experience in business process visualization. It should be possible for beginners to assess the ease of utilizing each method by drawing simple business processes.

The theme of the experiment should involve multiple stakeholders, information relationships between stakeholders, and business processes that are easy for beginners to image. Considering the above requirements, the business process of a restaurant chain store was selected. The business process involves multiple stakeholders at each stage of the supply chain, such as purchasing, headquarters, shops, and customers, as well as many mutual information relationships.

For comparison, it is desirable to exclude all factors, except the characteristics of the two methods, as far as possible. Specifically, it is necessary to reduce the difference in ability among attendants and to use methods of the same level of difficulty. To this end, instead of drawing G-RD and DFD for the same subject, the participants were divided into two groups and the drawing order of G-RD and DFD between the two groups was changed. Since the same subject matter is used, there is no difference in the difficulty of the subject between the two methods. However, the method that is used later is advantaged. Therefore, by comparing the results of the two groups, a significant tendency in the use of each method was observed.

For the evaluation index used for comparison, two of the four requirements of the business process method need to be included—that is, the number of stakeholders and the information relationships between stakeholders. With an excellent descriptive method, it should be possible to draw stakeholders and information relationships without omissions, and a large number of each should be included. In addition, we assumed that the characteristics of each method could be identified by observing the tendency and the factor when an omission occurs in one method but not in the other.

4.2 Outline of the experiment

The outline of the experiment, based on the above requirements, is described here. The participants are third and fourth grade university students majoring in management. The students were lectured on how to draw DFD and G-RD, and were given a simple exercise (90 minutes) on G-RD. The 12 students were divided into six groups of two people each. Among them, three groups mapped in the order of G-RD → DFD, while the other three groups mapped in the order of DFD → G-RD. There was no time constraint, and the experiment was terminated when each group has completed the exercise. To prevent the figure from being transcribed, the first figure was collected before the drawing of the second figure commenced.

A business requirements sentence was distributed first, after which the business processes were drawn by utilizing the two methods. Finally, students assessed the good and bad points of the two methods. The average drawing time of the three groups that drew in the order of G-RD → DFD was 23.3 minutes and 21.3 minutes for the two methods, respectively, while the average of the three groups that drew in order of DFD → G-RD was 33.3 minutes and 17.3 minutes, respectively.

Figure 8 shows the business requirements sentence of the restaurant chains used for the experiment, and Figure 9 shows an example of the correct answer of G-RD. Business requirements include detail of the procurement of foodstuffs, and the reservations and complaints of customers, and are presented in sentence form as shown in Figure 8. Students read the roles and functions of stakeholders and the information relationships between stakeholders from this sentence and described it in the figure.

· Company A is a restaurant chain that manages three stores (B store, C shop, D shop). The business flow of the company is as follows.
· A sales meeting is held at the sales headquarters at the end of the month, and sales goals of each store in the following month are determined.
· Each store checks the inventory of based on the sales goal and identifies the necessary ingredients.
· In the logistics department, they order the necessary merchandise of each store and order it to producers and retailers. Vegetables are trading directly with farmers without agricultural chemicals. Meat and fish are ordered for meat shops and fresh fish shops respectively. However, in case of emergency, there is a case that the shops contact each other and deliver the ingredients on their own trucks.
· Ask the logistics company that contracts the ingredients, and have them ship directly to each store from suppliers. However, because there are few places to store inventory of stores, they ask them to deliver the ingredients in advance after contacting the distributor.
· The customer makes reservations directly to each store. If the reservation is more than three days before the visit date, the store will contact the customer confirmation before the visit date.
· The customer complains about the service to each store or customer's head office. Complaints are shared at all branches, headquarters via sales headquarters.

Figure 8 Business requirements sentence

In Figure 9, stakeholders are described on the diagonal line. The upper left represents the companies upstream in the supply chain, and the lower right represents the customers downstream in the supply chain. In addition, the information relationships concerning procurement of food materials, customer reservations, and complaints are described. The number of stakeholders is 12 (cooperating enterprises 4; internal departments 7; customers 1), and the number of information relationship groups is 11 (food procurement 5; reservation 2; complaints 4).

Farmers			(Pickup)			Purchase order					
	Meat shops		(Pickup)			Purchase order					
		Fish shops	(Pickup)			Purchase order					
(Shipment)	(Shipment)	(Shipment)	Logistics company					Delivery request	Delivery request	Delivery request	
				Headquarters	Complaints						
					Sales headquarters		Complaints				
						Logistics department		Order	Order	Order	
							Customer's head office				Complaints
			Delivery		Sales targets Complaints			B store	Internal transport	Internal transport	Reservations Complaints
			Delivery		Sales targets Complaints			Internal transport	C store	Internal transport	Reservations Complaints
			Delivery		Sales targets Complaints			Internal transport	Internal transport	D store	Reservations Complaints
								Confirmation	Confirmation	Confirmation	Customer

Figure 9 Example of a correct answer for G-RD

5. Results of the experiment and discussion

5.1 Results of the experiment

Each group created two figures of G-RD and DFD. From these figures, the number of roles and functions of stakeholders and the number of information relationships between stakeholders were compiled.

There was no significant difference in the number of stakeholders extracted by each method. Therefore, only the number of information relationships will be reported. The results are shown in Figure 10 and Figure 11.

Figure 10 shows the change in the number of omissions of information relationships between the two methods. The figure on the left contains the result of the three groups (A, B, C) that worked in the order of G-RD → DFD, while the figure on the right is the result of the three groups (D, E, F) that worked in the order of DFD → G-RD. In the figure on the left, the left side of the horizontal axis refers to the G-RD that was drawn first, while the right side refers to the DFD that was drawn later. The vertical axis indicates the number of omissions in information relationships that occurred in each figure. For example, in group A, three omissions occurred in both G-RD and DFD. As a hypothesis, since the descriptive method to be carried out later is advantaged, it is assumed that all groups tend to fall to the right. However, in cases such as group B on the left side, results were not necessarily as expected. In addition, the numbers of omissions in information relationships shown in the figure range from two to six, and the proportion of these numbers divided by the total number of information relationships (i.e., 11 types) range from 18% to 55%. This result can be interpreted as representing the relationship between the level of the students and the degree of difficulty of the problem. In other words, it can be inferred that this experiment's problem matched the level of the students; it was not so easy as to elicit only correct answers, or so difficult that students could not answer at all.

Figure 11 shows the frequency of occurrence of omission types. All 11 kinds of information relationships can be classified into four omission types:

- ◎→◎ : It was possible to extract an information relationship on both figures.
- ×→× : It was not possible to extract an information relationship on both figures.
- ◎→× : It was only possible to extract an information relationship in the first figure.
- ×→◎ : It was only possible to extract an information relationship in the second figure.

In order to examine differences between the methods, the number of occurrences of the last two types out of four was extracted and shown in Figure 11. The groups in the left the right figures are similar to those in Figure 10. For the figure on the left, the left side of the horizontal axis represents an omission of type ◎ → ×, in which information relationships can be extracted in the first drawing only. The right side of the horizontal axis represents an omission of the type × → ◎, in which information relationships can be extracted in the second drawing only. The vertical axis represents the occurrence frequency of each omission type. For example, in group A, ◎ → × represents one case, while × → ◎ represents the same number. It can be inferred that G-RD is a superior descriptive method, as the graph on the left side goes down to the right and the graph on the right side goes up to the right.

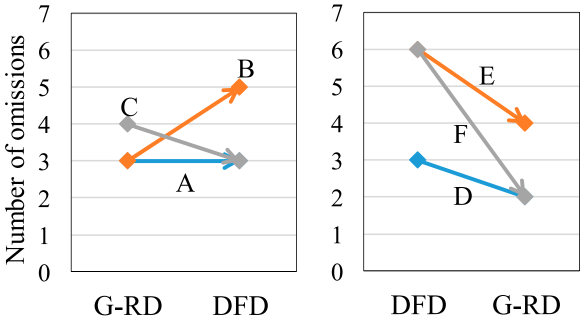


Figure 10 Change in the number of omissions

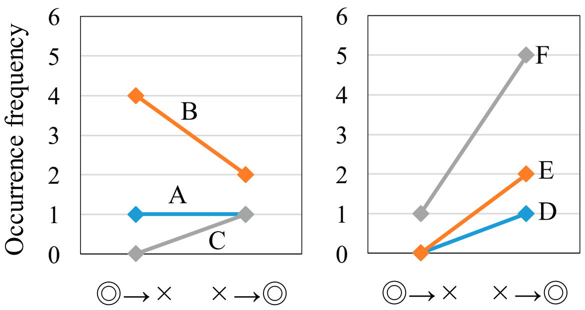
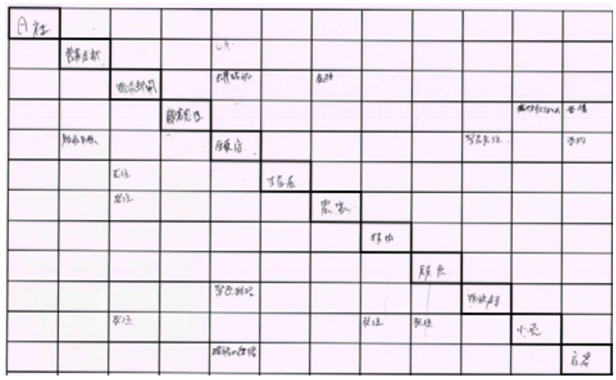
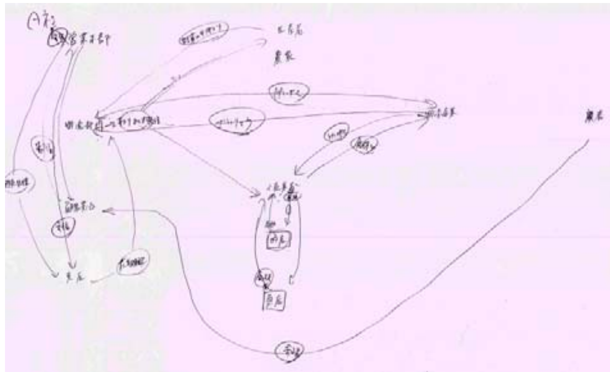


Figure 11 Occurrence frequency of omission types



(a) G-RD



(b) DFD

Figure 12 Output figures of the experiment (B group)

5.2 Discussion

In this section, the reason why the results in Figures 10 and 11 were obtained is explored.

First, group B, which showed a tendency different from that of the other groups in Figure 10, was investigated. In Group B, the number of omissions in information relationships of the DFD method is larger than that of G-RD. This may be due to the fact that the number of information relationships that can be extracted by G-RD only (i.e., four, as shown in Figure 12, ◎ → ×) is larger than the number of information relationships that can be extracted by DFD only (i.e., two, as shown in the same figure, × → ◎). Figure 12 shows the figures drawn by group B. In the G-RD results shown in Figure 12(a), information relationships of reservation and reservation confirmation by customers are described. In addition, contact of the desired delivery date of the ingredients and contact of the internal transportation between the stores are described. However, in the DFD shown in Figure 12(b), these information relationships have been omitted.

An interview survey of students of group B clarified why the information relationships that existed in the figure created earlier were omitted from the subsequent figure. The first figure was collected when writing the second figure; since it was a condition to draw the second figure in the absence of the first figure, the earlier result is not necessarily succeeded later. Furthermore, because of the omission of the information relationships in DFD, it was cited that rework occurred several times in the process of drawing the figure. Students drew figures while reading the business requirements sentence sequentially. At that time, the contradiction, and hence the necessity for improvement of the earlier figure, was found; in the process of discussing the correction method, rereading of the business requirements sentence and skipping occurred. As DFD allows stakeholders to be arranged freely, there was a discrepancy in the interpretation of the figure between the two members of the group, and rework took place several times. Especially, work in Group B was divided between a person who read the business requirements sentence and a person who drew the figure. The reader sees the drafter drawing the figure after reading the business requirements sentence. In the case where a figure different from the intention of the reader is created, exchange of opinions and rework of the drawing occurred. On the other hand, in G-RD, the position in which to write the information relationship is uniquely decided after the placement of stakeholders, and rework after drawing only occurred in a few cases. As a result, the business requirements sentence was sequentially written down in the figure, and there was no confusion.

Next, group F, with the largest improvement in the number of omissions in information relationships in Figure 10, was investigated. Group F could seemingly improve omissions of information relationships due to the large number of information relationships that could be extracted by G-RD only (the number is 5, as shown in Figure 11). In the DFD representation that the group first created, there were lack of reservations, reservations confirmation by customers, complaints to shops, company-wide sharing of complaints, and contacts for delivery of ingredients. However, they were described in G-RD. Group F took the longest to write the first figure (40 minutes, compared to 26 minutes for the other five groups); they found it troublesome to interpret the business requirements sentence and how to draw. Interviews with the students indicated that the discussion of the business process framework for the restaurant chains focused on the first drawing stage, and the interest in drawing was reduced. The later drawing could be based on the previous discussion. In particular, in the G-RD created later, they were able to draw while reading the business requirements sentence. As a result, the drawing time was 15 minutes, which is less than half of the first drawing time; as can be seen from Figure 10, they achieved the least number of omissions of all groups (two omissions). From this, it was found that the order of drawing advantaged the output of this group more than that of the other groups.

The results of the interviews are consistent with the results of a post-experiment questionnaire survey on the advantages and disadvantages of the two methods. When asking students for an impression of the experiment, the answers were almost the same. The advantages and disadvantages of G-RD and DFD presented contradictory results. The superiority of G-RD was attributed to the ease with which it was possible to create and read comprehensibly, due to the fixed position in which to capture stakeholders and information relationships. A disadvantage was that it is intuitively difficult to understand, because the rule interprets the direction of information in relation to its position. On the other hand, the ease of intuitively grasping the information flow of DFD, since it was indicated by arrows, was pointed out as an advantage. However, the ease of understanding the figure to be created varies, and this was considered inferior. The method has a high degree of freedom to arrange stakeholders. Therefore, it is easy to understand when it is successfully arranged, but difficult to understand when the placement fails. It was also pointed out that it takes time to understand the composition of DFD written by others, and that it is inferior in terms of information transmission.

Based on the above, the results related to Figure 11 are described. First, the graphs on the right-side rise to the right in all groups, whereas the slope varies depending on the group in the graph on the left side. It can therefore be inferred that G-RD is an easier method for beginner students, with less omissions of information relationships than DFD. Considering the individual groups, it was found that group F’s better improvement effect could be attributed to the excellence of the drawing method, as well as to the advantage of the work order. On the other hand, in the graph on the left side, the reason why group B goes down to the right is attributed to the fact that G-RD was found to be a method with limited rework.

6. Conclusion

In this paper, the results of a comparative study of two methods used to visualize business processes were reported. Specifically, the difference between the methods for the matrix-based G-RD and the flow-based DFD method in terms of the number that can be extracted without omission of information relationships between stakeholders and the number of stakeholders were compared.

For this purpose, university students who are not accustomed to business process analysis drew the business processes of a restaurant chain by utilizing G-RD and DFD. There was no significant difference in the number of stakeholders extracted. However, the information relationship between stakeholders drawn with G-RD was more than that drawn with DFD.

Since the positions for writing stakeholders and information relationships in G-RD are fixed, it was possible to write the business requirements mechanically; therefore, it was found that even beginner students were unlikely to omit relationships. In the case of DFD, since the degree of freedom for arranging stakeholders is high, it is easy to understand how to do successful placements; however, it may be difficult to understand when placement fails, and when rework is required. It turned out that this might lead to the omission of stakeholders and information relationships.

Based on the above results, it emerged that the definition and visualization of business processes by utilizing G-RD can reduce the omissions of stakeholders or information relationships and it lead to avoid serious requirements defects.

The results of this study confirmed the possibility of beginner students accurately describing the business process by utilizing G-RD. For this reason, it is expected that G-RD could be also applied successfully in future to the education of information system development and management as well as to the definition of business requirements in enterprises.

This paper compares and studies the difference of description methods about two requirements, (1) Stakeholder's function or role and (2) Information relationship between stakeholders. In the future, similar comparative studies on the remaining two requirements, (3) Decomposition and integration of stakeholder's functions utilizing level and (4) Responsibility demarcation of stakeholders, are planned to be conducted and these studies should lead to a proposal of better description method.

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Risk Assessment in the Online Condition Monitoring System

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Recently, various companies have started using online condition monitoring systems owing to the increasing popularity and utilization of Internet of Things and Big Data. The acquisition of the operating state and the environmental condition of each user's product in real time and analyzing them in real time has become possible. However, there are also risks in introducing the online condition monitoring system in-house, and the risk assessment for the system has not been clarified. In this research, we first identify the requirements of online condition monitoring systems and generalize the system in the view of enabling maintenance activities at the optimum timing for each user. Second, this research extracts the risks and considers the countermeasures. Finally, the proposed method is evaluated using the example of automobile manufacturers.

Keywords and phrases: Online Condition Monitoring Systems, Risk Assessment, Introduction of the IoT System, QFD

1. Introduction

Various companies have started using online condition monitoring systems because of the rapidly growing popularity and utilization of Internet of Things (IoT) and Big Data (BD). This has facilitated the acquisition of the operating state and the environmental conditions of each user's product in real time and their real-time analysis.

For example, Komatsu, Japan's construction machine manufacturer, provides an IoT system called KOMTRAX. In this system, each construction machine is equipped with sensors and GPS. This system individually performs operation management and vehicle management by using data obtained through online condition monitoring. Consequently, it is possible to manage the replacement timing of oil and parts, and to maintain and manage the vehicle. Furthermore, it is possible to manage the operation from the position information of the vehicle using GPS, operating time, and fuel information (Arakawa, 2002). Fuji Xerox, offering copying machines, printers and multifunction devices, operates a system called TQMS. This system remotely monitors the operating status of each customer's product, incorporates information on the usage behavior of each user, and enables maintenance personnel to perform maintenance at the optimal times (Takano, 2013). For example, it is possible to replace the toner when it is about to expire. Therefore, unnecessary inventory is avoided and customer satisfaction is improved.

However, there are also risks in introducing the online condition monitoring systems in-house, and the risk assessment system has not been clarified.

2. Online Condition Monitoring System

In this section, the online condition monitoring system is organized.

2.1 Condition Based Maintenance

Conservation activities can be classified into Breakdown Maintenance (BM) and Preventive Maintenance (PM). BM is a method of carrying out maintenance after a failure occurs. On the other hand, PM is a method of carrying out maintenance before a failure occurs. Furthermore, PM is classified into Time Based Maintenance (TBM) and Condition Based Maintenance (CBM). TBM determines the cycle in advance and regularly performs maintenance according to the cycle. CBM manages the deterioration tendency of the target and performs the best conservation at the optimum time prior to the failure.

The online condition monitoring system dealt with in this research acquires the target information online and carries out maintenance through CBM. The maintenance flow from this system is used to acquire target information online and analyze it. Then, based on the analysis results, the optimum maintenance response is examined and executed. This maintenance method has the following merits.

(i) Reduction of useless exchange costs
(ii) Reduction in personnel costs for maintenance
(iii) Efficiency improvement by avoiding downtime
(iv) Avoidance of the successor problem

This maintenance method is often used in facilities that are very important or those with high degradation rates. In recent years, with the spread of

IoT, this maintenance method is becoming easier to introduce.

2.2 Configuration of the System

The online condition monitoring system is divided into various fields of sensor devices, networks, database, and applications. The sensor devices collect information on products to be monitored. Networks enables cooperation of information between systems. Information is accumulated in Database. The applications analyze the collected information and displays the results.

3. Flow of creation of QFD

To conduct a risk analysis in the introduction of the online condition monitoring system, it is necessary to identify the requirements of the system and consider the system to achieve the requirement. Therefore, Quality Function Deployment (QFD) is utilized. This chapter shows the flow up to the creation of the QFD.

3.1 Project goal setting

The online condition monitoring system is required to have the speed and urgency of information processing as compared with a normal maintenance system. The online condition monitoring system is required to possess greater speed and urgency for information processing compared to those in a normal maintenance system.

This research sets goals in the project of introducing that system. Here, it is assumed that a company introducing the system is an enterprise that manufactures products and sells them to customers. In the target enterprise, online information such as sensor information, how to use customers and information on the environment is collected (customer usage information and environmental information are collected), and CBM is carried out within the company. CBM assumes that the prediction of the optimum maintenance time, detection of abnormality, and utilization of remote control during emergency are included.

In this research, the goal of the project is to develop the online condition monitoring system and to introduce it to the target enterprise.

3.2 Definition of stakeholder

Stakeholders for the construction of an online condition monitoring system are considered. First, the following stakeholders can be cited within the company in which the system is installed.

-maintenance department (maintenance personnel, customer support center, system operator, system maintenance person), managerial position person, production department, development department, procurement department, network management department-

Furthermore, the following stakeholders can be mentioned outside the enterprise.

-customers who use the monitored products, business partner of the products, administrative agency-

3.3 Derivation of requirements

After the stakeholder is clarified, the requirements of each stakeholder are considered. According to Liu and Yokoyama (2008), Mitsuo et al. (2012) and Mitsuo et al. (2013), requests are defined in a hierarchy. First, in the primary hierarchy, an abstract request is defined. Next, in the secondary hierarchy, the breakdown of the requirements of the primary hierarchy is clarified. Then, in the tertiary hierarchy, requests dropped to the stage closer to the specifications of the system are defined.

Here, some of the requirements are indicated. For example, the following requests in Table 1 can be cited as requirements from maintenance personnel.

Table 1 Requirements from maintenance personnel

Level 1	Level 2	Level 3
Reduced downtime from 【maintenance personnel】	Accurate failure prediction, Accurate abnormality detection	Accurate data on the target can be acquired
		Sufficient amount of data is acquired
		An appropriate prediction model is established
		An appropriate abnormality detection method is established
		A large amount of data is managed
	Conducting appropriate conservation activities	It is possible to accurately identify the place to be preserved
		Maintenance can be completed before failure occurs
		Remote control of objects for safety
		Communication is uninterrupted
Easy maintenance activities from 【maintenance personnel】	No need for difficult judgment for maintenance implementation	The result of analysis is easy to understand
		The result is visually easy to understand
		Easy identification of fault location
	Easy to hand over maintenance technician's	There are few operations to remember
		It can be sensuous operation
	Schedule conservation activities	Conservation visit using GPS
		Indication of the importance of the necessity of maintenance
	The system is stable	There are a few system bugs
		Spare power supply at power outage
		Less system maintenance time
		Data loss does not occur
		Administrator authority is clear

Each level represents the hierarchy of requirements.

Level 1 represents an outline requirement. Level 2 represents an element of each outline requirement. Level 3 represents a detail requirement. In addition, from customers who use the monitored products, the following requests in Table 2 can be cited.

Table 2 Requirements from customers of products

Level 1	Level 2	Level 3
High customer satisfaction from 【Customer of products】	Great value for quality and reliability	Maintenance information is also fed back to customers
		When a theft occurs, the location of the product is grasped
		Failure occurrence frequency is low
		Maintenance personnel respond quickly when a failure occurs
		Shorter downtime during maintenance
		Remote control can be received in case of danger
	Easy to use system for customers	The system operates under any environmental conditions
		The monitoring device does not disturb the use of the product
		Easy to understand the content of the information terminal for customers
		It is easy for customers to input information to the terminal
	The customer can use the product with confidence	There is no hazard due to sudden remote control
		There is no worry about security problems
		Low cost of maintenance

Furthermore, the following requests in Table 3 can be cited as requirements from those in managerial position at companies manufacturing these products.

Table 3 Requirements from a managerial position

Level 1	Level 2	Level 3
The overall maintenance cost is reduced from 【Corporate managerial position】	Parts are conserved just before failure occurrence	Fault prediction with high accuracy is performed
		Dangerous signs are detected
	Maintenance personnel expenses are reduced	Maintenance staff visit at the optimum schedule
		The maintenance person assuredly prepares the necessary parts
		Required repair and replacement are known beforehand
	Less loss due to downtime	Parts are replaced before a failure occurs
		Immediate recovery in an abnormal condition
High safety is guaranteed	There is no leakage of personal information	Information communication is encrypted
		Unnecessary personal information is not collected
		Database information does not leak to the outside
		Unnecessary information is properly deleted
	Product accidents do not occur	Monitoring of product's dangerous uses
		Dangerous usage environment monitored
		Minimal damage at the occurrence of an accident

3.4 Derivation of system functions

Next, the functions of the system are clarified. An example of the result is shown in Table 4. The functions of this system are also defined by the hierarchy. Level 1 represents an outline function. Based on all the configuration of the system, the outline function covers all the functions necessary for the online condition monitoring system.

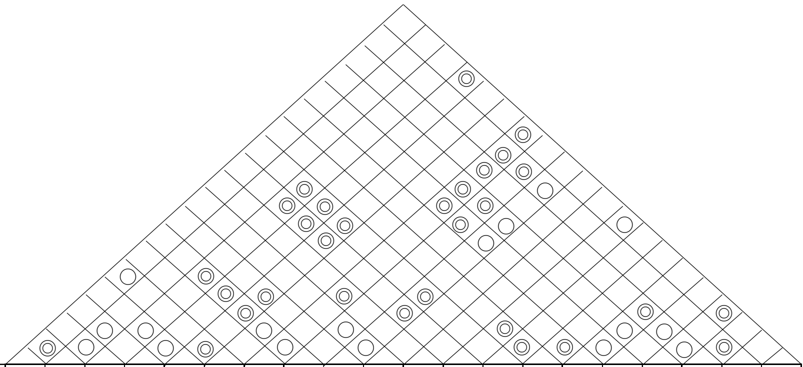
On the other hand, Level 2 represents a detailed function. Functions defined in Level 2 are numbered for identification.

Table 4 Functions of this system

Level 1	Level 2	Function No.
Data collection by monitoring device (F1)	Attach the monitoring device to the target product	(F1)1
	Secure power supply for monitoring device	(F1)2
	Collect the sensor information of the target product	(F1)3
	Collect information on how to use the target product	(F1)4
Data communication by communication network (F2)	Process information gathered by the monitoring device	(F2)1
	Transmission of gathered information to the database	(F2)2
	Communication between the database and each system	(F2)3
Data storage by database (F3)	Storing new data in the database	(F3)1
	Organizing existing data in the database	(F3)2
	Back up the database	(F3)3
Data analysis system (F4)	Retrieve data from the database	(F4)1
	Understand the current status of the target product	(F4)2
	Failure prediction of the target product	(F4)3
	Determine the location and timing of maintenance (including emergency situations)	(F4)4
Support system for conservation activities (F5)	Collect information on maintenance such as schedule and replacement parts	(F5)1
	Send information necessary for maintenance to the database	(F5)2
	Send emergency warning and control information to the database	(F5)3
Information terminal system (F6)	Maintenance personnel and customers can acquire information from the database	(F6)1
	Maintenance personnel and customers can input information	(F6)2
	The monitored target product can receive remote control from the support system	(F6)3

3.5 Creation of QFD

Finally, the requirements of each defined stakeholder are correlated with the function of the system, and a QFD is created. An example of the result is shown in Figure 1. First, the relationships among system functions are identified. It is possible to know the range of influence of the malfunction of each function. The triangular part at the top of the Figure 1 shows the relationship of the function. "○" indicates a part with a relation. "◎" indicates a part where the relationship is particularly strong among them. After that, the relationship between the requirements and functions of each stakeholder is clarified.



		Function / Demand	(F1)1	(F1)2	(F1)3	(F1)4	(F2)1	(F2)2	(F2)3	(F3)1	(F3)2	(F3)3	(F4)1	(F4)2	(F4)3	(F4)4	(F5)1	(F5)2	(F5)3	(F6)1	(F6)2	(F6)3
Reduced downtime from 【maintenance personnel】	Accurate failure prediction, Accurate abnormality detection	Accurate data on the target can be acquired	◎	○	◎	◎																
		Sufficient amount of data is acquired			○	○	◎			◎	◎											
		An appropriate prediction model is established			◎	◎	◎								◎	◎						
		An appropriate abnormality detection method is established			◎	◎	◎							◎		◎						
		A large amount of data is managed					◎			◎	◎	◎	○	○	○			○	○			
	Conducting appropriate conservation activities	It is possible to accurately identify the place to be preserved	◎		○	○								◎	◎	◎	◎					
		Maintenance can be completed before failure occurs													◎	◎	◎	◎		◎	◎	
		Remote control of objects for safety							◎					◎		◎			◎	◎		◎
		Communication is uninterrupted						◎	◎				○					◎	◎	◎	○	◎
Easy maintenance activities from 【maintenance personnel】	No need for difficult judgment for maintenance implementation	The result of analysis is easy to understand														◎	◎			◎		
		The result is visually easy to understand														◎	◎			◎		
		Easy identification of fault location														◎	◎			◎		
	Easy to hand over maintenance technician's skills	There are few operations to remember																		◎	◎	
		It can be sensuous operation																		◎	◎	
	Schedule conservation activities	Conservation visit using GPS	◎			◎											◎	◎		◎	◎	
		Indication of the importance of the necessity of maintenance									◎					◎	◎			◎	◎	
	The system is stable	There are a few system bugs							◎	○	○	◎							◎	○	◎	◎
		Spare power supply at power outage		◎						◎	◎	◎							◎	○	○	◎
		Less system maintenance time								◎	◎	◎	○	○	○	○	○			○	○	◎
		Data loss does not occur					○	○	○	◎	◎	◎	○							○	◎	
		Administrator authority is clear								◎	◎	◎					◎			◎	◎	◎
High customer satisfaction from 【Customer of products】	Great value for quality and reliability	Maintenance information is also fed back to customers							◎								○	○		◎	◎	◎
		When a theft occurs, the location of the product is grasped				◎			◎					◎					○	◎		
		Failure occurrence frequency is low												◎	◎	◎				◎		
		Maintenance personnel respond quickly when a failure occurs							○					◎		◎	◎	○	○	◎	○	
		Shorter downtime during maintenance							○					◎		◎	◎	○	○	◎	○	
		Remote control can be received in case of danger							◎										◎			◎
	Easy to use system for customers	The system operates under any environmental conditions	◎	◎	○	○			◎											◎	○	○
		The monitoring device does not disturb the use of the product	◎	◎	○	○																
		Easy to understand the content of the information terminal for customers							○		◎						◎			◎	○	
		It is easy for customers to input information to the terminal							◎	◎	○									○	◎	
	The customer can use the product with confidence	There is no hazard due to sudden remote control							◎					◎					◎			◎
		There is no worry about security problems					◎	◎	◎		○							○	○	◎		
		Low cost of maintenance														◎	◎			◎	○	

Figure 1 Part of the created QFD

4. Risk identification

By exploiting the explicit relationship between the requirements of each stakeholder and the function of the system, the risks of introducing online condition monitoring system are identified.

4.1 Knowledge obtained from function definition

For the functions of monitoring devices that require prompt and accurate information processing, the function of sending information and the relationship with the DB becomes clear. This is because of the ease of securing the power supply and ease of information transmission change, depending on how the monitoring device is attached. In addition, when incorporating it in the DB, it is necessary to process the data of the monitoring device in a form that makes it easy to transmit. Next, as a DB function, the communication of information to other systems is frequently performed. Therefore, it is necessary for the DB data to be easy to identify the target.

Furthermore, the relationship between the data analysis system and the monitoring device is also strong. This is because a certain degree of model needs to be established when deciding the type of equipment, where to place it, and what type of data is to be acquired. The relationship between the data analysis system and DB is also strong. To carry out the analysis smoothly, it is necessary to obtain the information and the inside of the DB must be organized. Moreover, when receiving the control remotely, the system will judge from the information on the usage and current state.

4.2 Knowledge from QFD

The findings obtained from the created QFD are summarized.

4.2.1 Maintenance personnel

First, the relationship between the request from maintenance personnel and the function of the system is shown. In this system, unlike ordinary maintenance systems, it is necessary to manage enormous amounts of data. Therefore, the function of the DB becomes important. At that time, it is understood that the necessary information differs depending on the purpose of utilization. It is necessary to separate it between emergency and normal maintenance. In addition, it depends on whether you need information on the current state or on future predictions.

It was also found that the cooperation of maintenance personnel and customers is also important to whether maintenance can be carried out appropriately before failure occurs. A maintenance worker who is handed the analysis result must trust the result and carry out conservation activities. In addition, the maintenance personnel must explain sufficiently to the customer that CBM will be performed based on the analysis result.

Regarding the communication, especially in systems of high importance such as remote control, it is not a problem especially if communication is interrupted. With regard to the DB, it is also necessary for the data in the DB to be regularly sorted out and to be able to respond to requests for data for schedule planning and determining the importance of the necessity of maintenance. Regarding the clarification of the administrator authority, it was found that it is particularly necessary in both, the DB and information terminal parts.

4.2.2 Customers of target products

In this system, there are also some problems for customers who use products to be monitored. One of them is whether customers of target products can definitely understand and utilize the system. As a request from the customer, it is understood that the function of the information terminal, which is a bridge to directly touch the system, is an important factor. For the information terminal, it is required that the operation is inconvenient. Furthermore, it is required that there is no problem in communication.

4.3 Risk identification

Risks were identified by assuming the scene in which this system is used. Removing all risks is difficult from a cost perspective. In that case, a trade-off is made in consideration of the construction time and cost of the system.

Here, risks can be identified based on the results up to when the derivation of QFD. By referring to the created QFD, the relationship between function and request can be ascertained. The Risks were revealed in terms of the consideration of the situation where system functions cannot achieve requirements of each stakeholder. Also, the relationship between functions can be confirmed from QFD. When identifying risks, the interrelationship of functions is also taken into consideration.

The following are some of the risks assumed for each element. Among the risks mentioned, unlike regular maintenance systems, the characteristic risk of the target system is detected.

(A) Risks of monitoring devices
- Devices are illegally remodeled
- The device breaks down due to a harsh operating environment
- The maintenance person does not notice the failure of the sensor part
- The developer does not know which sensor to install

(B) Risks of the communication system
- High cost due to frequent communication
- Communication is interrupted
- Communication is intercepted

(C) Database risks
- Data linkage does not work
- The format of the data does not match
- There is missing data

(D) Risks of data analysis
- Unnecessary data is collected
- Required data is not acquired
- Analysis system cannot distinguish between an outlier and communication error
- The customer does not trust the system because analysis accuracy is bad
- The analysis system cannot distinguish whether the customer is the cause or the manufacturing responsibility

(E) Risks of information terminal
- Customers do not accept preventive maintenance
- Maintenance persons misuse the information terminal

4.4 Countermeasures over risk

The countermeasures can be cited against the risk of "The developer does not know which sensor to install" of the monitoring device. For example, to proceed with the installation of effective sensors as far as possible and to consider adding sensors later are conceivable.

Further, as a countermeasure against the risk that the information terminal's "Customers do not accept preventive maintenance", for example, to propose preventive, rather than compulsory, maintenance to customers and to show customers the effect of preventive maintenance can be considered.

5. Case: online condition monitoring system in an automobile

Based on the opinions of automobile companies who are already working on the development of online condition monitoring system, the idea of risk analysis is validated by taking the application to automobile online condition monitoring system as an example. In the online condition monitoring system of an automobile, information from the sensors of each product is collected online through a SIM card. Then, after analyzing the data, the information on maintenance is conveyed to the automobile dealer. The collected data includes GPS location, vehicle speed, degree of depression of the accelerator, number of revolutions of the engine, acceleration, gear, detailed information before and after the point of occurrence of the abnormality, etc. In addition, alert information on electronic system abnormality is also collected. The collected data is processed and then sent to the DB. The collected information is accumulated in the DB. The information is analyzed and the result is sent to the terminal of each automobile dealer. It is then utilized for preventive maintenance and maintenance. At that time, the schedule of conservation activities can be decided together. In addition, the remote control of each customer is not considered, but automatic braking systems are installed in each automobile.

By comparing with actual cases at already introduced automobile companies, it was evaluated whether the risk extracted by the proposed method is realistic and appropriate. As a result of hearings from automobile companies, it was recognized that characteristic risks of the online condition monitoring system were identified for the risks that were discovered. In particular, "Risks of information terminal" which was identified by the proposed method is one of the difficult problem the already introduced automobile companies are currently facing.

6. Conclusions

In this research, the risk analysis in the introduction of online condition monitoring system is presented. The requirements of stakeholders and the functions of the system are arranged and the QFD is created. Based on the QFD, risks are identified based on the application scenes of the system. Unlike ordinary maintenance systems, promptness and urgency of information processing, collaboration between customers and maintenance personnel and customer's understanding are required. Finally, the result of the risk analysis is judged by the technical association of the automobile company. From now on, it is necessary to further investigate similar system construction methods.

Acknowledgements

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Management Support for Stakeholder Engagement Using Wants Chain Analysis

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In today's environment, projects usually have many stakeholders. Conflict among stakeholders can increase when problems such as low levels of participation are seen in the planning awareness of stakeholders. Therefore, stakeholder management is crucial in such projects. However, presently, there are few practical rules, tools, and methods to prevent low levels of participation or conflicts of interest in the planning awareness of the stakeholders. Therefore, in this study, a Wants Chain Analysis was applied to understand the association between stakeholder desires and actions. Furthermore, a management support method for stakeholder engagement was proposed, which increased the probability of predicting the strength or weakness of stakeholders' desires. A Wants Chain Analysis was applied to the data of a sample project to visualize the level of desire among the stakeholders.

Keywords and phrases : Wants Chain Analysis, Stakeholder Engagement Management, Visualization

1. Introduction

In today's environment, projects usually haves many stakeholders. This can increase conflict among stakeholders when problems such as levels of participation are seen in the planning awareness of stakeholders. Therefore, stakeholder management is crucial in such projects. A Project management knowledge system guide needs to be a part of stakeholder management.

Project stakeholder management identifies how an individual and a group or organization may be affected by a project. The expectations of the stakeholders and their influence on a project analyzed by Project Manager. A stakeholder can participate effectively in decision making and implementing a project. This is the process that is necessary to devise an appropriate management strategy.

Satake et al. (2014) said the range of a project expands with the penetration of IT, as many stakeholders become involved. In order for a project to succeed, one of the problems that needs to be worked on is how to eliminate indifference and disincentives such as resistance, which can result in conflicts of interest. The project can end up in situation where there is no cooperation from any stakeholders except the project manager because of the low levels of participation in planning awareness. Stakeholders' conflicts of interest then rise. Thereby, Fujino (2008) said it may occur because of differences in the recognition of fellow stakeholders. It is not easy to let solve those problems, and get stakeholders to focus on one goal. Strengthening relations with the stakeholders through stakeholder management can affect the success or failure of the project. This is a problem that should be settled.

However, presently there are, few practical rules, tools, and methods to prevent low levels of participation or conflicts of interest in the planning awareness of the stakeholders.

Therefore, in this study, a Wants Chain Analysis (WCA) was applied to understand the association between stakeholder desires and actions. Furthermore, a management support method for stakeholder engagement was proposed.

Makino (2011) developed a WCA where she applied Customer Value Chain Analysis (CVCA) to relate to desire as a technique for analysis of the design of a social system. With CVCA, it is possible to visualize the system of a society, which is the exchange of cash, products, services, and information. However, when a new system is designed, what is not mentioned is the reason a stakeholder participates in the system; in other words, what stakeholder need the system satisfies. WCA was applied to CVCA to enable understanding the stakeholder desire that can be satisfied.

In this study, WCA was applied to a systems development project. Furthermore, a management support method for stakeholder engagement was proposed using a decision tree, which increases the probability of predicting the strength or weakness of stakeholders' desires. Furthermore, the study attempted to visualize the level of desire among the stakeholders from the data of a sample project by applying a Wants Chain Analysis.

2. Project data

In this study, we attempted to visualize data of a sample project by applying a Wants Chain Analysis. The sample project data is introduction of SCM (Supply Chain Management), aiming at improving managerial efficiency, review of a series of organizations, duties related to sales, management, supply and demand management, production control, and, took 10 years from its introduction. The project is to replace the production control system, which had been obsolete for approximately two years.

2.1 Characteristics and problems of the project

In this case, information system development and changes in duties are carried out in parallel, and an unprecedented investment was made in large scale computerization of the production section.

The problem in the sample project data was that there was little experience in introducing large scale systems, and repeated specification changes were demanded by a user. This project was changed the delivery date priority from the project called system completion

3. Definition and setting of the suggested method

In this study, the sample project data classified desire of the stakeholders by investigating and identifying stakeholders, using Makino's (2011) attempt to establish a compression method. This study proposed sample project data classification by compression, which increased the probability of predicting the strength or weakness of desires of the stakeholders. In the following we discuss definitions and setting.

3.1 Classification of the desire

The study of desire was initiated by H. A. Murray, who made a list of desires. A.H Maslow built a desire hierarchy considering the relationships between desires by developing a list of desires. Saito tried extraction of desires, and added a large number of new desires to the original psychological developmental of desires by Maslow. As described above, there are many studies on the desires of individuals.

Makino (2011) proposed a method to classify a new desire from the results of the previous study and experiment. Figure 1 shows Makino's proposed classification method.

Makino proposed a classification method for a new desire that pays attention to the agent. The object of the desire has not received much attention so far, although Maslow's seven basic needs can cover all the desires of an individual. Makino classified desire by dividing it into an agent and an object, and broadly classified desire applying an approach called Mutually Exclusive and Collectively Exhaustive (MECE). Furthermore, this is a method used to classify an idea based on the state of Maslow's seven basic needs about "in condition more expecting" in each from. In introduction MECE does the target it has become possible to grasp the desire that both subjects and actors will become others, which had not been grasped so far.

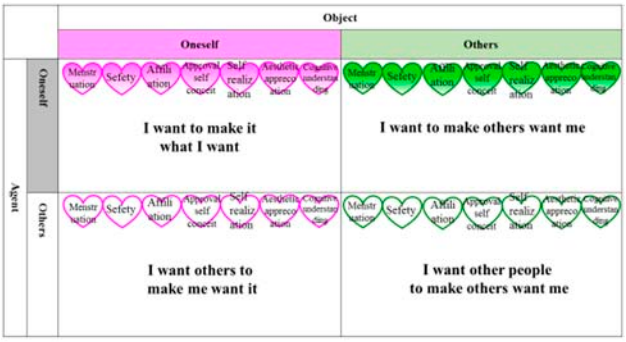


Figure 1 Method to classify of a new desire

3.2 About Wants Chain Analysis

Wants Chain Analysis is an analysis technique used to fill in the desires of stakeholders in CVCA. The desire that needs to be satisfied is classified using the classification method of desire described in 3.1. The desires of stakeholders are described using heart marks and colors. An example is shown in figure 2. The color of the heart mark is a red color when the object of the desire is him or herself. If the object of desire is another person, a green color is used. Also, if the action owner is himself, it is filled in and it is filled out if it is another person.

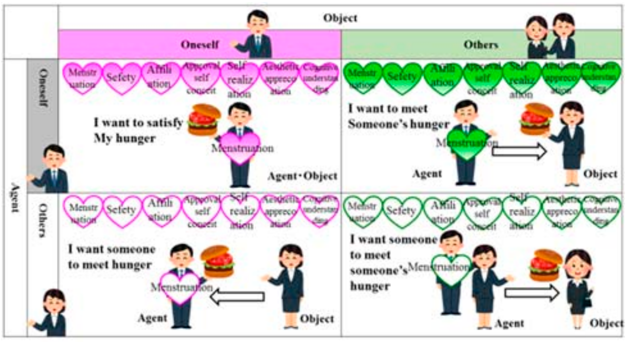


Figure 2 The kinds and colors of desire

3.2.1 Procedure of Wants Chain Analysis

Wants Chain Analysis is performed with the following procedure, using the desire marks shown in Figure 2.

(1) List important stakeholders related to products, services, and activities that we are planning to develop.

(2) Write the following flow along with the arrows to clarify the relationships between the stakeholders.

- -Money and capital
- -Things, opportunities, materials, services, -information
- -claims, plan influence, vote

(3) At the starting point of the arrow written in (2), fill in the factor (desire) where each stakeholder has taken

action by using the color and type of the heart mark shown in the figure. Furthermore, indicate the detailed description of the desire next to the heart mark of the desire. Since one action may be based on multiple desires, it is all right to describe multiple heart marks. An example using Wants Chain Analysis is shown in Figure 4.

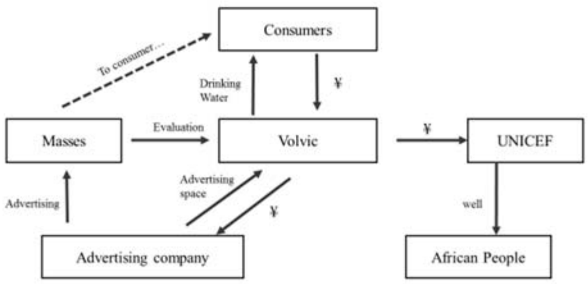


Figure 3 CVCA of the 1L for 10L of Volvic

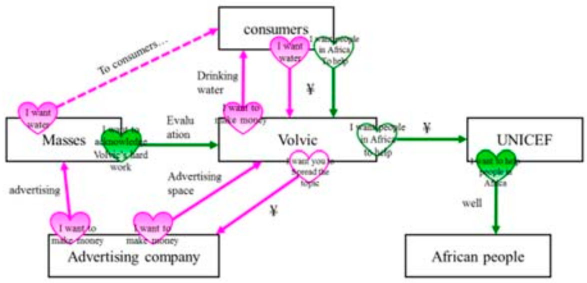


Figure 4 Wants Chain Analysis of the 1L for 10L of Volvic

In ordinary business, money, goods, and services are the main things frequently exchanged. In the example of Volvic, it is the sale of mineral water between Volvic and consumers. In CVCA, it is difficult to grasp “why it would be happening” other than exchange of money and goods or services. However, by using Wants Chain Analysis to fill in and visualize the desires of the stakeholders as shown in Figure 4, it becomes possible to understand the reasons for establishing communication between stakeholders.

3.2.2 Problem of Wants Chain Analysis

The following two problems can be cited as goals of desire linkage analysis.

(1) Since Wants Chain Analysis represents a momentary relationship between stakeholders, Wants Chain Analysis is a tool that reinforces CVCA. CVCA visualizes the flow of money, goods, services, and information between stakeholders and stakeholders in the social system at an arbitrary time. It can be described as a snapshot at a certain moment. Therefore, Wants Chain Analysis, which is a tool that reinforces CVCA, only visualizes the stakeholder’s desire at any given time and cannot consider the passage of time.

(2) Numerical verification using a quantitative method has not been done.

3.3 Decision tree element

Decision tree is graph for making decisions in the field of decision theory such as risk management.Decision tree is used to plan and reach the goal.Decision tree is created with the aim of helping decision making.Decision tree is a special form of tree structure.

3.3.1 Reasons to use a Decision tree

It is necessary to identify stakeholders’ priorities and the strength of their desires to support management. Therefore, we applied a decision tree to Wants Chain Analysis, considering estimated effect and risk.

3.4 Proposed method

Based on content theory which suggests that human behavior is based on desire, and paying attention to the relationship between stakeholders’ desires and behaviors, we propose a stakeholder engagement management method using Wants Chain Analysis to visualize the desires of stakeholders. The decision tree element helps in understanding the strength of the desires of stakeholders. In the following section, we describe the features and procedures of this method.

3.4.1 Features of the stakeholder engagement management support method are as follows.

The features of the proposed method are shown below.

(1) Chronological order

It can be applied to system development in chronological order, so it is possible to understand changes in the relationships of stakeholders.

(2) Changing notation of method

Changes can be made to the notation so it is appropriate for the method, according to (1).

(3) Exchanges description column

Conventional Wants Chain Analysis is described in the method. In this study, it is predicted that stakeholders will improve with use of the developed system and set up a description field.

(4) Adding Decision tree elements

It adds a decision tree element to estimate the strength of the desires of stakeholders, which could not be identified in a conventional Wants Chain Analysis.

3.4.2 Procedure for stakeholder engagement management support method

The procedure of the proposed method is shown below.

(1) Identify stakeholders

It is likely that the number of stakeholders will increase and decrease, depending on the progress of the system development. Each time there is a change, write it on the tool.

(2) Relationships among stakeholders are indicated by arrows, which should be colored according to Figure 2.

(3) Write a decision tree element.

(4) Add the desires of stakeholders.

(5) Write down what happened with the stakeholders in the description field.

(6) Repeat (1) to (5).

4. Visualization using sample project data

The sample project data in this study was visualized using the proposed method.

4.1 Results of visualization

The desires of the stakeholders during the sample project were visualized during the execution of system development process.

(1) The visualized results of the project planning phase is shown in Figure 5.

(2) The visualized results of requirements definition, design, and programming are shown in Figures 6 and 7.

(3) The visualized results of the test and transition phase are shown Figure 8.

(4) The visualized results of the operational phase are shown in Figure 9.

5. Consideration of Results

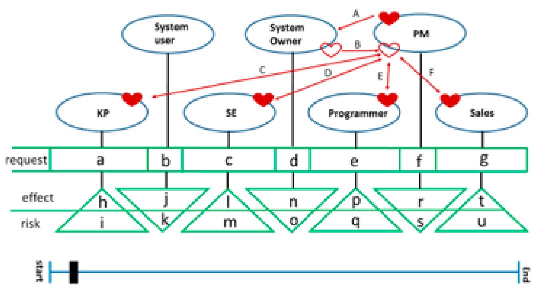
The results visualized by the method are discussed below.

(1) At the project planning phase, the desires of stakeholders were fulfilled by each other and the relationship was satisfactory. There was a sense of unity at this point.

(2) The user side and the Keyman + System Engineer side were divided. The project manager (PM) attempted to recover the relationship; however, it was not recovered. At this point, using the results visualized by the proposed method, a lot of arrows pointed to the PM. Desire was unilaterally present, but the desire was not satisfied. By examining the decision tree elements, you can clearly see the effects and the risk. This can be used as an aid in the PM's decision making.

(3) As a result of being subjected to change and modification requests in the design and programming phases, the schedule for the test and transition phase is pushed back. Visualization results: "There were many desires that I wanted to make me want it." "Desire is one sided and unfulfilled." By looking at the decision tree element, it is possible to identify the important stakeholders at the design and programming phase.

(4) System improvement work for the establishment of the new system continues. Desire is satisfied between PM and Keyman + System Engineer.



A	meeting	a	Completed with SE and programmer
B	meeting	b	Completion of the system
C	conference	c	Completion of the system
D	conference	d	Completion of the system
E	conference	e	Completion of the system
F	conference	f	Completion of the system
G		g	Completion of the system
H		h	
		i	
		j	
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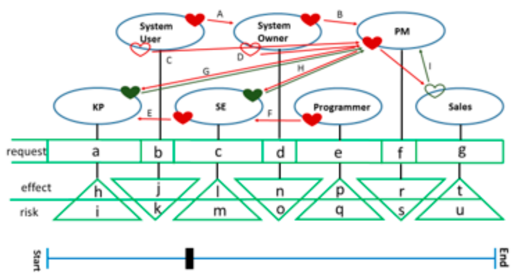
Figure 5 Project planning phase



A	Pursuit of profits,costs can not be transferred	a	Completion,a realistic schedule
B	Pursuit of profits,costs can not be transferred	b	Completion,pursuit of profit
C	To request	c	Completion,a realistic schedule
D	To request	d	Completion,pursuit of profit
E	Realistic schedule,To cost	e	Completion,a realistic schedule
F	Realistic schedule,To cost	f	Good completion
G	Realistic schedule,To cost	g	Good completion
H	Realistic schedule,To cost	h	It does not deteriorate the quality,it can be completed
I	I want you to proceed according to schedule	i	Expanding costs
J		j	Own interests
		k	Engineer's burden
		l	It does not deteriorate the quality,it can be completed
		m	Expanding costs
		n	Own interests
		o	Engineer's burden
		p	It does not deteriorate the quality,it can be completed
		q	Expanding costs
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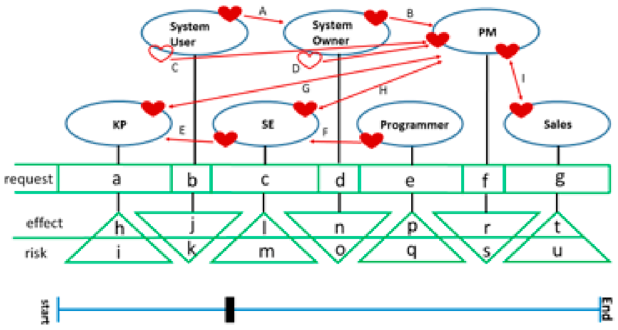
Figure 6 Requirements definition,design, and programming phase



A	Pursuit of profits,costs can not be transferred	a	From sensitivity and quality to closing
B	Pursuit of profits,costs can not be transferred	b	Completion,pursuit of profit
C	To request	c	From sensitivity and quality to closing
D	To request	d	Completion,pursuit of profit
E	Submit meaningless alternatives	e	From sensitivity and quality to closing
F	KP/SE discussion with users	f	Recovering situation
G	conference	g	Completion
H	Submit meaningless alternatives	h	Can be completed,do not increase the cost
I	I want you proceed according to schedule	i	Loss of trust
J		j	Own interests
		k	Engineer's burden
		l	Can be completed,do not increase the cost
		m	Loss of trust
		n	Own interests
		o	Engineer's burden
		p	Can be completed,do not increase the cost
		q	Loss of trust
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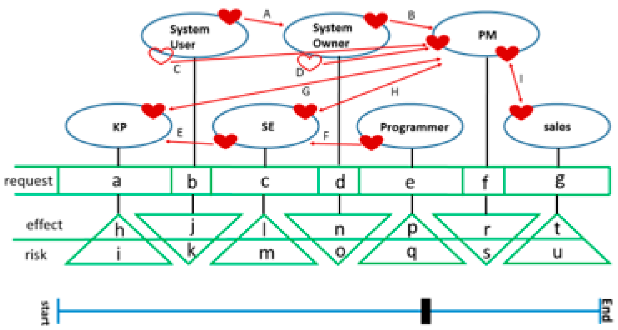
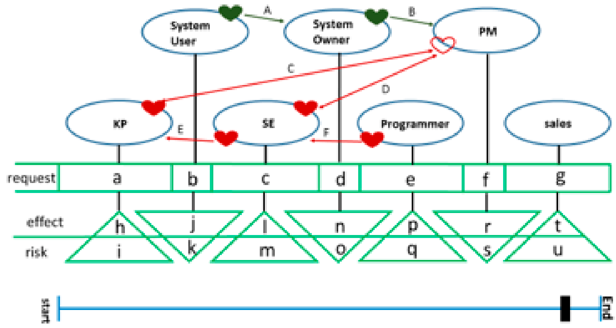
Figure 7 Requirements definition, design, and programming phase



A	conference	a	Completed anyway
B	conference	b	Competion,stable operation
C	Change,Request for corretion	c	Completed anyway
D	Change,Request for corretion	d	Competion,stable operation
E	conference	e	Competion,stable operation
F	conference	f	Project convergence
G	conference	g	Completion
H	conference	h	Completion
I	conference	i	Decline in quality
J		j	Completion
		k	Engineer's burden
		l	Completion
		m	Decline in quality
		n	Completion
		o	Engineer's burden
		p	Completion
		q	Decline in quality
		r	Project convergence
		s	Decline in quality
		t	Project convergence
		u	

Figure 8 Test and transition phase



A	conference	a	User assistance
B	conference	b	To the next step
C	About system remodeling	c	User assistance
D	About system remodeling	d	To the next step
E	About system remodeling	e	User assistance
F	About system remodeling	f	Reflection
G		g	Next order receiving activity
H		h	Trust recovery
I		i	Burden
J		j	
		k	
		l	Trust recovery
		m	Burden
		n	
		o	
		p	Trust recovery
		q	Burden
		r	
		s	
		t	

Figure 9 Operational phase

6. Conclusion

The purpose of this research was to apply Wants Chain Analysis to a system development project, propose a stakeholder management support method, and promote stakeholder awareness of project participation. Therefore, in this study, we verified whether the sample project data was practical for the proposed method. In this attempt, there were some useful results, reflections, and perspectives.

The desires of stakeholders in the project were successfully visualized by the proposed method. This is indispensable for proposing support methods aiming to promote the behaviors of stakeholders in the future and can be a very useful result.

The amount of description increased by Wants Chain Analysis proposed by Makino is an issue. The burden on the PM is large when it is used during the project. Our study was based on sample project data, however, Wants Chain Analysis is generally done during the project. In other words, it needs to be applied and fed back to the actual project being done.

As a future prospect, since extracting desire from project data becomes subjective, we would like to devise a method so that it can be objectively extracted and evaluated.

We would like to devise a method to motivate behavior from desires to action to encourage behavior, and then propose it as a support method.

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Work Engagement Research on Information Technology Engineer Based on Positive Psychology

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In late years the information technology is evolving rapidly, and the using the information systems is spreading. A difficult degree in the information system development project is continuing adding. To a project team continues achieving a performance above a certain level in such times, it is important to draw team potential, as each member shows strengths of the self. It is urgent business that the organization considers the making of such environment. I tried that I applied Positive Psychology applied technology there. With Utrecht Work Engagement Scale based on the Positive Psychology, I investigated it for a certain project continuously for a certain period of time. When the measurement result suddenly dropped, a member spoke of possibility of the quitting a job or the other member was absent from a project without notice. These things show that possibilities to assess personal internal psychological condition quantitatively from the outside. In the situation I am offering human resource development service, from that result, I consider that it might utilize effectively in the point of view of project manager growth. The most important thing to lead project to the success is to improve team performance and that is based on improving personal internal satisfaction. This report describes the investigation and consideration.

Keywords and phrases : Positive Psychology, Information System Development, Work Engagement, Utrecht Work Engagement Scale, Project Manager Resource Development, Human Resource Development Format

1. Introduction

Our company's Project Manager Training Program has close ties with the organizational efforts of Hitachi, Ltd., regarding project management. Information & Telecommunication Systems Group, which is an SE division of Hitachi, Ltd., began working on the introduction of a Project Management System and Project Manager Development System in the late 1990s (Sakagami, 2010). Our company has been engaged in building a Project Management Human Resource Development Framework in collaboration with the PMO of Information & Telecommunication Systems Group of Hitachi, Ltd. I am going to devise the new upbringing theme that agreed with the talented person needs of the project situation that continues changing.

The Ministry of Economy, Trade, and Industry's main information industries policy, which is one of its economic and industrial policies, states that amidst the rapidly expanding scope of the use of information technology and its increasing added value, there is a need to cultivate high-level IT talent who are not just users of IT, but also value creators who leverage IT (The Ministry of Economy, 2015). Heeding this, the Information-technology Promotion Agency titled their 2015 IT talent white paper (IPA, 2015) "Can we see a new stage? Designing the 'Next World.'"

If the current method of cultivating talent remains unchanged, it will be difficult to continue producing the talent needed to handle future information systems development projects. A shift in focus is therefore needed. We are in the process of developing an experimental program to cultivate project managers that uses applied positive psychology.

For a project team to continue delivering results, no matter how difficult the requirements of the projects may be, the team members need to have pride in their work, find meaning in it, and be able to become absorbed in it. It is the pressing need to create an environment where each team member can utilize their strengths so that the team can reach its full potential.

Recently, we have conducted a joint study with RDPi, a company that recognized the potential of positive psychology early on and works on refining systems to maximize the value of organizations' efforts by increasing employees' work engagement. Using the Utrecht Work Engagement Scale (UWES), which is based on positive psychology, RDPi has been studying work engagement of R&D engineers of a manufacturer over one year. The study's results suggested that it is possible to quantitatively and easily assess an individual's state of mind, which is difficult to observe externally. This paper will discuss the study and its implications.

2. About positive psychology

2.1 History and background

Positive psychology was first proposed in 1998 by Dr. Martin Seligman, then-president of the American Psychological Association. While the field of psychology - particularly clinical psychology - saw remarkable growth after World War II, its research was focused on human deficiencies, such as mental illnesses (Peterson, 2006). In contrast, positive psychology places emphasis on effective human functioning, which it assesses in each individual based on constructs such as optimism, courage, work ethic, future-orientedness, interpersonal skills, and sense of social responsibility to quantify their constructive human qualities (Shimai, 2006). It is a science that, Seligman says, indicates new a direction forward for psychology (Seligman and Csikszentmihalyi, 2000).

Each of the qualities with which positive psychology is concerned could be considered a suitable requirement for IT talent that will chart a course toward the 'Next World.'

2.2 Work engagement

"Work engagement" refers to a positive psychological state that encompasses sustained emotional and cognitive energy directed toward one's work in general sense, not limited to particular phenomena, people, or actions. It is made up of three dimensions: vigor, dedication, and absorption (Schaufeli, 2002)

(1) Vigor: energetic, full of confidence, persistent, doesn't get discouraged

(2) Dedication: feels a strong connection to one's work and cannot remain indifferent; motivated to find meaning in work

(3) Absorption: forgets oneself in work and loses track of time

Work engagement describes a state where one's work energizes and fulfills them. It influences not only individual work performance, but also team-level results, productivity of services, customer satisfaction, and physical health (Schaufeli, 2002).

2.2.1 Utrecht Work Engagement Scale

The degree of work engagement can be measured using the UWES, which asks respondents how they feel about their work. The full version consists of 17 items and there is a shortened version with 9 items as well. The UWES has been translated into 23 languages and is primarily used in studies/surveys in the medical industry. It was translated into Japanese in 2007 and its credibility/validity in Japan was confirmed (Shimazu, et al., 2008).

The shortened version of the UWES consists of three questions about each area (vigor, dedication, and absorption) to be answered on a 7-point scale (see Tables 1 and 2) (Schaufeli, 2006). Each response is worth 0 to 18 points, and a higher point total signifies greater work engagement. Based on the results of a survey whose respondents belonged to a diverse range of professions around the world, a "high" level of

Table 1 UWES Shortened version

Number	Questions	area
1	At my work, I feel bursting with energy. (VI1)	Vigor
2	At my job, I feel strong and vigorous. (VI2)	Vigor
3	I am enthusiastic about my job. (DE2)	Dedication
4	My job inspires me. (DE3)	Dedication
5	When I get up in the morning, I feel like going to work. (VI3)	Vigor
6	I feel happy when I am working intensely. (AB3)	Absorption
7	I am proud of the work that I do. (DE4)	Dedication
8	I am immersed in my work. (AB4)	Absorption
9	I get carried away when I am working. (AB5)	Absorption

Table 2 UWES indicator

Number	Feelings
0	Never/Never
1	Almost Never/A few times a year or less
2	Rarely/Once a month or less
3	Sometimes/A few times a month
4	Often/Once a week
5	Very Often/A few times a week
6	Always/Every day

work engagement is defined as a score of 36 or higher; "moderate," from 28-35 points; and "low," 27 or lower.

3. Our UWES-based survey

3.1 About the survey

We conducted a UWES-based survey of R&D section in one medium-sized B2B manufacturer for a year. The outline of the survey is shown in Table 3.

Table 3 Outline of the survey

Survey period	January-December 2014
Number of respondents	21-37 (the number changed depending on the period)
Respondents' professions	Managers, leaders, designers, programmers, etc.
Survey method	Administered via the shortened UWES at the beginning of the month to assess impressions about work during the previous month

3.2 Survey results

When the survey began in January 2014, there were 21 engineers including managers and leaders in the R&D section. As shown in Figure 1, more than 60% said they had a "low" level of work engagement. Figure 2 shows each individual's level of work

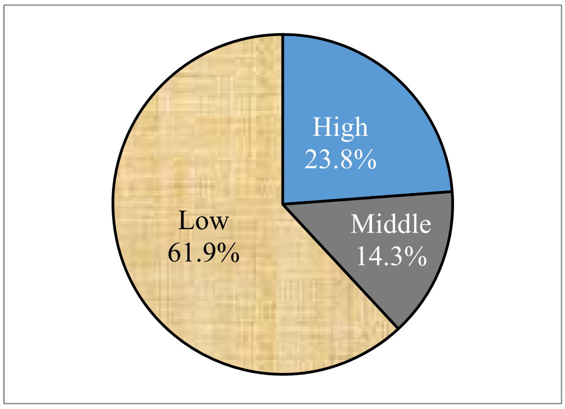

Figure 1 Work Engagement Survey of the Whole Project Employee

engagement. The crowding of data points in the "low"zone is not surprising, because given the high proportion of weakly-engaged individuals indicated by Figure 1. Furthermore, there is a scattering of highly unengaged engineers whose score was less than 10. The highest score was 49 and the lowest one was 4 - a more than tenfold difference.

Such a wide disparity even between employees working in the same environment means that it have to take more than uniform organizational initiatives like operational improvements and skills development to bring out the best in each individual. The first order of management is to understand each individual's unique traits affecting on each motivation at work; the level of work engagement of every team member must be raised before any gain in the team's overall productivity can be expected. Nevertheless, examining

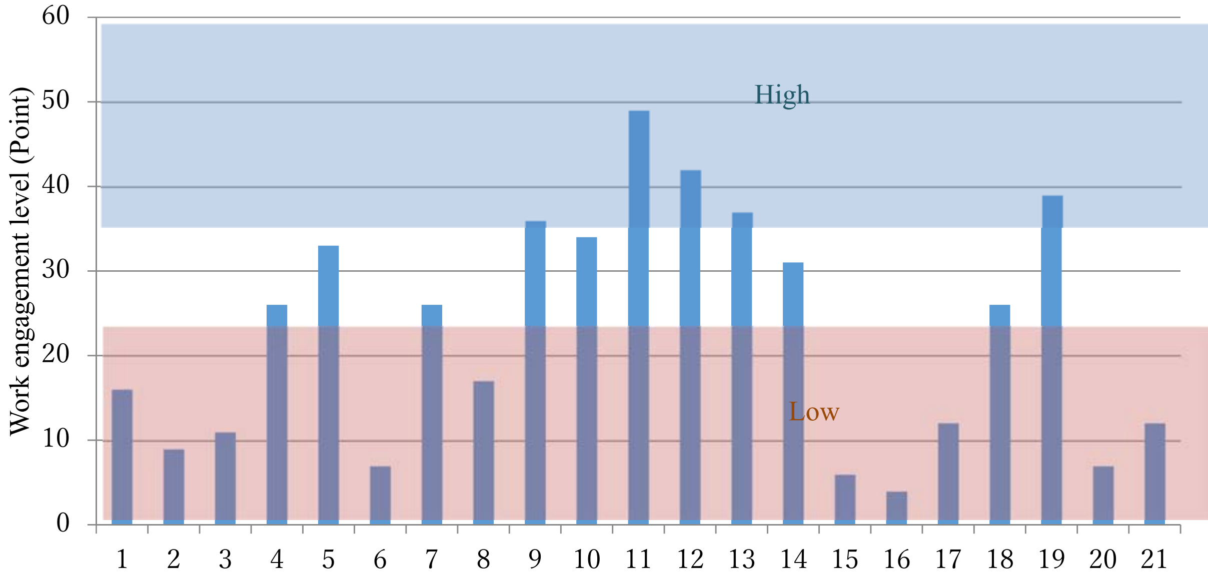

Figure 2 Individuals' work engagement

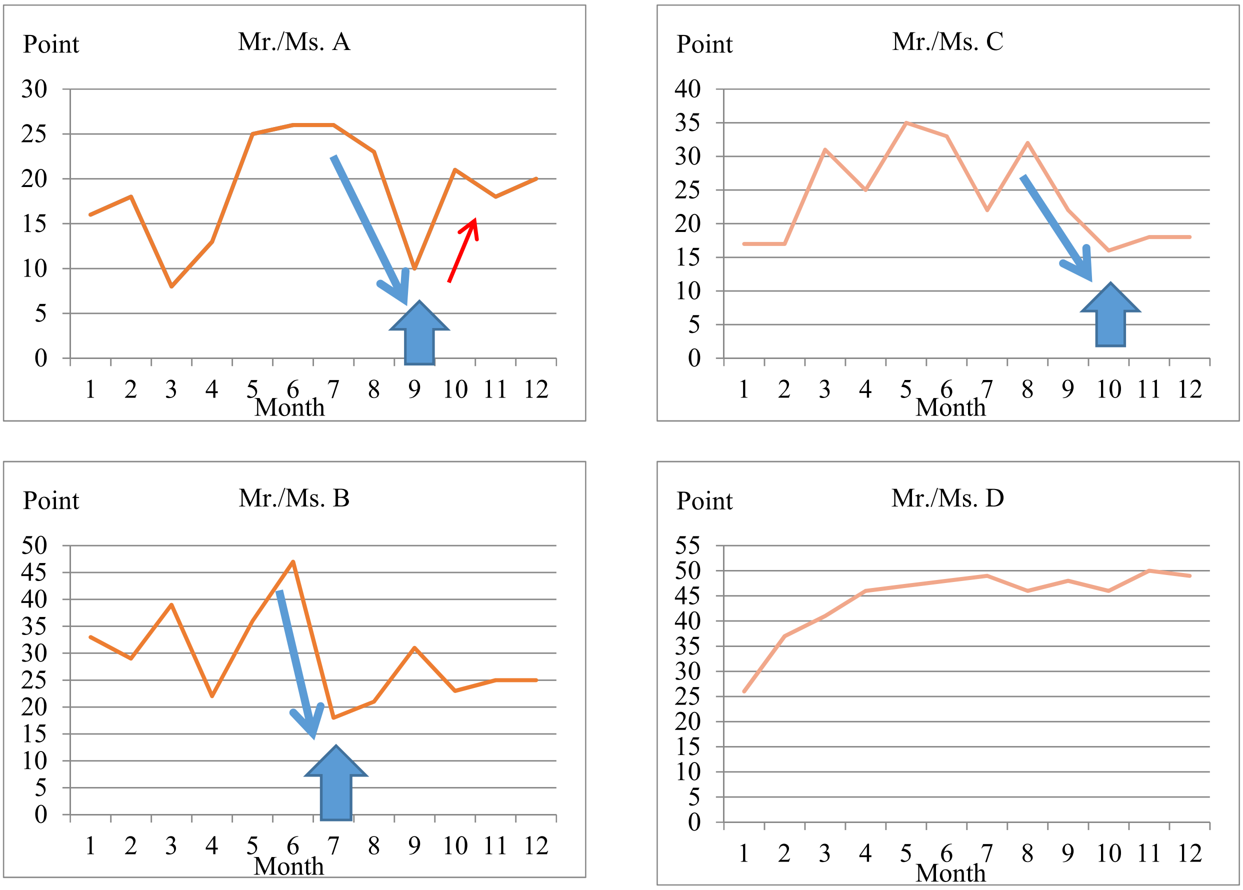

Figure 3 Changes individuals' work engagement

an individual's state of mind from outside is far from easy.

Figure 3 shows changes in individuals' work engagement in the monthly time series and indicates that a person's level of engagement fluctuates from month to month. Some respondents exhibited significant changes; others' levels remained steadier. I would like to focus on three respondents whose levels exhibited either a decline for consecutive three months or steep and sharp decline. Mr. A, whose work engagement level was on a downward trend for three consecutive months, suddenly said he wanted to leave the company at the point indicated by the arrow. Of two respondents whose work engagement levels showed steep and sharp decline, Mr. B suddenly took a two-week leave from the company. Mr. C took leave without permission, and we lost contact with him. The timing of these incidents is indicated by the arrow in both cases. As nothing seemed to be out of the ordinary with these three individuals until these incidents, the managers and everyone else scrambled to deal with the situation.

On the other hand, Mr. D was a reticent type who mostly kept to himself, yet he worked tirelessly and his level of work engagement increased steadily and gradually. Thus, external observation of an individual's day-to-day behavior is not a reliable way to ascertain what is happening internally.

In addition, Mr. A's level of engagement exhibited a V-shaped rebound following its sharp decline. This is due to a promise that, for his next assignment, he would be responsible for the project that he wanted. We were able to confirm, both quantitatively and visually, how extrinsic motivation led to an increase in the level of work engagement.

After this, managers began to pay attention to each individual's level of work engagement and discussed the issue one-on-one if they saw any dramatic changes. This created a considerate work environment that inhibited the sudden occurrence of problems.

4. Applications in training

4.1 Toward better project environments

A decrease in performance or a lack of human resources can be fatal for a project's success. Our survey's continuous measurement of respondents' levels of work engagement suggests the effectiveness of a quantitative understanding of the mental states of project team members. Taking an appropriate course of action at the right time to respond to individuals who exhibit a major change in their level of work engagement can be useful in preventing human resources-related issues.

Besides this, previous research (Shimazu, 2010) has also cited phenomena such as the ability of one individual's level of work engagement to "infect" another's and that the engagement levels of individual members who are part of a highly engaged team also rise. This is thought to be because on highly engaged teams, there are many opportunities to receive support from superiors and colleagues, which makes it easy to obtain a sense of self-efficacy.

To create better project environments, it is imperative for team leaders to watch for changes in levels of work engagement and engage in appropriate and well-timed mutual communication with the team. That said, it is surprisingly difficult to respond spontaneously and effectively to team members whose work engagement is declining.

For us, as providers of talent cultivation services, this is where the key to a new kind of project manager training lies. For example, role-play training that teaches how to influence team members whose engagement is declining, communication skills training, and leadership training are not only effective for skills development, but they also reduce the stress associated with a skills deficiency, thereby increasing confidence and efficacy on the job.

4.2. Applications in training

Successfully managing a project in a new field with a high degree of uncertainty requires reading situations precisely and creating new adaptive actions, rathern than the application of existing knowledge and skills. This is known as "knowing," which requires breaking through from the mold of past experiences and methods in order to be practiced effectively.

We conducted a training session where we presented a project as an ill-defined problem - a situation where one or more parameters are not clearly defined - and held a discussion about the skills considered necessary to solve it.

Trainees shared comments like these regarding the realizations that they had after the discussion:

i. The beginning is uncertain because the facts are not well understood; it is necessary to involve the person(s) in question to confirm and organize the facts
ii. Different people see situations differently due to cognitive differences. It's not a question of which interpretation is right, but rather it is necessary for both parties to understand why the other thinks the way they do
iii. Participation was open to all regardless of project manager experience; all participants learned a lot of new things
iv. I hope to see more uncommon training sessions created by participants

5. Conclusion

This paper touched upon the current situation of project manager training, which is in need of a new focus, and explained why our company is in working toward the experimental usage of applied positive psychology.

By using the UWES, which is based on positive psychology, to perform a continuous assessment of work engagement on a project over a fixed period of time, we found that individuals vary greatly in their levels of work engagement, and even the same individual's engagement fluctuates over time.

These findings indicate that it is difficult to bring out the best in individuals using only a one-size-fits-all approach, without making efforts to raise the baseline level of work engagement. They also suggest that it is effective to quantitatively assess individuals' internal states, which are difficult to ascertain from everyday behavior. Furthermore, the longitudinal aspect of the survey made it possible to observe sudden changes and prevent problems from occurring. Taking an appropriate course of action within a team will be useful in deepening interpersonal connections (engagement) and getting effective results.

As providers of talent cultivation services, we are currently considering various new concepts for project manager training, some of which are currently in the experimental phase.

Surveys and research on the effect of positive psychology in the workplace have only just begun. We will continue to do further research in the interest of cultivating strong project managers who can create a better work environment that brings out the full potential of the team and see difficult projects through to success.

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Theoretical framework for integrated stakeholder and risk management in Indian Smart Cities

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Fostering Nascent Intrapreneurial Communities

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Large organizations strive for innovation and often protest that they have very few intrapreneurs (entrepreneurs within existing organizations). To encourage more innovation within their organization, we created a nascent intrapreneur community (hereafter, "the Community") with a bottom-up approach, i.e. employees gather without orders from their superiors to create new business models with their own ideas. We conducted a survey of members to determine the effects and limitations of the Community. First, by being in the Community, nascent intrapreneurs may promote their activities more. Surprisingly, more than 90% of members who started their activities more than two years before are still trying their ideas with product or service users. Because they do what they want to do, they often become autonomous and highly committed. Second, intrapreneurial communities within large organizations are a good counter solution to organizational silos, one of the biggest obstacles to innovation. Once intrepreneurial employees join the community, they begin to network by themselves, exchange information, and cooperate. This paper concludes that fostering a community of nascent intrapreneurs is certainly a way for large organizations to foster more innovation without the need to change their structures.

Keywords and phrases: Innovation, Intrapreneurship, Intrapreneur, Community, Bottom-up Approach, Fujitsu

1. Introduction

Twenty years have passed since Christensen published "The Innovators' Dilemma" in 1997; however, large organizations still have contradictions between their current leading business (sustaining innovation) and (disruptive) innovation compatible at once in the same organizations. They often protest that they have very few intrapreneurs (entrepreneurs within existing organizations). Some organizations, such as Pitney Bowes and Cisco Systems, constructed an innovation community via top management.

Contrarily, a company constructing such a community via the bottom up, such as Fujitsu, may need another approach. This is what we attempted to do, i.e. to build a community of nascent intrapreneurs at the grass-root level (hereafter, "the Community"). Interestingly, employees with innovative ideas are eager to connect to other innovative employees. Once they started to socialize with the others, the network began to expand. As a result, embryos of innovation appeared. This study shows the effects and limitations of the Community from member survey results.

2. What and who is an intrapreneur?

First, what is an intrapreneur and who is he/she?

Intrapreneurship is often described as "entrepreneurship within existing organizations". Theoretically, every employee has the potential to create new business. However, some employees have already started their journey and many have not. Therefore, in this paper, "intrapreneur" is defined as an employee who has already been a part of the processes of something other than their actual jobs.

According to Ulijn et al., the ideal profile of intrapreneurs is as follows;

- Vision and creativity
- Initiative
- Internal motivation
- Autonomy
- Risk taking
- Internal control
- Commitment and persistence
- Market knowledge/customer orientation
- Knowledge of organizational structures and willingness to cross functional borders

Since this profile is ideal and there are very few intrapreneurs who have the complete profile from the start, the Community focuses on "nascent" intrapreneurs, i.e., a typical employee who already has parts of this profile but has never experienced creating new business on their own.

3. Road to intrapreneurialship

3.1 Training programs for creating new business

There are two typical thresholds to begin pursuing new business at Fujitsu. One is training courses designed to create new business from employees' ideas. They are mainly targeted to future managers who are often selected by management.

During three to six months, participants are to build a team, conduct research, and give a business presentation to senior managers. They are encouraged to make unique proposals, e.g., new business models, or even create totally new markets.

For instance, Fujitsu launched a health-care service for pets and their owners. Services for pets were not included in the conventional business domain of Fujitsu; hence, the launch was quite a challenge.

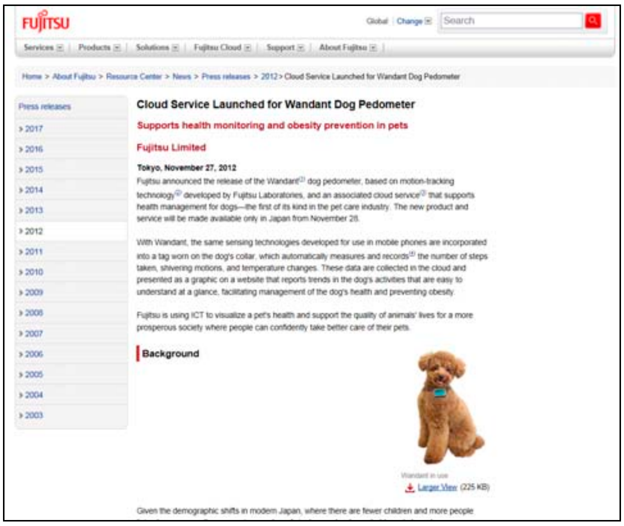

Figure 1 Press release of launching health-care service for pets and their owners

However, this is rather an unusual case. Because the service was created by a particular star employee.

Usually, once a training course ends by giving a presentation and receiving feedback, teams dissolve and participants go back to their usual jobs. The purpose of this training is to investigate processes of making business plans from ideas and nothing more.

3.2 Workshops, ideations, and hackathons

There is another threshold to new business at Fujitsu. For some employees who consider themselves as outsiders, workshops, ideations, and hackathons are preferable. These events are targeted mostly to employees only or seldom to people outside company, and are organized officially or unofficially.

Participants may sometimes have their own ideas to develop, and others may seek to expand their skills or network outside their jobs.

(a) Workshops and ideations

Workshops and ideations are common at Fujitsu. Some are open to all employees and others are not. One of the most structured workshops/ideations is Fujitsu Mirai-Kaigi, which has held more than sixty events in five years. Thirty-nine percent of community members had workshop experience.

Figure 2 Fujitsu Mirai-Kaigi website

(b) Hackathons

The most popular gateway for Fujitsu's nascent intrapreneurs is hackathons. In fact, 84% of members had joined hackathons at the company more than once. Plus, 39% had organized hackathons themselves.

There are two types of hackathons; one is organized by senior managers and the other by employees. Having them in the form of competitions, winners receive a budget for prototyping in most cases. The most structured hackathons are those originating from the R&D section. They had seven hackathons so far with 78 prototypes and dozens of patents.

(c) Others

Very few employees are assigned exclusively to innovation, i.e., those who work in the business development section. Although the Community has contact with this section, the Community is not for it.

4. Obstacles to nascent intrapreneurs

After entering thresholds and creating vague business plans, what happens next? There are two common obstacles to nascent intrapreneurs; organizational silos and demotivation.

(a) Organizational silos

Fujitsu has more than 80 years of history and 150,000 employees worldwide. Like other large organizations, employees tend to be specialists of specifically subdivided jobs. Thus, employees have their territories and information barriers. These organizational silos often hide creativity and talent [3]. Because of the lack of information exchange, good ideas or brilliant people may not connect with each other.

(b) Demotivation

Fujitsu is also a typical Japanese company; hierarchical by age. Hence, employees tend to be less opinionated and independent, compared to more flexible labor market country such as the United States. In fact younger people with ideas often choose to leave the company to create new business. For those who choose to stay, maintaining their enthusiasm is difficult.

5. Natural-born Community

Training programs, workshops, ideations, hackathons, and others are all mere thresholds for new business. In fact, nascent intrapreneurs seek opportunities to develop their ideas further into real business afterwards. They begin to solicit for more support or funds and ask their colleagues for information. This is how the Community was born in Fujitsu. We call the formation of the Community a bottom-up approach because 94% of members joined voluntarily, that is, without their superiors' orders. The characteristics of the Community are given below.

(a) Cross-functional

If one believes that "the best thinking can come from anywhere in the organization," the Community is for him/her. Once people start to connect, they cross borders.

One attribute common in members is curiosity. Sixty percent chose "because I personally am interested in the topic" or "because the events sound interesting" as answer to the question "what led you to join innovation activities?" Then, once intrapreneurial employees join the Community, they begin to network by themselves, exchange information, and cooperate. In fact, the Community has members with diverse ages and affiliations.

(b) Virtual and trust-based

The Community is virtual and is not tangible. This means that its style of management is totally opposite to conventional organizations. No name is attached to it and no specific physical space is needed.

Because the Community is not hierarchical, trust between members is essential. To maintain mutual trust, members are co-active in helping their fellow members. To cooperate with each other, the Community makes visible each member's strengths clearly.

Interestingly, these two characteristics match the idea of the agile software development management framework Scrum. Takeuchi et al. argue that "self-organizing project teams" have i) autonomy, ii) self-transcendence, and iii) cross-fertilization. The teams may become "a vehicle for introducing creative, market-driven ideas, and processes into an old, rigid organization."

6. What members do in the Community

The Community supports each nascent intrapreneur.

(a) Sharing information and skills

This is the largest impact of the Community on the conventional organization. As mentioned in the Chapter 4, large organizations tend to make employees specialists of specifically subdivided jobs.

An interesting example is the case of a staff member from the accountant department. He proposed an idea about a beauty salon booking system in the training course for future managers. Unsurprisingly, he had no way to promote his idea after the course since his job is completely unrelated. Therefore, he asked a Community member for help. In this case, he provides his knowledge in numbers while volunteer engineers develop a prototype to show how it works.

(b) Accelerating collaborations

Because the Community is virtual and trust-based, it takes time to collaborate with others. Therefore, Sumioka launched an online service called the 3000 Projects. Members share and create a flowchart of tasks together asynchronously. With this flowchart, members may collaborate on a specific purpose with various means, i.e., maintaining the diversity of activities.

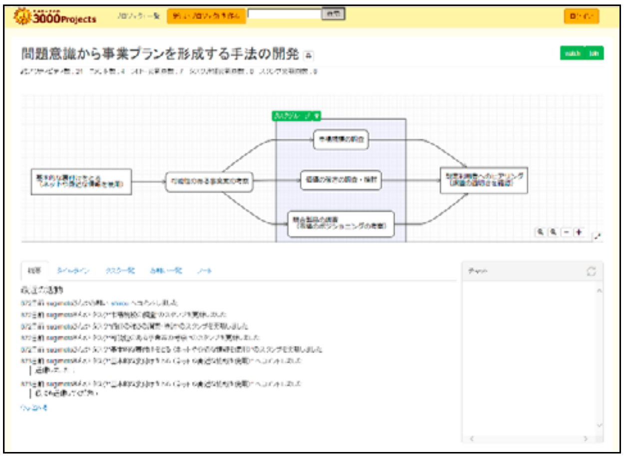

Figure 3 3000 Projects website

7. Effects

By creating a nascent intrapreneur community with a bottom-up approach, here are several effects that we have got so far.

(a) Virtual teams break organizational silos.

Teams can be considered "virtual teams" because members seldom see each other and generally do not have competing interests such as superiors and their staff do. This works for nascent intrapreneurs because they need various knowledge and resources to promote their ideas.

The Community member survey results indicate that the most valuable acquisition for 73% of members is social networking inside/outside the company.

Members first present their ideas not related to their jobs. Sixty-eight percent of them answered "ideas that have nothing to do with our jobs" to the question; "what type of ideas did you present?" However, 60% thought the ideas are "fully/partly beneficial."

For an example, a Community member got his initial financial capital for developing a prototype from a department other than his actual affiliation.

In summary, the Community breaks silos and positively impacts members' actual jobs.

(b) Members are internally motivated and autonomous.

Since members joined voluntarily, almost half have continued some kind of innovation activities other than their actual jobs for more than two years. Not every member spends much time on innovation; however, they have kept challenging to make their ideas into new business models.

From our observation, they are also internally motivated and autonomous because they do what they want. Also, they often become highly committed. The survey results indicate that more than 68% of members, who started their activities more than two years ago, are still proactive.

(c) Retaining employees

This is a rather secondary effect of the Community. The bottom-up approach can retain nascent intrapreneurs so they can take on the challenge of creating new business opportunities in a safer environment. Failure of an intrapreneur generally does not necessarily mean an immediate setback as would be the case for entrepreneurs. Actually, an intrapreneur says in his interview that he chose not to go because starting business on his own is too risky.

8. Is the Community feasible for any organization?

In 2009, Hamel called a new style of management for "moon shots for management" in Harvard Business Review. His proposed "Management's Grand Challenges" are as follows;

1: Ensure that the work of management serves a higher purpose.
2: Fully embed the ideas of community and citizenship in management systems.
3: Reconstruct management's philosophical foundations.
4: Eliminate the pathologies of formal hierarchy.
5: Reduce fear and increase trust.
6: Reinvent the means of control.
7: Redefine the work of leadership.
8: Expand and exploit diversity.
9: Reinvent strategy making as an emergent process.
10: De-structure and disaggregate the organization.
11: Dramatically reduce the pull of the past.
12: Share the work of setting direction.
13: Develop holistic performance measures.
14: Stretch executive time frames and perspectives.
15: Create a democracy of information.
16: Empower the renegades and disarm the reactionaries.
17: Expand the scope of employee autonomy.
18: Create internal markets for ideas, talent, and resources.
19: Depoliticize decision making.
20: Better optimize trade-offs.
21: Further unleash human imagination.
22: Enable communities of passion.
23: Retool management for an open world.
24: Humanize the language and practice of business.
25: Retrain managerial minds.

By these challenges, Hamel mentions the need of Management 2.0, and the idea is not for a specific organization but for all organizations.

Our challenge of fostering a nascent intrapreneur community fits all the challenges above. In addition, organizations do not even need to change their structure with this approach. In other words, the Community is more effective for large organizations than smaller ones since large organizations have more silos.

9. Limitations

However, two challenges remain regarding the Community.

(a) Locations

Most members are located in metropolitan Tokyo. Our next challenge will be to promote the Community throughout the Fujitsu group including companies outside Japan. Because the Community is trust-based, direct communication, such as face-to-face meetings, is preferred to indirect online conferencing. Company social networks might help overcome this limitation.

(b) Company rules

With the Community, members may overcome several obstacles. However, every intrapreneur will eventually realize that their company's' rules are unfavorable to them. Members struggle with inflexible rules or a closed culture in which failure is treated as a fatal error. Members are longing for "flexible rules"(67%) and "Open corporate culture"(66%).

10. Conclusions

The world needs more innovation and so do large organizations. Innovations depend on various key factors like financial budget, knowledge, skills, social network, flexible rules, open corporate culture, etc.. However, there is no doubt about that most essential key factor is those who promote innovations, i.e. intrapreneurs. Since they tend to be isolated, creating and fostering a community may be a solid foundation and a good accelerator for innovation within organization.

Many organizations wonder where to start in order to encourage more innovation. As noted in this paper, beginning with creating and fostering a community, organizations will be able to gain more potential and nascent intrapreneurs without changing their structures.

Acknowledgements

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Appendix: The survey results

The authors prepared surveys targeted for members of the Community. A total of 87 surveys were collected, the result of which are analyzed in this Appendix.

- Period 2017/6/13-6/23 (eight business days)
- Target 275 members
- Means Online (request via e-mail)

1. Select your affiliation.

Global Corporate Functions/Marketing/Sales	13%
Global Services Integration Business	13%
Global Cyber Security Business	0%
Digital Services Business	16%
Service Platform Business	8%
Laboratories	24%
Group Companies	26%

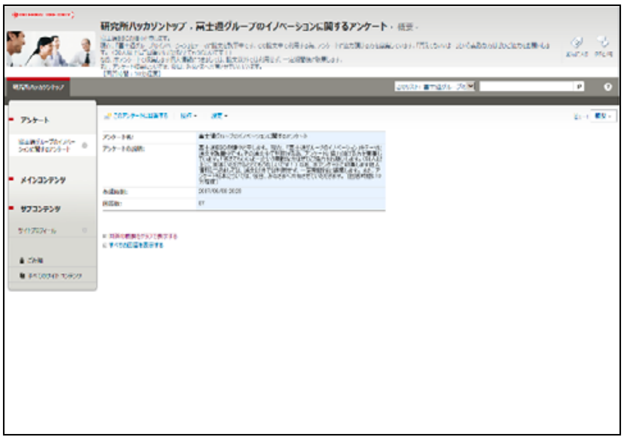

Figure 4 Screenshot of Survey

2. Select your age group.

Under 29yrs 16%
30-34yrs 21%
35-39yrs 16%
40-44yrs 16%
45-49yrs 11%
Over 50yrs 19%

3. Have you ever joined programs for innovation within Fujitsu?

Yes 91%
No 9%

4. (To those who chose Yes for Q.3) what sort of programs did you join? (Multiple answers)

Hackathons 84%
Trainings 29%
Competitions 21%
Ideations/Workshops 39%

5. Did you join the events voluntarily or as ordered by your superiors?

All by order of superiors 5%
Partly by order of superiors/Partly voluntarily 41%
All voluntarily 53%
Other 1%

6. Select the most suitable reason for you to join the events.

Because the topic is in my (job) domain 18%
Because I am personally interested in topic 31%
Someone suggested I join 7%
Because the events sounded interesting 31%
Other 13%

7. Were your superiors positive or negative to your joining the events?

Mostly positive 34%
Depends on topic or timing 46%
Mostly negative 8%
Other 12%

8. When did you join the events for the first time?

Within half a year 3%
Within a year 5%
More than a year ago and less than two years ago 19%
More than two years ago 73%

9. When did you join the events for the last time?

Within half a year 41%
Within a year 21%
More than a year ago and less than two years ago 29%
More than two years ago 9%

10. Which role were you in when you joined hackathons? (Multiple answers)

Participant 89%
Organizer 39%
Tech provider 23%

11. What types of ideas did you present?

Ideas fully related to my job 10%
Ideas partly related to my job 17%
Ideas that had nothing to do with my job 68%
Other 5%

12. What were the outcomes of the events?

User interviews 3%
Prototyping 70%
Business Plan 11%
Proposition to potential investors 3%
Other 13%

13. Are the ideas beneficial to your actual job?

Very beneficial 5%
Partly beneficial 55%
Not beneficial at all 32%
Other 8%

14. Did your joining the events have any impact on you?

Very much 38%
A little 57%
Not at all 5%

15. (To those who chose "very much" or "a little" for Q.14) what did acquire by joining the events? (Multiple answers)

Skills 58%
Social network 73%
Jobs 13%

16. Do you think of yourself as an intrapreneur?

Very much 16%
A little 57%

Do not think so	17%
Other	10%

17. How much do you work on innovation?

I lead innovation	10%
I support innovation	11%
I work occasionally on innovation	53%
I check mail from leaders or supporters	23%
Other	3%

18. What do you need for innovation? (Multiple answers)

Financial budget	47%
Knowledge or skills	32%
Social network	47%
Flexible rules	67%
Open corporate culture	66%

Applying Service Design Methods in Agile Software Development Projects: Process Framework and Case Examples

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NTT DATA Corporation

In the software development field, Agile is considered as an appropriate approach for adjusting the product features and the project scope to the customer needs, which may not be obvious when the new business is being conceptualized. However, Agile doesn't provide a general approach for designing business model and user experience, and assuring that the software application that are being developed supports the business in an appropriate manner. Service design methods can be used for such purposes, but product owners of an Agile project seldom have enough experience in using design methods, such as persona, customer journey map, and ideation workshop, and know when to use such methods in a project. This paper introduces a process framework that covers business model design and validation, software design and development, and business feasibility testing. In the project which uses this framework, service design methods are used for understanding customer needs, validating business and product ideas, and facilitating stakeholder participation. Case examples of the framework are introduced to illustrate how service design methods are used in the framework in complement to Agile practices to deliver the validated business model and the software products that support the business. Positive outcomes of using this framework, including a smoother accumulation of project knowledge, are also introduced.

Keywords and Phrases: Service Design, Scrum, Agile, Software Development, Business Design

1. Introduction

The role of information technology (IT) in business is expanding. Automated and optimized customer touchpoints, process automation, and analysis of customer behavior are widely used, and IT is now serving to determine the value and impact of the service. A growing number of customers needs the system development for building new businesses. To meet such demands, software developers need not only to build the software system, but also to build the business model, and design how to use IT for realizing the business.

Agile software development is used as a suitable approach for building a software system while clarifying the requirements for itself. However, Agile doesn't provide any method for discovering ideas and building concept for the new business. We established a process framework named "Altemista Project Now!" , which describes the standardized process and methods used in the project for generating new business ideas and developing software for the business, while keeping the average level of project efficiency and quality.

In this paper, we first explain Scrum as an Agile software development technique and service design as a service planning and validation approach. Next we discuss general situation of the system development industry to show why the framework was needed, and then describe overview and major characteristics of the framework. Finally, we introduce the application examples of the framework and outcomes.

2. Scrum and service design

It is said that in the development of software that supports new business, Agile software development is more suitable in the projects in that we can't have clearly defined requirements before starting the project, compared with the Waterfall product development model. Also, for creating a new business, approach of service design has been widely used in recent years. In this section, we briefly introduce Scrum and service design as suitable approaches for the new business creation.

2.1 Scrum

Scrum is one of the agile software development methods. In Scrum, paced by the limited period of time called "sprint" as a unit, the team iteratively and incrementally releases the product. According to Schwaber and Sutherland (2013), Scrum is "A framework within which people can address complex adaptive problems". In general, Scrum is said to fit in a situation where product requirements are not clear or justified, and the team has to implement a service while testing the business reasonability in parallel.

Consideration through the multiple views and people with different roles is necessary in the context of new business creation. Scrum defines different roles: development team, Product Owner (PO), and scrum master. PO is the person who is responsible to maximize the value of the product and the work done by the development team, therefore PO is a particularly important role for deciding the direction of the service. However, Scrum puts the value to self-organization, which means that Scrum members are recommended to contribute to each other in a flat relationship and proceed with the project in team agreement. Transparency is another important value in the scrum project, and the team should always make the project situation clear to all the team members.

2.2 Service design

Service design is the approach used in the various regions in realizing the business and public services. Stickdorn and Schneider (2012) set the five principles of service design as follows:

1) User-centered: Services should be experienced through the customer's eyes.
2) Co-creative: All stakeholders should be included in the service design process.
3) Sequencing: The service should be visualized as a sequence of interrelated actions.
4) Evidencing: Intangible services should be visualized in terms of physical artifacts.
5) Holistic: The entire environment of a service should be considered.

These features are consistent with what general stakeholders may be concerned about in considering a new business, and the service design is considered as a suitable approach in a complex and unpredictable projects with various stakeholders.

2.3 Methods of service design

Key methods used in service design include, and not limited to, the followings. These are known as UX (user experience) design methods too. However, we see them as of service design because the boundary between service design and UX design is not clear and sometimes UX design makes up a part of service design.

1) Persona

Description of an imaginary person who are likely to be a user of the new service. By building and sharing a persona in the team, they can share the common target of the service more easily.

2) Customer Journey Map (CJM)

A chronological representation of interactions with the service and the resulting feelings of the customer. By discussing the interaction at each touch point, the team can define ones that should be improved.

3) Idea creation techniques

To get an idea of the service and its functions and features, various types of ideation technique are used. In service design, workshop is conducted with the participation of a variety of people, in order to expand the variation of the idea or foster the engagement and solidarity of the stakeholders.

4) Business model canvas

A format to describe the key elements of the business model on a single sheet, in order that the stakeholders can discuss the new business from each viewpoint (Osterwalder and Pigneur, 2010). Lean Canvas is one of the variations of the original Business Model Canvas, for fitting to the use in an early stage of designing a new business (Maurya, 2012). Lean canvas is widely used in the Agile community.

5) Customer interview

Interviewing with potential customers may be one of the best techniques for understanding the experience of current users or testing the hypothesis of new business. In an interview study, the team meets with people who are similar to the Persona, and ask questions to validate their assumptions and get information about their experience and needs.

3. Need for a framework

Combining service design methods and Scrum can be beneficial in designing a new business and implementing the software system to enable it. However, it is not easy to do in practice, mainly because of following challenges.

<Challenge 1> Indirect connections between service design activities

In the service design, methods only help the team to get a better understanding of customers and the business concept that they are investigating, and make better decisions in designing business process and the software for the customers. There are no direct and obvious connections between the outputs of preceding activities to the other, and the links are often in the tacit understanding and considerations of the team members. Therefore, only the people who understand such an indirect connection between activities through the experiences on multiple projects can tell which method should be used at a specific point in the project, and decide how the activities should be linked to form a design decision.

<Challenge 2> Limited number of personnel with service design experiences

In addition, a PO candidate (e.g., representative of the new business) or a project manager (PM) tends to have the experience of system development, and seldom has knowledge and skills in service design. It is also possible to assign a person who has the know-how of the service design as an assistant of the PO and PM in the project. However, because the number of such personnel is limited, the number of the projects supported by such a teaming is also limited.

<Challenge 3> Need for project planning and estimation at the earliest point

Customers as an owner of the new business tend to request estimates of time and budget required for the project, in order to agree on the project contract. However, building a new business involves uncertainties, and it's not easy to identify a concrete approach at the project kickoff, considering all the risk factors expected. Plans and estimates of the project will be the pre-sales activities, and it is desirable for the company to reduce the cost, but such activities need considerable amount of time even by a skilled person.

Considering such a situation, it's not always possible to assume that PM or PO should select the appropriate service design methods at the appropriate timing in the project, and smoothly conduct the process with the methods. In other words, if we can save the efforts needed for the planning activities, it gives us a great improvement. These are the reason why we needed a process framework.

There have been reports of the practices of the combination of an agile development and service design approach (for example, Hirahara & Kobayashi, 2015). Many of such reports showed the project cases in which some service design methods were applied, or the concept of product development that includes the adoption of service design methods. There was no report of the standardized process in which specified methods are used in a specified order. Without such standardization, the practitioners have to have the know-how to choose method and design the process for the specific project. As developing a service design professional takes time, adaptive process design may be too ideal to implement and expand.

Ishikawa et al. (2015) and Hirano et al. (2013) also reported the process of building a new business by using the service design approach, but they didn't explicitly adopted Agile process for the development.

4. Overview of Altemista Project Now!

Altemista Project Now! ("Project Now!") is a process framework for the projects which include creation of the concept of a new business and design and development of technology for the business. Based on the concepts of process and team management in Scrum, Project Now! incorporates service design methods and viewpoints for covering vision and strategy of the project, which have been out of the main scope of Scrum. Transparency of the process in Scrum has a common nature with the co-creativeness in service design. The visualized analysis methods used in Project Now! are effective for making shared understanding of the vision and concept of the product.

Project Now! consists of the four phases (Figure 1). Service design approach is used in the three phases: Product Discovery, User Monitoring, and Field Testing.

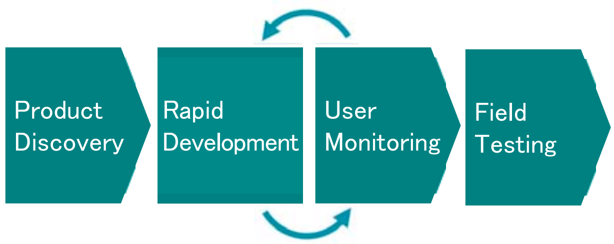

Figure 1 Four phases in Project Now!

4.1 Phase 1: Product Discovery

Create and validate the initial hypothesis of the business model through the use of ideation techniques, user-centered modeling, and Lean hypothesis testing, and then define key features of the product. Once the team get the initial idea for a new business or service, they discuss the vision, then target users and their contexts, and features to be developed. Final deliverable in this phase is product backlog, which is the common input for a Scrum development.

4.2 Phase 2: Rapid Development

Develop MVP (Minimum Viable Product: minimum product to realize the intended value) in a Scrum development as a POC study. As a Scrum project, features are developed in an incremental style, and the team always have a usable product.

4.3 Phase 3: User Monitoring

Get the MVP tested by the target customer as a closed beta testing, in order to verify the design. As the team has a working prototype developed in phase 2, the customers participate in the testing can actually see and interact with the materialized MVP. This phase is performed in parallel with the Phase 2. Based on the feedbacks from customers, modifications of the product backlog (features and their priorities) are discussed in the PO team.

4.4 Phase 4: Field Testing

Using the POC product that has passed through the hypothesis testing in phase 3, simulate the actual business in the similar situation to the actual service deployment (range of service features and number of customer can be limited), and measure the customer's behavior and reaction, in order to test the validity of the final product and service operation. Unexpected risk factors can be also found and coped with in this phase.

5. Characteristics of Project Now!

5.1 Tasks and the order

As already mentioned, deciding the best combination of methods to use in a particular project or discussing results from different analysis and design activities requires a certain level of experience. Project Now! defines methods and the order, and we assume any person with the implementation skills of individual technique can execute the project incorporating the practices of service design, even without a wide range of service design experiences. Figure 2 shows the tasks included in the Product Discovery phase, and you can see that above-mentioned service design methods are incorporated in the process. With such features, challenges 1 and 2 can be solved. Furthermore, by defining tasks and the order in advance, project plans and the estimates are facilitated, and Challenge 3 can also be eliminated.

Of course, some projects may be difficult to be accomplished by such a standardized process. However, configuration of methods and the process used in Project Now! are based on our experience in the projects in the similar context, and we assume that most of the projects conducted in our company can be covered by the standard process, except for some special cases. In addition, we don't prohibit applying tailoring of the process for the conditions of each project, and in the cases where major tailoring of the process is required, skilled professionals in service design, including the authors, support the project in planning and execution.

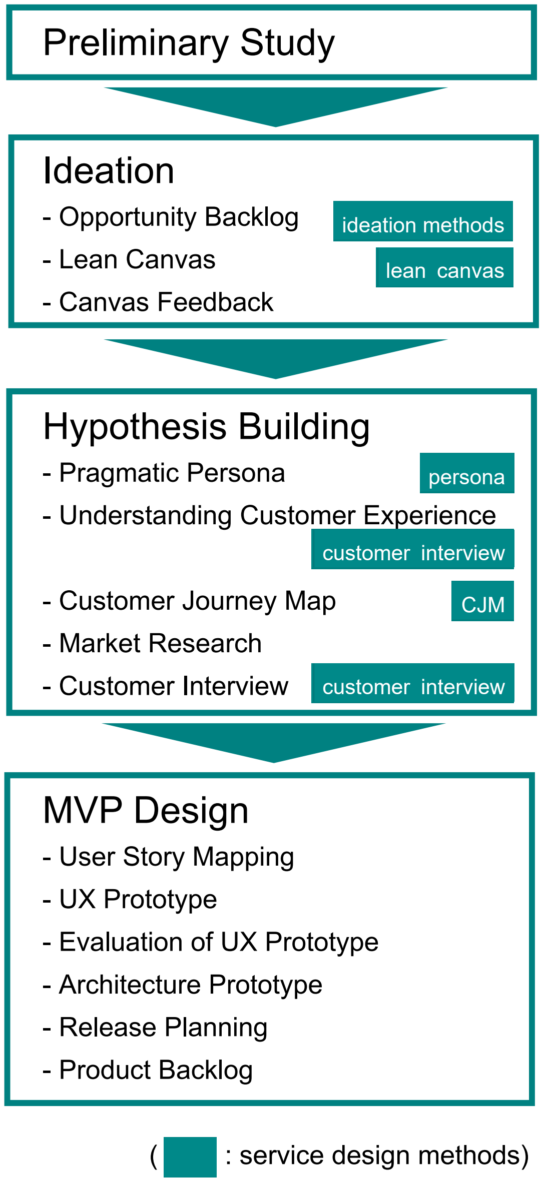

Figure 2 Tasks in Product Discovery phase

5.2 Designing from multi-viewpoints

In general the following three perspectives should be considered in designing a business model:

1) Feasibility (technical implementability)
2) Desirability (quality of experience and usability)
3) Viability (business reasonability, profitability, and scalability)

For each perspective, expertise in 1) engineering, 2) design, and 3) business analysis is required, and discussing from mixed viewpoints is crucial for building a reliable business model. For example, if the team considers only the business aspects and ignores technological feasibility, the assumptions of the software can be difficult to implement, and the whole business model may have to be reconsidered later.

We designed the process to be balanced between these three perspectives, and included the tasks for discussing from each view. Specifically, Product Discovery phase includes, discussion and evaluation of business model (viability), testing the hypothesis of the problems through the customer interview, and UI prototyping and evaluation (desirability), assessment of technical risks by architecture prototype (feasibility). This characteristic is introduced by combining service design approaches and Agile development.

5.3 Testing and learning

Business models and product concepts are hypotheses that are based on various assumptions. In order to realize a new business, we need to specify the assumptions used to form the hypothesis, and validate them through user interviews and experiments, and correct the business model and product based on the results.

Project Now! requires conducting validation of business model, customer challenges, product idea, and UI design, in the phases of Product Discovery, Hypothesis Testing, and Field Testing. The project team proceeds the project obtaining feedback from target customers and other stakeholders.

5.4 Progressive decision making

In the Product Discovery phase, discussion and validation of business model (vision of the product) are conducted first, and then of the target customers and the value proposition, followed by the function and the UI. By deciding more dominant factors earlier, we can proceed the project efficiently by minimizing the possibility of rework.

5.5 Facilitating accumulation of project knowledge

As a background of the Challenge 1, using different service design methods in different projects causes difficulty in sharing the experience with methods and project management across teams. In contrast, as Project Now! uses the same methods and processes across different projects, we can efficiently accumulate what we learn between projects and teams in the company, in order to raise skills and improve project performance. This is effective particularly for the software engineers who need to learn the service design approach.

6. Discussion and Application Cases

Project Now! has been used in some projects, in that business ideas and software products were produced. Below are some of the examples.

Case 1. Development of a smartphone app: A service idea of providing a recommended set of information to the customer, considering his/her preference, and a smartphone app for the service were produced. Detailed study was done from the idea generated in the ideation workshop to start the service, after the team confirmed that the users showed the intended reaction in the Hypothesis Testing phase using the Analytics.

Case 2. Development of a banking operation support system: Renewal of business support system using tablet devices. In supporting the IT system department of the financial customer, the team carried out service planning and requirements definition.

Case 3. Development of additional features for an in-house business tool: In the development of a mobile application for the internal use, the team used Project Now! as a process guidance for defining user needs, and generate and prioritize feature ideas.

In the above cases, PO from the customer company and the in-house development team worked together in business model design and feature discussions, carried out a study from the user's point of view using the persona, and defined the specification to deliver users with the intended value. The fact that PM with the software background were able to proceed with the process using the service design approach in these cases showed the effectiveness of Project Now!

As the projects were carried out while developing the framework, there were some differences in the process and the use of methods between projects. However, as the basic parts of the project were common, the experiences in one project were inherited smoothly to the later projects.

7. Conclusion

We introduced Altemista Project Now!, which is a process framework for the Scrum development projects that include designing a new business, with service design methods. Currently we are trying to expand the use of the framework by compiling a reference guide and providing training to for learning the process and techniques, and collecting feedbacks and lessons learned through practical application in the project, as well as organizing the common document formats and setting best practices. In the training workshop, the PO candidates from customer companies and system developers from our company work together in the exercise, in order to accustom the both sides to the collaborative situation in an actual Project Now! project. We will continue to enhance the common framework while consolidating experience from the applications in the projects, in order to perform more effective and efficient process in more and more projects.

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A Case Study of Super-Upstream Process Leading System Development to Success

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In system development, super-upstream process including requirements definition is crucial. It can be said that the quality of requirements definition determines the success or failure of the project. Various efforts are being made by user companies to improve the quality of the super-upstream process. Nevertheless, many reasons why system development fails are related to requirements definition. In order to make the requirement definition succeed, not only vendors' effort but also active participation of customers are indispensable. Our project was highly appreciated by stakeholders as we were able to build good relationships with the customer and avoid failure. In the project, communication was an issue because the physical distance to the customer was far, but we succeeded in team forming and demonstrated good teamwork. By using facilitation skills, communication was activated, so we could detect problems early and solved them quickly without causing inconsistency in recognition. Requirements increased too much and it seemed to expand the scope, but we could agree on a reasonable scope by adjusting and negotiating at an early stage. In this paper, I describe the measures and behaviors practiced in super-upstream process of a certain successful project.

Keywords and phrases: requirements definition, Team Formation, Facilitation, Negotiation

1. Introduction

In system development, super-upstream process (very early stages), especially requirements definition phase is crucial. According to the survey report of JUAS (2014), the top three reasons for delay in construction period and cost increase in failure projects were "Delay in determining requirement specification", "Insufficient work for requirement analysis", and "Increase in development scale" . All of the reasons are related to requirements definition and indicate that requirements definition is difficult but important.

There are many reasons why it is difficult to define requirements, one of which is the work that customers take initiative, so that vendors' effort alone will not succeed. In other words, we should respect to team formation and stakeholder management so that customers and vendors can join together for a common purpose. Otherwise, projects tackling with new customers and other vendors which are unable to share backgrounds and knowledge would become more difficult.

In this paper, I describe the measures and behaviors practiced in the super-upstream process of a certain successful project using practical examples.

2. The Issues of Super-Upstream Process

There are many tasks in a super-upstream process, but I focus on the following three points which I consider crucial from my experience in the project with new customers and other vendors.

(1) Team Formation
(2) Facilitation
(3) Negotiation

2.1 Team Formation

In order to organize a team, it is of utmost importance to choose members. Especially for members who do requirements definition, work knowledge is required in addition to system development skills. Also, as the number of people involved increases, communication becomes complicated and it is difficult to form a consensus, so it is better to organize a team with selected core members.

As soon as organizing a team, members often don't open their minds to each other. If more than one company gathers, interests may conflict with each other. Under such circumstances, clarifying the division of the labor and responsibility is not sufficient to make a team. In order for an organized team to work collaboratively and productively, it is necessary to revitalize communication within the team and establish a trust relationship at an early stage.

2.2 Facilitation

Since requirements definition is the phase forming consensus of stakeholders through discussion, it is indispensable for the facilitation function to operate the conference effectively and efficiently.

"Delayed determination of requirement specification" is certainly a problem, but it is easy to deal with as much as the problem becomes apparent and shared. The real risk for a project is that although there is "insufficient requirement analysis work" or "inconsistency in requirement recognition", it goes to the next phase without being detected.

In general, whether the developed system fulfills the requirement specification is verified by user operation staging (Figure 1). This means that even if there is inconsistencies in requirement recognition, it is difficult to detect until user operation staging.

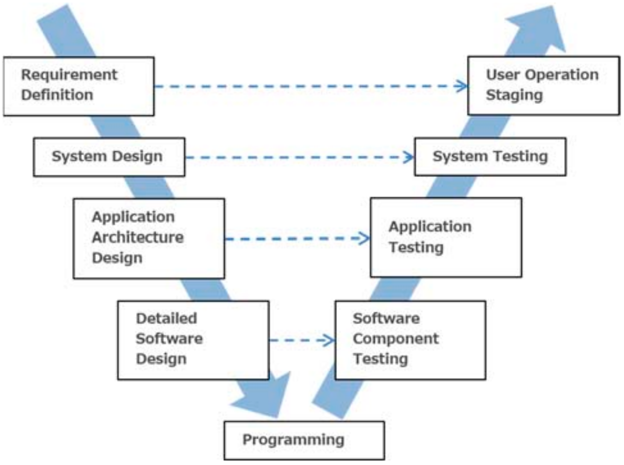


Figure 1 V-Model of System Development

The more upstream the process that created defects is and the more downstream the extracted process is the greater the cost of countermeasure becomes.

When defects in requirement specification are extracted in a user operation staging, the cost of countermeasures is large and the time left is also small, and so there is a high possibility of causing cost overrun and delay in delivery.

In other words, it is important to organize and share discussion flow and conclusion at every meeting. As a result, it is possible to confirm agreement of requirement recognition among stakeholders efficiently and reliably.

2.3 Negotiation

In the project it is important to balance the three constraints of time, cost and scope. In order to balance the constraints, it is essential to coordinate and negotiate with stakeholders, taking the project priorities into consideration.

Just because customers seek quick delivery and low cost, if you plan a project without negotiating with customers, the risk of cost overrun and delay in delivery will increase.

Especially in system development, in most cases, projects have fixed delivery dates which are unchangeable. For projects with priorities on deadlines, it is essential to verify the validity of man-hour and construction period and adjust it to the appropriate scope.

In projects where multiple vendors participate, vendors sometimes compete with each other as vendors pursue their own interests. Unless vendor conflicts are resolved and a cooperative relationship is established, project success becomes difficult.

In other words, skills to negotiate with stakeholders such as customers and other vendors are essential for smooth project management.

3. Project Outline

3.1 Background to the project initiation

The department to which I belong is developing construction process management solutions for telecommunications carriers.

In the customer company, the management method of the construction was not unified in the entire company, and there were problems of omission of work, miss-transmission, and delayed delivery. In order to solve these problems and to reform the business, a new system development was planned. The project started as the author who received consultation from this customer company introduced system cases developed by other peers in the same industry.

3.2 System Outline

The construction process management system is a system that uniformly manages the information necessary for laying the optical fiber lines and visualizes work processes such as survey, design, construction, and opening tests. By coordinating with peripheral systems such as customer management system, order management system, design support system, etc., we promote efficiency of construction work, improve of management accuracy, and shorten delivery time for service by timely sharing information among stakeholders.

3.3 Risk at the Project Initiation

At the time of project initiation, we recognized the following as risks.

(1) There is no IT department in the customer company, and all the project stakeholders have no system development experience.

(2) I heard that the target work is demand construction, planned construction, and relocation, but these tasks as well as requirements are not arranged.
(3) The customer management system (CRM) was being rebuilt with plans to go live at 11 months later. Since it is necessary to realize system linkage with this CRM and to be in production at the same time, the delivery date can't be changed.
(4) Because the customer office and our office are about 1,000 kilometers away, it is difficult to continue onsite services.

4. Practical Example in Super-Upstream Process

4.1 Team Formation

4.1.1 Sharing Prerequisite Knowledge

Since the customer staff had no system development experience, we shared the following points as the prerequisite knowledge of system development at the kickoff meeting.

(1) Outline schedule created by calculating backward from the delivery date and workflow (Figure 2).
(2) The relationship between development scale and man-hour and optimal development period is statistically determined.
(3) Even if a large amount of personnel is introduced, there is a limit to the shortening of the construction period, so if the delivery date can't be changed, it is necessary to adjust the scope.
(4) Since requirements definition and user operation staging are phases in which the workload of the person in charge of the customer is particularly heavy, it is necessary to adjust the reduction of the load of the regular work as soon as possible in order to concentrate on the project work.

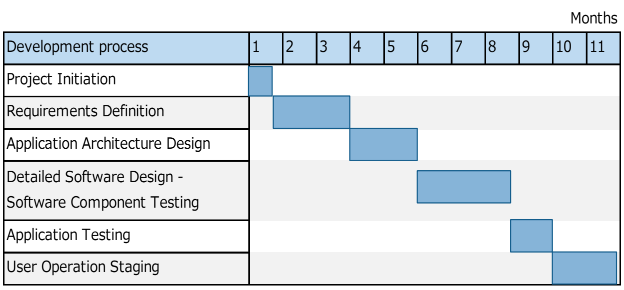


Figure 2 Approximate schedule at the project initiation

4.1.2 Procurement

In order to bridge the physical distance with the customer, I asked our group company based in the same city as the customer to participate in the project. I asked for system requirements definition and system infrastructure building with the onsite support in the operation phase in mind.

Also, as there was no IT department in the customer company, we had our group company take on the role of virtual IT department (Figure 3).

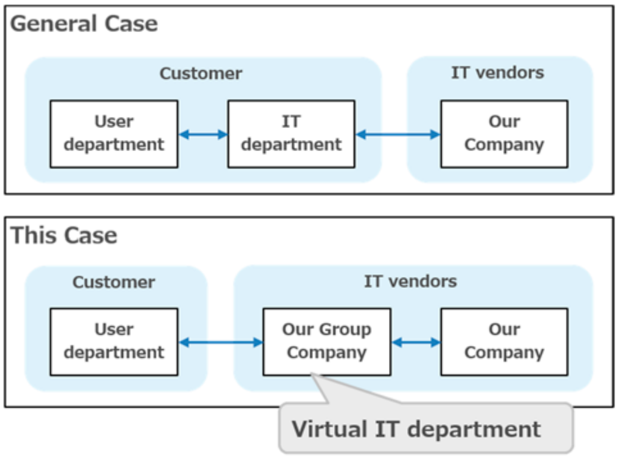


Figure 3 Virtual IT department

I thought that the selection of the members of business requirements definition was the most important matter to decide the success or failure of the project, and this work was dealt with by two people with business knowledge and experience of similar system development.

4.1.3 Colocation

Since close communication is indispensable for requirements definition, we adopted the colocation strategy. Two people in charge of business requirements definition resided in the project room of our group company and worked together. Since the physical distance to the customer was getting close, we held face-to-face meetings two or three times each week.

4.2 Facilitation

4.2.1 Unification of Terms

In order to prevent inconsistency in recognition, we created a glossary and a list of business rules and frequently maintained them.

Even if we create a glossary, new synonyms may come out from stakeholders, or we may feel uncomfortable as if the known terms are used differently. In such a case, we quickly opened the glossary, reconfirmed the definition of the word, and corrected it immediately.

4.2.2 Collaboratively Confirm the Minutes

It is often in the meeting place that recognition inconsistencies occur. Even if there are inconsistencies in recognition, it is desirable to be able to find and resolve them on the spot. Therefore, we created the minutes during the meeting, and in the last 30 minutes of the meeting, we took the time to confirm the minutes collaboratively and look back on the meeting.

In collaborative confirm of the minutes, we were particularly conscious of the following three points.

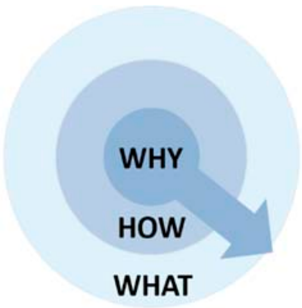
(1) The speaker's intention and the nuance of the word are correctly represented.

(2) It passes without misunderstanding to stakeholders who have not participated in the meeting.

(3) There are no conflicting remarks or decisions among multiple topics.

4.2.3 Focus on Why

According to Sinek (2009), great leaders inspire action of people by communicating from "Why" to "How" and "What" (Figure 4).



Source: Created with Reference to Sinek (2009)

Figure 4 the Golden Circle

If I don't understand the purpose of the requested work, I don't get a sense of satisfaction, and so I will not get into work. For that reason, I took care to allow the participants to work with a sense of satisfaction.

For example, when consulting the customer, I informed why I am asking this question and what this question will be used for. When requesting work from the project members, I clarified and informed the things we want to achieve rather than detailed work contents.

Also, I was strongly aware that I don't confuse the means with the purpose, clarifying the purpose. When discussion and thought stalled, we tried to correct the trajectory by asking "What was the purpose in the first place?"

4.2.4 Hearing Sheet & Workshop

In business requirements definition, we used a hearing sheet for organizing the basic requirements and a workshop for organizing individual work.

Initially, participants didn't understand each other, so we started with the work of filling in the hearing seat together. During the work, I observed stakeholders, analyzed them and grasp the working pace.

After that, we held workshops where stakeholders get together to discuss individual business issues and business processes. In the workshop, we were conscious of the following two points.

(1) To hold many times

After changing time and place or referring to another agenda, it is easy to get a new awareness, and so we hold a short workshop several times and raise the accuracy little by little.

(2) Extract exception case

Since users tend to talk while imagining the standard works that are usually done unconsciously, we devised questions so that consideration of rare cases and exceptions will not be leaked out.

4.3 Negotiation

Because the delivery date could not be changed, we adjusted the scope to balance the three constraints.

4.3.1 Proposal for Gradual Development

In the middle of the requirement definition, as a part of business reform, a new business pattern of demand construction was added. In addition, it was clear that it was necessary to manage contractors common to each construction work, and it was obvious that the scope will increase more than initially assumed. Therefore, before starting the estimate work, I introduced to the customer that the idea of lean startup proposed by Ries (2011) and explained that it is a good choice to divide the project and develop it step by step.

- As the scope is expanding, the risk of delivery delay has increased.
- Even if we inject a lot of personnel with cost, the problem whether quality can be secured remains.
- Even if the requested system is completed, the risk remains that it doesn't fit the real work and that it will not be used.

- First of all, it is possible to suppress the risk of project failure by gradually and continually adding/improving functions after developing the minimum-required functions. Also, it will be a long run system that fits the real work.
- As a disadvantage, it is generally more expensive to develop it dividedly more than all at once. However, as it is expected to improve development productivity and quality with repetitive effects, it may save cost in the long run.

4.3.2 Priority and Approximate Size of Functional Units

When the request function list was created to some extent, we started estimating the approximate size of functional units. The approximate size was calculated by analogy estimate and presented in the number of lines (KLOC). We set the priority and approximate size in the request function list and adjusted the scope.

Since planned construction and relocation were business unrelated to CRM, it turned out that it is not an essential function by the delivery date. Also we checked and adjusted priorities in functional units and set the scope of initial development (Figure 5).

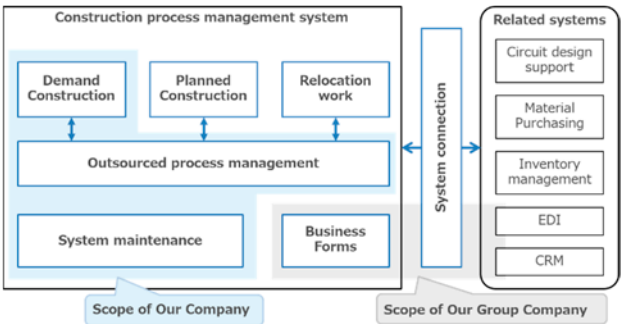


Figure 5 Scope of initial development

4.3.3 Adjustment of Work Sharing

We adjusted the scope and kept the development scale as small as possible, but it didn't fit the initially assumed scale, and there was a risk of quality degradation and delivery delay. Meanwhile, since our group company doesn't have much volume of work, they also wanted to participate in application development and expand working scopes. Therefore, I negotiated with our group company as they could develop some of the application functions. At that time, except for the business function which is the core of our solution, we asked for developing the function of system connection and business-form output (Figure 5).

5. Achievement

5.1 Team Formation

By securing two key persons, we were able to discuss business requirements equally with the customer. That led to trust from the customer.

By smoothly sharing prerequisite knowledge and how to proceed with the customer before starting work, smooth project management was realized.

By having our group company participate as a virtual IT department, we were able to compensate for the weak points of the customer.

As members were able to work together at the work place close to the customer, a sense of solidarity was born, and the relationship of trust could be constructed at an early stage.

5.2 Facilitation

By focusing on "Why", we were able to encourage the voluntary action of stakeholders and prevent delays in the schedule.

By sharing the glossary and preventing the fluctuation of the terms among stakeholders, communication became efficient.

By utilizing the hearing sheet and collaborating, we were able to foster sense of solidarity in the early stages of the team.

By repeatedly carrying out the workshop, mutual understanding and examination were deepened, and it was possible to prevent missed requirements and inconsistencies in recognition.

By drawing up and collaboratively checking the minutes during the meeting, we were able to detect inconsistencies in recognition at an early stage. In addition, the following effects were obtained.

(1) It is possible to reduce the time to draw up and circulate the minutes after the meeting.
(2) Because we look back at the meeting within memories clear, it makes us easy to notice mistakes.
(3) Since the meeting is over after the minutes are completed, you can concentrate on the next task by clearing your head.

5.3 Negotiation

By proposing gradual development with the same interests of both the customer and us, we were able to smoothly negotiate scope control without losing the customer's interests.

By asking our group company to develop some functions that are not the core of our solution, we were able to maximize mutual benefits and build a long-term win-win relationship.

6. Conclusion

The case project of this paper does not use special techniques or skills. It focuses on the principle and is a result of thorough basic operation of the project manager while being conscious of cooperation with stakeholders. Thorough basic operation is the most important thing.

As a result, this project, which was integrated with stakeholders, was able to be successfully completed without any special problems.

Finally, it should be noted that the secondary development project was also successfully completed.

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Applying Multinational PM Knowledge to IT Project Management in Exponential Society

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Possible impacts of exponential digitalization to Project Managers are discussed. Then feasible approaches are proposed, based on the similarity of issues and solutions between digitalized projects, and multicultural/cross-cultural projects. Leading edges digital technologies, including (1) Internet of Things (IoT), (2) Cloud Computing became applicable to enterprise usage and (3) Artificial Intelligence (AI), became sophisticated enough to support a part of human decision making. So that some professionals including IT Project Managers are challenged, and feel threat of being replaced by new players powered by disruptive innovation. Considering the additional impacts to the current society, Author applied the comparative analysis and the views derived from the research on cultures in Eastern and Western hemispheres, and the discussion with global/multinational IT professionals powered by digital technologies. Then, Author provides ideas for PMs to utilize the new methodologies to show their values, include (a) Creating clearly defined and mutually agreed Responsible Assignment in the Responsibility chart, (b) Recognizing Hybrid "Value System". And Author expands the business model with the innovative technology, recognizing as one of the expression of an "ethnic" characteristics, and co-exists with them, expanding the result of conflict-solving methods for multi-ethnic groups, including digital culture in Exponential Society, represented by the knowledge got after solving the conflict among different human ethnic groups, include Anglo-Saxon in Western hemisphere and Japanese in Eastern hemisphere.

Keywords and phrases: AI, Multinational Service Integration, Value System, Semi-Global Delivery Model, SECI model

1. Introduction

In this paper, Exponential Society, and Technological Singularity are defined as follows.

1.1 Exponential Society

The society exponentially grows with technological enhancement that is multiplied in numerical measures, including sales, amount, or others, within a couple of years. The growth is measured not with a single element but multi-elements as a whole. An industrial example is Moore's Law, as an example of technology as an element of a society. This is expansion of the idea with Exponential organization defined by Ismail (2014) and Saito (2015).

1.2 Technological Singularity

The technological Singularity is widely defined as "the timing that the technological progress has the huge impact to specific social activities". And the narrow definition of it is "the hypothesis that the invention of artificial super-intelligence will abruptly trigger runaway technological growth, resulting in unfathomable changes to human civilization" (Wikipedia 2016).

To focus the discussion, Author limits the referred, terminologies in the following meanings: (1) "Digitalization" to business process digitalization, and (2) "AI" to the weak AI with established technology by the first half of 2017, including Deep-Learning (DL), and excluding strong-AI with unestablished AI technologies like powered by quantum computing. Author considers AI and Cloud which contains big-data, are to be exponentially progressed in parallel. Therefore, the case for Cloud-integration is treated as one of wide Singularity, and the DL-based AI is classified as "narrow" Singularity, in this paper. Author picks Singularity with AI as a case of exponential social growth.

2. PM Issues with Exponential Digitalization

The Exponential growth in Digital technologies has big impacts on the society consist of both IT servicers and their customers. Especially traditional enterprises are challenged by the newly digitalized competitors. The detailed impacts for IT PMs are described below.

2.1 Business processes transformation

Enterprise customers' business processes are forced to be transformed due to the digitalization competition. Therefore, pre-sales engineers and project managers must to learn digital technologies for customers. Examples are Uber to transportation industry, Airbnb to hotel industry, GE and Amazon to IT service industry with transformation of industrial system requirements.

2.2 Cloud Vendors' penetration in IT Service industry

Google Cloud Platform [GCP] (2004~), Amazon Web Services [AWS] (2006~), and Microsoft Azure (2008~), are to share IT physical assets for enterprise customers, and are getting more and more popular for users. Typical cases in Sharing Services, including Airbnb (originally founded as "Air Bed and Breakfast"), and Uber (online transportation network company) for consumers, are Non-Asset business. Therefore they heavily rely on pay-per-usage business including IT Cloud Services listed above, in IT system development projects or operational jobs in late 2010s. So that some professionals are, challenged, and under pressure being replaced, by new players powered by new business models or technologies. It means almost all IT professionals are facing the threat of global expansion. In this paper, Author describes an Asian perspective how a project managers might co-exist or survive with new technologies. As previously mentioned, also designing process of IT Services are taken over by users, in customer companies, who are now virtually free from constraints of physical infrastructure.

2.3 Decreasing IT Investment for Custom System

For IT PMs, another threat caused by Sharing Service Providers (include Cloud Vendors, and former customer changed into IT Servicers with own API), that have started to co-exist with (or to replace), existing dedicated (custom) services in IT industry.

Industrial Analysts on global IT industry including Gartner, IDC, and Research division of Credit Swiss, reported that "a US dollar-increase in revenue of Cloud Vendors (AWS, MS), comes with 4 dollars decrease in revenue of all other IT (hardware/software/service) vendors (excluding Cloud business unit)" in 2015. It shows that a linear increase in Cloud vendors' revenue causes exponential decrease in IT venders (other than Cloud vendors). The more cloud usage, the less spending for IT assets and services. One of industrial analysts also reported that this is a cause of Hewlett-Packard Enterprise (HPE)'s sale of its Service Unit to Computer Science Corp (CSC) in 2016.

The more users' usage in Cloud services, the less non-cloud vendors' revenue. This results in decrease of "Contingency Reserve" for "Known Unknown-Risk", and "Management Reserve" for "Unknown Unknown-Risk" of Project Managers in non-cloud vendors.

2.4 PM's Possible Issues with AI

Kurzweil (2005) predicted that the ability of a single computer with AI will exceed that of a human-brain by 2029 (Pre-singularity), and of all human-brain in 2045 (Singularity). Kurzweil's prediction in 2005 has limited impact to the professionals or researchers in IT Industry. But, after the deep-learning (DL) technology was established early in 2010s, Shanahan (2015) and Wallach (2015) expressed the threat in the over-progress of AI technology, and the ideas of countermeasures for the risks. Artificial Intelligence (AI), or cognitive technology, either on premise or in public-clouds, have become sophisticated enough to apply some support for decision making processes, including provisioning and resource-assignment.

In the meantime, technology in General Artificial Intelligence has being accelerated by the competitions in development among firms, including Apple, Facebook, Google, IBM, and NVIDIA, and so on.

2.5 Human PM versus AI (or Human PMs with AI)

Ford (2015) indicated the threat of "Jobless Future" for human, caused by Robots with AI. And Zarkadakis (2015) summarized the possible conflict among human and AI systems. Kahneman (experience-based pro-logic), and Klein (pro-intuition) (2009), discussed the issue with AI, and expressed their opinions independently, and not reached to the same conclusion. These fears are to be realized a little bit ahead, but possible threat within a decade, because of technology acceleration with the development of Autonomous cars by Google, or Car manufacturers targeting commercialization of level-4 Autonomous car by 2020. If we limit our view to integrity or density of semiconductor, Moore's law is getting slower and has a gap in real world, but in the view of Computing power and cost performance, it is still applicable. For example, researchers on "Two person Zero-sum Finite determination Complete Information Games", and their AI, challenged and won human champions.

Table 1 Human vs AI, in "Two Persons Zero-sum Finite Determination Complete Information Games" fields

Game Name	Reversi / Othello	Chess	Shogi	Go
Board Size	64	64	81	361
Game-Tree Complexity	10^58	10^123	10^226	10^360
Year/AI won top level human	1980/Moor 1997/Logistello	1988/Deep Thought, 1996/Deep Blue	2013/ Ponanza	2016/ Alpha-Go
Key Paper	Allis V. (1994)	Shannon (1950)	Chorus(2012)	Allis (1994)

3. Suggestions for IT Project Managers

After the discussion with AI, Cloud, and business consulting Experts in IT industry, and professional users of those technologies in each industry, Author found that there are some limitations in usage of those technologies for specific users. So that Author's suggestion to IT Project Managers are as follows:

3.1 Limitations in Cloud model

Author found some limitation for both private clouds and public cloud. For example, scale-out limitation for private cloud, and customized function limitation for public cloud. Also unidirectional-migration from on premise to a public Cloud. These are the examples that Project Managers still may contribute to manage hybrid cloud system -integration, as a Cloud-Integrator in "Cloud-First" age.

3.2 Limitation of Deep-Learning based AI

Without pre-learning process, DL based AI cannot make any decisions or suggestions. It means, even an engine of DL-based AI can be designed in a nation, including US, when the AI system introduced to any other nation/region with different value-systems, external database with dictionary or learnt rules formulated through the learning process should be re-done in the local environment. Therefore PMs may manage the localization process. Current AI's recognition speed exceeded that of manpower in some fields (Table 1), but applicable fields are still limited. For example, the power to win the champions in Two-players Zero-sum games, the AI has not learned how to evacuate when the disaster occurs in the place of the game. So some IT companies, including IBM Japan as presented in SPM Spring Conference in 2017, have started PoC with AI for Project management, i.e. Application for AI's cognitive power to support PM's decision making. But the current level of AI is limited as stated above.

3.3 Human superiority to Weak/Narrow AI

The real projects are much more complicated, and not zero-sum, nor with complete information. Therefore only human can recognize the real situation of a project. (Human PM may expect AI support to analyze big-data, and report to him/her.) For example, some IT servicers, decided to utilize AI, not as "Artificial" Intelligence, but as "Augmented" Intelligence to support PM's decision.

When Author discussed the issue with a professor of JAXA (Japan Aerospace Exploration Agency), he mentioned that AI is applicable for space stone picking, but not for landing, because the conditions of the landing place is unknown (impossible to learn) until the spaceship reaches the target planet. It implies that the current AI cannot make any decision for unpredicted (un-learnt) project incidents. It shows that Human PM versus AI-PM case would not occur until a computer power exceeds a human brain power (maybe by 2029).

3.4 Similarity with Global Project

The accelerated progress both in Cloud and AI is caused by Global Competition between Nations and Regions, because most of the successful Cloud and/or AI venders are originated in Euro-American nations (the western hemisphere), and entering into Asian nations (the eastern hemisphere).

Considering situations above, and current global expansion of Japanese firms, Author found that a similarity between issues with Japanese IT Project Managers and those with global IT PMs being challenged by both Cloud vendors, and AIs. In short, both are challenged by unknown and or unexperienced situation. Therefore, Author re-analyzed the status of Japanese IT PMs, and propose the possible solution for PMs. Because the cases in multi-national projects are study material for PM with Cloud/AI. Klein claimed that Intuition is human's superior point compared to AI without Skin-senses.

4. Review of Multinational Projects Cases

4.1 The challenge for Japanese IT PMs in 2000s:

Japanese firms entered into the categories of "Global" in Rugman's definition, with "arms" established in Japanese competitive market in these decades. The definition of Global by Rugman and Verbeke (2004), are as follows: They analyzed financial statements of Fortune 500 companies in 2001, and 2002, to investigate how many firms were really "global" in "triad" market approach.

Table 3 Comparing Anglo-America & Other Region

Area(*Nation*)	Family Type/ Todd (1983)	Value System/ Todd (1983)	Organization Todd(1983), Ghemawat (2007)	Leadership Ghemawat, Fujimoto(1991)	Manufacturing Fine(2005), Aoshima(2010)	Firm, Rugman (2008), Endo (2012)
1. Anglo-America (*England, USA, Canada, Australia Netherlands, Denmark. France/Bretagne*)	Absolute Nuclear family ("la famille nucléaire absolute")	(1) Each family is Independent, leads to liberalism, (2) Do not care child-equality	Individualistic, Liberalists, (not eager in educating child) asset is shared unequally	Leader/Chief governs sub-ordinates Top-down order "Winner takes all"	Modular/Process with standardized Interface for discrete parts	Chrysler Dell, Cisco, Polaroid, Nortel Lucent
2. So-Europe & Latin-America (*N-France, S-Spain, S-Italy*)	Egalitarian nuclear family ("la famille nucléaire égalitaire")	Equality & freedom. (1) Parent and child is independent, (2) Child is in equality	Individualistic, the asset is shared equally to child/ subordinates	Leader/Chief governs sub-ordinates Top-down order Not one-to-one	-	-
3a. N.W. Europe (*Germany, Belgium, S-France [excl. Mediterranean], Scotland, Sweden, N-Italy*)	Strain family ("la famille souche")	Parent/master is (1)authoritarian to children/pupils, & (2) Inequality for the child (the oldest has priority)	Relatively Flat, Decision is made by field manager (in the middle of hierarchy)	Negotiation in high-context society like a family, Maestro/Meister/Master/ "Oyakata(Japanese)" and Decepolo/Schuler/Pupil/ "Deshi (Japanese)"	Integral/Process with Integration	Daimler-Benz
3b.E- Asia [ex-China] (*Japan, Korea, Taiwan) and Israel [Jewish]*)						Toyota, *Mazda*
4. Mid-Eurasia and E-Europe (*China, Russia, Mongol, Finland, Hungary, N-India, France/mountain & Mediterranean*)	Exogamous community family ("la famille communautaire exogame")	Community consists of big family. Parent is authoritative for the child, and siblings is equality	"Communism" is/used to be popular in most of the areas	Consensus within Community based on big family	Hybrid (Nokia applies Modular for Hardware, Integral for Software)	Nokia
5. Middle-East, and N-Africa (Represented by Turkey, & W-Asia, and N-Africa	Endogamous community family ("la famille communautaire endogame")	Relatively big family, Custom is superior to Authority	Organization based on Muslim (Islamic) culture/law	Community leadership, Not enthusiastic to education	-	-

Triad consists of (1)North American Region (NAFTA), (2)European Union (EU), and (3)ASIA includes China, and Japan. And then, Rugman did same study focusing on Japanese firms to compare between the firms in the Western and the firms in an Eastern nation. Rugman's research indicated that even globally known companies with famous brands were not necessarily had business opportunity equally in three regions, North America, EU, and APAC, until early in 2000s. In this sense, "The world is NOT yet flat". This situation is also pointed out by Ghemawat (2007). Especially, Euro-American firms tend to focus their business in Europe and/or American continents, in another word, their home region. The fact implies that Euro-American companies might expect the business success mainly in home region except accustomed to the Sense of Values in each region (Asian, African, and South American region.

Table 2 Classification of Global "Fortune 500" Companies (Rugman et.al in 2002 (2004, 2008)

Category / (Year)	Home-region Oriented	Multinational	Global in Triad
Fortune 500 (2001)-> Segment/Region available 365	320 [87.7% of 365]	45 [12.3%of 365]	9 (of 45MNC) [2.5% of 365]
Fortune 500 (2008)-> # of Japanese Firms : 64	-	-	3 [of Japan*]

(*)Japanese Firms as "Global" in 2008 were, Canon, Sony, & Mazda

4.2 Cultural Difference in each Nation or Region

When a Japanese enterprise merges a foreign company as "buying time" to expand business overseas, the foreign target company is bought as it is with its IT system, in most of the cases. Then the IT vender, providing its IT service to the Japanese company, suddenly comes across either connection of two different systems with development of the interface subsystem, or introducing the parent company's system into the new subsidiary overseas. It means the IT servicer has to learn not only the new subsidiary's IT system, but also the culture and laws controlling the industry and the company abroad.

4.3 Case of the Difference in Areas/Nations

Typical difference in organizations in nations is shown in Table 4, based on the research by IPA, Japan (2011).

Table 4 US-Japan difference in organizations which IT Engineers belong, IPA (2011)

Nation / IT Engineers	User Organization [in thousands, (%)]	IT Vendors [in thousands, (%)]
U.S.A.	2,362 (72%)	255 (28%)
Japan	941 (25%)	771 (75%)

According to author's interviews to multiple projects in the US, most of the cases, average IT development projects consist of 50% of the proper employees (including contractors) of the user company, and 50% of 3rd party vendors including hardware/software suppliers, and ICT servicers, such as System Integrators, and Network Integrators.

The most important difference is whether the representative person of IT and the leader of PMO, belongs to the user company or vendor firm. In many Japanese company cases, the role of CIO is a part of job of the Chief Financial Officer or Chief of Administrative Office, with less IT knowledge and experience. On the other hand, US CIOs are must IT

professionals with knowledge of business through communication with CXO.
The case above is the comparison between IT professionals represented CIO in US and Japan. Author expanded the cultural comparison among global areas based on demographic data and business process preferences. The areal comparison is shown in Table 3, using frameworks by Ghemawat (2007), referring the demographical information by Todd (1983), business process preferences by Fujimoto (1991) and Aoshima (2010), Fine (2005), and Endo (2012, 2015).

4.4 Legal Systems

As Culture Distribution of Anglo-America and Others Value Systems based on the each cultural system strongly affect legal systems in the region/nation. The typical case is the difference in the legal systems for Anglo-America [Common/Case Law System], and for other European areas [Statute/Civil Law System]. Quebec State in Canada, and Louisiana State in the US, keep French Culture, so that they mainly apply Civil Law as France does, even though their Federal Laws apply Common Law. Also Scotland [Non-Anglo-Saxon region] in the UK applies the mixed law.) Addition to the differences in the base law systems, contract types differ region by region. For example, popular IT project contract types in Anglo-America are the "Fixed Price" contract and the "Time and Material" contract. Similar contract types in Japan [Case Law System] are "Contract with fixed price [with Warranty]", and "System Engineering Service Contract [with Warranty]" respectively. If a customer prefers warranty in Anglo-America [Common Law] System, the counterpart requires additional cost or other operational and/or maintenance costs, in the most of cases.

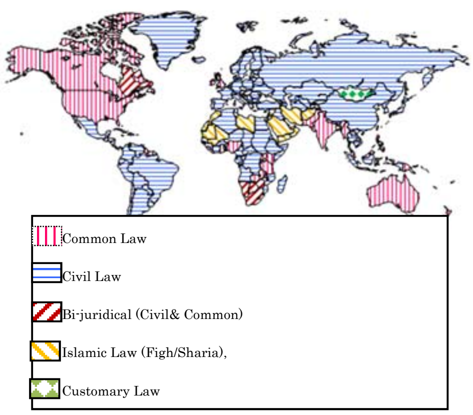

Figure 1 World Legal System with each Value systems

4.5 Knowledge Sharing System

SECI Model by Nonaka and Takeuchi (1995) introduced cyclic knowledge conversion among person and group of people, and transformation between tacit and explicit knowledge. After the review of realization styles in organizations, Author assume that knowledge conversion style is highly affected by Value Systems defer region by region. In East Asia, represented by Japan, small group of Quality Improvement Activity is very popular in manufacturers. Tacit (personal) knowledge of continuous improvement is easily shared within a group (unit of community or society), for improving group performance. On the contrary, in Western hemisphere, the systems like KPMG's "Shadow Partner" are required for promoting knowledge sharing within a group/community/society.

5. Global Standardization & Local Differentiation as Firm Specific Assets (FSAs)

5.1 Standardization for communication (Dictionary, Standard Business Process, etc.)

As Author showed in ProMAC 2010 and 2012, so many Western consulting firms have standardized consulting manuals for each customer's industry. The manuals refer to the common business process and remarks for consultation. After the independence of consulting division of auditing firms, those manuals and dictionary also became so popular in IT service industry.
Author also had shown a standardized methodology of a major System Integrator for Package Implementation and Rollout Projects, as an example. In this case, the methodology consists of PMI's best practice, ERP vendor's standardized processes, and Implementation knowhow and templates of the System Integrator. Those tools are utilized for communication among customers and service providers.

5.2 FSA as the differentiator to challengers

Experienced multinational-projects as a Project Manager, Author found that the skill of bridging different Systems of Values or Culture is FSA of PMs. In late 1990s and early 2000s, the introductory era of Euro-American application packages including SAP, Oracle/EBS, frequent "Add-on" functions into package software, and support from SIer are required. And even the turn-key/vertically integrated IT appliances in IT assets are introduced, still further integral tasks are required. For example, idea of Appliances saves the time and setup cost for customers when customer is satisfied with as is function, but once tuning is required, frequently it takes more cost than the system made from scratch.

Figure 2 Redefining Global Enterprises and customized process as Firm Specific Asset (FSA)

Redefining "Global" Enterprise (depending on the situation and positioning of each enterprise), Author found that "Multinational" could be enough for the most of enterprises, even though not reaching Globally Integrated Enterprise level, if the enterprises are accustomed for their market and get enough revenue and profit from the market. As stated in the beginning of this paper, 365 enterprises disclosed revenue by regional segments, and only 9 companies were recognized as "Global" enterprises, out of 45 Multinational firms in Fortune 500 in 2001. Within Japanese enterprises, only 2 in 2001, and 3 in 2008, were recognized as "Global", according to the classification (balanced revenue diversity in North America, Europe, and APAC).

Based on the result above, Author would classify Multinational enterprises as, a part of, Global Enterprises. Based on this assumption or classification, Author strongly recommends IT servicers to apply Semi-global approach, with local-modification to globally standardized process. For example, the manufactures influenced by Anglo-America culture are good at Modular manufacturing process, Integration, while Japanese or East Asian culture nations are good at Integral manufacturing process. IT services are to be customized to each customer preferences. Sometimes mix of the development methodologies are required for Information System Integration and Implementation, as a couple of samples shown in Author's papers, Endo (2012, 2015).

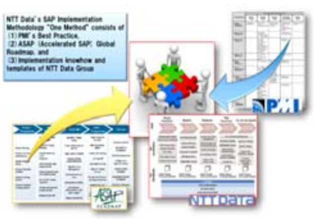

Fig. 3. Example of Globally Standardized Methodology

Fig. 4 Global Handbook edited to Country Versions (Localization Knowhow is applicable to Projects with Exponential technology including AI.)

5.3 Analysis using Framework and Analytical Tool

Using frameworks including Cultural – Administrative – Geographical - Economic (CAGE) framework and ADDING tool by Ghemawat (2007) as the analytical tools, Author compares those cases in the view of Regional characteristics, and points out the issues within the project cases.

Table 5. ADDING Evaluation on Standardization & FSA approach (Integration for Japanese Servicers)

	Evaluation element	The SIer's outcome/trial/will	Evaluation	Explanation
1	Adding volume	Increased # of engagement with wider scope of solutions	+	Additional solutions within global group companies
2	Decreasing cost	Almost half at Offshore site (Certain % decreased Onsite)	+/-	Delivery(development) cost reduced, Mgt. (incl. bridge) cost increased
3	Differentiating	Semi-Global is differentiator from competitors with GDM	+	Competitors already introduced American GDM. Semi-GDM is plus.
4	Improving industry attractiveness	Easier to apply to Non-American customers	+	With global support plus localization(semi-Global)
5	Normalizing risk	Reduced risks	+	Risks are caused by mutual misunderstanding with customer
6	Generating knowledge	On top of the global standard, local preferences added	+	Daily basis Increasing customer satisfaction

6. Conclusion and Further Research

6.1 Case Analysis

Having analyzed the cases above for Globalization of Regional IT Project Managers, Author found that the skill bridging multinational culture would be applicable to the hybrid society with on-premise/cloud computing system, and Human and AI.

6.2 Regional and Historical Analysis

Exponential Society, recognized as relatively newer concept these days, but we find many cases of exponential social growth with technology as a whole. Same as sharing economy system, seemed to be new in Western hemisphere, had been established in Eastern hemisphere for centuries. We may find examples of the exponential and long-lasting society in Asia. One of cases in Sothern Indo-China Region prior to the colonization by Western Great Powers. Jomon period in Japan (10,500 ~ 300 B.C.) is another sharing society that provided enough food to the people and lasted more than ten thousand years, that reported by. Matsumoto and Bessho (2016). This is one of good example of "Sustainable Society". We might reach the next stage of coexisting with different culture.

7. Further Research Plan

7.1 Discussion with experts in other fields/Industries

Further discussions candidates for fields are as follows: For cloud business, discussion with developer/vendors and users. For AI technology, Cross-cultural and cross-field discussion are required, including biochemists for the definition of life, researchers in knowledge management, and philosophers for the definition of "human beings".

7.2 Cultural discussion with historians

With new findings supported by Biochemical tools and Computer Tomography, archeologists releases papers on ancient Asian cultures. For open innovation with diverted ideas, we may refer to the other field include archeology to find Truth for the global society.

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The Effective Way and the Practice of Program Management

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Program management is an important method for overlooking the goals and measures of each project and arranging them so that there is no contradiction. Meanwhile, Recent projects are being required for high quality, high productivity and low price, and the complexity of individual projects is increasing. In addition, the speed of change in required business goals is fast, and stakeholders are also increasing. In such a circumstance, the author has led the projects ("Functional Enhancement for regulation change and for usability", "Application and Data Migration for infrastructure change", "Application Maintenance", "Research the Concept for Next Architecture") concurrently as a general project manager in government industry. At this time, there were some secret of success as program management. For example, effective allocation and motivation of resources, adaptation to change of customers, risk management, financial management of the entire program, etc. Therefore, in the practice and effectiveness of program management which the author actually worked as a general project manager are discussed in this report.

Keywords and phrases: Program Management, Multiple Mission Management, Goal and Value Management

1. Introduction

Program management as shown in Figure 1 is an important method to surely achieve business goals when executing multiple tasks and projects by defining and implementing necessary missions, and guaranteeing the consistency of each objective.

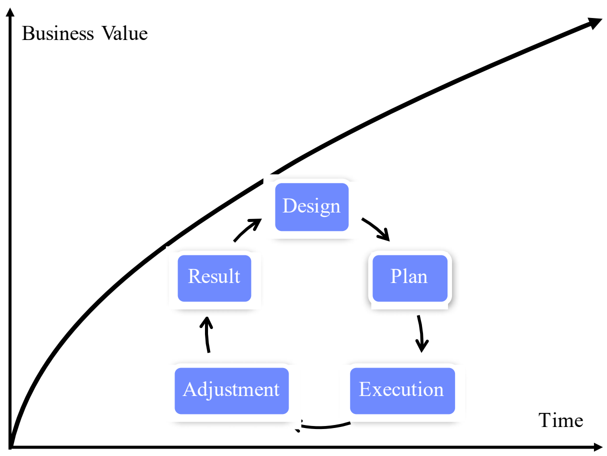

Figure 1 Program Management

Meanwhile, recent projects are being required for high quality, high productivity and low price, and the complexity and uncertainty of individual projects is increasing. In addition, the speed of change in required business goals is fast, and stakeholders are also increasing. In such a circumstance, the author has led a number of projects ("Functional Enhancement for regulation change and for usability", "Application and Data Migration for infrastructure change", "Application Maintenance", "Research the Concept for Next Architecture") concurrently as a general project manager in government industry. In carrying out these projects, there were many difficulties and problems such as frequent changes in customer requests and lack of experts overwhelming existing systems. In this case, since the schedule of experts is involved in important tasks and critical paths, these problems are greatly affected.

Therefore, in this report, the practice and effectiveness of program management which the author actually worked as a general project manager are discussed.

2. Issues in author's projects

Program management is a method of organizing business value, implementing conception planning, determining the purpose and scope of individual projects, and implementing them.

This time, the author was in charge as the general project manager who leads the overall project activity concerning each project entrusted by customers of the central ministries and the next project of the customer.

The scope of management is illustrated in chronological order in Figure 2.

Below is a summary of the managed projects and task activities.

- 2 ongoing projects
  - Functional enhancement project
  - Minor enhancement / QA related current system

- 3 proposal activities and execution for those projects
  - Function enhancement project (different from ongoing project mentioned above)
  - Applications and data migration project for infrastructure renewal
  - Research project of next system architecture
- Proposal activities and various improvement activities for further projects ahead

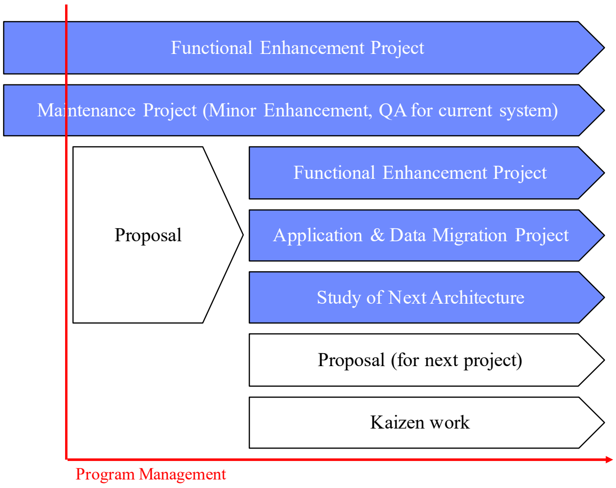

Figure 2 Scope of Management

The following are the problems encountered in carrying out these projects and tasks:

- There is a shortage of resources possessing skills (in particular, resources with knowledge of customer's work) against the required output for individual projects, and it is necessary to share these resources between projects.
- Changes in the business environment of customers are quick, the required output by individual projects change from time to time and project management under these uncertainties is required.
- The tasks and risks of individual projects are highly dependent on other projects.
- It is necessary to set up various improvement activities and tasks simultaneously for each project, governance and integrated management for financial aspect is required for these activities.

Also, from Japan IT Strategic Headquarters (2013-1, 2013-2), in the case of the author, the situation was such that customers themselves were required to reduce various expenses by the citizens and political pressure, strengthening of governance by the CIO organization within the government, and so on. Even though the past and existing projects could be carried out stably in such circumstances, it was necessary for the contractor side to provide futuristic value in order to contract business in the future. Especially within our customers "cost reduction", "improvement of competitiveness of procurement", etc. is required. As a business entity, we had to explore solutions on how to contribute to the customer. Hence, it is necessary to carry out improvement activities concurrently with the next proposal activity.

These studies cannot be considered in a single project, instead, it is necessary to acquire knowledge of key persons while carrying out each project. Therefore, in order to manage these issues from a larger viewpoint, rather than managing individual projects individually, the author made use of the program management method and practiced it.

3. Proposed Solution

The solutions applied in the following sections will be described in detail with respect to this issue. As shown in Fig. 3, these solutions were implemented in a cyclic manner and each other process are evaluated / controlled at any time, designed to further improve the business value.

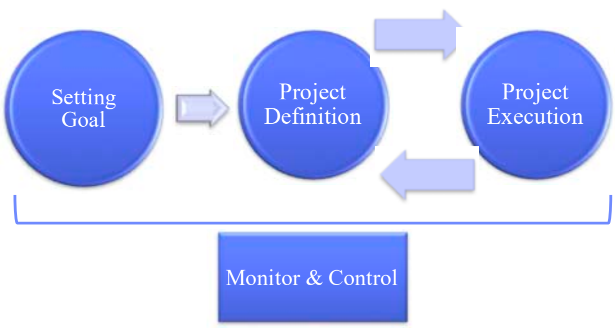

Figure 3 Program Management Process

In the following sections, the implemented solution is described.

3.1 Formulation of strategic objectives for each project

Organize the values and goals that can be offered as business operators, the strategic positioning of each project, and the positioning of additional tasks for the goals that the customers want for current projects and the innovations that we want as business operators.

Then, although it is the arrangement of the customer's goal, "the goals the we want to solve and realize on the business" is organized in chronological order. This goal has "want to ~" and "to be able to ~" as positive goal and "must do ~" as negative goal. Regarding the positive goal, as this time we were a customer of central government agency, we have not conducted a strategy examination such as SWAT analysis, etc. in the market environment such as analysis of the market environment, furthermore the value to be indicated in that, and as a political goal We aim at the mission of a given customer as a goal. Specifically, it is a mission such as "Operational expense reduction by Heisei XX year". Regarding the negative goal, the customers opinion of external pressure was organized in a bottom-up approach. Then the period wherein these missions should be achieved was clarified.

We organize these, and as a business operator we thought to create innovation and lead the project success with the following as a mission.

- Reduce system maintenance costs
- Increase project productivity
- Implement visualization of the current system

Table 1 Goal Statements

Category	Goal	Priority	Due Date	Key Person	Main Issues and Risks
Contract Scope	A	Mandatory	2017/3	A	• Tight schedule to release • ITB Failure has not converged
	B		2017/6	B	• Technical difficulty of solution
	C		2017/9	A	• Contract scope might be changed by public comment
Proposal Work	Requirement Refinement	High	2017/9	A	• Need deep business knowledge in XXX • Need many efforts to confirm new regulation and listening to end users • Need client's corporation
	Solution Development	High	2017/9	C	• Need knowledge for infrastructure • Need resource coordination
	Proposal Doc. Creation	High	2017/9	E	• Cooperation on simple work from non-project members
Kaizen Work	Productivity Improvement	Middle	2018E	B	• Need B's strong leadership for the work volume
	Cost Reduction	Middle	2018E	A	• Consideration for shifting to low price resource
	Security Improvement	Middle	2018E	D	• Latest knowledge and measures
	Document Creation	Middle	2018E	A, F	• Need deep knowledge for making for zeroand strong leadership for the work volume

According to Yoshida, T. and Yamamoto, H. (2014), these strategy goals are often expressed using balanced scorecards. However, at this time, we summarize strategic goals, priorities, key issues, key risks, implementation timelines and key persons in Table 1 from the case-specific background such as the simplicity of maintenance and want to evaluate from the perspective of resources with high restrictions.

3.2 Formulation of strategic objectives for each project

For the mission organized in 3.1, we examined the project as a solution and redefined the current project (change of scope and implementation method). For your information, the content of consideration in this case is described below.

- Reduce system maintenance costs

As a Japan government policy, encouraging budgets for IT systems that should prioritize policy on IT budgets, other systems have been strongly urged to reduce expenses overall. As a result, the system that the author was in charge was subject to strong demand for cost reduction. Although customer-led consideration was given to cost reductions, expenses for expanding and developing the system were also requested to be reduced. Therefore, we conducted a factor analysis that high development costs have been stopped, "We are bidding customers with unclear requirements", "Low development productivity", "Reduced cost related to development environment and process" etc. "Development productivity" will be described later, but here is a mission such as "cloud of development environment", "use SaaS service of routine work" and so on.

- Increase project productivity

We gathered current project performance and conducted Gap analysis with general productivity index. We also examined improvement measures through interviews with project experts. In this time, the mission was to develop the necessary documentation and tool for implementing the system expansion / maintenance / renewal project, Specifically, "Improvement of design documents of existing systems", "Centralized management of project control documents", "Simplification and Tool Creation of security-related procedures such as participation / leave process and checking of development environment" etc.

- Implement visualization of the current system

Extended development has been implemented for the existing system for a long period of time, and fragmentary design documents have increased, resulting in shortage of documents representing the entire system. As a result, new vendor cannot estimate the amount of work from procurement specification documents and browsing materials, and as a result, the businesses to be bidding have been fixed and client has been pointed out high marks. For this reason, document preparation expressing the entire existing system has been strongly demanded. Even as an existing vendor, the business environment in which customers themselves are continuously exposed to external criticism is at risk of unexpected budget cuts and the like in the future, and certain cooperation is also necessary for maintaining the relationship of trust with customers was. Therefore, we have developed roadmaps for document development focusing basic design documents with customers, and partly defined as missions in order to make it easy to modify existing materials.

Table 2 Definition of Projects

Goal	Requirement Refinement
Background	1. A requirement definition was implemented by another vendor. However, some requests from users are compiled but not exhaustive. Also, its specific system requirements are not defined. 2. The amendments that affect the system have not been determined.
Milestone / SOW	(-2017/04) · Encourage early examination of system revision content and ask customer to confirm consideration milestone. · Encourage early consideration of amendments revision and ask customer to decide consideration milestone. (-2017/09) · Refine the requirements until estimates are possible.
Main Work	1-1: Organize user's requests and consider solutions. 1-2: Present a solution and ask the customer to decide what to do in this procurement. 2-1: Encourage early examination of system revision content and ask customer to confirm consideration milestone. 2-2: Read and interpreti the material of amendments revision. Also, investigate the impact of the system based on this result. 2-3: Ask the customer to determine the system requirements based on the contents of law revision.
Member	· A and A's team members
Cost	· Request customer to define requirement definition · Secure proposal cost

We organized these solutions and planned to restart existing projects and implement new improvement projects. Specifically, for the redesign of the project, we separated the important goals and the task associated with it into manageable units, identified and arranged the key resources, and secured the necessary cost in carrying out the work. We reviewed the background, SOW, milestones, key work, necessary resources for each project, and summarized it in the form shown in Table 2. SOW and milestones will be represented for the first time by improvement activities. The ongoing project also redefined, such as "shifting resources to new members in stages", "achieving each milestone ahead of schedule", from the initial plan.

In addition, these projects allocated more work to administrators and key persons more densely than before, and since this leads to simultaneous parallel work, a close communication aimed to improve motivation of related members is done, and got stakeholder agreement.

Moreover, we explained explanations to the customers to the extent that we can disclose the contents summarized in 3.1 and 3.2, and asked customers to evaluate positive attitudes as business entities and to obtain cooperation as necessary.

3.3 Monitoring the execution status of projects / Controlling goals and value

The various projects were implemented based on the project planned in 3.2. In the implementation phase, depending on the situation of each project, it may not proceed as planned, so if necessary it had to make a course correction by project redefinition.

Therefore, like the general project management, the following evaluations were carried out on a monthly basis.

- Project progress
- Financial status
- Issues and Risks

In addition, there are cases where the usefulness of each mission being implemented changes due to changes in the external environment (change of stakeholders, changes in missions owned by each, business environment, etc.), in which case the goal It is necessary to revise itself. Therefore, the following evaluation was also done at the same time.

- External environment
- Customer consent status
- Usefulness of the mission for the goals

Also, if the project is already working, we must re-plan and reprocess this project itself. Furthermore, it is important to maintain the motivation of the members in order to create a situation of high load as a result of having to carry out the task activities concurrently with this already moving project. For that reason, we made communication with members about once in a quarter. Based on these evaluations, we decided to change the scope and priority of each project as a whole, redistribute resources and costs accordingly.

4. Verification

The business domain of the IT system in charge of this time is unique in its business domain, and few engineers have knowledge of this business domain. Also, customers themselves are also transferred once every two years due to the custom of personnel change of the central ministries, and few customers have knowledge of this system. Therefore, it is hard to receive support from outside the project. On the other hand, at the time when the business scale expanded sharply, it was necessary for experts in this project to cooperate work on improvement activities while smoothly implementing existing projects.

In addition, although projects scheduled to be implemented after each proposal activity had a prospect of securing budget, there was uncertainty that the detailed scope was not decided due to lack of advance adjustment. However, as a business operator, our company thought that we would like to make this proposal activity successful for expansion of business. Under such circumstances, it was necessary to manage the entire project as a program, not individually implementing projects underway, suggestion activities and improvement activities for the future.

Under such circumstances, it is necessary to maintain the goals as a form that can be seen as a list, and to define projects including improvement activities, etc., to collectively manage them, to gain consensus among related parties through evaluation and control, and we are starting to see certain results on improvement activities as well. We believe that this is the result of the following effect on the program management method of this time.

- We were able to "organize the whole picture" to achieve results and "consensus formation" of stakeholders.
- It became possible to grasp what "important factor" for achieving the goal was, and it became possible to conduct "alternative solution".
- The "achievability" of the goal can be grasped.
- There was an effect of "unity consciousness" of project members.

Particularly, the improvement effect was great effect of "consciousness unity in members" of the fourth point, since the definitions and priorities of goals to be carried out every day are constantly changing, it was necessary to form a team that can bear with timely evaluation and uncertainty. Also, unlike the periodic project activities, these tasks increased the value as a business operator and contributed to the improvement of customer satisfaction.

5. Conclusion

This time, because of the importance of "The need to effectively carry out the various activities such as changing requirements from customers and various improvements at the proposal stage before the start of a large-scale project", in order to cover the scope that cannot be dealt by doing only ongoing project management, we had not only manage the each project, but also carried out activities aimed at managing the whole as a program and following the goals of the customer, and flexibly dealing with various changes.

In this time, prioritization at the mission definition stage of the initial project and reevaluation of the value offered to the goal in the monitoring phase cannot be done systematically and are evaluated arbitrarily. Therefore, I would like to consider what kind of evaluation axis is effective according to individual circumstances in the future.

As in this case, we believe that there are many other circumstances, in which your business goals change from moment to moment and you need to operate the project under uncertainty, or in which it is necessary to propose additional projects with the same members during project implementation. I think that there are many people who already have the same kind of experience already according to this situation, but I hope you can use it as a case example of how to deal with Project Manager at that time.

Acknowledgements

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The Value Creators: a new educational concept to address wicked challenges

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Society at large and organisations at a smaller scale, are being confronted with complex challenges that are global with a local impact, or local with a global impact and which are difficult, if not impossible, to solve. Examples are global warming, the world economic crisis, food security and depletion of resources. We call these challenges "wicked", because for each possible solution, due to interdependencies, other questions and challenges arise. In wicked challenges, many stakeholders are involved with different and often contradicting interests. We need to prepare young professionals on how to collaborate with these different stakeholders to address wicked challenges, such as, together.
This interactive workshop gives an insight into the new educational concept The Value Creators of the BBA program in Global Project and Change Management offered by Windesheim Honours College (WHC), the Netherlands. Participants will experience a method that is developed by the Value Creators Team, and which is called the Four E-model for Global Challenges: (1) Explore: What is the challenge about? What are the causes and possible solutions; who is involved and what are the main interests? What is the big DREAM? (2) Engage: who is involved in the global challenge, how are they involved, how can different interests been brought together? (3) Elaborate: How to get from Dream to Reality? What needs to be done and by who? (4) Evaluate: which value can we create for whom and how to assess the created value?

Keywords and phrases: Wicked global challenges, value creation, 5 minds of the future, 4E-model for Value Creation

1. Introduction

Young professionals and students will be working more than ever before in a complex world, facing huge global challenges that need to be addressed in a network society. They are increasingly confronted with developments and challenges that are "wicked" in nature, such as global warming, global food security and depletion of resources. These challenges are difficult, if not impossible, to solve. Moreover, due to interdependencies, with each solution, other questions and challenges arise (Rijsdijk & de Bot, 2017). To prepare young professionals for these wicked challenges, the bachelor programme Global Project and Change Management of Windesheim Honours College in the Netherlands developed an innovative educational concept, called "The Value Creators" and a 4E-model for Value Creation. As wicked problems cannot be solved, we should not be looking for solutions, but for value creation in different ways, for different people, for the earth and society.

2. Wicked challenges

The first scientists to describe and define wicked problems were Rittel and Webber (1973). They distinguish wicked problems from tame, based on the number of uncertainties involved as well as the unsolvable nature of a wicked issue and argue that problems of social policy are "wicked" per definition. They even argue that the formulation of a wicked problem is problematic: "(….) The formulation of a wicked problem is the problem! The process of formulating the problem and of conceiving a solution (or re-solution) are identical, since every specification of the problem is a specification of the direction of the treatment that is considered. Thus, if we recognise deficient mental health services as part of the problem, then- trivially enough- "improvement of mental health services", is a specification of solution. If as the next step, we declare the lack of community centres one deficiency of the mental health services system, then "procurement of community centers" is the next specification of solution. If it is inadequate treatment

Proceedings of the 11th International Conference on Project Management (ProMAC2017) 1055

within community centers, then improved therapy training of staff may be the locus of solution, and so on." (Rittel and Webber, 1973: 161).

Because of this wicked nature of problem formulation, a "system-approach" is very relevant for wicked challenges, meaning that you need to act at a system level rather than addressing single elements within the system. The big question is: How do we do this? and How do we teach students to act at a system level rather than addressing single elements within that system? To find some answers to these questions, it is relevant to look at the main characteristics of Wicked Challenges. Based on a literature review and 9 in-depth interviews with senior project managers dealing with complex and wicked problems, Rijsdijk, Groenevelt and de Bot (2016) defined 7 main dimensions of "wickedness" (see table 1).

Table 1: Dimensions of Wickedness

	Dimensions	Items at the wicked end of the spectrum
1	Boundary crossing	diversity in countries of origin, regions, departments and/or organisations, crossing policy domains, political and administrative jurisdictions, and political "group" interests
2	Interdependency	of a high number of stakeholders, including institutions and organisations, regarding information, legislation, finances etc.
3	End goal	is not or not clearly defined, is open to change, does not encompass the complete scope of the challenge
4	Influence and context	high influence of political, organisational and other contexts
5	Information and interests	info is to derived from a variety of sources providing partly info and possible unreliable info, which may be influenced by their interests
6	Relevance to society	impact on society is high
7	Approach, process and result	the challenge is unlikely to be dealt with via a planned, well defined approach.

Preparing young professionals and students to deal with wicked problems, means we need to prepare them to deal with above mentioned dimensions; dealing with different, often competing, interests, understanding the political, organisational and cultural context, how to approach the challenge at a system level and without a planned, well-defined approach, dealing with uncertainty, connecting with different networks and create value instead of solutions (because there are no solutions).

3. The Value Creators

Global Project and Change Management is a four-year English taught Honours Bachelor of Business Administration (BBA) programme for selected international students. The selection of these "honours" students is based on motivation, above-average ability and social involvement. In year 3 and 4 of the programme, students can follow the Value Creators semester, where they work on a so-called wicked challenge. Our departure point are the Global Goals for Sustainable Development. These global goals are in essence wicked challenges; there is no template to follow, there is always more than one explanation, depending greatly on individual and political perspectives and the global goals are very much interdependent and interconnected; "solving" one problem immediately leads to the prominence of another problem. You need to address different goas at a system level to book progress.

Students who follow the Value Creators semester can work on these Global Goals in one of the following four areas:

(1) Global Health
(2) Urban Dynamics
(3) Civil Society
(4) Social Entrepreneurship

Apart from in-depth and state-of-the-art knowledge of one of the above mentioned themes, acquired through an online course of 6 weeks, students acquire different essential 21st century skills like critical thinking, social responsibility, collaboration and leadership, creativity and innovation and problem solving. The Value

Creator educational concept is developed in co-creation with students and professional networks and is based on connectivism theory (Siemens, 2005), Theory U (Scharmer & Senge, 2009), Five Minds for the Future (Gardner, 2008) and communities of practice (Wenger, 1998). The mission of the Value Creators was formulated as follows: “We believe in young potentials who can change the world and create value. We create environments where professionals and young students can co-create the future connecting local and global SOULutions to the challenges ahead.” (Mission Value Creators). We wanted to create an environment which enables students to use knowledge as a tool, instead of knowledge as a goal. As bounded freedom is a fundamental part of the DNA of the Windesheim Honours College, we extended this concept in the Value Creators programme by taking away the class schedules and operating with education on demand. Students build up their own toolbox during the value creators journey by following and organising different workshops and with which they can operate in the “real world”, discovering and engaging with professional networks to co-create value and change.

5 Minds of the Future

To make students aware of their own learning journey, we developed and introduced a self-assessment practice, where students are in control of 25% of their grade. In order to do this, students get three individual coaching sessions. In the first session, students are invited to define their own learning objectives based on the framework of the 5 Minds for the Future (Gardner, 2008). These 5 Minds of the Future are:

(1) The disciplined mind: this mind has mastered at least one discipline very well. Students need to know how to do at least one thing very well. This means the ability to focus and develop deep knowledge to stand out from generalists. Becoming an expert in something, means dedication, hard and focused work. Students need to be facilitated and learn how to do this.

(2) The synthesizing mind: this mind is able to take information from different sources, understands and evaluates the information objectively and puts different information together in a way that it makes sense to people. Combining existing information and by combining it, come to new understanding and knowledge.

(3) The creating mind: this mind is very important to develop new, original ideas by posing unexpected questions and looking for alternative ways to change the world. This also means a lot of experimenting, trying new things, playing around, fail, learn from it and try again.

(4) The respectful mind; this mind values differences, trying to understand “the other” and seeks to co-create with them. This mind is not afraid to acknowledge differences as good.

(5) The ethical mind is the mind that is not-selfish and looks for how the nature of one’s work can serve the needs and desires of the society and the world in which he lives.

Based on reflection on above 5 Minds, students formulate learning objectives related to these and to the Value Creators’ learning objectives. In the second meeting, issues are discussed that the student is experiencing related to the learning journey and his learning objectives, extra tools they may need to achieve their goal are being discussed as well as any other issue that comes up to facilitate their learning journey. In the last session, students present their assessment of their own learning journey and present the evidence to support this assessment before a professional jury, consisting of lecturers, professors and work field representatives.

To facilitate the students in the Value Creator journey, we developed our own methodology for value creation: The 4E-model. The 4E-model will be explained in below paragraph.

4. The 4E-model for Value Creation

In order to help students navigate through the process of addressing complex issues, we developed the 4E-Model for Value Creation. Inspired by traditional forms of design thinking and incorporating elements of different theories mentioned before, this model is a simple method to help students and other stakeholders to focus, to identify the most important stakeholders and ingredients to take action and co-create societal change and value.

The 4E-model consists of the following four steps:

Step 1. Explore: We invite students and a network of professionals, researchers and business people to explore a wicked challenge they are addressing. To enable the participants to not focus on one element of the wicked challenge, they are invited to explore the context, possible causes and possible solutions and make the challenge as big as possible. This is done by brainstorming, shaping good questions and discussing together the Big Dream.

Step 2. Engage: In the second step, participants identify together the relevant stakeholders and networks that are valuable in addressing the complexity of the challenge. Questions like: Who are they and why are they relevant in this process? Are they part of the problem or of the solution? What is their specific role or power in moving things forward?", are being addressed and discussed.

Step 3. Elaborate: In the third step, participants become a bit more concrete in shaping ideas and being more specific on the role of each network and stakeholders in addressing the wicked challenge. In this step, participants define possible roles and activities for each stakeholder or network. It is about going from Dream to Action.

Step 4: Evaluate: During the last step of the model, the evaluation, participants first define the value that will be created and for whom. If necessary, adjustments and recommendations will be done for further actions.

The outcomes of the Value Creation process is gathered on a Canvas (see Figure 1). The 4E model for Value CreationValue Creator process can be done in a pressure cooker session of 1 to 2 hours, and is used throughout the Value Creation process, which can take up many years. It is a continuous cyclic process.

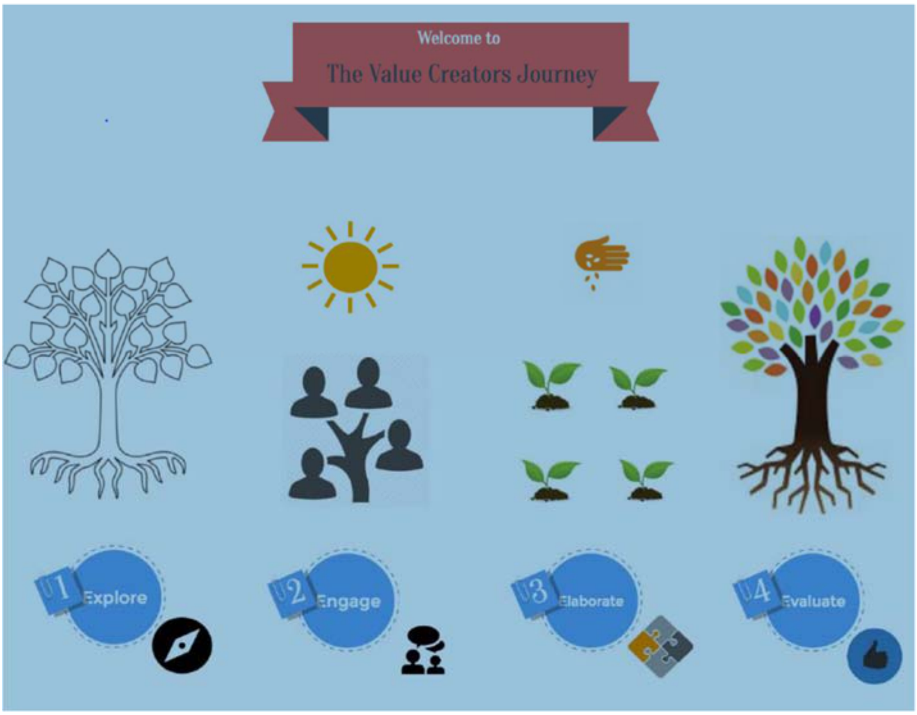

Figure 1: The 4E-model for Value Creation Canvas

5. Conclusion

To address a wicked challenge, collaboration, co-defining and co-creation between and with all relevant stakeholders is essential. The 5 minds of the Future are essential in this Value Creation process and students need to acquire new, 21st century skills, to prepare them well for the wicked challenges of today and tomorrow. The Value Creation educational concept and the 4E-model for Value Creation developed by Windesheim Honours College provide students an experimenting and learning environment to start a process of value creation, connecting with relevant stakeholders and networks to co-create value and make change happen.

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The IT Human Resource Development and Improving Development Efficiency by Improving on the Education in Project

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In order to develop IT human resources, OJT (On the Job Training) is often used as a place for practical skill improvement. The human resource development at our company places importance on the acquirement of the skills of the software construction process by new employees, for developing highly skilled IT human resources. We have developed OJT program in which new employees participate in system development project and experience the software construction process and the software integration process. The system development projects need to keep the delivery date and quality. If the project members are new employees who lacks IT skills, the projects need to consider a way to ensure the delivery date and quality. Therefore, in the developed OJT program, the skill improvement of new employees by OJT is evaluated by achievement of a quality standard and the development efficiency. In the first year, when we implemented the developed OJT program, we could not achieve the target value of development efficiency in the software construction process. In this paper, we analyze the reason why the target of development efficiency could not be achieved, and introduce examples which we improved the development efficiency of new employees by improving the contents of education during OJT.

Keywords and phrases : Human Resource Development, On the Job Training, Education, Development efficiency

1. Introduction

The human resource development is important for the growth of companies, and it is necessary to implement policies for human resources development from a long-term perspective. In recent years, it has been reported to organize development programs for young engineers systematically by Miyoshi (2015).

Our company has been systematizing educational programs by hierarchy so that system engineers could improve their skills gradually. In these programs, we carry out OJT targeted at new employees. At OJT for system engineers, new employees participate in system development projects and experience the software construction process and the software integration process. The new employees acquire the basic skills of system development through this experience, then they will be going to upgrade their skills as the system engineer by experiencing upper and lower processes.

Additionally, in accordance with the increase of the use of OSS (Open-source software), we decided to develop a new OJT program for new employees to develop their skills to use OSS as the system engineer.

When we developed the new OJT program, we considered how to measure and evaluate skills improvement. As a method for evaluating skills of system engineers and programmers, Kuchiki et al. (2010) reported an evaluation method specific to programming skills such as initial programming skills and debugging abilities. On the other hand, we have evaluated works in the software construction process and the software integration process by the achievement of quality standards and the development efficiency [SLOC (Source Lines Of Code)/the man-month].

Additionally, in consideration of the variance of the skill level of new employees, Uzawa et al. (2002) reported the development method that ensure constant development efficiency and quality in OJT. On the other hand, in this paper, we introduce the case of an OJT program in which we improved the development efficiency of the software construction process by improving contents of "Education in the project".

2. The outline of the OJT program

New employees of our company take the education programs for new employees after joining the company, then they are brought into the OJT program. In the education programs for the new employees, they learn about the basic skills as a system engineer, such as the basics of computer, system development process, programming languages, and database.

Our new OJT program had to premise on this education for new employees of a systems engineer.

Our new OJT program therefore consists of the following three parts.

(1) Education in the project
(2) Practicing development
(3) Outcome summary

We explain the contents of each program in sections from 2.1 to 2.3.

2.1 Education in the project

In order to give new employees baseline knowledge of the project which they participate in the OJT, we educate them on development support tools, application frameworks, and programming languages used in the project. The new employees learn basic knowledge of OSS used in the project with "Education in the project" program before "Practicing development" program. Figure **1** shows the contents of "Education in the project" program.

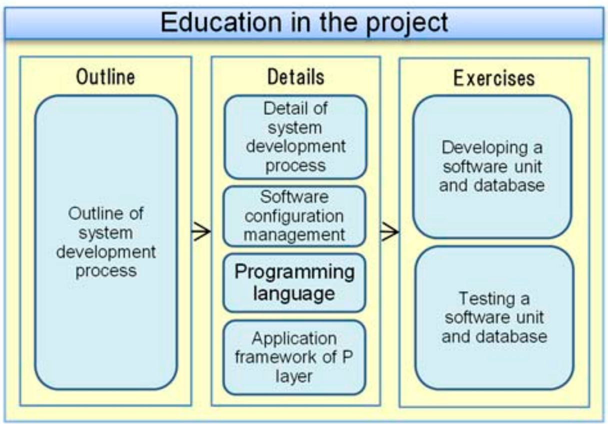

Figure 1 The contents of "Education in the project" program

2.2 Practicing development

In the OJT program, new employees carry out the software construction process and the software integration process of the target project. It is necessary to keep the delivery date and quality in the OJT because our OJT program is based on an actual system development project. We therefore defined the quality standards and the target development efficiency [SLOC/man-month]. Additionally, we use "conformance to the quality standards of the project" and "achievement of the target development efficiency" as an indicator of skills improvement in the OJT.

We evaluated conformance to the quality standards in each process. Meanwhile, we evaluated development efficiency at the end of the OJT because we expected the improvement of their proficiency level through the OJT.

2.3 Outcome summary

About the software construction process and the software integration process in the "Practicing development" program, each new employee analyzes their development efficiency and the quality of their deliverables quantitatively. Based on the result of their analysis, they summarize their outcome of the OJT and future issues. After that, they make a presentation about their outcome of the OJT to their managers. They plan their personal growth plan for next years based on feedback from their managers.

3. Issues and solutions of the OJT program

In this chapter, we describe issues and solutions about the software construction process in the "Practicing development" in the OJT program.

3.1 Issues

We applied the OJT program to project A (hereinafter referred to as the OJT A). Table 1 shows the outline of the OJT A.

Table 1 The outline of the OJT A

No	Items		Contents
1	Application architecture		3 layer type web application
2	Program size		150[KSLOC]
3	Target processes		Software construction process Software integration process
4	Term	Education in the project	2 weeks
5		Practicing development	20 weeks
6		Outcome summary	2 weeks
7	Number of developers (New employees)		30

We inspected data from the OJT A and investigated the problem happened in the OJT.

In the OJT A, we achieved the quality standard of the project A. Meanwhile, we could not achieve the target development efficiency in the software construction process. In both presentation layer (hereinafter referred to as the P layer) and function layer (hereinafter referred to as the F layer) of the software we developed, the average value of the development efficiency was lower than the targeted value. The development efficiency of the P layer and the F layer is shown in Figure **2** and Figure **3**. In those graph, all indices are based on an index of 1.0 for the target development efficiency.

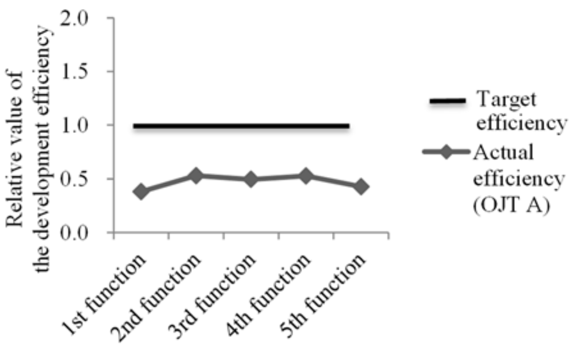

Figure 2 Development efficiency of the OJT A (P layer)

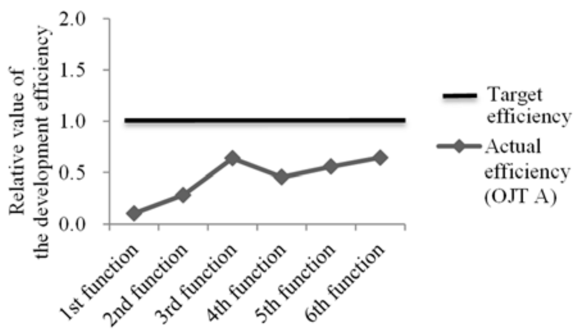

Figure 3 Development efficiency of the OJT A (F layer)

From the inspection, we found the following points:

(1) The P layer

New employees could not achieve the target development efficiency in any function.

The development efficiency was roughly flat and hardly increased after the development of the second function.

(2) The F layer

New employees could not achieve the target development efficiency in any function.

The development efficiency was increased after the development of the second function.

3.2 Cause analysis

We analyzed the reason why the development efficiency of the P layer and the F layer of the software construction process was not able to achieve the target value from the following two points of views:

(1) Tasks that the actual workload exceeded the estimated workload

(2) Causes of the workload excess

Figure **4** and Figure **5** show the detail of our analysis about the estimated workload and actual workload. In those graph, all indices are based on an index of 1.0 for the estimated workload.

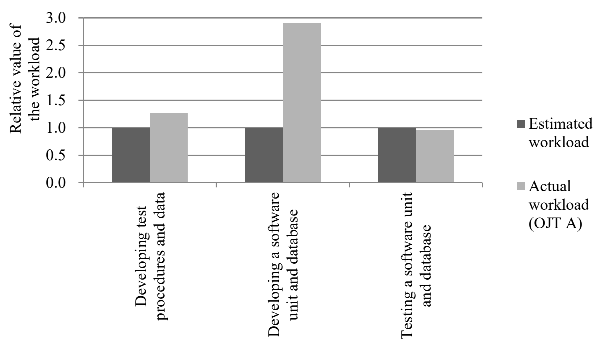

Figure 4 Task-by-task workload in the OJT A (P layer)

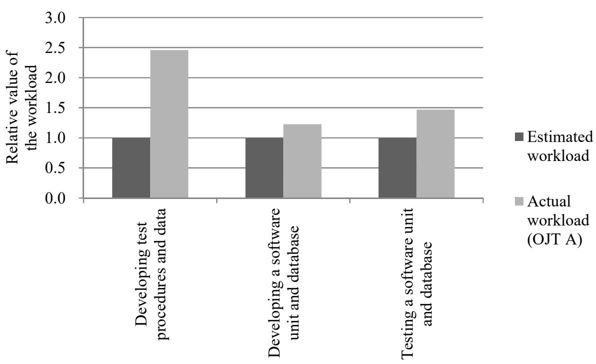

Figure 5 Task-by-task workload in the OJT A (F layer)

In the P layer, the actual workload of "Developing a software unit and database" greatly exceeded the estimated workload. In the F layer, the actual workload of "Developing test procedures and data" greatly exceeded the estimated workload.

For these tasks, we inspected weekly reports from the new employees for causes of the workload excess. The result is shown in Figure **6** and Figure **7**.

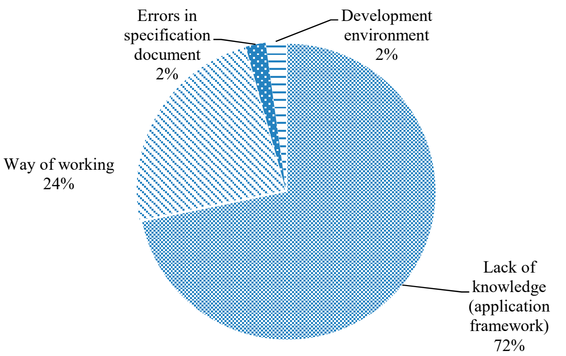

Figure 6 Cause of low development efficiency (P layer)

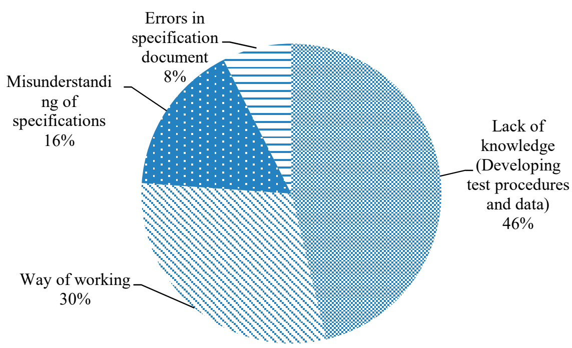

Figure 7 Cause of low development efficiency (F layer)

Figure **6** suggests that the main cause of the workload excess is the lack of knowledge of application framework in the P layer. Figure **7** suggests that the main cause of the workload excess is the lack of knowledge of developing test procedures and data in the F layer.

Additionally, we analyzed the causes that the development efficiency was roughly flat and hardly increased after the development of the second function. The new employees learned usage of the application framework in the "Education in the project". However, they only learned the ways to implement some screen patterns used in the "Practicing development". After the development of the second function, the new employees developed screens that do not fit into the patterns which they have learned in the "Education in the project". We therefore inferred that is the cause of the low development efficiency.

3.3 Solutions

We examined the solutions for the two causes that decreased development efficiency. New employees have learned "application framework in the P layer" and "developing test procedures and data" in the "Education in the project". We therefore inferred the "Education in the project" program had lack of some items.

So we made a hypothesis that could settle the issues of the software construction process by improving the contents about "Application framework of P layer" and "Developing test case and data of F layer" in the "Education in the project" program. Based on the hypothesis, we added the following two exercises:

(1) The exercise of P layer Application framework

We added the exercise to the screen pattern from results of the OJT A.

(2) Exercise to create test cases and test data

Since it is not possible to change the duration of the OJT program (six months), we reviewed the contents of the whole education program so that we did not have to change the term (two weeks) of the "Education in the project" program.

4. Inspection

We adopted the solutions described in 3.3 Solutions to the OJT program, which derived from project B (hereinafter referred to as the OJT B), and we carried out the OJT B. Table 2 shows the outline of the OJT B.

Table 2 The outline of the OJT B

No	Items		Contents
1	Application architecture		3 layer type web application
2	Program size		370[KSLOC]
3	Target processes		Software construction process Software integration process
4	Term	Education in the project	2 weeks
5		Practicing development	20 weeks
6		Outcome summary	2 weeks
7	Number of developers (New employees)		50

In the OJT B, we achieved the quality standard of the project B. We inspected the effectiveness of the solutions described in 3.3 Solutions from the following two points of views:

(1) The actual workload to the estimate in the P layer and the F layer in the software construction process
(2) The development efficiency in the P layer and the F layer in the software construction process

We explain the result of each inspection in the following sections.

4.1 Inspection of the workload

Figure **8** and Figure **9** show the estimated workload and actual workload. In those graph, all indices are based on an index of 1.0 for the estimated workload.

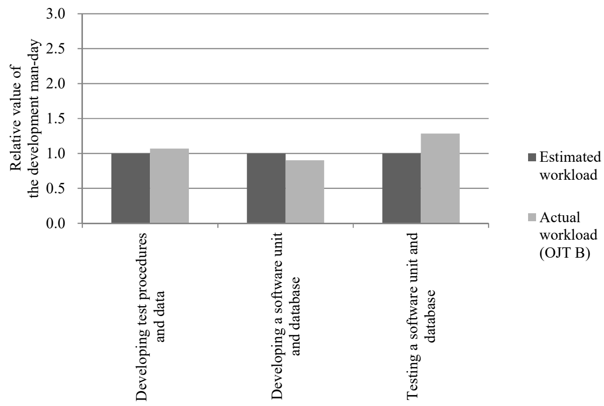

Figure 8 Task-by-task workload in the OJT B (P layer)

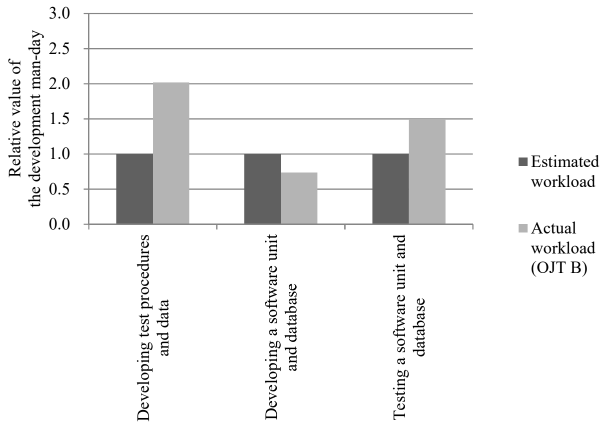

Figure 9 Task-by-task workload in the OJT B (F layer)

From the inspection, we found the following points:

(1) The P layer

In "Developing a software unit and database", the actual workload in the OJT B is almost the same as the estimated workload. On the other hand, the actual workload in the OJT A is about three times as much as the estimated workload. Therefore, the workload improved.

(2) The Flayer

In "Developing test procedures and data" of the OJT B, the actual workload is about two times as much as the estimated workload. On the other hand, the actual workload in the OJT A is about 2.5 times as much as the estimate. The workload improved by 20% from the OJT A.

4.2 Inspection of the development efficiency

In the OJT B, the development efficiency in the P layer and the F layer is shown in Figure **10** and Figure **11**. In those graph, all indices are based on an index of 1.0 for the target development efficiency.

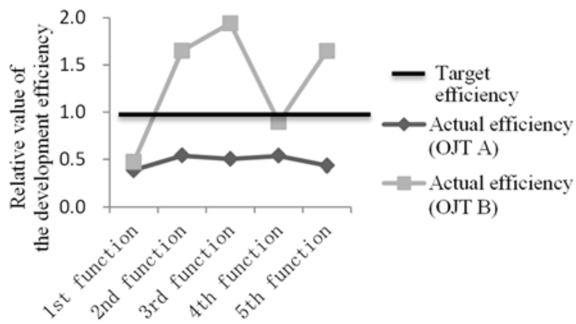

Figure 10 Development efficiency of the OJT B (P layer)

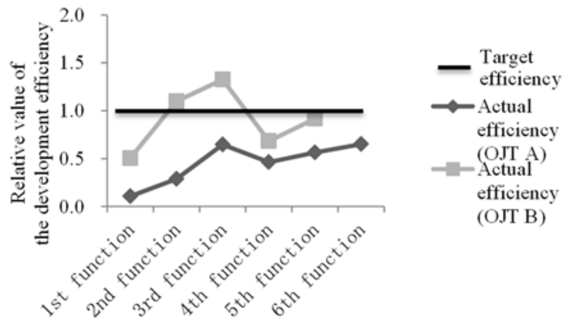

Figure 11 Development efficiency of the OJT B (F layer)

From the inspection, we found the following points:

(1) The P layer.

New employees have achieved the target development efficiency in the second, third and fifth functions.

(2) The F layer.

New employees have achieve the target development efficiency in the second and third functions.

(3) The comparison with the OJT A

Comparing the development efficiency of the OJT A and the OJT B, the development efficiency in the OJT B is higher than the OJT A in all functions of the P layer and the Flayer.

These points suggest, in both the P layer and the Flayer, the actual development efficiency in the OJT B exceeded the OJT A.

Note that the development efficiency of the fourth function decreased in the P layer and the Flayer. The cause of this decrement is the increased difficulty of the developed function. In development plan of the OJT B, we considered that the proficiency level would improve by experience, so we planned to develop relatively difficult functions as the fourth and fifth function. The decrement is therefore a result within the assumption in the management of the OJT B.

5. Consideration

The development efficiency in the OJT B exceeded the development efficiency in the OJT A. Also, we achieved the target development efficiency in the OJT B. We think therefore our improvement in the "Education in the project" program has been effective to increase the development efficiency. We consider that these results are the case show the effectiveness of training in project human resources management.

On the other hand, this inspection result has the following limitations:

(1) We did not consider the influence by the difference in the business of the development object.

(2) We did not consider the influence by the difference in the scale of the development target.

(3) We did not consider the influence by the difference in the populations of the new employee.

6. Conclusion

We picked up the issues in the software construction process in the "Practicing development" program by analyzing the outcome of our OJT program. By improving "Education in the project" as solutions to these issues, we make the new employees achieved the target development efficiency of the software construction process.

In the future, it is necessary for us to consider the solutions to the following four issues about the OJT program:

(1) We need to improve our "Education in the project" continually according to the condition of the project and the change of adopted technologies.

(2) We need to improve our OJT program according to the change in the necessary skills to the system engineer.

(3) We need to analyze the software integration process. After that, we need to improve "Education in the project" by focusing on the result of the analysis.

(4) We need to consider the way to develop the human resource in the project besides OJT.

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Managing Personal Software Process Education Course Based on Motivation Process Model by Using System-Theoretic Method STAMP/STPA

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Since software development process plays an important role in software intensive projects, Kyushu Institute of Technology offers a class of the PSP (Personal Software Process) training course in addition to PBL(Project-Based-Learning). One of the problems of the class is low completion rate and professors have been trying to resolve the situation. One of the trials is formalizing the motivation process of the PSP course trainees by using state transition modelling based on the Organizational Expectancy Model. The latest model, Practical-STM, treats an individual trainee of the PSP course as a state machine, and formalizes the motivation process of a trainee using the state, values of the factors regarding the trainee's motivation and a set of operations from the course instructors. Theoretically, instructors can decide effective actions for the trainees based on the assumption on the state and the corresponding state transition function of the trainees. However, it is difficult to develop and analyze the instructor scenarios, series of instructions during the PSP course, by considering the trainee's motivation. We use a system theoretic method STAMP/STPA originally proposed for "safeware" to make a guideline architecture to manage the situations during the course in a top-down manner based on the Practical-STM.

Key Words & Phrases: Education improvement, Motivation management, System-thinking

1. Introduction

Since software development process plays an important role in software intensive projects, Kyushu Institute of Technology (Kyutec) offers the training courses of PSP (Personal Software Process) and TSP (Team Software Process) (Humphrey, 1999, 2005, 2007) in addition to PBL (Project Based Learning). One of the problems of the class is low completion rate and professors have been trying to resolve the situation. In general, when an individual or organization tries to introduce a new technology or method, it is necessary to appropriately motivate the individual or organization. In introducing PSP through the corresponding training course, we also need consider this issue.

The model of state transition in a motivation process (Ishibashi et al., 2012) based on the Organizational Expectancy Model (Sakashita, 1985) is useful for the analysis of a process in introducing and establishing a new technology or method. The Organizational Expectancy Model models interactions between the target process and its monitoring and controlling process from a view point of motivation process. This Organizational Expectancy Model is also useful for software process education in a university setting even though the parameters of the factors in the model, such as the content of rewards, are different between the working environment and the education environment. There have been proposed two state transition models based on the Organizational Expectancy Model, and applied to the management the PSP training course. The first one is the Baseline-State Transition Model (Baseline-STM) (Ishibashi et al., 2012). The second one, a practical state transition model (Practical-STM) of a motivation process in the PSP course is defined in order to more precisely manage the course according to the actual experiences of instructors (Umeda et al., 2014). The Practical-STM is intended to extract the detailed features or characteristics of trainees related to the motivation for PSP. It is useful for instructors to presume states and state transition functions of the trainee during the course. This model enables us to formally describe a scenario, a state transition path of the motivation process, on which a trainee falls into a specific state of motivation. As the next step, we need an effective method to generate such a scenario from the view point of the PSP instructor in university.

In this paper, we discuss an approach to develop a top-down instruction architecture on top of the Practical-STM by using STAMP/STPA, Systems-Theoretic Accident Model & Process/Systems Theoretic Process Analysis (Leveson, 2012). Our approach is useful in making guideline for instructors to develop instructing scenarios that can prevent trainees from falling into undesirable states in the Practical-STM.

In the rest of the paper, section 2 describes the structure and state transition model of a motivation process based on the Organizational Expectancy Model, and introduces the Practical-STM in the PSP course. Section 3 introduces STAMP/STPA and section 4 explains our approach with STAMP/STPA. Section 5 makes a conclusion.

2. State transition model of motivation process

2.1 Motivation process and its structure

Our approach is based on the Organizational Expectancy Model that incorporates factors related to the environment or organization into the Expectancy Model (Lawler, 1971). Figure 1 illustrates the motivation process model based on the Organizational Expectancy Model. It represents the relationship between a personal motivation process embedded in a context of a project to introduce new technologies or methods, and a monitoring and the controlling process in the environment or organization to which the project belongs (Ishibashi et al., 2012). In the figure, *Bep* is the person's belief concerning the probability (i.e., subjective probability from 0 to 1) that the performance *P* at that level will be achieved if an effort *E* performing at that level is made. Bpo_i is a person's subjective probability from 0 to 1 that *P* at the intended level will lead to an outcome O_i $(i \geq 1)$, where *i* is an index to an individual outcome. V_i is a valence from -1 (very undesirable) to +1 (very desirable) that represents the degree of personal emotion or preference for O_i that *P* leads to. $Bpo_i * V_i$ is summed up because that there are more than one O_i in general. $Bep * \Sigma_i Bpo_i * V_i$ denotes that the motivation *M* is high if the possibility that *E* leads to *P* at that level is high ($Bep \gg 0$), the possibility that *P* leads to O_i is high ($Bpo_i \gg 0$), and O_i is desirable ($V_i \gg 0$).

E is determined by *M*, while $P = E*C*R$, where *C* denotes a person's prerequisite ability and *R* denotes a person's role perception. The role perception *R* is a person's perception in which the effort *E* leads to performance *P*. *P* leads to outcomes *Oi*, which are either or both of intrinsic rewards *Rint*, such as a sense of job accomplishment, and extrinsic rewards *Rext*, such as a pay raise or promotion. The job satisfaction *J* is given as $J = Rint * Rext * Requ$, where *Requ* denotes a person's perception of equitable reward. The example effects of *J* are absenteeism, grievances, and organizational identification. Arrows *X1, X2*, and *X3* denote that personal experiences in the processes of $E \rightarrow P$, $P \rightarrow O_i$ will affect *Bep*, Bpo_i and O_i, and V_i, respectively.

Environmental and organizational factors of the monitoring and controlling process represent the external factors that affect the personal motivation process. For example, operations, such as giving an instruction and an advice, by the monitoring and controlling process affect *R*. Operations issuing written

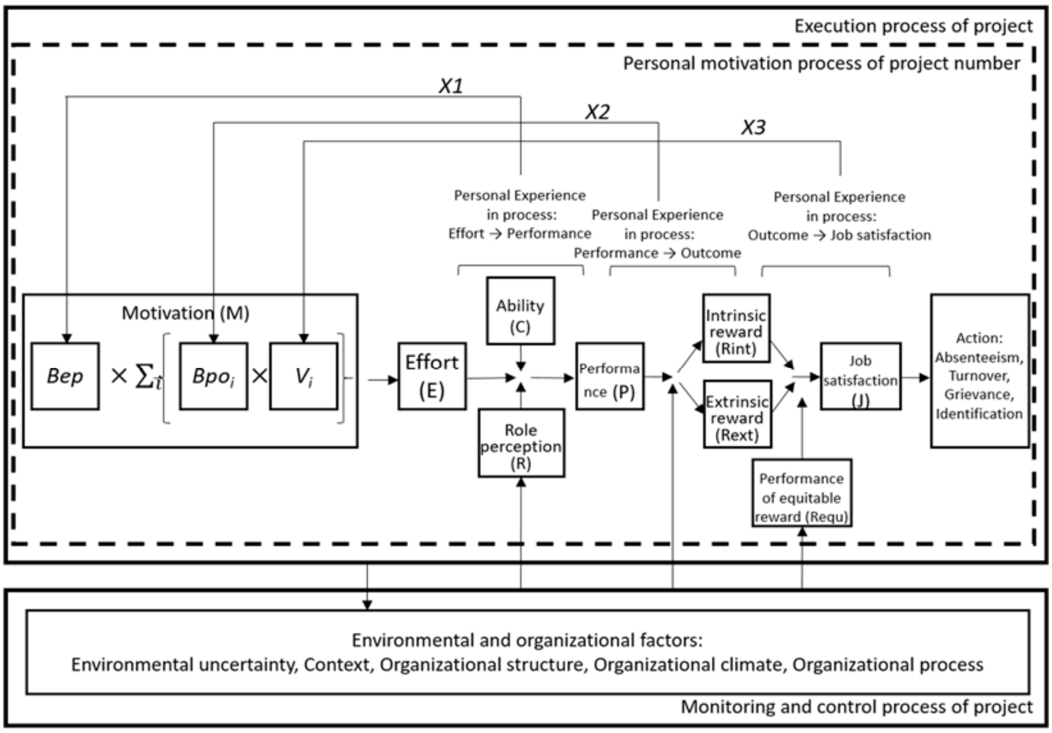

Figure 1 The structure of motivation process based on the Organizational Expectancy Model

appointments, such as those relating to a pay raise or promotion, affect *Rint* and *Rext*. Operations announcing a compensation plan or personnel assessment system affect *Requ*. Because *R* and *Requ* are directly affected by environmental and organizational factors, the arrows on the both sides from the monitoring and controlling process are connected to the corresponding factors. On the other hand, the arrow from the monitoring and controlling process is connected to the arrows from *P* to *Rint* and *Rext*. This is because the relationship between *P* and rewards is reinforced by the environmental and organizational factors.

2.2 State transition model

The Practical-STM treats an individual trainee of the PSP course as a state machine, and formalizes a motivation process of a trainee using a set of states represented by factors regarding motivation and a set of operations from course instructors.

Table 1 shows factors and state values of the Practical-STM. Each factor has discrete values, like {VeryHigh, High, Low, Unknown} for the effort *E*. While there exist several versions of SEI-certified PSP training, we assume the PSP for Engineers, consisting of two sub-courses, PSP-Planning and PSP-Quality. Each sub-course has four days of the pair of a half-day lecture and the corresponding assignment and the fifth day of the postmortem report. According to this setting, 10 performance factors are used for eight assignments, intermediate report, and final report of the PSP for Engineer course. For the role perception *R*, 87 are used according to the contents of the PSP for engineers (Umeda et al., 2014).

Table 1 Factors and state values of the Practical -STM

Factor	State value set
Bep	{VeryHigh, High, Low, Unknown}
Bpo	{High, Low, Unknown}
V	{High, Low, Unknown}
Effort *E*	{VeryHigh, High, Low, Unknown}
Ability *C*	{VeryHigh, High, Low, Unknown}
Role Perception *Ri* (i=1..87)	{Perceived, NotPerceived, Unknown}
Performance *Pj* (j=1..10)	{Accomplished, NotAccomplished}
Intrinsic Reward *Rint*	{Given, NotGiven}
Extrinsic Reward *Rext*	{Given, NotGiven}
Job Satisfaction *J*	{HighLevel, LowLevel}

Theoretically, the instructors can decide effective actions for the trainees based on the assumption of the state and the corresponding state transition function of the trainees. However, it is not easy to develop and analyze the instructor scenarios, series of instructions during the PSP course, by just using the motivation state of trainee students. While each factor in the motivation process model has a small number of state values, like {VeryHigh, High, Low, Unknown} for effort *E*, the wholistic state space become large as there exist multiple factors in the motivation process model. Thus, we use a top-down approach rather than bottom-up one in developing and analyzing instruction scenarios for the PSP training course by considering the motivation state of the trainees.

In this paper, we discuss the use of a system theoretic method STAMP/STPA originally proposed for “safeware” in order to handle the undesirable situations during the course in a top-down manner based on the Practical-STM.

3. STAMP

STAMP is an accident causality model based on the systems theory rather than the traditional reliability theory and analytic reduction. Safety is an emergent property that arises when system components interact with each other in the STAMP model. Accidents occur when the interactions violate the safety constraints, or, appropriate constraints are not imposed on the interactions.

STAMP has three basic concepts: safety constraints, hierarchical safety control structures, and process models. STAMP assumes that hazard occurs due to not only a failure of the single component but also inappropriate interaction between the multiple components. Control loops exist between every level of the safety control structure.

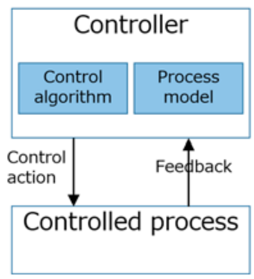

Figure 2 Basic control loop in STAMP

Figure 2 shows a basic simple control loop. Each controller contains a model of the process it is controlling and an algorithm to decide what control actions to provide. The algorithm uses the model of the current state of the system it is controlling in making decisions. The requirements for controllers in a safety control structure must ensure that the safety constraints are maintained in the controlled process. The control structure for the target system is constructed by combining the basic simple control loops. For example, in a class of the PSP training course, an instructor is the controller process, and a trainee is the controlled process.

In STAMP, we examine whether safety constraints and requirements are enforced on the control structure and process model. When the control structure for the safety cannot maintain the safety constraints, the system falls into a hazard state in which an accident can occur. These key concepts are defined as follows (Thomas and Leveson, 2015).

- Accident: An undesired and unplanned event that results in a loss, including a loss of human life or human injury, property damage, environmental pollution, mission loss, financial loss, and so on.
- Hazard: A system state or set of conditions that together with a worst-case set of environmental conditions, will lead to an accident (loss).
- Safety constraint: Once hazards are identified, we can derive requirements or constraints from them. When using a top-down approach, we can develop high level safety constrains first, and modify them and derive further ones during the analysis process.

STAMP is just an accident causation model, and not an engineering technique. However, by using STAMP as a theoretical foundation, powerful tools and processes can be constructed as shown in Figure 3. We use STPA as the tool for developing and analyzing instruction scenarios for the PSP training course based on the motivation process model.

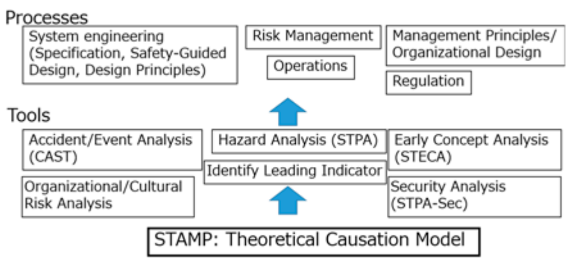

Figure 3 Tools and Processes on STAMP

4. Course Management Guide with STAMP/STPA

In this section, we discuss the usage of STAMP/STPA for developing and analyzing a guideline of instructor for managing the PSP training course with the motivation process model.

STPA is a hazard analysis technique based on the STAMP accident causality model. STPA is a top-down system engineering approach to system safety and focuses on the system dynamics by considering interactions between the controlling process and the controlled process in the system. STAMP/STPA has already been applied to various domains. Although there exists no single definitive STPA processes, there exists a reference process (Thomas and Leveson, 2015).

- Step0: Preliminary steps
  - ✓ Identify potential accidents/losses, hazards, and safety constraints.
  - ✓ Construct a functional control structure.
- Step1: Identify unsafe control actions (Unsafe Control Action: UCA), and examine system and component safety requirements.
- Step2: Identify causal scenarios for unsafe control actions. Augment system and component safety requirements and controls (mitigation) in system design.

We apply this modeling and analysis technique STAMP/STPA to our scenarios generation for the PSP training course class.

4.1 Guideline case

As a case study, we consider the instance of the PSP training course class in Kyutec, Kyushu Institute of Technology. They already have a guideline, a list of check items and the corresponding actions, in managing PSP training course as follows.

(1) A trainee quits the course before satisfying the PSP completion criteria set by SEI, completing all exercises, the intermediate report, and the final report.
- Instructors and lecturers from industry explain the life-long importance of the PSP completion through activities like special workshop and lecture.

(2) A trainee quits the course before satisfying the course credit criteria set by Kyutec, completing two-thirds of exercises.
- Instructors explain the requirements for the credit in a comprehensive way so that trainees can have perspective for the credit.

(3) A trainee repeats the same mistake without improving his/her personal process.
   - Instructors assist the analysis of the reason why the trainee cannot achieve improvement, and repeatedly give advice for the corresponding issues.
(4) A trainee cannot generalize lessons learned through the course.
   - Instructors repeatedly give advice for the corresponding issues without directly giving the answer.
(5) A trainee cannot complete his/her exercise within the scheduled time frame.
   - Instructors set appropriate small-step milestones to check the progress of trainees and make some mitigation actions like rescheduling of class or assignment.
(6) A trainee cannot make enough analysis in proposing his/her process improvement plan.
   - Instructors advise to facilitate the awareness of trainees.
(7) A trainee cannot realize his/her process improvement due to his/her low engineering skill.
   - Instructors give advices from a viewpoint of software engineering

STAMP/STPA is effective in improving PSP course management guidelines for instructors like above based on the motivation process model, Practical-STM.

4.2 STPA preliminary step

Identifying and defining accidents, hazards, and safety constraints are the important starting steps in STAMP/STPA. We want avoid trainee's cancellation of the PSP course before satisfying the course or class qualification. Such an undesirable event is an accident of mission loss type in STAMP/STPA. The undesirable event corresponds to the transition to the actions rightmost part in Figure 1, such as absenteeism or turnover, in the Organizational Expectancy Model. The hazard in this case is the state of incompletion of an assignment within the scheduled time frame. This corresponds to the problem of the performance *P* in the Organizational Expectancy Model. The safety constraint is constraints to prevent this *P* problem in the control loop of the PSP training course control structure explained below.

Control structures play an important role in STAMP/STPA. In the case of the PSP training course, the instructor corresponds to the control process and the trainee to the controlled process (See Figure 4). In order to reflect the motivation process model in the scenario, we use a control structure in which the Practical-STM is embedded in the controlled process.

As the controller, the instructor has process model variables for the state of the controlled process, the trainee of the PSP course, in the process model. This process model variables in the controller process are referred to when the instructor implements the control algorithm in order to issue the control action. Control actions from the instructor may directly or indirectly affect the motivation status of the trainee. Instructors need to monitor the motivation status of the trainee and update the process model variables at appropriate opportunities, in addition to take appropriate actions for the motivation status.

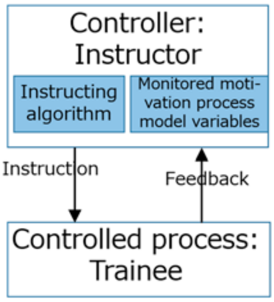

Figure 4 Control structure of PSP training course

Top-down system-thinking in STAMP/STPA helps us to analyze the state transitions in the motivation process model in a top-down manner. Although the factors in the motivation process form cyclic dependencies as seen in Figure 1, we can prioritize factors and choose a factor as the top-most state of motivation. For example, the factor *J*, one step before the rightmost action in Figure 1 is calculated by using the intrinsic reward *Rint*, extrinsic reward *Rext*, and the performance of equitable reward. This factor is included in the dependency loop involving the dependent factors for the motivation factor *M*, which determines the effort *E*. It is not clear which is the top-most one, as the dependency relation does not constitute a simple tree structure. In this case, we regard the performance *P* as the top-most one. Problematic states of *P* are hazards, as the state of *P* is strongly related to the completion of work-products such as an assignment report completion within a scheduled timeframe.

4.3 Unsafe Control Action

After defining accidents, hazards, safety constraints, and control structure as explained above, the next step is to identify the following four types of unsafe control actions among control actions from the controller.

1. Not providing a control action required for safety leads to a hazard.
2. An unsafe control action is provided that leads to a hazard.
3. A potentially safe control action provided too late, too early, or out of sequence leads to a hazard.
4. A safe control action is stopped too soon or applied too long (for a continuous or non-discrete control action) leads to a hazard.

There is a fifth way, a required control action is provided but is not followed. This fifth possibility will be handled in STPA Step 2. Even an instruction compliant with the PSP training template can be an unsafe control action, when instructor has wrong assumptions on the state in the motivation process model. Using STAMP/STPA is effective in analyzing this kind of situation.

Usually, a table format is used to analyze unsafe control actions as shown in Table 2.

1. Not providing causes hazards: Instructions and advices for the trainee to draw more efforts that realize the performance of the intended level are not provided when they are needed.
2. Providing causes hazard: A hazard may be caused if the trainee is provided inappropriate instruction or advice that prevent the trainee from making a desirable motivation state transition. For example, improper instructions that the trainee can achieve without proper efforts may reduce the trainee's efforts and prevent from having a disciplined mind-set to complete a series of gradually advanced assignments.
3. Too early, too late, wrong order causes hazard: Instructions at a wrong timing, missed opportunity, instruction sequence of improper order may cause a hazard.
4. Too short, too long causes hazard: Stopping such an instruction sequence too early that realizes consistent data collection of certain period of time may cause a hazard.

4.4 Causal factor analysis of unsafe control action

After identifying unsafe control actions, the next step is the identification of the scenarios leading to the unsafe control actions and analysis of the causal factors, including the causes of the process model being incorrect. The control loop to keep the safety constraints and related components are investigated in order to identify how they could lead to unsafe control actions. Scenarios in which a required safe control action for safety being given but not executed are also analyzed.

For example, in the case of unsafe assignment instructions, instructors might have improper assumptions in the process model or fail to monitor the situation of the trainee and associated work environment. Some instructions might seem appropriate while trainees cannot completely follow the instructions.

STAMP/STPA enabled us to reorganize the initial course management guideline based on Practical-STM

Table 2 Example of unsafe control action analysis in a table format

Control Action	Not Providing	Providing	Too early, too late, wrong order	Too short, too long
Assignment_i	...	Assignment based on the wrong assumption of the motivation status may cause a hazard.	Assignment before getting necessary skill may cause a hazard.	...
...	...	...	...	...
Instruction_j	Instructions & advices for the trainee to draw more efforts that realize the performance of the intended level are not provided when they are needed.	Improper instructions the trainee can achieve without proper efforts may reduce his/her efforts & prevent from having a disciplined mind-set to complete a series of gradually advanced assignments.	Instructions at a wrong timing, missed opportunity, instruction sequence of improper order may cause a hazard.	Stopping such an instruction sequence too early that realizes consistent data collection of certain period of time may cause a hazard.
...	...	...	...	...

and construct a top-down architecture of the course management guideline. The initial guideline (1) and (2) were redefined as accidents, and (5) as a hazard. The rests of the initial guidelines were classified as leading indicators that indicate a trainee may be in a state that can lead to a hazardous state without proper instructions or with improper instructions.

5. Conclusion

In this paper, we explained our approach to improving the course management scenarios for the PSP training class in a university setting. We used the previously developed motivation process model, the Practical-STM, which has been proposed and investigated based on the Organizational Expectancy Model. By using Practical-STM, instructor can formalize a motivation process of a trainee using a set of states represented by factors regarding motivation and a set of operations from course instructors. In this paper, we discuss the use of a system theoretic method STAMP/STPA originally proposed for “safeware”. By identifying most undesirable events as accidents, the course management scenarios to handle the situations during the course based on the Practical-STM was analyzed in a top-down manner. We refactored the initial guideline and constructed a top-down architecture of course management for the PSP training. We need to proceed to further analysis along with the motivation process model with more detailed factors. We will refine our approach by reflecting the accumulating experience of the actual PSP training courses.

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Proposal to Define "Risk Border" as a Risk Attitude Metric to Prevent Catastrophic Situations

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Estimation Method of Economic Batch Size in Iterative Development

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In iterative development, it is common to decide on an iteration period, such as several weeks, and develop a range of software to be implemented within this period. However, because the batch size is determined after the determination of the iteration period, there is a possibility that it is not an advantageous condition from the total cost viewpoint. Therefore, in this study, a method of estimating an economic batch size is investigated from the overhead costs for releases that increase as the repetition period becomes shorter and from the scales of the proportional costs associated with consolidation and flaw remediation. As a result, a method of modeling overhead cost combining a function point method, a fixed cost, and a method for modeling the defect repair cost according to the software scale is proposed. As a result of applying the proposed method to concrete development cases, it became possible to identify an economic batch size and confirm the feasibility of the proposed method.

Keywords and phrases: Iterative Development, Batch Size, Overhead Cost, Scale Proportional Cost, Function Point Method

1. Introduction

In recent years, the business environment has become increasingly dynamic, and customer requests for information systems are also likely to change. For this reason, an iterative development process has attracted attention, because it can flexibly respond to changes in requests of customer, allow for an easy development of the system, and bring it to the market in a timely manner (Tsuda, 2012). In iterative development, a certain repetition period is set, and by repeating it, the development of the entire system is completed. There are various known development methods, such as the method of increasing completeness where the same part is repeatedly developed, as well as the method of gradually changing the part to be developed and thereby covering all of the parts. Agile development, which has been widespread in recent years, is an example of iterative development (Takahata, 2013). For example, well-known scrums are included in this method.

However, in the past, the unit of repetition was often decided based on the experience of the project manager in the organization. For example, for the repetition period, units such as one week or two weeks are often adopted conventionally. Also, Batch, which is a unit of software development, is often passively determined from the repetition period.

On the other hand, a method of quantitatively determining the iteration period that is one of the repeating units has been reported (Shiohama et al., 2011). In this research, assuming the variability and complexity of the project constraints and the software requirements to be developed as an abstract value of 0 to 1, the trends of the value generated by Agile development and the required cost are analyzed. However, it is difficult to apply it to estimate an appropriate size for individual software requirements. Moreover, the batch size of software has not been studied.

This study aims to estimate an economical batch size in iterative development. If the batch size is too large, the cost proportional to the scale will increase. On the other hand, if it is too small, an overhead cost becomes necessary, and the cost also increases. In this research, a method to quantitatively discuss such a trade - off problem will be examined.

2. Research object and problem setting

2.1 Research object

The objective of this research is to provide a cost evaluation method of a software development unit (batch).

If the batch size of the software is too large, it is known that costs proportional to the scale will increase, such as the cost of finding and correcting defects and the cost of integrating new batches into existing modules. On the other hand, if the batch size is too small, it is known that the overhead cost increases for the type of development that provides value to customers with every release, such as Agile development. The reason for this is that the setup (system test, user acceptance test, packaging, installation, manual preparation) to deliver value to customers is required each time.

Conventionally, such a trade-off problem has been introduced as a qualitative trend, but a framework for quantitative discussion has not been presented.

2.2 Previous research

In terms of conventional techniques related to researching objects the following will be described: a method of dividing software, a cost estimating method, and a method of estimating a repeating unit in iterative development.

A method of determining the development unit of software is the concept of developing by dividing it into the minimum unit called a module, at the design stage. Modularization methods include a compound design method focused on the data flow, a data structure division method focusing on the structure of data, a common functional decomposition method for extracting common functions, in addition to others (Koizumi et al., 2003). In these methods, the degree of coupling between the modules is low, but the stronger the module is, the better the division is. However, these methods do not include cost as a factor under direct consideration.

On the other hand, various estimation methods have been proposed regarding software development cost, such as a function point (FP) method to calculate the software scale, and an improved use case point method for object development. These methods estimate the scale of development based on various actual values taken from the software structure and the requirement contents. However, the overhead generated when the whole is decomposed into parts is not considered.

Furthermore, as for the method of estimating the repeating unit in iterative development, as described in the previous chapter, a method of quantitatively determining the iteration period has been reported. However, it is difficult to apply it to specific software requirements, and the batch size of software has not been studied.

2.3 Problem setting

As described above, determining the batch size from an economical viewpoint has not been sufficiently covered by conventional methods. In addition, the overhead in the case of decomposing the whole part in the method of estimating the development cost of software was not considered. Furthermore, there was room for consideration in the procedure for economically determining the specific development unit of software as a method of determining the repeating unit.

This research proposes a method to quantitatively discuss the trade-off problem of leveraging batch-wise economy in the iterative development of software, which has often only been qualitatively discussed. In order to realize this, the overhead factors caused by division are taken into account when estimating the development cost. Furthermore, by combining the overhead cost with the software scale proportional cost, a method for estimating the batch size with the lowest cost is proposed.

3. Research method

In this study, the following procedure is proposed.

(1) Modeling batch size and release overhead cost

First, an overhead cost which increases when the batch size is reduced is modeled. The overhead cost *Co* can be categorized into the development cost *Cc* of the batch part, the cost *Cv* that varies in proportion to the scale of the batch size, and the fixed cost *Cf* irrelevant of the scale. These are defined as the following equation.

$$C_o = C_c + C_v + C_f \qquad (1)$$

Here, *Cv* increases in proportion to *Cc*. Therefore, in order to define *Cv* in a reasonable way, it is necessary to define *Cc*. Also, it is necessary to make the unit of *Cf* the same as *Cv*. For this purpose, *Cc* is used as an intermediary for defining *Cf*. As mentioned above, it is necessary to define *Cc* to obtain *Cv* and *Cf* in a reasonable way. In this study, the function point (FP) method is adopted. In the cost estimation of iterative development, aside from the FP method, the use case point method can also be considered as a candidate. However, in the use case point method, it is necessary to add actor weights to the functional requirements. Therefore, the development scale cannot be determined according to only the functional requirements.
As a result, this method was not adopted. Here, *Cv* can be modeled by increasing the evaluation point of the end-user efficiency of the adjustment factor (the degree of improvement of the usability for the end user). In addition, *Cf* can be defined as a value having a relative meaning by multiplying *Cc* + *Cv* by a constant *Rf*. In this study, *Rf* is called a fixed-cost adjustment parameter.

$$C_f = R_f \cdot (C_c + C_v) \qquad (2)$$

(2) Modeling of batch size and costs due to delayed detection of defects

Next, the cost increase proportional to the batch size is modeled. Cost factors that increase in proportion to the batch size may include the cost to integrate new batches into existing finished parts and the cost to find hidden defects and fix them. The former cost (integration cost) depends on the type of software and the purpose of use, so it is difficult to model in general. Nevertheless, there is a possibility that the latter cost can be modeled by referring to past research. For example, Matsumura et al. (2006) reported that the relationship between the defect discovery process and the man-hours to correct the development of a medium-scale information system consisted of about 330 K steps. Similar research has been done in the past by Boehm (1984) for large and small information systems. Matsumura et al. compare their own data with the data of previous studies. For example, assume a defect that costs 10 is found and fixed in the coding process. Cost increases if this defect is found and corrected in the acceptance test. Specifically, it is reported that it costs about 180 for a large-scale system, about 80 for a medium scale system and about 35 for a small-scale system. Based on the above information, the relationship between the cost, *Cb,* for delayed defect discovery and the batch size was examined. As a result, in the range where the change in the batch size is small, the change in cost can be a multiple. However, it is necessary to model the cost change as an exponential increase in the batch size change for a large-scale range. From this, it is possible to formulate *Cb* as shown below when the batch size change lies within a small-scale range.

$$C_b = R_b \cdot (C_c + C_v) \qquad (3)$$

Here, *Rb* is a proportionality constant between the development scale and the cost due to a delay in discovering the defect. In this study *Rb* is called a scale proportional cost parameter.

(3) Size estimation and cost estimation of the evaluation target system

The size estimation by the FP method is implemented for a specific information system. At that time, it is assumed that the original size is divided into a 1/2, 1/4, etc. batch size. Also, based on the results of the FP method of each batch size, the overhead cost of the release described in (1) above and the cost for delaying the defect discovery described in (2) are calculated. Here, factors which are difficult to identify are set as parameters. Then, a change in cost when a parameter is changed is observed, and a reasonable value is estimated.

(4) Estimate the batch size that minimizes the total cost

Draw a graph in which the horizontal axis is the batch size and the vertical axis is the total cost. The values (1) and (2) above and the total cost, *Ct,* are displayed on the graph to estimate the batch size with the minimum total cost.

$$C_t = C_o + C_b \qquad (4)$$

When the above-described parameters are used, the reliability of the total cost is estimated by changing *Ct*.

4. Research result

4.1 Example system

In order to verify the feasibility of the proposed method, it was tested using a specific information system.

A library information system was adopted as a test case of the target information system (NTT DATA, 2008). This case automates the manual work such as the lending of books, acceptance of return, dumping for return, reservation of books and so on. In this study, we estimate the economical batch size using the case of developing this system as an example.

A use case diagram is shown in Figure 1. Actors are librarians, members, and timers for carrying out processes related to time. Examples of use cases include CRUD (Create, Read, Update, Delete) of member information, CRUD of book information, book lending, book return, reservation, reservation cancellation, and the like. In addition, timers required for reservation guidance, cancellation of reservations, and demand for return are displayed as actors. In all, there are 15 use cases and 5 actors.

4.2 Experiment

Experiments were conducted to estimate the economical batch size using the proposed method for the above system.

First, the overhead cost of a release was calculated. The results are shown in Table 1. The row of the table is the use case of the target system and the column is the calculation result of the overhead cost. Then, the batch cost *Cc* (unadjusted FP) developed in each batch was calculated. The results are shown in the *Cc* (unadjusted FP) column of Table 1. The minimum is 20 points and the maximum is 41 points. Although

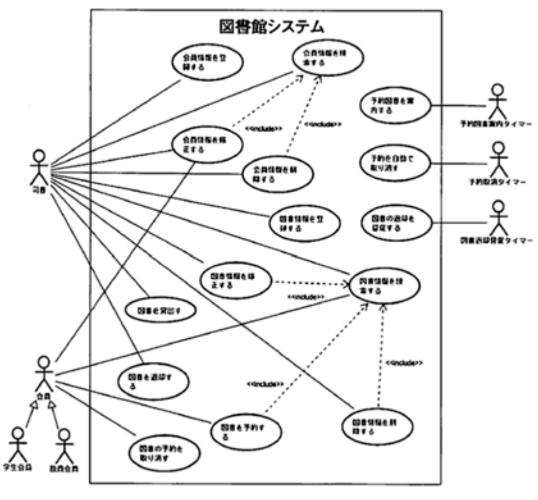


Figure 1 Use case diagram

Table 1 Overhead cost of release

No.	Use case		Cc (Unadjusted FP)	Adjustment coefficient	Cc+Cv (Adjusted FP)	15 divisions (Including Cf)	4 divisions (Including Cf)	2 divisions (Including Cf)	1 divisions (Including Cf)
1	Member information management function	Member information registration	20	0.7	14.0	114.0	156.0	270.8	452.8
2		Member information search	20	0.7	14.0	114.0			
3		Correction of member information	20	0.7	14.0	114.0			
4		Delete member information	20	0.7	14.0	114.0			
5	Book information management function	Book information registration	41	0.7	28.7	128.7	214.8		
6		Search book information	41	0.7	28.7	128.7			
7		Correction of book information	41	0.7	28.7	128.7			
8		Delete book information	41	0.7	28.7	128.7			
9	Book lending function	Book lending	38	0.7	26.6	126.6	206.4	282.0	
10		Returning books	38	0.7	26.6	126.6			
11		Book reservation	38	0.7	26.6	126.6			
12		Book reservation cancellation	38	0.7	26.6	126.6			
13	Book reservation function	Information on reserved books	35	0.7	24.5	124.5	175.6		
14		Automatic cancellation of reserved books	38	0.7	26.6	126.6			
15		Reminder to return books	35	0.7	24.5	124.5			
Total			504	0.7	352.8	1852.8	752.8	552.8	452.8

there is about twice the opening, these 15 pieces are set as the minimum unit of the batch size. The total is 504 points. In this paper, the cost unit is explained by FP. Desirably, it should be converted into man hours or a monetary amount, but in this paper FP is used because an absolute amount of money is not discussed and a relative comparison of amounts is carried out. Therefore, the development cost *Cc* of the entire system is set to 504.

Next, in order to calculate the variable cost Cv, the adjustment coefficient of the FP method was calculated by according to the following formula.

$$\text{Adjustment factor} = (total\ impact\ degree \times 0.01) + 0.65 = (5 * 0.01) + 0.65 = 0.70 \quad (5)$$

Although there are 14 influence factors of the FP method, this time only the influence degree of the end user efficiency is set to 5 and all other items are set to zero. The results are shown in the adjustment coefficient column of Table 1. Cv is calculated using this value, and the value added to *Cc* is shown in the *Cc* + *Cv* (adjusted FP value) column in Table 1.

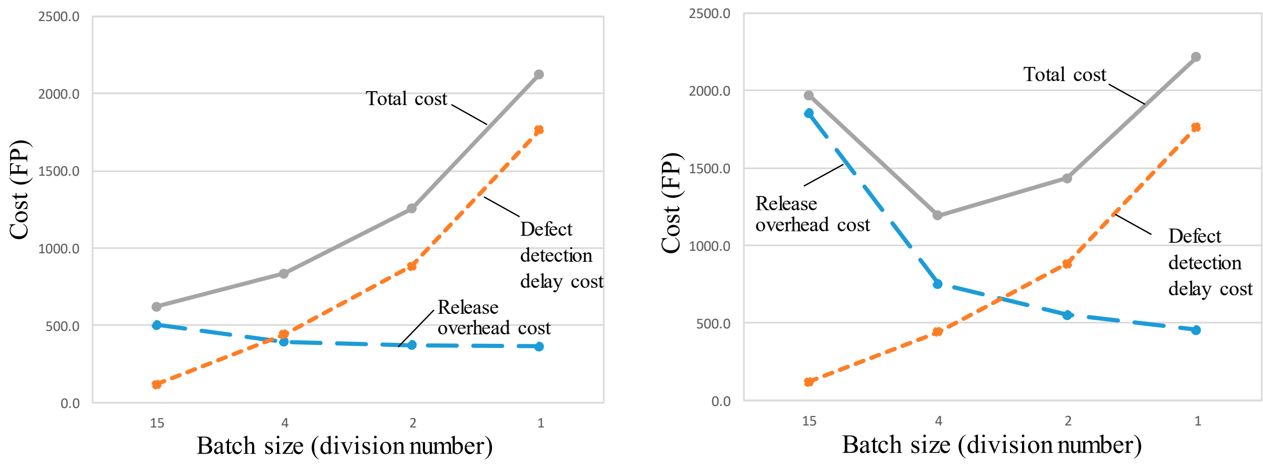
Each column on the right side of the 15 divisions in Table 1 is the result of calculating the cost when the batch size is changed. For example, a column of 15 divisions is a case where releases are made in units of 15 use cases. On the other hand, the rightmost column shows a case in which the release is performed after the completion of the entire development and repetitive development is not performed.

In each of these columns, the fixed cost *Cf* is added. The fixed cost is, for example, the cost of accompanying a salesperson for an explanation to a customer, and it is not related to the batch size. Fixed cost should be set considering the individual case and the company's circumstances, so it is set as a parameter in this paper. In Table 1, *Cf* is set to 10 which is slightly smaller than the minimum value of *Cc* (in this case, the fixed cost adjustment parameter *Rf* of (Expression 2) is in the range of 0.35 to 0.7). For example, in the column of 15 divisions, 10 is added to the value of *Cc* + *Cv* of each row. On the other hand, in the rightmost column, 10 is added only once to the total value of the *Cc* + *Cv* columns. From the above results, the overhead cost of release when the batch size is changed was calculated.

Next, for each of the four batch sizes (15 divisions to 1 division) shown in Table 1, the cost *Cb* for the delayed detection of defects is calculated. In the case described in this paper, the adjusted FP value is 352.8 from Table 1. For example, when the development language is Java, the number of lines of the code is presumed to be about 12 K steps. This is smaller than the mid-scale information system development mentioned in the previous section (about 330 K steps).

Therefore, it can be regarded as a small information system development. For this reason, the cost of delayed detection of defects can be regarded as proportional to the size of the system, without a rapid rise, according to the reports of previous research. From the above, it is assumed that Equation 3 can be applied. Here, the scale proportional cost parameter *Rb* depends on the ability to detect defects. Since this ability depends on the organization, it is difficult to be determined unconditionally. Therefore, this time *Rb* = 5.0 in consideration of the balance with the size of the overhead cost of release.

Figure 2 shows an example in which economic batch size is estimated. The two figures are the results of changing and comparing two kinds of parameters. Case 1 shown in Figure (a) on the left shows the case where the fixed cost adjustment parameter *Rf* = 0.35 to 0.7 (fixed cost *Cf* = 10) and the scale proportional cost parameter *Rb* = 5.0. Case 2 shown in Figure (b) on the right shows the case where the fixed cost adjustment parameter *Rf* = 3.5 to 7.0 (fixed cost *Cf* = 10) and the scale proportional cost parameter *Rb* = 5.0. Explaining



(a) Case 1
Fixed cost adjustment parameter Rf=0.35～0.7
(Fixed cost Cf=10)
Scale Proportional Cost Parameter Rb=5.0

(b) Case 2
Fixed cost adjustment parameter Rf=3.5～7.0
(Fixed cost Cf=100)
Scale Proportional Cost Parameter Rb=5.0

Figure 2 Example of economical batch size estimation

in the example of (a), the horizontal axis is the number of divisions for determining the batch size. It is 15 divisions, 4 divisions, 2 divisions, and 1 division from the left side. The vertical axis is an index of cost, and in this paper, it is taken as the adjusted FP value. The three graphs are the overhead cost of release, the cost of delaying defect discovery, and the total cost of these. Paying attention to the economic batch size which minimizes cost, (a) shows 15 divisions, and (b) shows 4 divisions.

4.3 Discussion

The results of Figure 2 will be described. First, the characteristics of the two curves constituting the graph of Figure 2 are confirmed again. The downward sloping graph is the overhead cost in the release. The main factor determining the slope was the fixed cost that occurred at each release. The fixed cost was set as a relative value based on the development scale obtained by the FP method. Conversely, the graph rising to the right is the cost due to the delay in finding defects.

This cost was proportional to the development scale. Based on past research it was assumed that in small development efforts the cost does not increase as rapidly as in large-scale development.

However, the verification of the previous case did not demonstrate the basis for determining the relative relationship between the two curves. Therefore, the value of each parameter has room for improvement. For example, the fixed cost of Figure (a) was set to 10, less than the minimum value of 14 of the development cost *Cc* shown in Table 1. However, as can be seen from (a), the change in the overhead cost, which is a downward sloping graph, is gentle compared to the slope of the discovery delay cost of defects which are a right-rising graph. As a result, the leftmost 15 divisions are selected as the economical batch size. However, in Figure (b), because the fixed cost is increased to 100, the slope of the change of the curve going down to the right is large. As a result, the economic batch size is the division number 4 which balances the release overhead cost and the defect discovery delay cost. However, the fixed cost of 100 is about 3 times the maximum value of the development cost *Cc* in Table 1 and can be regarded as a considerably large value.

As mentioned above, determining the basis for the relative relationship between the two curves was not shown in the verification by the previous case and proved to be problematic. However, when utilizing the proposed method in a specific organization, there is a possibility that data that serves as the basis for these can be acquired. For example, it is possible to calculate the fixed cost by finding the work to be done at every release time. On the other hand, regarding the delay in finding the cost of defects, the relationship between the software scale and the cost caused by the delay in discovering the defects can be considered to be measurable based on the fact that it is being carried out in previous research. After these preparations, it is possible to estimate the economical batch size as shown in Figure (b) if the appropriate batch size is set on the horizontal axis.

5. Conclusion

In this study, we investigated a method to estimate an economical batch size from the sum of the overhead cost of release that increases as the repetition period becomes shorter and from the scale proportion cost with defect correction that decreases as the iteration period becomes shorter. As a result, a modeling method to determine the overhead cost based on the software scale was proposed combining a function point method, a fixed cost, and a modeling method of defect correction cost. As a result of applying the proposed method to concrete development cases, it was possible to identify the economical batch size and confirm the feasibility of the proposed method.

As a part of a future study, it is necessary to apply the proposed method to actual cases of iterative development and to evaluate its practicality. In doing so, it will be possible to introduce more practical cost parameters and also introduce a parameter setting method.

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Risks Causing Delays in Upstream Construction of Gas Projects: an Australian Perspective

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Analysis of Requirements Elicitation Approaches based on the PRINCE Model

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In requirements elicitation approaches for information system development projects, there are requirements that are difficult to extract without lower processes. The PRINCE model has been proposed in a previous study, which determines the period that can be elicited depending on the quality characteristics of the requirements. Accordingly, in this study, we aim to investigate the developmental applications of the PRINCE model, focusing on the co-occurrence of requirements, the approach of elicitation, and the analysis of correlation from results. First, we evaluate the approach of requirements elicitation using the requirements management tables of actual projects. Next, we apply association analysis to the requirements categorized according to their quality characteristics and extract the co-occurrence of the requirements. In this report, we describe the basic concept of the study, analysis methods and procedures, and extraction results.

Keywords and phrases: PRINCE Model, Requirements Maturity, Requirements Difficulty Level, Quality Characteristics, Association Rule Mining

1. Introduction

Requirement definition strongly influences the success or failure of an information system development project. What is most problematic in the requirements definition is elicitation of requirements of the first process. In other words, it is important to include user requirements in the requirements elicitation process. However, users with poor knowledge of the system do not have a detailed understanding of the system in upper processes; there are several cases where additional requirements or specification changes occur in lower processes. Moreover, in a mainstream waterfall-type development project, it is difficult to accept additional requirements and specification changes. However, currently, multiple system development vendors accept additional requirements and specification changes to satisfy user requirements.

It is necessary to perform requirements elicitation in a planned manner to respond to additional requirements and specification changes. In other words, it is important to extract necessary requirements at an appropriate time.

Nakatani et al. (2009) showed that the extraction period consists of early term maturation, medium term maturation, and latter term maturation, based on the quality characteristics of requirements, and proposed the PRINCE model. They suggested that there are requirements that are difficult to extract without lower processes. In addition, Nakatani et al. (2011) analyzed the correlation between requirements maturation efficiency and the requirements that are easy to extract and clarified the requirements that can be planned at the beginning of a project.

These studies describe the significance of management that includes latter term maturation type requirements, which can become additional requirements and specification changes that are closer to early term maturation type and medium term maturation type requirements; however, concrete analysis has not been carried out. In addition, these studies describe the necessity to investigate the maturity of requirements in various types of system development projects. Accordingly, in this study, we aim to examine developmental applications of the PRINCE model during requirements elicitation and apply the PRINCE model using the requirements management tables of actual projects. Furthermore, we focus on the co-occurrence of requirements, the method of elicitation, and the analysis of correlation from results.

2. Method

In this study, first, by applying the PRINCE model to the requirements data of two actual projects, we clarify the type of maturity based on the quality characteristics of requirements and verify the PRINCE model. Next, we evaluate the method of requirements elicitation from the requirements management tables of actual projects. Specifically, we analyze the exchanges of analysts and users until the requirements are finalized and define the requirements difficulty level, which represents the difficulty of requirements elicitation. Furthermore, we apply association analysis to the requirements categorized according to quality characteristics and clarify the co-occurrence of the requirements.

2.1 Target Projects

Analysis was conducted using the requirements management tables of two actual projects. These two projects are shown in Table 1.

Table 1 Target projects

No.	Project name
1	Production management scratch development system
2	Telemarketing operator management system

2.1.1 Project Issues

The two projects have problems in requirement elicitation, which hindered either quality, cost or delivery.

a) Production management scratch system

The issues in this project were as follows:

(1) Abrupt secession of project leader.

(2) When the project leader was changed, a large number of requirements were discovered and the design was reviewed.

(3) The release was postponed nine months from the original schedule, and cost increased due to further postponement.

b) Telemarketing operator management system

The issues in this project were as follows:

(1) Short delivery time of six months.

(2) A situation in which it was impossible to contact companies that developed the current system.

(3) There were several existing bugs, and there was no development design document.

(4) The client previously contracted with another company to develop the system; however, the client withdrew after six months because the current database was complicated, data migration was impossible. Ultimately, the requirements of the system were complicated and it became impossible to respond.

(5) This project was for a new customer, and it was difficult because it was a started without an existing system and business knowledge.

2.2 PRINCE Model

The PRINCE model is a requirements elicitation maturity model proposed by Nakatani (2009). According to the period of elicitation, the maturation rate of requirements elicitation is categorized into early term maturation, medium term maturation, and latter term maturation. The PRINCE model is shown in Figure 1. The horizontal axis represents the progress of the development project, and the vertical axis represents the maturation rate of requirements. In this study, it is assumed that PRINCE model is applied during requirements elicitation.

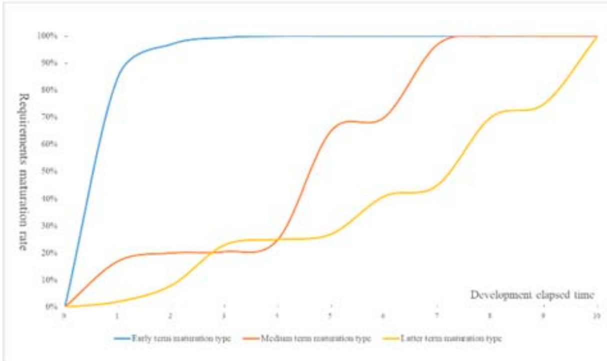

Figure 1 PRINCE model (Source: Nakatani(2009))

2.3 Definition of Requirements Difficulty Level

The requirements difficulty level refers to the difficulty of extracting a requirement. In the requirements elicitation process, to include the requirements to be elicited, it is important to understand the requirements that are easy to extract and difficult to extract. These create appropriate correspondence. In this study, the requirements difficulty level is defined using a simple method. This method is based on the contents of the exchanges between analysts and users obtained from the requirements management tables until each requirement is finalized. The definition of the requirements difficulty level is shown in Table 2. However, to obtain the requirements difficulty level inherently, it is necessary to consider complicated factors such as the requirements elicitation capability of the requirements analyst, the nature of the requirements, and the knowledge level of users.

Table 2 Definition of requirements difficulty level

Difficulty Level	Definition
High	Requirements not to be comfirmed at the meeting during the day
Medium	Additional requirements or change in requirements during confimation (Requirements that was confirmed at the meeting during the day)
Low	Requirements to be confirmed by approval or confirmation (Requirements that was confirmed at the meeting during the day)

3. Results

3.1 Classification of Requirements

Generally, while some projects are similar, none of them are exactly the same. Each project consists of various aims and goals, in addition to constraints and participants.

Similar to projects, even though requirements may be similar, the contexts of the projects where the requirements occur are different. In short, even if we obtain the essence of the individual requirements and attempt to explore their relationship, this relationship may not be correct because individual requirements can be similar but not identical. With this in mind, this study classifies requirements into eight types of functional requirements and eight types of nonfunctional requirements.

3.1.1 Classification of Functional Requirements

There are eight classifications of functional requirements, as shown in Figure 3.

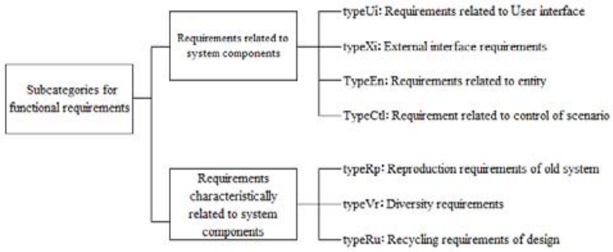

Figure 3 Functional requirements

3.1.2 Classification of Nonfunctional Requirements

There are eight classifications of nonfunctional requirements, as shown in Figure 4.

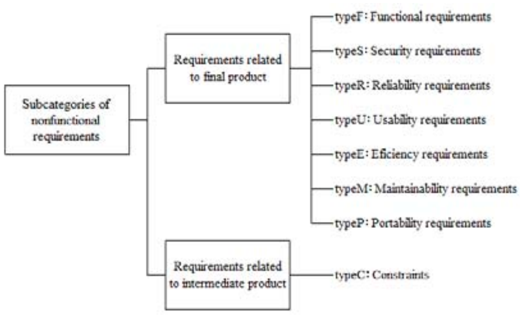

Figure 4 Nonfunctional requirements

3.1.3 Requirements Classification Results

Classification was performed based on the requirements difficulty level for the requirements classified according to quality characteristics. These classifications are shown in Figures 5 and 6. In both projects, requirements belonging to Type F (for functionality), Type U (for usability), and Type Ui (for user interface) occur more frequently. Regarding the requirements difficulty level, "low," which refers to requirements that are easy to extract, is existed a lot in the production management scratch development system. However, "high," which refers to requirements that are difficult to extract, is existed a lot in the telemarketing operator management system.

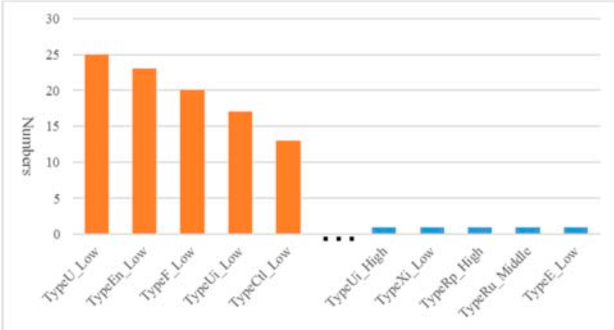

Figure 5 Requirements classification results (production management scratch system)

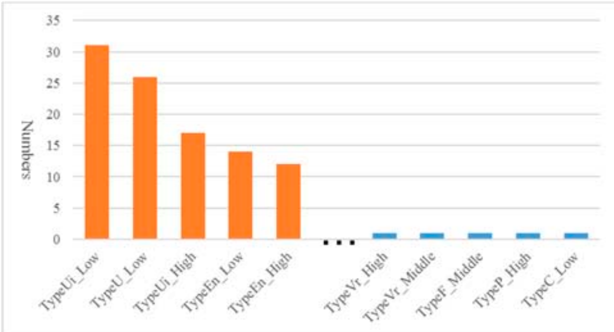

Figure 6 Requirements classification results (telemarketing operator management system)

3.2 Application of PRINCE Model

We applied the PRINCE model to the data used in this study. The requirements maturation levels are shown in Figures 7 and 8.

3.2.1 Production Management Scratch System

Requirements of Type Ru (for reuse of design) and Type E (for efficiency) belonged to the early term maturation type.

Requirements of Type Ui, Type F, Type En (for entity), and Type Xi (for external interface) belonged to the medium term maturation type. Most types of requirements belong to the medium term maturation type.

Requirements of Type R (for reliability) and Type P (for portability) belonged to the latter term maturation type. In addition, even though it was confirmed that requirements of Type Vr (for diversity) belong to the medium term maturation type, their maturity became high during the late term. Thus, in this study we considered that these requirements belonged to the latter term maturation type.

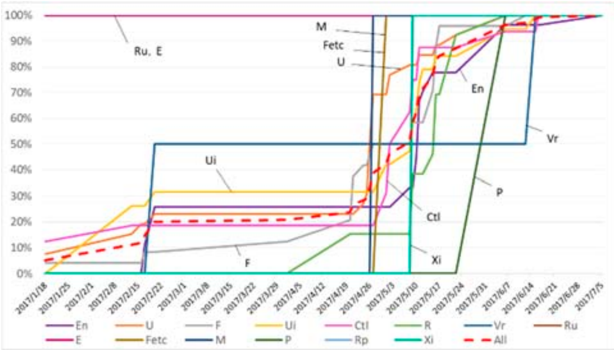

Figure 7 Requirements maturation level (production management scratch system)

3.2.2 Telemarking Operator Management System

In this project, it was impossible to confirm the existence of the requirements belonging to the early term maturation type. Requirements were extracted during the early term; however, their maturity became high after the medium term. This may be because the client of the project was a new customer and there was no knowledge of the current system and business. Thus, it was not possible for the requirements reach maturity during the early term.

Requirements of Type F and Type Ui belonged to the medium term maturation type.

Requirements of Type Vr and Type M (for maintainability) belonged to the latter term maturation type.

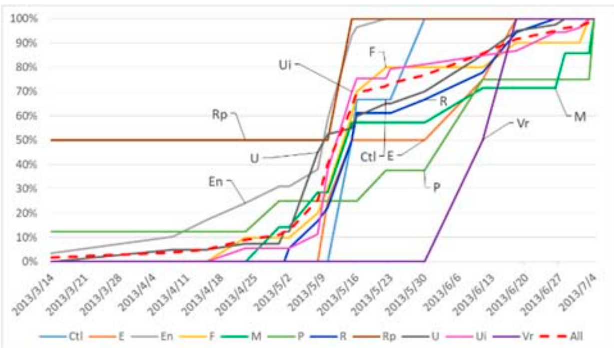

Figure 8 Requirements maturation level (telemarketing operator management system)

3.2.3 Application Results

In the production management scratch development system, requirements with a large total number of extractions, such as those of Type F and Type Ui, are requirements of the medium term maturation type that are continuously extracted from the start to the completion of the project. These results are the same as those of the analysis performed by Hori et al. (2008). In other words, it is common in the project to say that Type F and Type Ui are medium term maturation type for the requirements. However, in this study, requirements of Type R belong to the latter term maturation type, and they are elicited in the latter term of the project. However, according to the analysis by Hori et al. (2008), these requirements belong to the early term maturation type. Thus, the results are different.

In the telemarketing operator management system, it was determined that requirements of Type F and Type Ui belong to the medium term maturation type. These results were obtained for all projects, including previous studies. In addition, even though requirements of Type R belonged to the medium term maturation type, they were close to the latter term maturation type. The results observed for Type R in this study were new as they were different from the results of previous studies.

3.3 Association Rule Mining

Association rule mining uncovers strong relationships between events called association rules. More specifically, it extracts rules such that if event A occurs, a separate event B also happens. In association rules, individual products sold on the market are called items, and the list of products that a customer purchases is called a transaction. For example, to analyze the transactions of all customers, we can gain the following kind of insight: “out of the customers who bought butter, 80% also purchased bread and milk, and customers who purchased all three of these products make up 4% of all customers.” Association rules are indicated as follows.

Association rule mining has three main evaluation criteria: “support,” “confidence,” and “lift.” Support refers to the ratio of all transactions that simultaneously fulfill the condition and conclusion; that is, support refers to the prevalence of the rule itself. Confidence indicates the ratio the conclusion occurring (Y) when the rule condition (X) occurs. Therefore, a higher value signifies a stronger relationship between the rule condition and the conclusion. Moreover, in order to determine whether a rule is valid, one must use both support and confidence. However, even when these measures are high, there are cases where useless rules are produced. Lift indicates a rule’s strength against the random concurrence of an antecedent and a consequence, each possessing a support value. This is the probability that the conclusion would take place, given the existence of a premise. When the lift is generally bigger than 1, it is said to be an effective rule. The rules will be determined using the above three evaluation criteria. Regarding the actual extraction of rules, the minimum values of confidence and support are established, and only the rules that fulfill these conditions are extracted.

3.3.1 Experiment by Association Rule Mining

In this study, we extract the association rule of classified requirements data and verify its effectiveness.

3.3.2 Setting Values and Experimental Results

For each project, we set a minimum support of 1, a minimum confidence of 10, a rule length of 2, and a lift of 1 as the initial values of association rule parameters. Then, the minimum support value is adjusted and narrow down the rules.

3.3.2.1 Production management scratch system

Based on the data output according to the initial values, it was found that there are 118 existing cases with a support value of 3.33, against all the 162 cases. Based on this, we narrowed down the value of minimum support value and adopted 4 as an appropriate value. Additionally, based on the results of preliminary experiments, a minimum confidence of 15 and a lift of 2 were selected.

Table 3 Results of analysis (1)

No.	Premise	Conclusion	Confidence(%)	Support(%)	Lift
1	TypeCtl_Medium	TypeCtl_Low	100.0	10.0	3.33
2	TypeCtl_Medium	TypeUi_Low	100.0	10.0	2.73
3	TypeF_Medium	TypeR_Medium	100.0	6.7	15.00
4	TypeR_Medium	TypeF_Medium	100.0	6.7	15.00
5	TypeF_Medium	TypeF_Low	100.0	6.7	2.50
6	TypeR_Medium	TypeF_Low	100.0	6.7	2.50
7	TypeEn_Medium	TypeEn_Low	80.0	13.3	2.40
8	TypeEn_Medium	TypeUi_Low	80.0	13.3	2.18
9	TypeVr_Low	TypeEn_Low	66.7	6.7	2.00
10	TypeEn_Low	TypeEn_Medium	40.0	13.3	2.40
11	TypeUi_Low	TypeEn_Medium	36.4	13.3	2.18
12	TypeCtl_Low	TypeCtl_Medium	33.3	10.0	3.33
13	TypeUi_Low	TypeCtl_Medium	27.3	10.0	2.73
14	TypeEn_Low	TypeVr_Low	20.0	6.7	2.00
15	TypeF_Low	TypeF_Medium	16.7	6.7	2.50
16	TypeF_Low	TypeR_Medium	16.7	6.7	2.50

3.3.2.2 Telemarking operator management system

Based on the data output according to the initial values, it was found that there are 192 existing cases with a support value of 4.76, against all the 300 cases. Based on this, we narrowed down the value of minimum support and adopted 4.8 as an appropriate value. Additionally, based on the results of preliminary experiments, a minimum confidence of 51 and a lift of 4.21 were selected.

Table 4 Results of analysis (2)

No.	Premise	Conclusion	Confidence(%)	Support(%)	Lift
1	TypeCtl_High	TypeF_High	100.0	9.5	7.00
2	TypeP_Medium	TypeEn_Medium	100.0	9.5	7.00
3	TypeUi_Medium	TypeE_High	100.0	9.5	10.50
4	TypeE_High	TypeUi_Medium	100.0	9.5	10.50
5	TypeVr_Medium	TypeE_Low	100.0	4.8	10.50
6	TypeVr_Medium	TypeF_Low	100.0	4.8	5.25
7	TypeM_High	TypeF_High	100.0	4.8	7.00
8	TypeM_High	TypeUi_Medium	100.0	4.8	10.50
9	TypeM_High	TypeE_High	100.0	4.8	10.50
10	TypeM_High	TypeRp_Low	100.0	4.8	10.50
11	TypeF_Medium	TypeU_Medium	100.0	4.8	7.00
12	TypeM_High	TypeCtl_High	100.0	4.8	10.50
13	TypeF_Medium	TypeR_High	100.0	4.8	10.50
14	TypeF_Medium	TypeC_Low	100.0	4.8	21.00
15	TypeC_Low	TypeF_Medium	100.0	4.8	21.00
16	TypeC_Low	TypeU_Medium	100.0	4.8	7.00
17	TypeVr_High	TypeE_Low	100.0	4.8	10.50
18	TypeC_Low	TypeR_High	100.0	4.8	10.50
19	TypeVr_High	TypeP_Low	100.0	4.8	10.50
20	TypeP_High	TypeF_High	100.0	4.8	7.00
21	TypeCtl_Low	TypeR_Medium	100.0	4.8	10.50
22	TypeF_High	TypeCtl_High	66.7	9.5	7.00
23	TypeEn_Medium	TypeP_Medium	66.7	9.5	7.00

3.4 Extraction Results

According to Table 3, it is possible to extract a few interesting rules for the production management scratch development system. In No. 3 of Table 3, rules with Type F and a requirements difficulty level of “medium” and rules with Type R and a requirements difficulty level of “high” were extracted. In no. 16, rules with Type F and a requirements difficulty level of “medium” and rules with Type R and a requirements difficulty level of “medium” were extracted. In the requirements maturation model, Type F and Type R contain requirements of the medium and latter term maturation types, respectively. Based on this, it was found that when Type F was elicited, Type R could be obtained simultaneously. In addition, from the viewpoint of the requirements difficulty level, “low” => ”medium” or “medium” => ”medium”. Thus, search the requirements on functionality, which can be obtained easily, leads to the extraction of requirements on reliability.

In no. 14, rules with Type En and a requirements difficulty level of “low” and rules with Type Vr and a requirements difficulty level of “low” were extracted. Requirements of Type En and Type Vr are of the medium and latter term maturation types, respectively. Based on this, it was found that when requirements of Type En were elicited, requirements of Type Vr could be obtained in the medium term of the project.

3.4.1 Effectiveness of Results

We compared the rules extracted in the production management scratch development system with the rules extracted in the telemarketing operator management system. According to Table 4, considering the rules extracted by the telemarketing operator management system, it was found that for no. 13, rules with Type F and a requirements difficulty level of "medium" and rules with Type R and a requirements difficulty level of "high" were extracted. Based on these results, we can observe the strength of the connection between the requirements on functionality and reliability. In addition, for the requirements on functionality, as the requirements difficulty level increases from "low" to "medium", the requirements difficulty level of the requirements on reliability increases from "medium" to "high". Such requirement leads to a difficult to extract in stages. This result is common to both projects, and we consider that the results are highly relevant.

4. Conclusions

The purpose of this study was the developmental application of the PRINCE model during requirements elicitation. Therefore, by applying the PRINCE model to the requirements data of actual projects, we attempted to solve the problem by classifying the maturity type of requirements based on their quality characteristics. In addition, we analyzed the co-occurrence of the requirements.

For the developmental application of the PRINCE model, it is necessary for management to bring the requirements of the latter term maturation type closer to the requirements of the medium term and early term maturation types, after understanding the maturity of the requirements. Based on this point of view, a useful result of this study was that we could extract a few requirements of the medium term maturation type, considering the requirements difficulty level. In other words, it is possible to predict the requirements that occur later in the project. This can lead to flexible design, such as consideration of additional requirements and changes in specifications. Moreover, we consider that this can contribute to decrease in risk.

For further development, it is necessary to consider how to utilize the results of this study. It is necessary to develop flexible designs and create a clear indicator for implementation. Therefore, it is important to clarify the maturity type of requirements and the relationship between requirements by analyzing project data further. Moreover, it is necessary to quantitatively obtain the requirements difficulty level. In other words, it is necessary to establish a method to quantify complex elements such as requirement elicitation capability, requirements analysts, nature of requirements, and the knowledge level of users about the system.

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"Monozukuri Dojo" for Launching System Development Project

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Regarding IT system development for enterprises, in many cases, IT vendors participate in a project from the "requirements definition", and then continue to be involved in the project in system development as well. Since "system development" is pursued based on contents of its "requirements definition", it is important for IT vendors to prepare to use the required technologies effectively prior to development, but some projects cannot be pursued smoothly and suffer from the cost overrun because of insufficient preparation. Therefore, in order to make sure to prepare for the projects sufficiently in advance, we implemented "Monozukuri Dojo" measure to standardize, consolidate, and make the best use of development / test environment, training curriculum and so on. Monozukuri Dojo prevents the occurrence of cost overruns by implementation of appropriate preparation from the appropriate time. In this paper, we will describe the case of A project which took Monozukuri Dojo. By taking Monozukuri Dojo, the A project was able to acquire development technology before system development and additionally, to suppress the occurrence of bugs beforehand based on the know-how of past projects taking Monozukuri Dojo. A project that had prepared according to Monozukuri Dojo has been launching in the system development smoothly; as a result, no deficit cases have occurred.

Keywords and phrases: Project Start-up, Preparation, Education, Monozukuri

1. Introduction

IT systems are generally developed going through the processes of work requirements definition, system requirements definition, system format design, software requirements definition, software format design, programming, software integration, software testing, system integration, system testing, and (work) operation testing (Information-technology Promotion Agency, Technology Headquarters, Software Engineering Center, (2013)). Work requirements definition is a process done by the person (the IT vender's customer) requesting IT system development. However, IT vendors often participate as supporters and continue to be involved in system development following system requirements definition.

In IT system development, it is necessary to define the system architecture, that is, the frame of the system configuration including system foundational technology, such as the programming language used in development or the DBMS (database management system) used to achieve the work requirements. With system architecture, the larger the scale of the system, the more difficult it is to make changes after it has been determined. It is therefore desirable that there are no changes.

In order to prevent changes to a system architecture that has been decided upon, it is important to investigate beforehand if the system architecture considered for use can achieve the work requirements. If the investigation is insufficient, it may be discovered during system development that the work requirements cannot be achieved. Therefore, in order for system development to proceed smoothly, "preparation work" which investigates beforehand if the system architecture considered for use can achieve the work requirements is important (Fig. 1).

Furthermore, poor preparation leads to increased chances the project will fail. If we categorize the reasons for work delays due to IT vendors reported in 2016 by the Japan Users Association of Information Systems (JUAS)(2016) into "insufficient preparation," "poor estimate accuracy," and "other," we see that approximately 20% of projects are delayed due to insufficient preparation (Fig. 2). Also, approximately 16% of our company's cost overrun for the 2016 fiscal

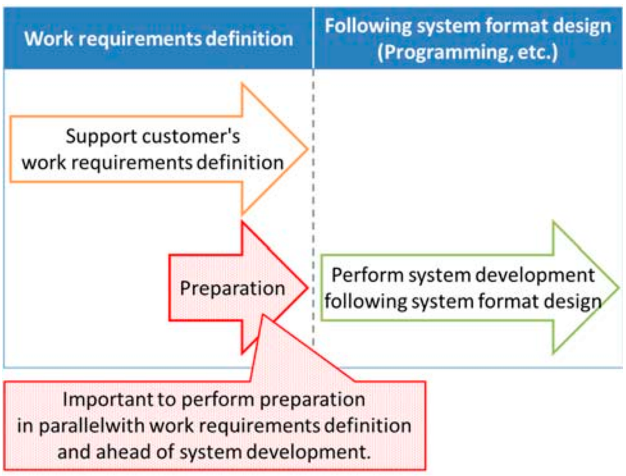

Fig. 1 Illustration of the time-line for preparation

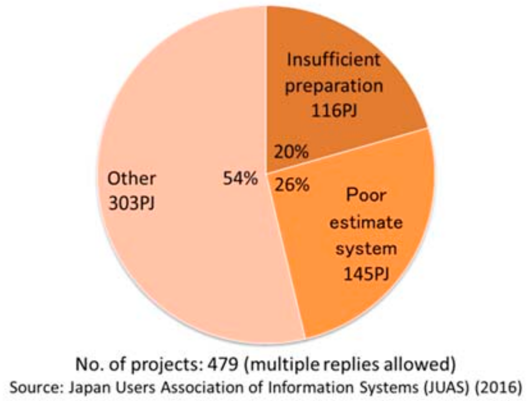

Fig. 2 Reasons for work delays due to IT vendors

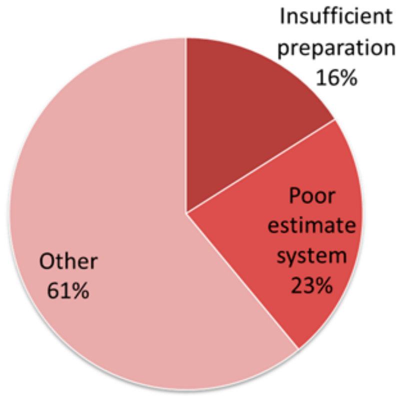

Fig. 3 Causes of cost overruns in our company during FY 2016

year was caused by lacking preparation (Fig. 3).

In addition to investigating the possibility of achieving the work requirements, there are multiple items that should be done during preparation to ensure that system development proceeds smoothly. Examples of items that must be done during preparation are shown below.

- Verifying and arranging the development environment
  Selecting the system architecture and investigating if that system architecture can achieve the work requirements.
  Discovering all restrictions of the system architecture.
- Arranging development procedure
  A development procedure is arranged to match the system architecture to be used, so that all the development members can proceed with development smoothly.
- Preparing assignment of project members
  Members who can develop with the system architecture to be used are assigned.
  Particularly when using new technology, training for learning technology must also be arranged.

To make sure that preparation for development is properly performed, we implement the "Monozukuri Dojo" measures to standardize, arrange, and utilize training curriculum and the like.

2. Monozukuri Dojo

Monozukuri Dojo is a training curriculum comprised of the following two stages of training.

(1) Group fundamental training
(2) Practical training through prototype development

In Monozukuri Dojo, we achieve preparation from an appropriate time and preparation with appropriate content. Fig. 4 shows an outline of Monozukuri Dojo.

The following describes the content of the Monozukuri Dojo measure.

2.1 Achieving preparation from an appropriate time

2.1.1 Appropriate time for preparation

For IT system development, once the system development job is ordered, the project starts up and design and development are performed based on the work requirements. Preparation must be done before the development, which begins after project start-up.

Before the job is ordered, generally there are

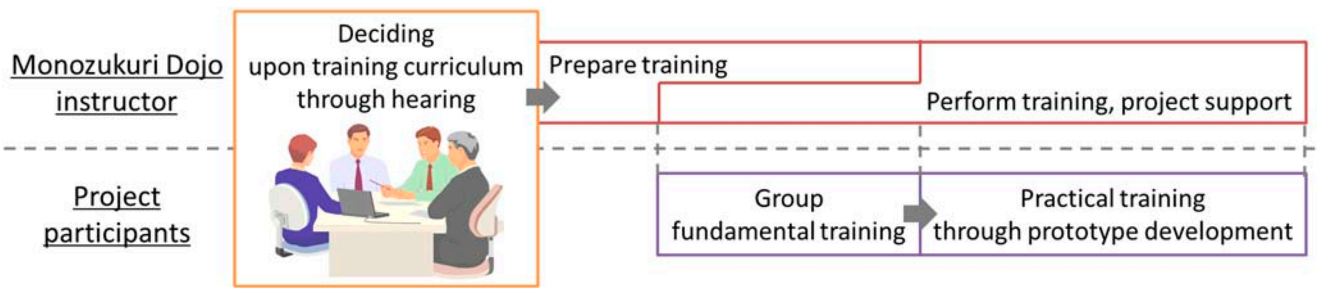

Fig. 4 Outline of Monozukuri Dojo

various activities that must be done, including a proposal, estimate, and ordering.

During proposals, a vendor proposes a system plan to the customer.

During estimates, a vendor calculates an estimate price and shows it to the customer. To calculate the estimate price, an estimate of the development work hours is necessary, and so it is necessary for the system architecture and programming language used in development to be decided.

During ordering, a contract is signed with the estimate price that the customer agreed to, and the job is considered ordered.

As described earlier, preparation must be performed before the job is ordered and the project starts up, and therefore must be done during either the proposal or estimate. During the estimate, however, the investigation as to if the work requirements can be achieved must be finished. Also, the system architecture and programming language must be decided.

Therefore, preparation should be done during the proposal.

2.1.2 Approach for preparation to projects undergoing proposals

Our company has an in-house system that aggregates and displays the statuses of in-house jobs and projects. Therefore, we used this system and approached project members regarding Monozukuri Dojo so that preparation can be done when each project is being proposed.

We also held multiple seminars, striving to explain the importance of preparation during proposals and spread the Monozukuri Dojo measure in-house. As a result, we were able to improve in-house awareness to the point where even if we did not approach them, project members inquired with us about Monozukuri Dojo (Fig. 5).

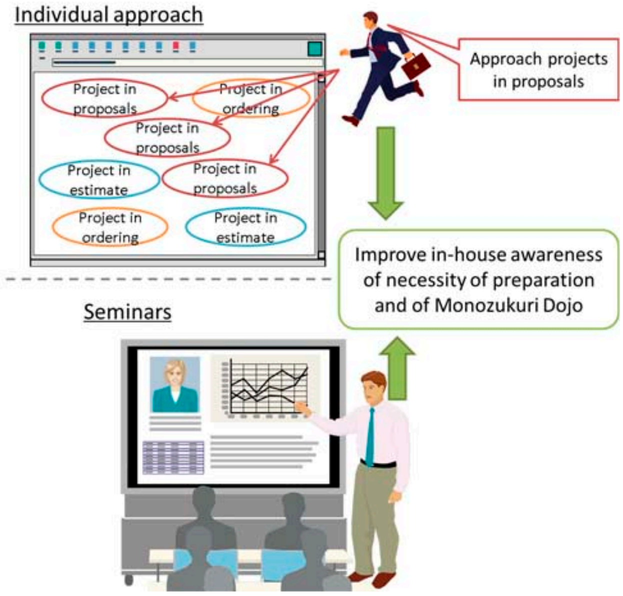

Fig. 5 Approach for preparation

2.2 Achieving preparation with appropriate contents

Monozukuri Dojo is implemented using the following flow (Fig. 4).

(1) Performing a hearing

A hearing is held regarding the system architecture planned for use, the development technology that should be learned, and any other desired preparation support. Also, the training curriculum to be implemented is decided upon.

(2) Group fundamental training

Training is done using a classroom lecture format.

(3) Practical training through prototype development

Prototype development is done for the functions planned to be developed during the project.

Monozukuri Dojo has the following three characteristics.

- Flexibly customizable training curriculum
- Practical training through prototype development using real projects
- Accumulating and swiftly expanding know-how

The following describes each of these characteristics.

2.2.1 Flexibly customizable training curriculum

With Monozukuri Dojo, we arranged a standard development environment as recommended system architecture. The standard development environment determines the fundamental development and test environment and the procedure therefor. Therefore, just by using the standard development environment, we can cut the work hours for selecting a system architecture and the work hours for arranging a development environment and procedure necessary for preparation.

Next, we arranged the training curriculum of the group fundamental training to meet the standard development environment.

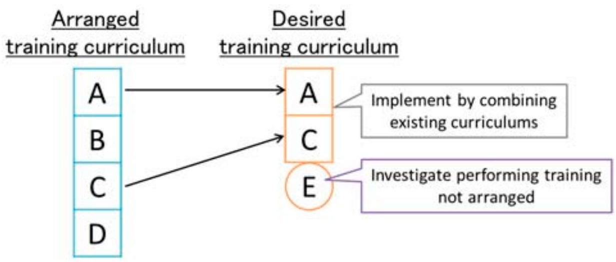

Fig. 6 Illustration of deciding upon training contents

Conventional training for learning system development technology often included multiple development technologies in a single training curriculum. Furthermore, developers could only use part of the development technology they learned in the project.

However, with Monozukuri Dojo, we removed dependency between each training curriculum so that developers can learn only the minimum necessary for the project, minimizing the training curriculum units for the group fundamental training in the two-stage training. This allows us to perform training that combines only the training curriculum necessary for the project (Fig. 6).

However, in some cases, the project needs training for development technology not included in the standard development environment. With Monozukuri Dojo, we confirm the development technologies that require training during the hearing, and if possible, also hold training for development technology not included in the standard development environment. In the past, we have held training for a hybrid application, a type of smartphone application, and for a micro-service which created multiple small-scale services for one system.

2.2.2 Arranging practical training through prototype development using real projects

With Monozukuri Dojo, we first hold group fundamental training in a classroom lecture format, which was also commonly used in conventional training. Then we hold practical training through prototype development in order for developers to learn more practical development technology that they can also use in the development project. Practical training uses the functions planned for development in the actual project as material and has the developers perform prototype development. Therefore, we can investigate if the system architecture planned for use can achieve the work requirements by developing a

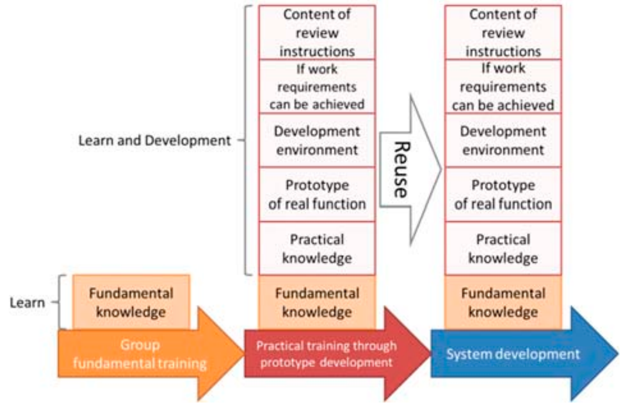

Fig. 7 Illustration of practical training through prototype development

system that actually operates.

At the same time, because developers develop the functions actually planned for development, the products created in practical training, such as program source code, can be reused in the development project. Also, because the development environment constructed for development can also be reused in production development, the development project can start up more quickly (Fig. 7).

Furthermore, practical training teaches not only programming, but also provides design instructions through the design sheet review or the like.

During each instruction, we use the know-how accumulated in Monozukuri Dojo to point out locations where bugs are likely to occur. As a result, the contents of instruction are material that can be immediately utilized in the development project, contributing to the improvement of quality and the prevention of bugs and the like in the development project.

2.2.3 Accumulating and swiftly expanding know-how

For general training curriculum, we create material for implementing training. However, since it generally takes time to create materials, there is a chance that the material will not be completed when you want to perform training, or that the development technology will become obsolete while materials are being created.

With Monozukuri Dojo, we arranged an environment that accumulates know-how from past participation projects so that anybody can reference them at anytime. This enables for know-how to be easily turned into material for performing training, even when the material is not complete (Fig. 8).

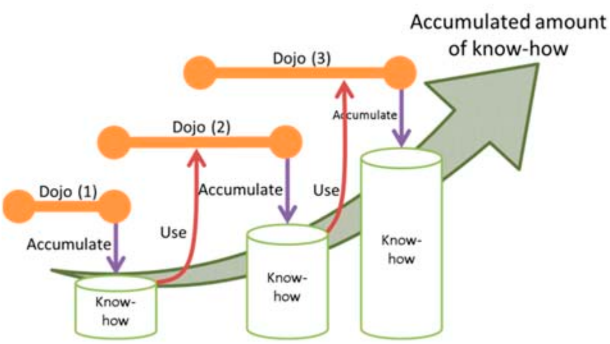

Fig. 8 Illustration of accumulating and using know-how

Know-how from other projects, such as know-how related to generic parts like authorization, can easily be used in any kind of project. Furthermore, the know-how is from actual projects, so it enables highly-practical training.

By implementing the Monozukuri Dojo measure described above, we enable preparation for development to be properly performed, aiming to lead to the success of the project.

3. Practical examples of Monozukuri Dojo

This section describes an example, Project A, where Monozukuri Dojo was performed.

3.1 Learning of group fundamental training

With Project A, all technology included in the standard development environment was planned for use in the project in order to reduce work hours for selecting the system architecture. Therefore, in group fundamental training, the full training curriculum prepared in Monozukuri Dojo was performed.

3.2 Performing practical training through prototype development

In practical training, developers developed a prototype for the master maintenance function (Note 1), one of the functions planned to be created for Project A. Development of the master maintenance function is often implemented in the Monozukuri Dojo for other projects and has plenty of know-how accumulated. This ensured that prototype development was performed smoothly. Furthermore, products such as the program source code created and the development environment constructed during practical training were reused in production development. Doing so contributed to quicker start-up of the development project.

Table 1 Examples of items pointed out during the review

#	Items pointed out during the review
1	Realize a mechanism that prevents the user screen operation during communication.
2	Definitely check on the server the values input for user input items.
3	SQL injection measures are automatically done by parts included in the system, and therefore do not need to be considered by developers.

Furthermore, the design sheets, source code, and system undergoing operational checks were reviewed. During the review, the know-how was used to provide a total of 21 points of advice, such as regarding bug prevention for bugs that may occur later or for the design specific to the system architecture in use. Table 1 shows examples of items pointed out during the review.

Review implementation contributed to the improvement of quality and the prevention of bugs and the like in the development project.

3.3 Learning the standard development environment

With Project A, in order for developers to assuredly learn the standard development environment, midterm evaluations were held regarding their learning of the standard development environment during the practical training period through prototype development. Supplementary training was given for items with a poor learning status, thus improving the learning.

The learning status was investigated through self-evaluation by Monozukuri Dojo participants, who evaluated each development technology on a scale from 1 to 3. 3 was the highest evaluation, indicating, "I can do it on my own," and 1 was the lowest evaluation, indicating "I can understand the contents."

As a result of the midterm investigation, there were development technologies for which the average evaluation was less than 3. If the average evaluation is not 3, it cannot be said that the developers have learned the standard development environment. Therefore, supplementary training was given to developers for items with poor learning statuses, aiming for an average evaluation of 3 for all development technologies.

The supplementary training did not cover

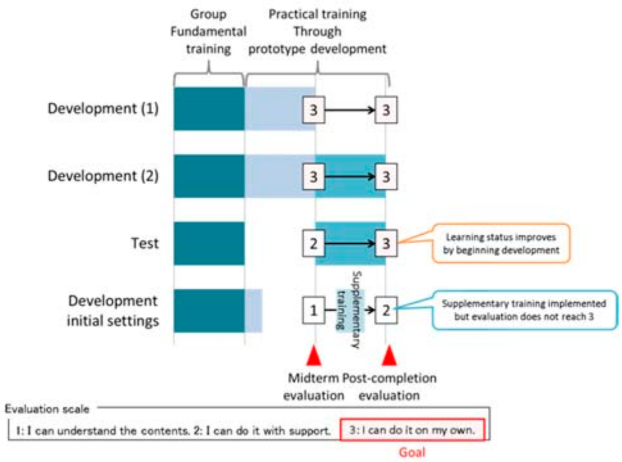

Fig. 9 Trend in learning status midterm and after supplementary training

development technology planned to begin development in the practical training following the midterm evaluation. Furthermore, the material for supplementary training was not completed when doing the supplementary training, so training was performed using accumulated know-how.

Fig. 9 indicates the acquisition status of learning at the midway and completion points for Monozukuri Dojo.

Development technologies other than "development initial settings" have an average evaluation of 3, so the goal has been achieved. However, regarding "development initial settings," supplementary training was implemented, which did improve the average score. However, the evaluation remained at 2, and the goal could not be achieved. This is because the "development initial settings" need to be performed only once when starting development, and a chance to put this into practice could not be ensured.

Therefore, support was given following the completion of Monozukuri Dojo for items where supplementary training was given.

4. Expected effect of Monozukuri Dojo

If preparation is done through Monozukuri Dojo, cost overruns due to poor preparation can be prevented. The following describes the expected effect if preparation had been done through Monozukuri Dojo for two of our company's projects where cost overruns occurred during the 2016 fiscal year.

Table 2 indicates the reasons cost overruns occurred in the two projects, and the ratios of the cost overrun which are believed to have been preventable by undergoing Monozukuri Dojo. Preventable ratios were calculated based on the occurrence cause ratio of the cost overrun for each cause gained through project analysis.

Table 2 Causes of cost overruns and ratio of preventable cost overruns

PJ	Cause of cost overrun	Can be prevented with the Dojo?	Prevent-able ratio
B	- Poor estimate of development scale	No	14%
	- Insufficient organization	Yes	
	- Poor development schedule	No	
	- Poor system format design	No	
	- Poor build due to lack of knowledgeable persons	Yes	
C	- Non-arrangement of development procedure	Yes	52%
	- Poor software format design	No	
	- Poor estimate of development scale	No	

It is believed that by cultivating human resources through the Monozukuri Dojo, Project B could have prevented insufficient organization and poor build due to lack of knowledgeable persons, thus preventing a cost overrun of 14%.

It is believed that by organizing the development procedure for the standard development environment through Monozukuri Dojo, Project C could have prevented the non-arrangement of development procedure, thus preventing a cost overrun of 52%.

5. Conclusion

5.1 Summary

In IT system development, it is necessary to define the system architecture, and it is necessary to investigate in "preparation" beforehand if the system architecture considered for use can achieve the work requirements. Poor preparation leads to increased chances the project will fail. Therefore, to make sure that the preparation for development is properly performed, we implemented the "Monozukuri Dojo" measures to standardize, arrange, and utilize training curriculum etc., and verified the effect. As the result, the effectiveness of the Monozukuri Dojo was confirmed through practical training based on group fundamental training and prototype development.

With the Monozukuri Dojo, we used an in-house system and approached project members about products being proposed and improved in-house awareness to achieve preparation from an appropriate time. We also arranged a standard development environment, training curriculum, practical training through prototype development using real projects, and methods to accumulate and swiftly expand know-how, achieving implementation of training with appropriate content.

Monozukuri Dojo has thus far been implemented for 30 projects, including Project A. Project A has not yet been completed, but due to the preparation done through Monozukuri Dojo, development is proceeding smoothly and the project is expected to conclude without cost overruns.

5.2 Future issues

As Monozukuri Dojo is done while the job is being proposed, it is expected we can offer estimates with higher accuracy if we acquire the productivity during prototype development and create estimates during the estimate stage based on that acquired productivity. However, with the current prototype development of Monozukuri Dojo, development is done concurrently with learning the standard development environment, and therefore productivity is generally low and cannot be used in forming estimates.

Therefore, a future issue will be establishing a method for learning the standard development environment over a short time to acquire productivity that can be used in forming estimates.

Notes

Note 1) Function for performing maintenance on the master data of a DB (database) or the like. Generally has all CRUD functions.

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Role of Customer Orientation in IT Program Management

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The goal of the project is the achievement of the planned QCDS. Meanwhile, its parent organization, such as IT vendor, often expects a continuous order from the customer by acquiring customer satisfaction through implementation of the project. The previous research modeled that SI vendor's active involvement in customer program management contributed to the creation of customer profit and satisfaction, and contributed to SI vendor's profit acquisition by continuous ordering. It verified this model by referring to the case study. One feature of this model is he implementation of the proactive customer-orientation by SI vendors. Although subjects are different, many researchers, such as Narver and Slater and Kohli and Jaworski etc. mentioned the influence of the business results implemented customer-orientation. In this research, the authors examine the meaning and value of clarifying customer orientation of SI vendor in IT projects, and propose the customer oriented model, which incorporates program and project management.

Key Words & Phrases: Customer Orientation, System Integration, SI Vendor, Program Management

1. Introduction

The progress in the information society encourages organizations in all areas to use the high-degree application information technology (IT). As reported in the surveys of the Ministry of Internal Affairs and Communications (MIC, 2016), and the Japan Information Systems and User Association (JUAS, 2017), the long-term trend of IT investment by user-side organizations, (hereafter customer) in Japan almost shows a tendency to increase since 1980.

Contrary to the actual status of outside Japan, the domestic information system development project (IS project), in-house production by customer is increasing mainly in the financial sector in late-coming. However, it is still common to utilize external IT solution vendors (hereafter vendors) throughout the information system development processes (e.g., Information-technology Promotion Agency: IPA, 2015, 2016, 2017).

Under such context, the services, provided by Japanese vendors are mainly entrusted development for scratch development and replacement of information systems (IS). In general, it is important to achieve high customer satisfaction while attempting to achieve the quality, cost, delivery time, and scope (QCDS) planned at the time of the contract as well as to improve the system development efficiency in IS development. In other words, the behavioral principle of each vendor's project is to maximize the benefits of the customer's business while securing their profits by completing projects as planned.

Temporary is well known characteristics of project, and whether success or failure that is evaluated based on the achievement of project goal and objectives leads the project to its closing phase. If the discussion is limited to how to realize project success, project managers aim at optimization including related management to achieve planned goal of QCDS, which is mutually decided among stakeholders at the project planning phase. When a project is launched, if the vendor can agree on an achievable goal of QCDS with the customer as the goal of the project, the probability of success of this project from the point of view of the vendor is inevitably improved. The probability of project success related to IS development in Japan has been increasing gradually since the introduction of modern project management, which is the result of efforts to match the estimation of cost and time with reality and the adaptation of a project plan to according facts. Furthermore, it is easy to conceive the limitations in improving the probability of project success from this viewpoint. These limitations include limitations in the ability of vendors to explain to or persuade customers and the limitations of projects, such as IS projects that require stepwise refinement and involve a high risk of specification change due to changes in the environment surrounding the project. In many cases, customers consider oversights of defects in software requirements specification as design failure by vendor, on the other hand, vendors understand the same case as the specification changes by customer. Customer claims such as defects in the requirement definition and the lack of aggressive problem-solving by the vendor, as shown in the survey results of the Japan Information Systems and User Association (2016, 2017), support such trends. In addition to determining the causes of problems, the identification of problems from different viewpoints by customers and vendors causes the delay of actions for problem-solving.

In IS projects, which strongly engage the IT department of customer and actively involve the incorporation of innovation, in addition to conventional waterfall development, the introduction of the collaboration model between the customers' IT department and the vendors using agile methods, such as Scrum, has been progressing. These efforts appear to have provided a certain solution to the type of problem mentioned above. However, the success in using an agile method, such as Scrum, requires both customers and vendors to have a certain level of competence in program management and project management. Therefore, such methods cannot necessarily be applied uniformly to all projects.

Consequently, in many IS projects, project managers aim to achieve only goals of planned QCDS without closely collaborating with the customers. Occasionally, project managers eliminate changes that affect the assumptions and constraints of the project as much as possible. Such an attitude may cause delays in decision-making to respond to change requests from customers and to environmental changes. In fact, the satisfaction level of IS projects has declined, contrary to the success probability of projects.

This deviates from the idea of aiming at the simultaneous maximization of the benefits of both the customer and vendor, as mentioned earlier. By successfully completing a project, a vendor expects to maximize their benefits by receiving more orders from a customer and consequently acquiring new business through corporate trust. As mentioned earlier, to maximize benefits to both customers and vendors, advanced project management and sophisticated program management are necessary. Specifically, under the integrated objectives and goals of both the vendor and customer, higher-levels of project management that is developed with the goal of achieving planned QCDS is required at the development site, while program management that is developed with the goal of maximizing benefits to the customer is required for promoting the customer’s business. Generally, under the assumption that no defects exist in the deliverables of a project, vendors behave as per the expectations of customers during a project, and whether deliverables can contribute to the expected benefit depends largely on whether the objectives and goals of a project under the contract were properly set.

According to the concept of project, program, and portfolio management (PPPM), the customer's business is planned by the portfolio, executed by the program, and realized by the project. Strictly speaking, PPPM is expected to realize business objectives and goals defined at the portfolio level under close cooperation among program components, including operations, other programs, and projects. In other words, project-level objectives and goals discussed so far are set at the program level. Therefore, in order to set objectives and goals at the project level appropriately and to maximize the benefits of customers and vendors, a strong involvement in program management is necessary, which leads to solutions to the problems discussed so far.

Sekiguchi and Seki (2016, 2016a, b) proposed a solution to this kind of problem that lets vendor staff participate in the program management office (PgMO).

In the next section, the problems and subjects for the successful project, the dilemma of the project managers, and previous study by Sekiguchi and Seki (2016, 2016a, b) are summarized for the preparation of the discussion and proposals. It also presents the scope of this research. Section 3 proposes customer orientation as the goal of the vendor organization and shows that personnel is involved in attaining the objectives and goals of PPPM. The section also proposes introducing customer orientation to the research of Sekiguchi and Seki (2016, 2016a, b). Section 4 summarizes the beneficial effect of incorporating customer orientation into the research of Sekiguchi and Seki (2016, 2016 a, b). Finally, section 5 gives a summary of this paper.

2. Confirmation of various issues and summary of previous research

2.1 Paradox in project success

In general, the expectation from a project manager is to complete a project by achieving the goal of planned QCDS. This is generally understood as the project success. On the other hand, the objective of a project is to achieve the target value of a predetermined quantitative index of the benefits that are realized by successfully completing the project. It is not always evaluated by the result of individual project. In many cases, the objective of a project is an evaluation baseline of the validity of the direction and the target of project goals. It is a reason of change and the index of change management occurring during the project.

In the structure of PPPM, many projects are created under a program. Programs are created by the portfolio, which is placed at the top of PPPM. Portfolios aim at achieving the business goals of organizations and set goals for realization, that is, the expected values of benefits that programs should achieve. Programs consist of components such as sub programs, projects, and operations. Programs set goals for individual components so that the integrated results of these components lead to the expected benefits, which are the goals of a program. At this time, the PgMO gives each program component the individual goals necessary for achieving the objectives of the program.

As described above, the objectives and goals of the project are determined by the higher-management level. Consequently, PPPM makes project managers attempt to achieve only QCDS, and it makes them dislike changes in the assumptions and constraints on projects, as discussed in section 1.

Customers naturally expect to achieve the business goal that is at the root of creating a project. Therefore, if vendors expect continued business and sustainable growth, they should not only pursue the profit generated by the results of a single project but also contribute to maximizing the customer's business benefits. This allows vendors to earn the benefits they expect, including continuous orders and extended orders from customers due to increased corporate trust.

From the considerations presented above, we can confirm the existence of a paradox concerning the project success.

First, consider the success at the management level, namely the portfolio level:

1) The customer's success under the structure of PPPM is to achieve business goals.
2) The success of vendors is in acquiring not only the immediate profit from the completion of the project but also the benefits that will lead to the sustainable development of vendors from the success of the customer business.

1) and 2) indicate that customers and vendors identify portfolio-level goals and program-level objectives. Programs have goals set in a manner that these same objectives can be achieved, and necessary program components are created to realize the goals. At this time, the objectives of each component are program-level goals, and the goal of each component is set so that these goals can be achieved.

As a result, the project success under goals and objectives optimized towards achieving the business goal, which is a portfolio-level goal, is considered as follows:

3) The project success is to achieve the planned QCDS through the most efficient means and simultaneously to realize customer satisfaction.

As project objectives, goals, and the definition of success are set in this manner, project managers need the following attitudes:

4) Project managers should take special caution while changing the project scope according to the project-management principle.
5) The principle of action of project managers to be cautious about changes contrary to the project environment and customers' expectations is not a mistake.

On the other hand, it is necessary to take decisions on whether or not to implement necessary and minimal changes including secondary risk and to implement concrete countermeasures. A general understanding of changes is also required, as mentioned below:

6) A project has the general nature of stepwise refinement, which is recognized as the existence of undecided items at the initial stage of the project or the existence of ambiguity within an acceptable range.
7) Modern society is forced to make frequent changes to the project, and customers expect a flexible response to changes related to project scope to achieve their business goals.

Despite requirements 6) and 7), project managers will stick to attitudes 4) and 5) to ensure the success of the project management, as detailed in 3). This results in a terrible scenario in which the essential success of an organization with 1) and 2) cannot be secured.

It is easy to understand that the source of the paradox concerning the project success is the mistake at the premise in accurately determining the objectives and goals of a program, which constitute the basis of the objectives and goals of a project. According to Sekiguchi and Seki (2016, 2016a, b), the reason why vendors misunderstood the objectives and goals of projects is that the communication management by

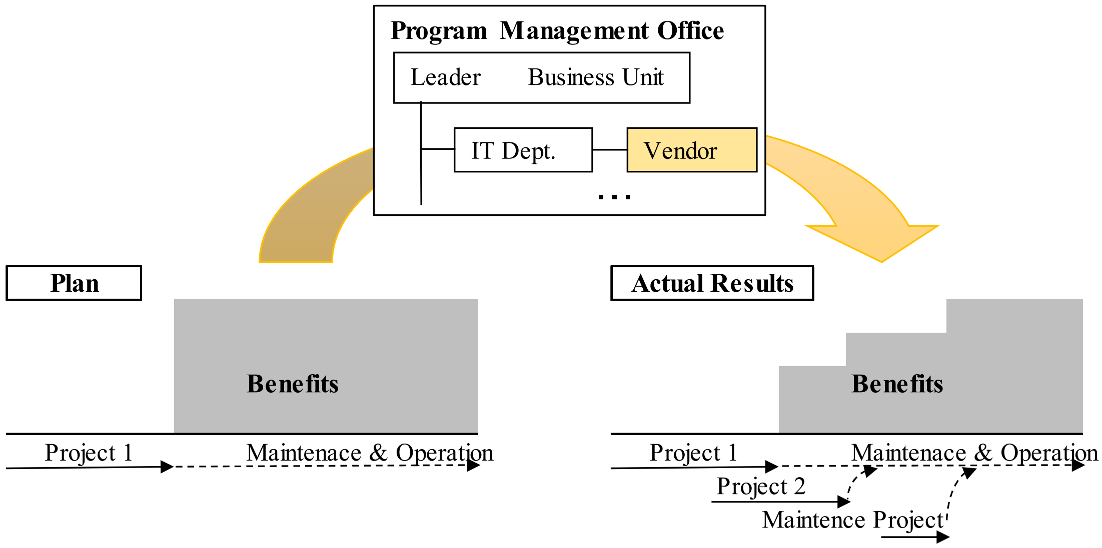

Figure 1 Monitoring and controlling benefits by the program management office

customers is not necessarily appropriate, and portfolio-level decision making is not necessarily transmitted to the program level and project level accurately. This is also the reason why customers do not necessarily have sufficient knowledge about IS development or human resources for analysis and definition. Therefore, it is not possible to accurately grasp the dependency among program components and the relationship between ongoing projects and existing IT assets. In addition, it is notable that the idea of the customer's staff and the end user of a project does not necessarily reflect the business goals.

To solve this paradox of success, Sekiguchi and Seki (2016, 2016a, b) proposed a framework to promote program management, which aims to maximize the customer's benefit by ensuring the involvement of vendor staff in the PgMO. Section 2.2 outlines the proposal of Sekiguchi and Seki (2016, 2016a, b).

2.2 Summary of previous research

Sekiguchi and Seki (2016, 2016a, b) proposed letting vendor staff take part in the customer's PgMO as a part of customer-side personnel and take actions to maximize the customer's benefits. The effect of this proposal on a program and project level is summarized as follows:

1) Vendors can accurately determine the latest detailed information on the customer's business without intermediation.
2) It enables closer contact and cooperation among the customer's IT department and PgMO members so that vendors can grasp the issues of the customer's business and the status of existing IT assets, other programs, projects, etc.
3) Based on 1) and 2), vendors can propose to improve the customer’s information systems to maximize the customer's benefits.
4) It is possible to support prompt and accurate decision-making necessary for 3).

Sekiguchi and Seki (2016, 2016a, b) stated that such actions allow vendors to gain strong trust from customers, allowing vendors to move from mere IT partners to long-term business partners.

Figure 1 shows the work of PgMO established by Sekiguchi and Seki (2016, 2016 a, b). Generally, in a high-level decision scene such as the planning phase, it is common to plan to achieve the expected benefits by the completion of a project, as shown under "plan" on the left side of Figure 1. On the other hand, in reality, both the customer and vendor have limited resources, and the ability of customers to accept the results of projects is limited. In addition, the start of new projects and the acceptance of the results have an impact on other activities; therefore, it is necessary to grasp and evaluate existing IT assets, other programs, and projects. "Actual Results" on the right side of Figure 1 shows the actual situation including the adjusted plan to ensure the expected benefits are achieved based on the results of these strategies or tactical adjustments, taking these requirements and the environment into consideration. For such adjustment activities, it is necessary to grasp the situation of a customer and knowledge of IS development, and project management for examining concrete countermeasures is required. The PgMO, located at the center of Figure 1, represents that vendor staff participates and acts as members of the customer's PgMO.

Sekiguchi and Seki (2016, 2016 a, b) proposed letting personnel dispatched by vendors to the PgMO act as "customer's staff." When a vendor formally proposes this scheme to a customer, it is not easy for the vendor to earn the customer's trust, especially when a conflict of interest exists. However, it is possible for the dispatched vendor staff to act as an individual to acquire the customer's trust. If this is done as a vendor's strategy, as suggested by Sekiguchi and Seki (2016, 2016a, b), it is obvious that the actions of vendor-side personnel under the customer must be materialized under the identification of their objectives and goals, which should have been reached under an agreement between the dispatched vendor staff and the vendor management. This topic will be discussed in section 3 after confirming the issues of project managers in section 2.3.

2.3 Issues of project managers

This section examines the source of the problem that creates the paradox regarding the project success described in section 2.1. The proposal of Sekiguchi and Seki (2016, 2016a, b) described in 2.2 is a rational mechanism to assign accurate objectives and goals to program components including projects. In contrast, this section will consider the countermeasures to maximize the benefit at the portfolio level, which is expected by the proposal of Sekiguchi and Seki (2016, 2016a, b), by classifying and organizing problems that a project manager should deal with.

When projects are started, various problems occur, and it is common to not proceed as planned. According to the results of a survey of customers of IS projects conducted by the Japan Information Systems and User Association (2016), the number of projects with a clear delivery delay in FY 2015 was evaluated as 42.3% of the total number of projects. If we include projects that were "to some extent completed as planned," the delivery date was delayed for 78.1% of all the projects. In addition, the reason for the delay was regarded as a problem of the requirement definition in 55% of the cases, and it is understood that a defect or deficiency in the requirement definition is a significant problem for project success. Under such circumstances, customer satisfaction with vendors is not high.

Problems occurring at the site of projects can be roughly classified into problems caused by vendors, customers, and the external environment.

Problems caused by vendors include estimation mistakes, lack of skill, and work delays. These are cases in which troubles and disadvantages occur in the work process at the vendor side, including work before the contract.

Problems caused by customers include excessive requirements, change requests after specifications are frozen, and work delays at the customer side (design review, testing, etc.). Although some of these cannot be categorized as a problem caused by customers, a problem arising as a result of customer-side work is considered as a problem caused by customers in the present study.

Problems caused by the external environment include changes in system requirements due to changes in various environments surrounding projects that could not be anticipated at the beginning of the projects as well as increases in workloads due to changes in release requirements of IT products.

Problems caused by vendors are solved within the vendor's responsibility, and problems due to customers and external environment are generally solved by consultation between customers and vendors.

Problems caused by vendors should be solved by them, but the impact of such problems is not limited by the fact that they are not the customers' concerns. Project QCDS, as is well known, is placed under constraints represented by the project-management triangle. There are differences in how QCDS is affected the problem and its extent, but it is inevitable that, if there is an influence on any of the factors, the other factors will also be affected. In solving problems caused by vendors, changing scopes are generally unexpected, and changes accompanying deterioration in quality are not acceptable for the customer. Therefore, this kind of problem is revealed by the expectation of a formal delivery delay, and it is solved by utilizing the vendor's contingency reserve for cost increase by crashing. If a vendor cannot solve the cost increase on their own, the vendor consults with the customer to solve the problem.

For problems arising from customers and the external environment, it is often difficult to isolate the responsibilities related to the occurrence of the problems. Depending on the relationship between the

Table 1 Impact on QCDS by Problem Factor

Factor	Main Problems	In charge	Impact on customer QCDS	Difficulty of negotiation
Vendor	Change in cost and delivery due to estimation mistake Work delay due to lack of personnel skills Work delay (programming, testing, etc.)	Vendor	None * Basically vendor's responsibility	Easy
Customer	Excessive systemization requirements Request for change after specifications frozen Work delay (review, testing etc.)	Customer + Vendor	Affected * Authorizable ones within the customer will be changed	Extremely difficult * Agreement on which party takes responsibility is very difficult
External Environment	Change of legal system Changing competing environment in the market Changes in work due to failure to meet external procurement requirements	Customer + Vendor	Affected * Negotiated under the assumption of change	Difficult

customer and vendor, the vendor may accept some of the burden of solving the problem if it is minor; occasionally, the problem does not affect the QCDS from the customer's viewpoint. On the other hand, in many cases, the customer and vendor must negotiate, coordinate, and make decisions involving changes in the planned QCDS. Since this negotiation affects cost and delivery time, it is often very difficult and, in some cases, significantly impacts the smooth operation of a project. Depending on the cause of problems, Table 1 lists examples of main problems, stakeholders who are in charge of solving the problems, impact on customer QCDS, and difficulty of negotiation.

If it is easy for both parties to accept a proposal for solving a problem caused by the customer or the external environment, many of the difficulties of negotiation, as listed in Table 1, do not exist. However, there are differences between customers and vendors in terms of constraints for problem-solving and the reason for decision-making.

As discussed in section 2.1, project managers manage under the premise of achieving the planned QCDS because project management expects project managers to act. In response to a change request, they adjust so that the project-management triangle will not collapse. In other words, when a decline in quality is out of question, if not changing the scope is the premise of change, project managers expect changes in the cost and delivery date, and if it is required to not change the cost and delivery date, project managers propose to divide the project scope. On the other hand, customers request their management's approval for acceptance or non-acceptance. It is difficult in many projects to make the decision-making layer of the portfolio level or program level accurately understand the status of individual program components and the impact of their defects on the benefits. In addition, the motivation of the teams of customers that have the responsibility of corresponding with vendors and actively communicating difficult situations to decision-making layers is not necessarily strong. In general, it is quite difficult to isolate the cause of a problem, and the distrust of vendors is fostered during that time. Consequently, concessions in the customers' QCDS due to changes will involve great difficulty.

For example, under the premise of a settlement due to reserve expenses by a vendor, a vendor asks a customer to accept cost burdens and delayed delivery because of customer agreement on frozen specifications. However, a customer can point out the lack of documentation and lack of explanation presented at the design review. Then, they will not respond to consultations concerning their burden. Even if a customer considers solving this type of problems, the customer often expects an inclusive solution that also addresses problems occurring in other programs and projects due to cost increase, delay, etc. Consequently, there may be obstacles to rapid decision-making for resolution.

Figure 2 shows the differences in the response policy between vendors and customers and their impacts. The real problem is that, although the goal of a portfolio as shown in section 2.1 is consistent between a customer and vendor, the interests of both sides conflict on the problems.

In the following discussion, the proposals by Sekiguchi and Seki (2016, 2016 a, b) is referred as the basis of the consideration. In the next section, the discussion for how to realize a project environment that not only the vendor's staff participating in the customer's PgMO but also the effort by all stakeholders of both that aim the mutual concerted goals between them and achieve the respective expected benefits is provided.

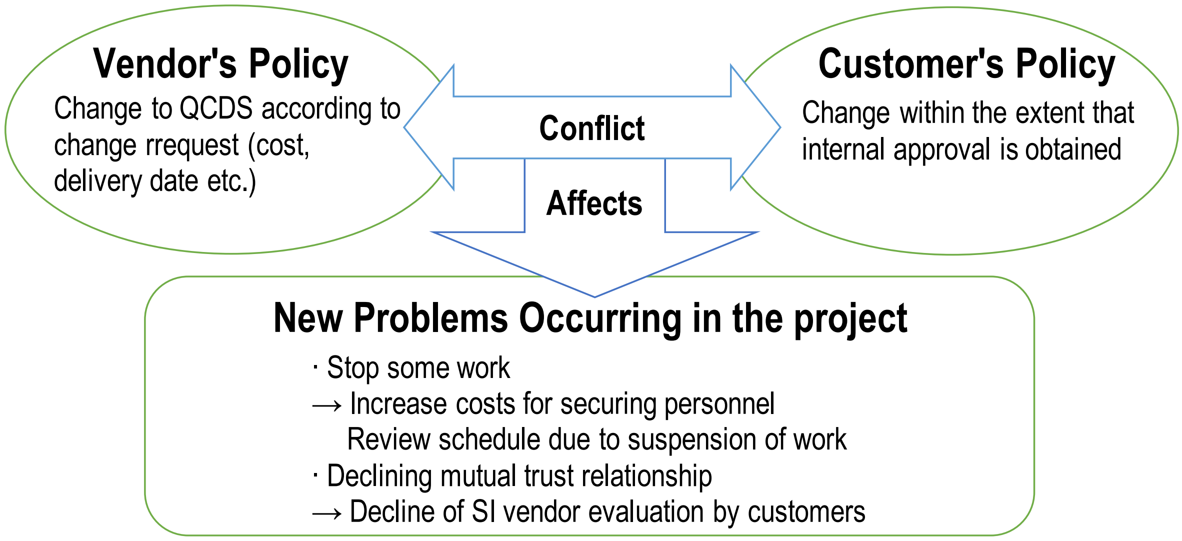

Figure 2 Differences in Response Policy and Secondary Risk

3. Necessity of customer-orientation

As shown in section 2.2, Sekiguchi and Seki (2016, 2016a, b) suggest that, to solve the various problems in SI projects and to maximize benefits expected by both customers and vendors, it is necessary for vendor staff to participate in the customer's PgMO devotedly. Section 2.1 presented a paradox regarding project success. Section 2.3 discussed the conflicts between customers and vendors caused by the paradox. Project management allows project managers to make adjustments by actively utilizing changes while expecting project managers to improve the accuracy of the plan and achieve the goals set by the plan. According to Sekiguchi and Seki (2016, 2016a, b), the solution to the paradox of project success is the action of vendors aiming for the success of customers' business. This section will examine whether customers and vendors in a conflict relationship in terms of profit can inevitably have a customer-oriented position to maximize mutual benefits.

3.1 Necessity of customer orientation in IS development

In general, the goals of IS projects include overcoming technical difficulties and achieving agreed QCDS under a severe project environment. These ordinary goals are often set as orders of the organization to which the member belongs. In research and development projects, the team's goal is often to set challenges for technical difficulties. However, in IS projects, this goal is often thought of as a goal for individuals to grow, and in general, it is difficult to set a goal that both organizations and individuals agree to.

Onzo (2013) showed through research on new product development that customer-oriented development is not technologically driven but rather advanced to respond to customer characteristics and customer needs through market research and customer observation. This comment indirectly supports the proposal of Sekiguchi and Seki (2016, 2016a, b) for IS projects, and at the same time, it can be thought of as providing a solution for requirement definition concerning the existence of difficulty and uncertainty. Matsuo (2002) conducted research on customer-oriented sales jobs and pointed out that customer-oriented sales staff strive to acquire much information to solve customer problems and simultaneously attempt to eliminate uncertainty, and they exchange information with competing salespeople. An IS development team not declaring customer orientation tends to focus on being technology-oriented and achieving planned QCDS. Therefore, they also tend to lose the original objectives of the team that is, the production of deliverables that the customer can accept, and the viewpoint of improving the efficiency of the process. The results of Matsuo's research show that customer orientation is also effective in solving such problems.

3.2 Necessity of customer orientation by organization

Deshpandé, Farley, and Webstar (1993) and Kotler (2000) showed that customer orientation is linked to the long-term success of companies. It was also pointed out that customer orientation causes return on assets (ROA) to increase (Narver and Slater, 1990), it is the driving force for innovative new product development (Lukas and Ferrell, 2000), and it eliminates the novelty of deliverables and promotes uptake of their usefulness.

Onzo (2011) treats customer orientation and market orientation synonymously in the context of new product development. Generally, IS development is the development of new products to meet the needs of individual customers. In this paper, considering markets as synonymous with customers, the results of market-oriented research are introduced and their effect on the profit of IS development companies is shown. In the following, for consistency, the notations market and market orientation in the original work will be replaced with customer and customer orientation.

Kohli and Jaworski (1990) pointed out that the goal of customer orientation is to realize the systematic generation of current and future needs. They also pointed out that current and future needs will be shared by all relevant departments and that organizations should respond to them systematically. Narver and Slater (1990) showed that customer orientation is useful for creating superior value for customers.

When an IS development company thinks about its sustainable development, the foundation of their growth is "customer creation" and continuous orders from good customers. It is easy to understand that Kohli and Jaworski and Narver and Slater pointed out indispensable viewpoints for IS development companies.

Based on the above discussion, it is understandable that setting companies' goals based on customer orientation promotes sustainable development and is an effective measure for shareholders and employees who are required to return profits. In addition, the development of ISs based on the customer's current requirements and future needs will support social and corporate activities by providing high-quality information systems and contribute to the realization of social responsibility.

3.3 Necessity of customer orientation by individuals

Kohli and Jaworski (1990) point out that, prior to their research, the relationship between company customer orientation and employee attitudes has not been adequately considered. Ruekert (1992) confirmed the proposition by Kohli and Jaworski that "Customer orientation improves job satisfaction, cohesiveness, and organizational commitment of employees." He also empirically showed that highly customer-oriented presentation by a company leads to higher job satisfaction and greater confidence in the management team, and simultaneously, the intention of job separation can be reduced. Jaworski and Kohli (1993) also confirmed the employee commitment for organizations and cohesiveness are improved by customer orientation.

Siguaw et al. (1994) pointed out that customer orientation decreases the divergence between conflicting expectations of organizations and customers from sales representatives, and it reduces the conflict of roles. Many IS development companies expect to secure profits and strictly observe the planned QCDS, as mentioned earlier. Consequently, members placed in conflict with customer requests additionally presented in a time series will feel strong stress from both companies and customers. According to Siguaw et al. (1994), customer orientation by a company is a factor in lowering the ambiguity of members' roles and working to improve job satisfaction and organizational commitment.

As mentioned above, the formally declaration about “customer-orientation” as the company policy will enhance the project member’s motivation and reduce their job stress. Consequently, it can be confirmed that it leads to individual interests and active participation towards projects, such as increased strength of the commitment to organizations and reduction of job separation.

4. Acquisition of benefits by customer orientation

4.1 Customer-oriented project management

Based on the discussion so far, the primary objective of vendor staff participating at the customer's PgMO is to maximize the customer's expected benefits, and its effects are as follows:

1) Understand the customer's business objectives and goals, and give the programs and program components appropriate objectives, goals, and scope.
2) Understand the capabilities and resources of customers and optimize the new program plans and the composition of program components.
3) Understand the situation of IT assets and optimize the relationship among its operation, modification, disposal, and a program to be undertaken.

4) Grasp the signs of environmental changes in a program, give information and options for appropriate consideration in the management of a customer, and encourage prompt decision-making.
5) Acquire signs of environmental changes and problems of a program component operation, support correct information exchange among vendors and project managers and customers, and aim for appropriate and prompt solutions.

The success of a customer will secondarily give a vendor an extended order and additional orders from a customer. As a prerequisite for such behavior, fostering a strong trust relationship between a customer and vendor is required. The basis for that is the customer first principle and customer orientation.

The customer first principle is the basic idea of quality management. The vendor's efforts for customers create customer success. The profit is returned to vendor staff, who guarantees the customer's success. Finally, the profit will be returned to the vendor. The profit to be returned to vendor personnel is continuous employment or monetary compensation generated as a result. On the other hand, a partial guarantee of physiological, safety, and social desire is not a basis for maintaining the motivation of vendor personnel for a long time, without introducing Maslow's idea. Therefore, the customer-oriented introduction discussed in section 3 is necessary. Customer orientation, which has been discussed much in marketing, shows that working for a customer under the guarantee of the organization leads to gaining trust from customers and high productivity.

In addition, the proposal of this research gives the following effect to the paradox regarding project success and the conflict a project manager encounters with a customer in the process of problem solving:

1) The objectives and goals of a project created by a customer under the support of vendor staff working at the customer's PgMO are reasonable in view of both the capability and skill of the customer and vendor, and they will be able to reach a concrete agreement.
2) Project managers can proceed with appropriate preparations based on change requests or prospective signs made by vendor staff working at the customer's PgMO, and it will be possible to avoid confusion to carry out projects with sudden change requests.
3) Customer orientation developed under the same identity as the management of vendors can contribute to resolving the conflict shown in Figure 2.

As described above, it can be confirmed that the introduction of customer orientation is likely to solve many problems occurring in a project. Figure 3 shows the cooperative structure between the vendor program staff and a project manager under the structure of PPPM.

5. Conclusion

The consideration and proposal of this research are intended to seek empirical and theoretical support through research related to customer orientation, based on empirical research analyzing and considering cases in which vendor staff participating in a customer's PgMO contributed to project success. The previous research by Sekiguchi and Seki (2016, 2016a, b) proposed letting vendor staff participate in a customer's PgMO and verified the benefits to both customers and vendors, that is, they verified the business effect in both parties. This research further solves the problems at the

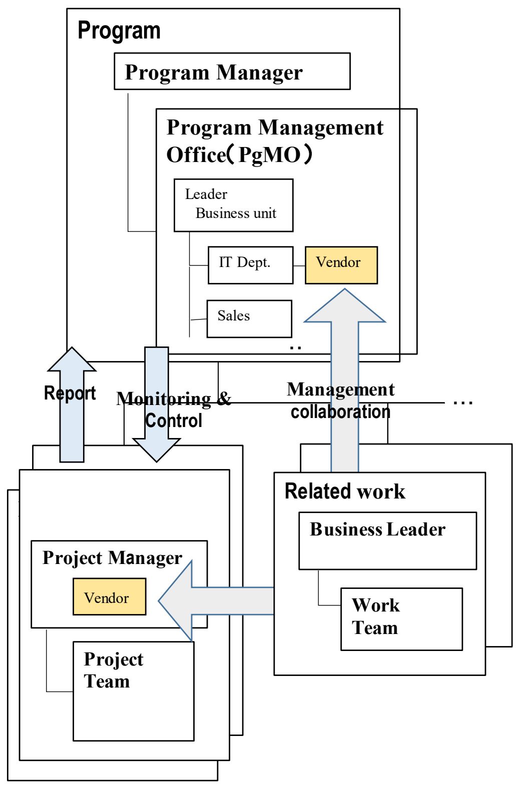

Figure 3 Collaboration through vendor staff between customer PgMO and project

project level, and it is confirmed that the structure of the proposal of Sekiguchi and Seki (2016, 2016a, b) is effective for solving the problem under PPPM. In addition, it is shown that customer orientation is effective and necessary to secure and enhance the motivation of personnel participating in the proposal of Sekiguchi and Seki (2016, 2016a, b), and it consequently increases the profits of vendors.

Meanwhile, the introduction of program management is not necessarily common in Japan. The lack of practices that organize PgMOs and promote programs is an obstacle to understanding the proposals of this research. The understanding of PPPM has progressed globally, and the introduction of program management is becoming common. Promotion and dissemination of program management in Japan is also expected to improve the success probability of projects and to overcome global competition. When considering project success, it is easy to understand that the probability of success increases not by considering only the project but by viewing from a higher perspective.

Acknowledgements

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Reverse globalization –Impacts and opportunities in IT outsourcing industry

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Current trends in global socio-economic environment are clearly indicating towards a significant turn-around in the way globalization was looked upon till recently. This reverse globalization that was arguably initiated by Britain exiting from European Union (BrExit), followed by populism approach taken by newly elected president of United States of America and later endorsed by Australia & New Zealand by declaring visa restrictions to IT engineers. Such reforms are bound to bring significant changes in the way recent markets have been practicing for past few decades. Effects may be different on countries that are outward looking (export oriented) from those which are focused internally (domestic market) till now. The effect may also vary depending upon the in-house capabilities required for self-sustenance by any country. On the other side, these changes might bring lot of opportunities if carefully observed and acted upon in timely & effective manner. IT outsourcing has been a key contributor in establishing and spreading global business environment in past three decades. Therefore, now it is inevitable that the same industry will witness the maximum impact of reverse globalization.

This paper presents a fact based analysis to predict major effects of reverse globalization on IT outsourcing industry. It will also describe likely opportunities in this industry given a new business ecosystem.

Keywords and Phrases: Globalization, Outsourcing, Opportunities, Socio-economic changes, reverse globalization

1. Introduction

In last 3 decades global business has taken new dimension of growth where businesses across countries has increased tremendously moving from not just trading raw material or produced goods but also service outsourcing business has grown manifold. The services that are commonly outsourced are IT Support, IT Security, Back office activities such as accounting, insurance, data processing and Business process outsourcing.
As the Figure 1 depicts, the global market size of service outsourcing increased from 45.6 billion USD in 2000 to 104.6 billion USD by 2014 where the growth curve was almost always steadily upwards.

With time, service outsourcing industry has matured in terms of both process and customer acceptance perspective. Today such is the maturity of offshore IT services that it is almost eccentric if a company outsources certain IT services to an onshore location or keeps it in-house. Businesses can receive services from all corners of the world, with different advantages. Refer Figure 2 for a glimpse of major flow of service outsourcing globally.

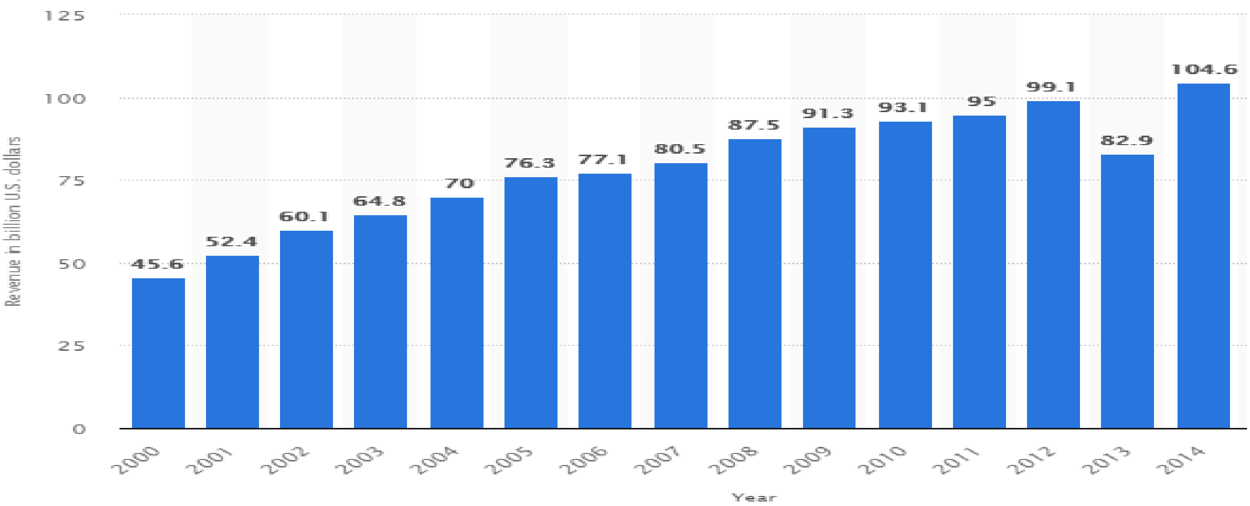

Figure 1 Global market size of outsourced services from 2000 to 2014

As depicted in Figure 2, around 80% of the outsourcing requirements are generated from US, UK/EU and Australia. Therefore, any change in business strategy in these countries will have major impact on global IT outsourcing industry.

While many countries like China, Vietnam, Philippines and Romania etc have established themselves as key contributor in IT outsourcing business but India has pioneered this securing more than 55% of worlds' total outsourcing business. India has continued to hold onto its leadership position for more than 15 years. Therefore, India has been considered as a representative of IT outsourcing destination for the purpose of this paper.

2. Recent events indicating threats to globalization

Incidentally, last couple of years has witnessed some major events globally indicating a trend away from globalization. Some of the major reasons for such reverse globalization include low employment in outsourcing countries themselves or political situations generated by socio-economic background in these countries

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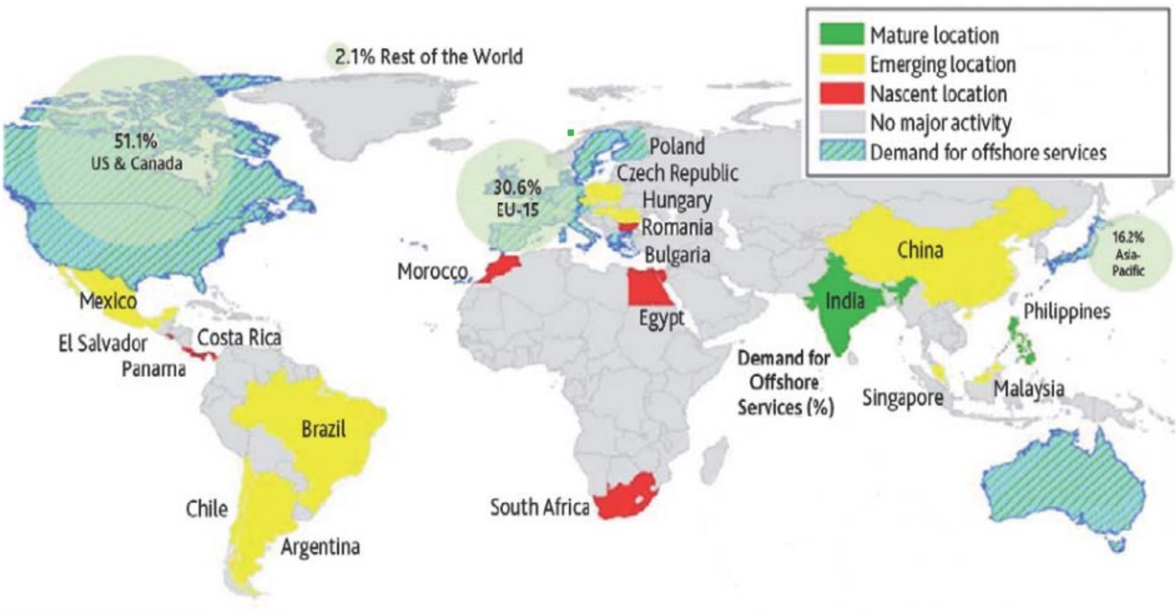
2.1 UK's exit from European Union (BrExit)

Europe is the second-largest market for India's IT outsourcing industry generating around 30% of its revenue. Out of which typically 17 per cent is from the UK and about 11.4 per cent from other nations within the EU. For large Indian IT companies, over a fourth of their revenues come from Europe, in particular from the UK.

Many IT companies have their EU headquarters in the UK and use the country as a gateway for business across the EU. Some 800 Indian IT companies currently have exposure to the UK, and employ around 110,000 people there. However, UK's exit from European Union has disturbed the economic equation leading to a falling pound vis-à-vis dollar and the Indian rupee ratio.

Currency has always been a wild card for the IT sector. Wild swings in the pound vis-à-vis dollar and the rupee, will also impact revenues and profits for Indian IT companies. With pound depreciating sharply around 20% against INR over the past year touching its 30 years low, has caused revenues of Indian IT companies under pressure. This can reduce cost arbitrage for companies outsourcing to the UK.



Source: CGGC, Duke University based on data from Everest and Datamonitor

Figure 2 Outsourcing of services from various geographies

Major challenges for Indian companies could arise not only from the volatility of the British pound, but also further uncertainty about future policies between the UK and Europe, and changes in financial and banking systems.

As decisions regarding Britain's terms of exit get worked out, decisions regarding large projects could get postponed. Further any negative impact on the British economy in terms of slower growth or worse, could reduce opportunities for Indian companies in UK.

UK has always acted as a gate pass for Indian companies to access the European companies. It is more because of the access to financial markets in London and ease of doing business with Europe from UK. Indian IT companies may need to establish separate offices and hire different teams for the UK and the EU after the fallout, putting heavy expenditure burden on IT companies in the near-term

Indian IT industry has already started gearing up to handle further impacts. There could be a “decline in the value of the British pound, which could render many existing contracts losing propositions unless they are renegotiated,” Indian IT industry body NASSCOM said in a statement. “The uncertainty surrounding protracted negotiations on the terms of exit and/or future engagement with EU could impact decision making for large projects.”

2.2 Changes in immigration policy by USA, Australia and others

USA has been global leader to create and nurture outsourcing model. It creates more than half of the overall outsourcing business. A report from National Science Foundation mentioned that 950,000 scientists and engineers of Indian origin were supporting USA in 2013. Additionally the Philippines and China contributed 465,000 and 438,000 workers respectively.

However, newly elected USA President Donald Trump’s policies to protect the US economy will adversely affect the outsourcing industry. Trump has clearly declared that all the policies on trade, taxes, immigration, foreign affairs will be targeted to benefit American workers and families. The promises made by Trump in the election campaign, which shook the world are as follows:

- Penalizing the companies that will move their work offshore by heavily taxing them
- A cultural environment favorable for excluding the companies keeping their work offshore will be developed
- Major changes in immigration laws will challenge the prevalent labor outsourcing model which presently utilizes H-1B and L-1 visas for landed, in-country outsourced resources.

The biggest beneficiaries of H-1B visas (combined all skills) are Indians, followed by the Chinese. In 2014, 70% of total H-1B petitions approved were from Indians. Nearly 86% of the H-1B visas issued for workers in computer occupations go to Indian workers.

Figure 3 GBP to INR chart indicating fall in GBP post BrExit

Another expected change in rules is the doubling of the minimum salary of H-1B visa holders to $130,000.

If the above-mentioned policies are strictly imposed then the outsourcing model will become much more expensive, hence unattractive.

On similar lines, Australia has also abolished a popular work visa. The programme known as 457 visa allows businesses to employ foreign workers for a period of up to four years in skilled jobs where there is a shortage of Australian workers. This visa is used by over 95,000 foreign workers. The majority of the visa holders under this category were from India, accounting for almost a quarter of the intake, followed by the UK and China at 19.5% and 5.8 % respectively.

This visa has been abandoned with intent to tackle the growing unemployment in the country and so to protect jobs of Australians. Australian Prime Minister explained the decision - "We are an immigration nation, but the fact remains: Australian workers must have priority for Australian jobs, so we are abolishing the 457 visa, the visa that brings temporary foreign workers into our country".

Needless to say that such policy changes from prominent outsourcing countries will force India's software services industry that is already facing pressures on profitability and revenue, to make fundamental changes in their business strategies.

3. Possible opportunities from reverse globalization

In such situation, companies may become unwilling or unable to continue to do business under the current status quo conditions. It would no longer be politically acceptable for them, and their existing work based on the labor arbitrage model would become increasingly more expensive and therefore less attractive.

The alternative is to turn to the new business models accompanying the new technologies in the market today.

3.1 Faster adaption of new technologies and collaborative tools

Companies would tend to adapt new technologies that enable seamless and efficient development methodologies to reduce their dependencies on large talent pool. They will accelerate their adoption of robotic process automation (RPA) and cognitive technologies. They would move further into a software-defined world and move infrastructure and apps into cloud and SaaS models.

Enterprises would accelerate adopting DevOps models, which utilize small services teams located next to business units rather than large factories of talent offshore.

There are a set of disruptive capabilities in technologies such as automation, analytics, cloud and cognitive computing, which companies have been experimenting with for some time. These technologies are now at a stage of maturity where they can support a completely different volume and level of work and capable of driving a different business model.

However, the services market is constrained because many large enterprises are not confident about adopting the new business models that accompany these powerful technologies. These maturing technologies that are capable of changing the world are sitting in the wings, but not being largely adopted till date because

(a) service providers find them threatening and do not want to change their business models and

(b) their customers are not yet comfortable with the new models.

New economic scenario may cause this to change. In doing so, their actions would create credentials for the new business models and make enterprises more comfortable with them.

3.2 Evolution of new business delivery models

Outsourcing service providers will significantly increase their functional capabilities in key process areas and build better organizational change management capabilities. They will thrive harder to move up the value chain in their service offerings by taking more responsibilities in overall business partnership model. Some of these models will move away from staff augmentation to more overlapping models like turn-key projects or partnering through risk-reward sharing kind of relationships.

Turn Key projects

Service companies may become more aggressive in fetching business by taking more responsibilities/stake in projects. They may move from traditional time & material (T&M) model to fixed price model guaranteeing delivery within stipulated time at a fixed cost with assurance on quality.

Some of the big outsourcing companies in India have already started reaching customers with proposals that own complete transformation in the way enterprise are working presently.

Such models require minimal regular interactions with customers. A small team of business analysts visits onsite to study the existing system, prepare a transformation plan in consultation with customer and finalize contract. Subsequently, the entire development is done at offshore which also performs reasonable extent of testing also at offshore on simulated test environment. Finally, a QA team again visits onsite to perform system testing and ensuring user acceptance testing. Output is assessed in terms of value delivered.

Intent is to reduce onsite presence and hence not just reduce cost but also ease out development process for customer as they save on regular reviews and communication overhead while still protecting their interests. It also enables the service outsourcing company to independently execute their commitments as per their best abilities without micro management from customer.

Risk reward sharing

Some of the companies may be open to a more intense partnership into exciting IT collaboration opportunities. They may want to share the initial investments and in return expect a share in the benefits, subsequently. Such models can be a win-win proposition for customer also as it reduces upfront investment (read risks) on their non-core business function, i.e. IT.

Moving from projects to reusable Solutions

Outsourcing service companies are also already assessing a model to move from project based business line to product/solution based business line. They are keen to identify and develop common platforms and/or solutions that can be quickly customized to cater to multiple customers.

Such one-to-many offerings will optimize overall software development volume by effectively utilizing carefully crafted common platforms/solutions.

Their vast awareness of various industries and their common respective needs enables such IT outsourcing companies to conceptualize very effective solutions that are surprisingly useful across industry.

3.3 Abundance of skilled engineers

Despite of above measures, any strong shift from globalization by major contributing countries like US and Australia will impact outsourcing industry at least in short or mid-term. This will lead to reduction of outsourcing business and hence availability of high skill engineers. This might create an environment in outsourcing countries to become even more attractive in terms of cost benefits.

Countries in other parts of the world like Japan and Europe can leverage this opportunity to take maximum benefit out of this situation.

Need of trained man power in USA/Australia

While USA and Australia’s policy changes are to facilitate insourcing IT jobs to their respective citizens, but in present situation there will be a huge gap between demand and supply in these countries. It will create a dire need of skilling potential employees which may open a new business opportunities in the area of education and trainings.

3.4 Evolving Socio-politico- economic changes in EU may create new opportunities

With UK exiting from EU, new business centers may evolve in EU. Germany and France have already started positioning themselves through their huge economies driven by large presence in industrial, automobile, energy, aerospace sectors clubbed with strong leadership. New power centers in EU will create a new socio economic situation. In this journey, they may be willing to adapt globalization more openly creating new opportunities going forward.

On the other side, in the longer run, BrExit could help strengthen India-UK economic relationship as the UK seeks to compensate for loss of preferential access to EU markets.

Additionally, with the UK less dependent on intra-EU immigration into the UK, it could become more open to high-skilled immigration from other non-EU countries including India.

4. Conclusion

The economic ties that were bonding different parts of the world, through closer business relationships expanding from goods to service business, are observing a threat caused by nationalist approach of some the key players who were contributing to the globalization the most till recently. This has led to a new socio-economic situation that the world is going through these days.

New power centers might evolve from this turmoil. Some of the key players of global service outsourcing countries might need to change the way they have been doing business traditionally and adapt advanced technologies to add better value to the business. The new technologies and business models present an opportunity to not only maintain the cost basis they achieved through labor arbitrage, but they could potentially further reduce costs.

Such changing business scenarios in one part of the world can be effectively leveraged by other countries that have not been directly associated with these changes. They might find abundance of skilled resources that are willing to adopt new business models and embrace new technologies, probably at a more favorable cost.

Despite of many recent decisions that prima facie look quite strict, it still seems to be positive opportunities for the entire world to improve the way businesses are happenings by adapting advance technologies and brining each other closer in long term may be with different equations amongst each other.

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Learning Environment Design in Home Education

-Report Introducing Lessons Learned System Design-

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The Ministry of Education, Culture, Sports, Science and Technology aims to improve the educational power of the family, suggesting a direction regarding home education. The reason is that home education is the start of educational projects that people who are the starting point of all education. The circulation of the PDCA cycle model is necessary in education. Compared with the past, it can be inferred that the company receives substantial losses from the weakness of mutual help opportunities due to the decreasing of mutual help opportunities related to the dilution of the connection with the community and parenting. We implemented educational projects for parents who are the subjects of family education and introduced lessons learning management system through Lessons Learned System. We try to maximize the effect of family home education such as regional education, school, learning activity unit from individual family education.

Keywords and phrases: LLS, Elementary PM Education, Home education, Active Leaning,

1. Introduction

In this research, we clarified that PM experience can be utilized for home education. The LLS handled in this paper contributes not only to home education but also to school education. Due to the aging society with a declining birthrate, the number of children in downtown areas and rural areas has been decreasing year by year. Cooperation between schools, families and residents is necessary for the healthy development of children and the community. As a legal basis, in 2006 the Fundamental Law of Education was revised to meet the needs of the times. Article 10 was newly established for home education. Also, article 13 was established about the cooperation between schools, families and residents. Article 10 states that “while respecting the autonomy of home education, we must try to take measures to support parents' learning opportunities, information provision and other home education.” It can be interpreted that appropriate participation of public education is necessary to support home education.

Article 13 states that “schools, families, residents and other people involve must have an awareness of their roles and responsibility on education and try cooperation.” It can be interpreted that education is a project by not only schools but also families, communities and nearby companies. Therefore, we try LLS test cases in home education practice as the first step of the cooperation. As a sequel to (Hidaka,2016) he practiced based on knowledge of extracurricular lessons of elementary school life department. We propose “Two-Active Learning” (hereinafter called "Two-AL") model for PM education on family education and consider the scope of LLS adaptation and issues on PDCA cycle. Two-AL model is a model in which parents and children each perform AL. It makes sense to convey awareness through interactive AL. LLS uses it to knowledge awareness. The visualized knowledge contributes to the process of commitment in school education, which is an element of home education.

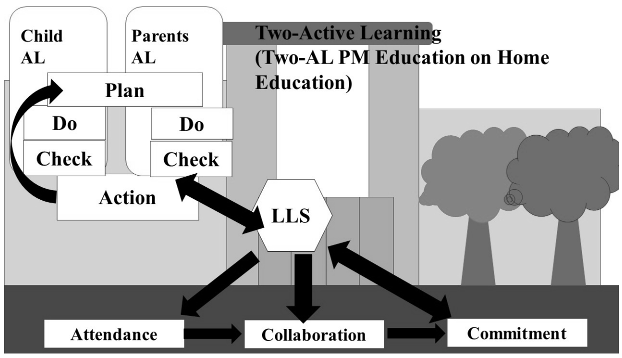

Figure 1 Commitment process of Two-AL LLS Model

2. Research Background

2.1 Home Education Systems

In this paper, we organize home education. Home education was practically promoted after the revision of the Education Basic Law in 2006. The term "home education" was clearly written in 1995 (Central Education Council,1995) "About the way of education in Japan that outlooked the 21st century". Among them, it is clearly stated that "In education in the future, we attach importance to foster 'Ikiruchikara' through school, family and community".
'Ikiruchikara' is the educational purpose which published in the inquiry of the Central Edition Council in 1996 for the first time. Ministry of Education says it is the force, which is necessary to survive modern society, balanced three abilities: academic ability, humanity, and healthy body. There is the word in the next course of study. As home education in the future, "it is home that assumes the ultimate responsibility for children's education and personality formation." "Home education develops the fundamental ability of 'Ikiruchikara' through communication with family members, and is the starting point of all education". (Kimura,2017) explains that "modern family have a sense of crisis that children cannot receive enough education to make lifestyle habits, foster a sense of self-respect and keep a balance between mind and body" as a reason why administration of education promote home education.

Companies also must understand about home education correctly. Many companies can contribute to the support for home education. (Central Education Council,1995), the ministry of education requests companies to appeal for fathers to have a responsibility of home education and for companies to cooperate. As a measure to improve them, it presents some support and promotion of father's participation in home education such as providing learning opportunities for home education in the workplace.

This draft of a report was made twenty years ago, however, there are still few cases that companies independently participate, support and promote home education. About this, there is room for discussion on practical cases in SIer enterprises, but we will consider it at another opportunity. To improve home education, we mention in a tripartite cooperation between school, family and community.

2.2 Three-party Cooperation in Home Education

Fujii insists about the purpose of tripartite cooperation between home, school and community. He said that "Although we allotted roles to home and community, the ability of education did not make progress. It is important to address the issues which caused the expansion of the educational function undertaken by school such as the decline in the educational power in home and community." The report by the Central Council for Education and the Curriculum Council also said that "the educational power in home and community did not improve enough." We consider the tripartite cooperation between home, school, community from the case of regional activity through elementary school. The Ministry of Internal Affairs and Communications describes the usefulness of the school utilization model as a project manegement of local activity. It said that "community has some interests; however, people tend to band together for children who hold the community and they communicate actively." At Shakanai primary school in Odate city, Akita prefecture, the project began in 2010 and established an executive committee organization to expand without burdening of teachers and patents, and the collaboration with local groups was realized quickly.

In the case of the elementary School in Naha City, Okinawa Prefecture, they involved community in the PTA activities, encouraged community to participate in the activities. It is said that realizing PTA activities that allow residents who are not parents of children to participate contributed to regional cooperation.

Figure 2 Certificate of appreciation to the people of the area by students of Syakanai elementary school

In addition, as the accumulation of activities of the PTCA organization, comprehensive regional sports clubs which take responsibility for facility management and so on. It was reported that community independently took over some functions which was fulfilled by schools before. Hayashi asserts the model "Attendance", "Collaboration", "Commitment" as a role by participation in the learning community.

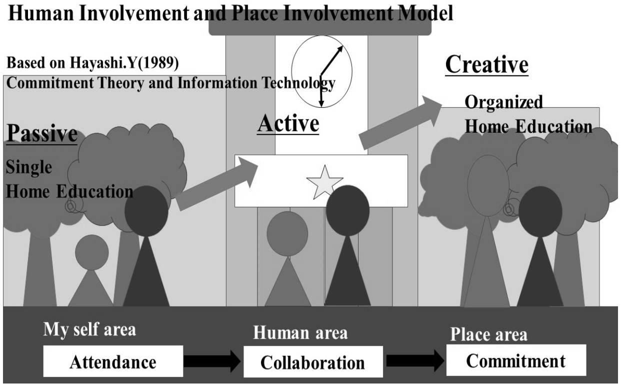

Figure 3 Human involvement and Place Involvement Model. (Based on Hayashi,1989)

Based on successful examples, we infer that sustainable community has developed because newcomers changed their roles from peripheral jobs to central jobs and learned to revitalize schools and regions. Particularly, school which is the base of regional revitalization always have people joining and leaving. Therefore, it is indispensable to build the system and to have “key persons” for continuous activities.

'Key persons' exist in schools, administrative districts and regions, and the close collaboration leads to effective effort. In the case of Shakanai elementary school there are two key persons: the headmaster and PTA president. In the case of Ama junior high school, college students who sympathized with the lecture are listed as key persons. The process of key person’s participation did not exist from the beginning of the project. Therefore, changing roles from peripheral tasks to central tasks matched the model that Hayashi maintained.

Accordingly, the approach from orthodox peripheral participation theory claimed by (Lave and Wenger,1993) is useful in discussing the evolution process of the community towards regional activity. We think about learning knowledge and skills through activities that revitalize school and community and contextual learning about practices that can revitalize the region. It means that regional community of school revitalization is practical society. These things show that members who take part in extracurricular actives aiming to study not only become full participation or legitimate peripheral participation but also leave community. Fig.3 shows the members who participated in community of practice relate to school and regional society. Even if they do that, it isn't permanent. Far from it, many of them break with that. Because school has the system of graduation, participants leave community at the timing. Therefore, transmission of knowledge isn't perfect. That's why, we think that we utilize the knowledge of PM education for not only home education but also school education and extracurricular actives.

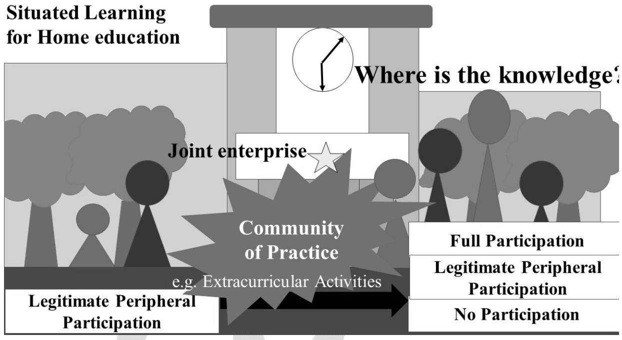

Figure 4 Situated Learning for Home education

2.3 Limit of School Education

There is a limit of education that can revitalize the region, even if we made a public cost investment such as application recognition for activation. Thus, there are many failures as well. (Kubo,2015) insists that in a small-scale accredited school, it cannot be used by only children whose home have a certain degree of economic and cultural environment. On that basis, it has been pointed out that if the school give a prejudiced special education, it becomes the school where children living in the area cannot go to. This is a useful suggestion for realizing regional activity through schools.

Shinohara claims that to activate school aiming at regional activity, we carry out the management not only within schools but also school district society. Although we are talking about agricultural village as a case, it is difficult to make teaching materials from regional resources as a strategy because teachers are not always growing up and living in that area. It can be pointed out that teachers do not know about the area and the indication like this can occur in any region. It is claimed that it will fail to bring from other areas just by packaging " individual lessons", "introducing after school activities" and "expansion of primary school English". Therefore, even if education packaging, management education, and educational measures on the area are implemented on the sides of the school and teacher, it leads to a busy school work burden, and as a result, educational opportunities and educational value for children and parents can be declined.

3. For Sustainability in Home Education

In the previous chapter, we discussed the current state of school and community in implementing home education. In this chapter, we will discuss the probability of permanence in implementing home education. Collaboration with the community is indispensable to implement home education. Implementation of systemization is necessary for smooth realization.

Fujikawa argues that to solve social problems caused by modern education, it is important to secure collateral for high quality educational opportunities without imposing a burden on some participants. Revitalization of region makes heavier demands on people in the area and the continuation becomes difficult, then it will stray from the main topic. To solve these problems, it states that the practice that both community and school can take an advantage is desirable. Based on these facts, this paper argues that parent and child but not school should implement it. Parents and children focused on the characteristics of the school lifecycles that switch simultaneously from residential areas or other areas. There is a possibility that knowledge may be passed down as a "Community of Practice" by practicing education that provides benefits to both parents and children. The revision of the Guidelines for the Course of Study in elementary school and junior high school shows a possibility toward transmission of the knowledge.

Parents and children focused on the characteristics of the school lifecycles that are switched simultaneously from residential areas or other areas.

There is a possibility that knowledge may be passed down as a “Community of Practice” by practicing education that gives benefits to both parents and children. Implementing an educational model for home education that has advantages for both children and guardians should implement practices that contribute to the development of home education after implementation of educational models for teachers and communities.

4. Revision of Guidelines for Teaching in Elementary and Junior High School

4.1 Reason for Revision

About the reason for revision the guidelines for teaching, (MEXT,2017) says that “children are hoped to be supporters having great creativity to make sustainable society based on the Fundamental Law of Education or the School Education Law and make use of education practice in Japan. We try to develop children’s ability to live in the predictable future society which changes quickly, and take part in the formation of society. In doing so, we emphasized ‘societal educational curriculum’ to share what ability is asked for children with society and cooperate.”
That is, we should implement an educational curriculum that matches the modern society.

4.2 Realization Measures in Revision

Realization of the “subjective, interactive and deep learning” to enhance the ability of understanding knowledge is clearly stated. Specifically, it is shown below.

1. Clarify what “will become possible” The goal of the subject was brought together to three points
Point1 Knowledge and skills
Point2 Thinking ability, judgment ability, expression power, etc.
Point3 Power to learn, humanity, etc.
With these three points, let 's visualize what you can do.
2. Improvement of class towards subjective, interactive and deep learning
"It is important to improve the quality of understanding students' knowledge by revitalizing improvement of lessons based on the accumulation of educational practice and develop the abilities required in the future. Therefore, it is not necessary to introduce completely different teaching methods in elementary and junior high schools. We try to take over the accumulation of educational practice and improve in teaching way according with the actual conditions of children and the contents of textbook.” It is required to realize subjective, interactive and deep learning, on the other hand, we judge that the idea that we should improve based on previous lessons.

4.3 Main Improvement Items of Education Contents in Elementary and Junior High School

Six things about educational contents of

elementary and junior high school are improved.
Point1 Fostering certain language ability
Linguistic activities by experiment reports in each subject
Linguistic activities through discussions that clarified their position and grounds
Point2 Fostering information utilization ability
Introduction of programming education in elementary school
Point3 Enhancement of science and mathematics
Increase number of class hours by 20-30%
Collect and analyze the data and resolve issues based on trends.
Expand contents about statistical education and natural disasters
Point4 Enriching education on tradition and culture
Enrich guidance of Japanese language culture such as classics
An understanding of major cultural assets and annual events in the prefecture
Enrich guidance on local music, Japanese musical instruments, martial arts, Japanese food and Japanese clothing.
Point5 Enhancement of experience activities
Emphasize the experience of staying in a group and workplace experiences in nature
Point6 Fulfillment of foreign language education
In elementary school, “Foreign language activity” is introduced in middle school year, “Foreign language department” in high school year

4.4 Relevance to Home Education

There is a great affinity between educational practice of amendment of the guidelines for teaching and home education. It can be inferred from the direction returning to the community and constructing an informal network. On the other hand, parents do not realize enough about the support for home education. Therefore, we will organize the support for home education.

It is backup what the support for home education. As the committee on the promotion policy of home education support discussed, it focuses mainly on the establishment interactive relationship between some players. There are four types of home hold education support organization.
Point1 Comprehensive type (Hashimoto City, Wakayama Prefecture)

Various human resources will support the expertise and network.
Point2 Course type (Chiba City, Chiba Prefecture)
“The support team for home education” go and give lectures with school events or PTA activities, support team” will go over, give lectures and courses, and provide opportunities for parents to learn about home education.
Point3 Base type (Ishinomaki City, Miyagi Prefecture)
Provide a place where parents can learn parenting and parents and children can enjoy activities together. Parents can exchange opinions with home education support team members.
Point4 Visiting type
After confirming collaboration according to the case meeting, a member of home education support team visits the home and consults troubles concerning child learning.
To form a home education support team,
STEP1 Find human resources in a community
STEP2 Training leader
STEP3 Construction of operating system
STEP4 Formation of team
It goes through four steps.

In this paper, we give PM education which is recognized by human resources in a community who is the preliminary step.

4.5 Affinity with PM Education

PM education gives a very useful suggestion for improvement items accompanying the revision of elementary and junior high school guidelines for teaching. Training of information utilization abilities should not make sense just doing programming education and should consider programming education as PM education. In addition, the knowledge of PM education is useful for improving matters such as reliable development of language ability, improvement of science and mathematics education, and improvement of experiential activities. Contributing to public education as a cross-cultural learning activities through knowledge of company and PM experience will contribute to public education, community and home education support.

This time, among PM education, we implemented LLS education program, made sure parents were informed and inspected effectiveness.

5. Implement PM Education

5.1 What Is LLS

LLS stands for Lesson Learned System

(hereinafter called "LLS"). (JICA, 2014) proposes that LLS is the system that make the knowledge process of lessons and the process of utilizing the lesson of PDCA cycle on the projects.

In general, it is called a lesson learning management. It is the system that the predecessor who carried out the project and leaved experience and retrospection as a moral for the successor.

In this paper, we carried out it through the extracurricular learning activities of parents and children using LLS. In Fig.5, reflection after AL was made to function with LLS. In consequence, it is built as knowledge.

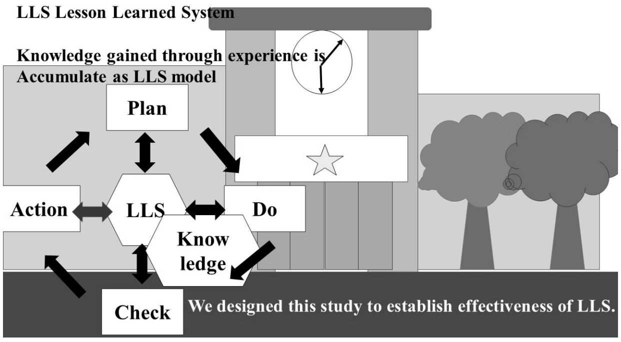

Figure 5 This time LLS model

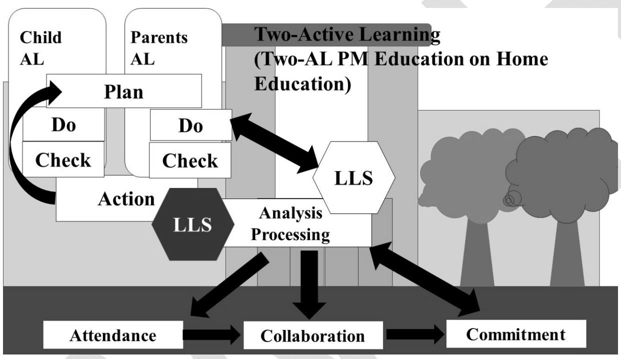

Figure 6 Two-AL LLS model

In FIG. 6, a model in which Two-AL is operated as a PDCA is shown. Reflection is analyzed through LLS. In consequence, it contributes to Commitment process. This paper is reflection that has reached LLS.

5.2 Practice Overview

The experimental procedure is as follows.

Step1 Planning for Two-AL(Plan)
Step2 Implement for Two-AL(Do)
Step3 Document reflection for Two-Al(Check)
Step4 Analyze the document for Two-AL(Check)
Step5 Get noticed from LLS(Action)
Step6 Leave knowledge to LLS(Action)

5.3 Practice Overview

We distributed and explained LLS in the cookie workshop conducted in the previous year to parents and children, and conducted similar practices.

Date and time at the end of July 2017
Participant 5 homes (mother friends) 5 parents, 7 children

In the previous year, to promote more concretely, from a thing that was done by a single family, I practiced it in a community called Momma friend. I especially asked for their father's participation, but this time they did not participate us.

6. Result

6.1 Parent-child Type Experimental Quantitative Evaluation

In the questionnaire after the experiment, all the guardians rated at the best against 5 samples(n=5). About the time, I got the answer that it is appropriate, and searching for the optimum time is needed to use ICT efficiently in the future. Regarding the implementation time, there were many parents who replied that it is suitable to play not only at night but also in the next morning. To balance their housework and childcare, we must consider a reduction in working hours. Retrospection contributes greatly to the guardians, it is useful to make a document and to keep it as a visualized material.

6.2 Parent-child Type Experimental Qualitative Evaluation

In this paper, we collected comment data and tried analyzing. It has become clear that tends to emphasize the process such as progress and effort more than the term of grades or test. Details will be announced in PROMAC 2017.Natural language processing was performed on the comment data.

6.3 Parents' Practice

About the learning of children, they only saw the result of the grades and tests, and they did not see the progress. However, by introducing this program, they began to pay attention to the progress.

6.4 Child-to-child Practice

Among children, the effect of LLS was small. This is because they cannot understand the documents made from experiences in the developmental stage. Therefore, interactive LLS of parents / children is preferable to between children.

6.5 Knowledge Lore by LLS

We will edit the LLS that was compiled last year and this year and prepare the next year. For that purpose, it is indispensable to utilize ICT, and we will prepare for some open system implementation.

7. Conclusion

In this paper, we divided home education into parents and children and conducted research through educational practice. In discussing home education, we organized realistic problems of schools and communities that are components. As a result, we will review issues between school and community after practicing home education with the basic group which is composed of a parent and child. PM education for parents and children greatly contributes to ‘ikiruchikara’. It is obvious from the fact that it is demanded the ability to open the future by subjective, interactive and deep learning. In this paper, we experimented the TWO-AL model using LLS which we can try the subjective dialogue through experience, even in PM education. As a result, the effect became clear to the AL on home education of parents and children. There was no effect in the case of the practice to children. This is because they did not realize the self-understanding in their development stage. Therefore, as an alternative plan, it is preferable to practice by the interactive LLS between parents and children. Also, we realized PDCA cycle through home education support according to the practice for two years. We assume that we can design 3S, 'scheme', 'system ', 'service ' model scenario through a long-term vision. LLS model has great effect not only on home education but also on school education in the future. About the collaborative learning environment design in home education, we need to consider not only a single project but also cooperative program management with schools and regions.

As the future issue, it is necessary to make an experiment of Two-Al model but not of One-Al model. As an effective strategy for that, we must cooperate with SIer that has PMP holders and employees with PM experience. In addition, we will promote home education support and PM education development using knowledge and places owned by SIer.

Acknowledgements

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Consideration of the Improvement in a Development Organization Based on CMMI Process Diagnosis

Norihiro Kambara
OMRON corp.

An electric product development manufacturer is exposed to severe competition in these days. Thus, manufacturer is working on improvement of a development process every day for progress of the development efficiency and the quality. In OMRON environment division establishes and operating QMS (Quality Management System) based upon ISO9000, 9001. However, even if it is operating outstanding QMS, it is also a fact that defect is rarely come out after the sale, because of the limit of period and a human resource for reflecting many strategy changes from the market. Probably, at many development fields it is assumed that the general project management, such as progress management, issue management, and risk management are satisfactory performed. On the other hand, project monitoring and control, and configuration management are ready to perform sufficiently? We built up the hypothesis that the systematic weakness is in the latter portion. In year of 2016 our division determined to perform diagnosis SCAMPI (Standard CMMI Appraisal Method for Process Improvement) that is based on CMMI to analyze current condition objectively. Those results were considered as the input of future improvement activities. In this paper, the circumstances of carrying out CMMI diagnosis, the target process, the diagnostic result, and the improvement activities are introduced.

Keywords and phrases: CMMI, SCAMPI, Development, Process Improvement

1. Introduction

An electric product development manufacturer is exposed to severe competition in these days. To survive such competition, most of all manufacturers are working on improvement of a development process every day for progress of the development efficiency and the quality indicated by Kambara, N. (2016)

In Omron environment division, establishes and is operating QMS based upon ISO (International Standard Organization) 9000, 9001 indicated by ISO 9001: 2015. However, even if it is operating outstanding QMS, it is also a fact that defect is rarely come out after the sale , because of the limit of period and a human resource for reflecting the strategy changes from the market.

For example, a front-loaded delivery date is given for development from the strategic marketing section. In the development section, they can shorten a certification period by paying a limited express fare to a certification agency. However, in a system test, priority must be given to an examination required in order to obtain certification, and the whole comprehensive examination could be postponed. For that kind of irregular examination, product defect might flow out to the market.

2.1 Development issues and hypothesis

Actually, how many manufacturers are holding an ideal development environment and time period? Because the standard way of the quality control of software has not been established, various trials are done in each company. (Ogasawara, H 2010) In a lot of companies, it is thought that the common problem includes the problem in a current development process, and tries improving. Probably, at many development fields, it is assumed that the general project management, such as progress management, issue management, and risk management are satisfactory performed. On the other hand, project monitoring and control, and configuration management are ready to perform sufficiently?

We built up the hypothesis that the systematic weakness is in the latter portion. However, this is just a hypothesis, and although working on improvement of project monitoring and control, and configuration management, and if we couldn't get expected result, it will turn into a useless measure. Thus, a policy to prove this objectively is necessary by some kind of standard methodology. The activity to solve this is written in following chapter.

2.2 Choice of the methodology

In S/W development, CMMI (Capability Maturity Model Integration) and ISO/IEC15504-5 are generally used as model international standard specifications. (Anderson et al. 2012) As a common challenge for many companies, it believes that the problem in the current development process and are trying to improve. As one of them, the company which applies CMMI (CMMI Institute: 2013) is also increasing.

CMMI-DEV (CMMI for Development, Version 1.3: 2010) is well known model that is systematized the best practices from the daily use of concepts, principles and skills, techniques, tools, management know-how in the S/W development. As for CMMI-DEV, the ML (maturity level) may be written in the RFP (request for proposal) by the side of an order received to measure supply conditions for systems development.

Therefore, level acquisition is thought as important in many cases. However, it is originally applied as the tool which is effective when one self does process improvement regardless of maturity level acquisition. In view of such an effect, our division determined to perform CMMI diagnosis to analyze current condition objectively.

3. CMMI Overview

There're 22 process domains are included in CMMI-DEV. (Table 1)

Table 1 22 Processes

ML	Name	Abbr	Domain
5	ORGANIZATIONAL PERFOMANCE MANAGEMENT	OPM	Process Mgmt
	CAUSAL ANALYSIS AND RESOLUTION	CAR	Support
4	ORGANIZATIONAL PROCESS PERFORMANCE	OPP	Process Mgmt
	QUANTITATIVE PROJECT MANAGEMENT	QPM	Project Mgmt
3	REQUIREMENTS DEVELOPMENT	RD	Engineering
	TECHNICAL SOLUTION	TS	Engineering
	PRODUCT INTEGRATION	PI	Engineering
	VERIFICATION	VER	Engineering
	VALIDATION	VAL	Engineering
	ORGANIZATIONAL PROCESS FOCUS	OPF	Process Mgmt
	ORGANIZATIONAL PROCESS DEFINITION	OPD	Process Mgmt
	ORGANIZATIONAL TRAINING	OT	Process Mgmt
	INTEGRATED PROJECT MANAGEMENT	IPM	Project Mgmt
	RISK MANAGEMENT	RSKM	Project Mgmt
	DECISION ANALYSIS AND RESOLUTION	DAR	Support
2	REQUIREMENTS MANAGEMENT	REQM	Project Mgmt
	PROJECT PLANNING	PP	Project Mgmt
	PROJECT MONITORING AND CONTROL	PMC	Project Mgmt
	SUPPLIER AGREEMENT MANAGEMENT	SAM	Project Mgmt
	MEASUREMENT AND ANALYSIS	MA	Support
	PROCESS AND PRODUCT QUALITY ASSURANCE	PPQA	Support
	CONFIGURATION MANAGEMENT	CM	Support
1			

Confirm Some SG (Specific Goals) by case

Confirm All SG and GG (Generic Goals)

3.1 Two Types of Representation

CMMI shows an improvement process to the matured process which was two different representations such as staged and continuous. It's possible to get approach different in process improvement depending on this. (Table 2)

Table 2 Two Types of Representation

Level	*Continuous Representation Capability Levels*	*Staged Representation Maturity Levels*
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4		Quantitatively Managed
Level 5		Optimizing

The "Staged Representation" shows the improvement course that focused on an organization maturity degree with "a maturity degree level" set for the meeting of predefined plural process domains. The "Continuous Representation" shows an improvement course enabling the flexible action that focused on the ability of the process domain with "an ability level" to be set about each of that an organization chosen process domains. Most of the model contents in CMMI are common in both representation, and equivalence is secured, so it's possible to use both representations in one organization without confusion. (Igarashi, S 2009)

3.2 SCAMPI Overview

SCAMPI (CMMI Institute, Standard CMMI Appraisal Method for Process Improvement (SCAMPISM) Ver.1.3a: 2013) is a method which execute appraisal by using CMMI model. Appraisals with the CMMI model shall conform to the content that is defined in the ARC (Appraisal Requirements for CMMI) but SCAMPI has satisfied all requirements of the ARC. SCAMPI also can support evaluation which fits in with ISO/IEC15504 of international standards.

An important concept for the SCAMPI is points to a defined type of objective evidence. In SCAMPI appraisal, it is possible to make the "Strengths" and "Weaknesses" of an organization process correspond to a CMMI model, and to obtain the discernment to the capability of an organization. Objective evidence to verify the practice is defined as a "Practice Implementation Indicators".

3.3 SCAMPI Execution Policy

A policy has been decided as follows.

Purpose: Analyze the present conditions of the development objectively and assume the result for input of the next improvement activity.

Principle: On the basis of CMMI, express the gap with the model as findings.

Interview Team organization as follow.

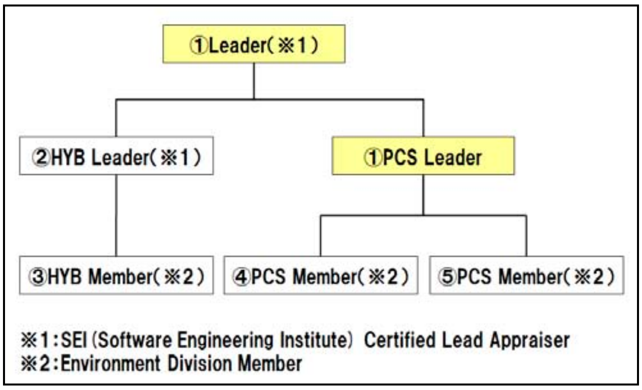

Figure 1 Interviewer team organization

Interviewees are described in Table 3. Totally, 16 members are cooperated from 2 development theme.

Table 3 Interviewee Matrix

Specific Appraisal Responsibilities	Person	
	Theme1	Theme2
Product Manager (MM)	TO	HO
Group Leader and Project Leader (PL)	TS	TR
System Requirement Development and Testing (RD)	NK	-
Component E Development Leader (CEL)	MK	TR
Component-E Development and Testing (CEP)	-	AA
Component-M Development Leader (CML)	KS	KM
Component-M Development and Testing (CMP)	-	BB
Component S Development Leader (CSL)	CH	NK
Component-S Application Development and Testing (CSP)	KK	KK
Component-S Controller Development and Testing (CSP)	NI	-
Component SB Acquisition (CSBL)	IW	-

Interview target theme

- Theme 1 (HYB : Hybrid PCS)
- Theme 2 (PCS : Power Conditioner System)

Interview target process: 7 Process in ML2 and few processes in ML3 (by case) -> refer Table 1

A secret is defended. The personal information is closed. Theme information is also basically closure. Diagnosis is carried out with the diagnostic team and organizational collaboration. (Developer interviews, development product confirmation and preliminary review of a result) It is not audit (Not all gaps that must corresponded immediately).

3.4 SCAMPI Execution Procedure

Executed as following steps

1. CMMI DEV V1.3 training for Environment division members.
2. Diagnosis Preparation (Table 4)

Table 4 Diagnosis Preparation

【day1】
□ Process Diagnosis Initiative
□ Team Building
□ Site Orientation
 □ Standard Development Process
 □ Objective Theme Overview
 □ Role Confirmation
 □ Identify Risk and Countermeasure
【day2】
□ Diagnosis Lecture
 □ A.Introduction
 □ B.Team Building
 □ C.Method Overview
 □ D.Preparing for the Onisite
 □ E.Document Review
 □ F.Affirmations
 □ G.Practice Characterization
 □ H.Preliminary Findings
 □ I.Assign Appraisal Ratings
 □ J.Concluding Activities
【day3】
□ Final Preparation
 □ Document Review
 □ Interview Script Preparation
 □ Readiness Review

3. Kick-off by all members
4. Interview depend on schedule
   In each team, decide Interviewer and Secretary. Then, confirm contents each other.
5. Summarize result
6. Interim report
7. Adjustment (Re-interview)
8. Final report

4. SCAMPI Execution result

A result of the interview was written in the fixed script, and the theme team contents were shared and confirmed. (Table 5) This chapter describes qualitative evaluation (Strengths and Weaknesses) to each PA (Process Area). Depends on classified matter, I'll compose the results of some representative PA.

Table 5 Interview script

Supplier Agreement Management

SG/GG	Key Practice / Notes	Source of OE	Document (s)	Comments
SG1	***Agreements with the suppliers are established and maintained.***			
SP1.1	***Determine the type of acquisition for each product or product component to be acquired***			
ALL	Prepared questionnaire in Japanese.	Obtained answer.		
Machine	Prepared questionnaire in Japanese.	Obtained answer.		
Electric	Prepared questionnaire in Japanese.	Obtained answer.		
SW	Prepared questionnaire in Japanese.	Obtained answer.		
SP1.2	***Select suppliers based on an evaluation of their ability to meet the specified requirements and established criteria.***			
ALL	Prepared questionnaire in Japanese.	Obtained answer.		
Machine	Prepared questionnaire in Japanese.	Obtained answer.		
Electric	Prepared questionnaire in Japanese.	Obtained answer.		
SW	Prepared questionnaire in Japanese.	Obtained answer.		
SP1.3	***Establish and maintain supplier agreements.***			
ALL	Prepared questionnaire in Japanese.	Obtained answer.		
Machine	Prepared questionnaire in Japanese.	Obtained answer.		
Electric	Prepared questionnaire in Japanese.	Obtained answer.		
SW	Prepared questionnaire in Japanese.	Obtained answer.		

4.1 Requirement Management (REQM)

Strengths

1. By making arrangement with a customer and strategic marketing section, the requirements are understood in general.
2. A related document and a plan may be suitably corrected when requirement change.

Weaknesses

1. Requirements may be unable to agree till the end of development.
2. The bidirectional traceability between requirements and a product is not established.
3. The man-day of requirement management activity may not be managed at all.

4.2 Project Planning (PP)

Strengths

1. The scope of a theme has estimated by the whole system configuration and project WBS.
2. It may be planned how a development output is managed.
3. There have been eliminated the gap between the estimated and the resources available.

Weaknesses

1. Scale estimate which is a base for the development man-day is almost not documented.
2. The risk is not probed at the time of a theme planning phase.
3. The man-day of project planning activity may not be managed at all.

4.3 Project Monitoring and Control (PMC)

Strengths

1. The progress of a theme is confirmed to a plan.
2. The involvements of stakeholders are confirmed in the whole theme and each development part.

Weaknesses

1. Risk monitoring is not always implemented.
2. The confirmations of the planned output are not always monitored.
3. The man-day of project monitoring activity may not be managed at all.

4.4 Supplier Agreement Management (SAM)

Strengths

1. Determinations of contractors are made by selection and evaluation.
2. Agreements with the contractors are made by contract or order sheet that has written rules and outputs.

Weaknesses

1. Determinations of contractors are sometimes not documented.
2. The man-day of supplier agreement management activity may not be managed at all.

4.5 Measurement and Analysis (MA)

Strengths

1. EVM has been used as a quantitative measure to manage the progress of the theme.
2. The acquired data is collected and analyzed.
3. Data and analysis results are saved, that have been reported.

Weaknesses

1. The purpose of quantitive index is not clarified.
2. There is no clear definition for what to measure and not to measure in the theme.
3. The role for collecting and analysis of data isn't always clear.

4.6 Configuration Management (CM)

Strengths

1. The documents which should be created by a theme are specified in the document plan in a development process definition.
2. The documents reported when DR (Design Review) approved or product certification agency is generally provided as a baseline.

Weaknesses

1. It is not documented which outputs should follow under the configuration management.
2. The time to make a baseline isn't always documented.
3. It is not documented for the rule of changing outputs.
4. Configuration audits are mostly not implemented.
5. The procedure for operating the folder of a server as a configuration management system is not documented.

4.7 Institutionalization (Generic Goals)

Strengths

1. There're operational procedures such as DR or other related rules must be followed t to carrying out product development.
2. The role of the development section is indicated on a quality manual and a work flow document.
3. In the important theme, progress and conditions may be checked by the upper management in the weekly progress meeting.

Weaknesses

1. Training for a development management activities are not implemented
2. Project manager is not always attended for progress meeting, so that they can't participate for solving issue timely.

5. Summary of the results

As for tight schedule, the theme is managed by an individual's efforts and dense communication inside and outside of the theme. They are performing corrective action by each issue. On the other hand, construction of the systematic structure for whole theme development, including "Configuration Management" and "Measurement and the analysis" is insufficient.

In addition, operation of a theme is supported with a DR practical procedure systematically, however for each development (Machine, Electronic, S/W including vender) configurations are not visible from the outside and almost no support by an organization.

5.1 Issues derived from a result

After the final report, the team was discussed with a management layer and embodied issues in a development process as follows.

5.1.1 Requirement Management is insufficient

The date delivery is previously decided by the state where requirements are not decided. When requirements are changed, resource rearrangement is not fully performed. The person who is responsible for requirements determination process is unclear.

5.1.2 Configuration management is insufficient

The development output or documents are made clear in early DR stage, but the locations of the server, finalization activity and maintenance activity aren't managed appropriately. When transferring from a design section to a manufacturing section, baseline management is insufficient.

5.1.3 Low recognition of the Development Process

It seems that work flow of development, such as DR and other rules are not understood for members who is not directory related to particular theme. Strategic marketing section cannot be imagined the impact of requirement changes.

5.2 Organization improvement policy

According to our issues, followings are considered as high priority organizational improvement policies.

5.2.1 Improvement of Requirement Management

When the requirements are not determined or changing after the development started, influenced reworks are never been small. Therefore make requirements management certain by development section to reduce losses. Make discussion to determine requirement with related person by measuring followings.

-The number of requirement determination (definite rate)

-The number of specification (definite rate)

Proceed the visualization of requirement determination by creating a development road map and expressing the definite rate of requirement determination.

5.2.2 Improvement of Configuration Management

To make a rule for configuration management for objective documents as well as clarifying a transferring procedure. Apply the change management rule after a baseline has published. The state and revision history of a product should be recorded and be reported. The completeness and consistency of a product are collateralized.

5.2.3 Improvement of Development Process recognition

By creating a development process standard from the following viewpoints, a development process is made legible from a leader and related person.

-View point of project leader

Project leader, management skills in a variety of area is required, such as delivery date, quality, cost, procurement and communication. These elements are closely related to a development process. We have to settle on an appropriate development process, that correspond project specific situation, the feature of the technological standard and development environment which changes in every day indicated by Funakawa, M (2004).

-View point of organization

CMMI model is the guide of developing a process, and for most of development organization CMMI Maturity Level is generally aiming at the level higher than ML3. ML3 requirement is "Experience of S/W development and maintenance is shared as an organization, and the standard process is defined" so that we need to improve along with this.

6. Conclusion

This CMMI diagnosis was the first trial for our organization. Under the common purpose which is "Analyze the present conditions of the development objectively", we could listen to honest opinions from development leaders and members. Furthermore, using the standard CMMI template, we could get good outcome which isn't obtained only by our own division. On the other hand, found the complexity of products that has been designed differently according to the specification of the product. It was also very meaningful as the input information to standardize a development process.

The largest effect is the case that implicitly assumed weakness points are proved objectively. It can be said that there was an outcome, the whole organization work on improving development process including the top management. In order to improve a process and to take out an effect, it is meaningless if the process is not continuously used. The most important thing could be the motivation to execute that for the person who works along a process indicted by Miura, K (2008). Then, what is a high motivation for carrying out the process? Here, it is realized as the "Simple Usability" of using of the process. The "Simple Usability" is that the person who executes a process actually can use intuitively and without any stress. Therefore about the process improvement measure, "Simple Usability" should be considered for a member to activate daily work.

Improvement policies written in the 5-2 is running at the moment. About these quantitative outcomes, I'd like to write again in the next chance.

Moreover, I would like to consider diagnosis of another model of CMMI in the near future.

1. CMMI-SCV - The guidance to the service provided to an internal and external customers.
2. CMMI-ACQ -The guidance for improving a procurement of operational practices.

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Team Building Methodologies in Global Project by Using "Liaison Manager"

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In a multilateral global project, there are cases that organizations are differed among countries and project managers are assigned for each country. In such case, the power of a project manager is limited in their domestic section, and project manager for entire project not to be assigned in most of cases. However, to lead the project to success, it is very important to coordinate closely between countries and minimize misunderstandings. To resolve this issue, this paper proposes "Liaison Manager" as one of solutions. Liaison Manager is assigned country wise and inter-country coordination is integrated to Liaison Manager. Mission of Liaison Manager is to become a inter country communication hub, manage the inter country issues and create the action plans. Liaison Manager contributes the success of global project through fostering affinity as whole project, not country wise, and preventing the risk factors.

Keywords and phrases: Team Building, Global Team, Virtual Team, Liaison Manager, Matrix Organization

1. Introduction

In recent globalization trend, many projects assign team members from multiple countries and regions (Hayashi, 2010). Projects are formed in various ways. For example, in usual offshore development cases, requirement definition and design are done in head office country and development is done in offshore countries, e.g. China, India. In other scenario, there are cases such as adopting head office systems into overseas branches.

In these global projects, there are cases that organizations are differed among countries and project managers are assigned for each country. In such cases, the power of each project manager is limited in their domestic section, and project manager for entire project not to be assigned in most of cases.

This paper explains the difficulties in these global projects, especially in team building, and proposes the "Liaison Manager" as one of key factor to lead the project to success.

2. Why Team Building is So Difficult in the Global Project?

In global projects, despite the importance of itself, the difficulties of team building are become very high in most of cases. Why team building in global projects is such difficult?

2.1 Specifications Regarding Global Project

In normal projects, there are only one project manager in each project and project organization have coordinated hierarchy allowing that project manager is able to control all project members including other countries. (Figure1 Organization Structure of Normal Project)

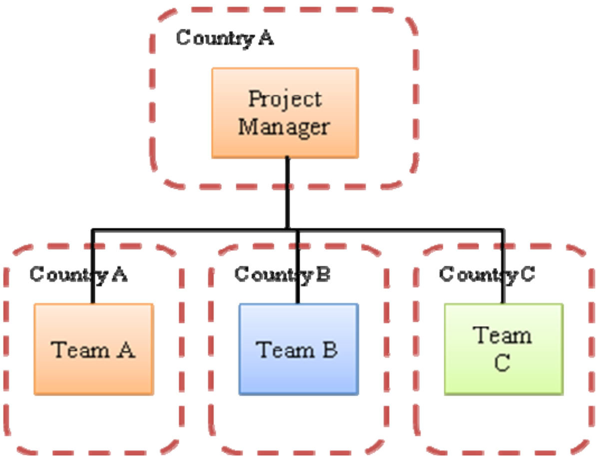

Figure 1 Organization Structure of Normal Project

Contrastingly, in cases such as project adopting head office's systems etc., there are cases that 1) hierarchy structure is coordinated in each organization including project manager, 2) hierarchical relationship between organizations become equal. (Figure2 Organization Structure of Global Project)

2.2 Factors to Make Team Building Difficult in Global Project

The biggest issue of global projects is project manager is assigned in each organization. Therefore, 1) power of project manager is limited in their domestic region, 2) sense of unity hardly ferments, and as conclusions, 3) misunderstandings between organizations cannot be clarified and project runs under high risk.

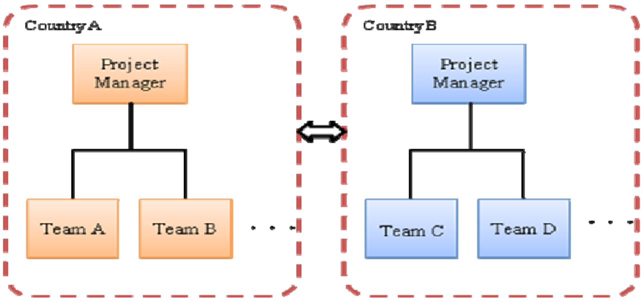

Figure 2 Organization Structure of Normal Project

1) The Power of Project Manager

As shown in figure 2, sometimes multiple project managers are assigned in global project. Hence, the coverage of each project manager is closed in their organization and management over entire project cannot be operated. It is true that every project have the person who will have the responsibility and control entire project. However, he/she is usually the management layer and most of these cases. It is become reporting line, not the project manager.

Since organization is flat, power game between project managers can easily happen, and it is hard to maintain coordinative relationship between organizations.

2) Lack of "Sense of Unity" among Whole Project

In global project, each member is assigned in their own organization and reporting line has no duplication with other organizations. Therefore, project members hardly have the regard to the other organizations' processes, which makes out of scope from their own organization's tasks.

As a conclusion, "sense of unity" among entire project hardly ferments and each project member have interested only to their own organization's tasks.

3) Misunderstandings between organizations cannot be clarified

When 1) Project Manager's power is closed manager's own organization and 2) each project member has only interested on their own organization's tasks, project members will take responsibility to their own organization only, and they have limited or non-involvement regarding other organization's tasks and risks they have. In such case, all organization seldom have motivations to exclude the other organization's risks, hence risks among project cannot be extracted properly. As a conclusion, project status became "risk that there is no risk".

If project fall to this scenario, project have no delay or no troubles until the development phase ends. However, project reached to testing phase, especially during integration testing, many errors due to misunderstandings, examination leakages, and task leakages will occur and project have to go back and re-start from the beginning.

2.3 Reasons That Normal Team Building Approaches are hard to Adopt in Square Type Global Project

There are many tips and know-how's to tell us how to treat with team building. For examples, top-down approaches from the project manager to activate communication, ferment sense of unity by using pare programming and the two-week trust-building exercises. However, it is hard to be adapted to all of global projects as it is.

In this section describes commonly used team building methods and why these methods cannot be adopted to global projects by as it is.

1) It is Hard to Resolve Issues by Top-Down

In global project, it is very important to unite whole project members together. According to Majcharzak et al., project leaders who adopted virtual teams are lay high weight to communication with all project members (Majcharzak et al., 2004). However, in the case when project have multiple project managers, there is no such project manager who controls all project members. Hence it is impossible to contact all of project members by one project manager and activate project members' communication.

Furthermore, to make a decision, it is necessary to get the agreement from all of project managers and it makes hard to solving problems from top-down.

2) It is hard to gather All Project Members in One Place

In virtual team's team building, pare programming or the two-week "trust-building exercises" are effective (Jarvenpaa et al., 1998) (Majchrzak et al., 2004). By using these exercises, create sense of unity with members who are not working in same office, and facilitate the communications. Moreover, early detection of issues and continuous improvement processes can be formed.

However, if there are multiple organizations in the project, it is very hard to hold the exercises involving all project organizations. Especially for inter-organization pare programming, there are many issues regarding roll and responsibilities such as travel fees, human resource costs, and responsibilities of deliverables. Therefore, it is hard to execute these exercises unless both project managers understood the effectiveness and have a motivation to do it.

Furthermore, even if team-building exercises were held, it will be only the organization internal in most of cases. As a result, it is very hard to eliminate the mind that other organization members are "out-side members" from all of project members. Hence, it can be help for domestic organization's teambuilding, however it will not effective to the whole project's team building.

3. Proposal for Global Team Building Approach

As mentioned in previous section, in the global project, there are cases which cannot adopt usual team building methods. It is very hard to unite whole project members as one and keep inter-organization relationship in coordination. For this situation, this paper proposes to assign "Liaison Manager" for these global projects' team building. In this section will describe roll of liaison manager and expected effects by assigning liaison manager in global projects.

3.1 What is "Liaison Manager"?

"Liaison Manager" is the person who has responsible to communicate with other organizations. Liaison manager is positioned directly to the project manager and have no charge for function developments. Liaison manager integrate inter-organization accommodation (Figure 3 Liaison Manager).

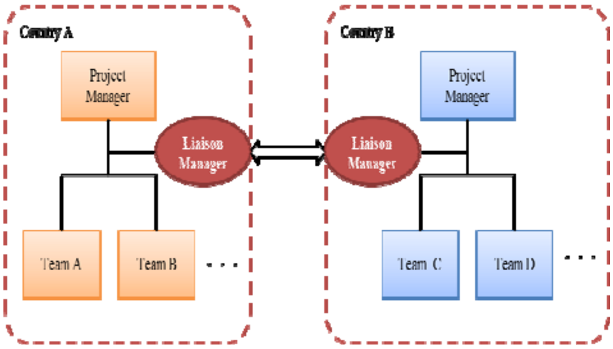

Figure 3 Liaison Manager

3.2 Rolls of Liaison Manager

The rolls of liaison manager are 1) become the gateway to inter-organization communications, 2) collect and inform the inside/outside organizations' information and 3) extract inter-organization issues and plot out the action plans regarding each issue.

1) Become the Gateway to Inter-organization Communications

As described, close communication between project members are very important to lead the project success. However, in global project, project manager to communicate directly with other organization members are sometimes considered as an "arrogation". Hence sometimes project manager have a reluctance to contact with other organization members. Also, if each member want to refer to other organization members, it makes difficult since he/she does not have any connection to respective person. In such cases, despite setting regular meeting, e.g. weekly progress meeting, agenda and contents become formative and meeting become a "dead meeting". Therefore it is hard to closely communicate during these regular meetings.

To deal with this issue, liaison manager become a gateway to other organizations. Not only to treat official communications, facilitate regular meetings, to send/receive Questions and Answers (QA's) etc., but also to treat irregular communications by using e-mail, phone, and chats.

Therefore, communication will be done by regular/irregular cases and it activates inter-organization communications effectively.

2) Collect and Inform the Inside/Outside Organization's Information

Main role of liaison manager is to be the inter-office communication gateway, but it is not enough. Especially for external design which requires coordination with other organizations, e.g. interface design etc., misunderstandings are frequently occurred and sometimes it will cause the changes of project plan. To minimize these misunderstandings and reduce risks, liaison manager have responsibility not only to inform the internal progress and issues to other organizations, but also inform other organization's issues and progresses to internal organization members.

3) Extract Inter-Organization Issues and set the Action Plans regarding Each Issue

In some global projects, project manager's power is limited to their own organization. It is hard for project manager to disclose "risk factors" to other organization unless it is no longer able to hide. Also for issues of other organizations, there is less incentive for them to point-out unless it is clear to have negative impact to their own organization. Otherwise it is marked as the "arrogation" and relationship is become aggravated easily.

Table 1 Difference of Project Manager and Liaison Manager

	Project Manager	Liaison Manager
Human Resource Control	Manage the human resources of internal organization.	No power of human resource control
Task Control	Manager the tasks of internal organization	Plots out the action plans for inter-organization risk factors
Schedule Control	Manage the schedule of internal organization	Monitor the progress of inter-organization related tasks. Raise alarms to other liaison managers if it is required

Hence, it is important to handle inter-organization "risk factors" by liaison managers not the project managers. Liaison managers also plot out the action plans of each risk factor. Action plans will be managed by project managers and progresses are shared with liaison managers.

3.3 Difference between "Liaison Manager" and "Project Manager"

Section 3.2 describes the rolls of liaison manager, however in normal cases, project has the project manager and issue management and quality control are conducted by the project manager. In this section describe the difference between "Project Manager" and "Liaison Manager" in 3 point of views, i.e. 1) human resource control, 2) task control, and 3) schedule control (Table1 Difference of Project Manager and Liaison Manager).

1) Human Resource Control

Liaison manager is only the gateway with other organization. Hence liaison manager have no power regarding human resource control. Resource planning and task assignments are controlled by the project manager.

2) Task Control

As described, liaison manager plots out the action plans for inter-organization risk factors. However task assignment and ensure quality of each tasks are managed by the project managers. Also, tasks which are not belonging to inter-organization risk factors are managed by the project manager and the liaison manager has no impact on it.

3) Schedule Control

Project manager handles the schedule of their own organization. Liaison manager monitor the progress of inter-organization related tasks and raise alarms to other liaison managers if it is required.

4. Practicality of Proposed Approach

This section explains the practicality of assigning the liaison managers by using 2 cases, one is assigned the liaison manager and another is not.

4.1 Project Background

The project I was assigned as a project manager was to develop management information system (MIS system) into overseas branches. Platform, data warehouse (DWH) and downstream interfaces are developed in Japan, downstream functions and reports are developed in local branches. Therefore, different project managers are assigned in Japan and local branches. I was in charge of local side.

It had developed this MIS system in 2 branches (Indonesia and India). Liaison manager was assigned in India project however it was not assigned in Indonesia project. Describes actions that liaison manager had taken and effects of actions by using case study of these 2 cases.

4.2 Measures during Planning/Design Phase

In basic design phase of India project, which assigned the liaison manager, the first task of liaison manager is to extract the inter-organization risk factors. As a result, liaison manager founds 13 risk factors, e.g. design requirements regarding interface, overall design of MIS system, etc. Both Japan and India's liaison manager are work together to plot out the action plans not to appear these risk factors and meet the agreement with both project managers. Also action plans are shared with all project members.

In Indonesia's case, risk factors are extracted from their own organization and shared in regular meetings. However any issue was detected since the project managers were not wanted to disclose their own project issues and risks to other project members.

4.3 Measures during Executing Phase

In Indonesia case, progress was managed by weekly regular meetings and no delay were detected during development phase. However, at the time when just before exiting development phase, it was founded that interface file layout design was different between Indonesia and Japan. As a result, 3 requirement changes were occurred due to this issue. Also, one of screen function cannot be used at the start of integration testing phase (Japan side was decided to hide this delay to Indonesia until integration testing phase since they underestimate that the delay can be resolved before the integration testing phase start). Therefore severe delay was occurred during integration testing phase.

In India's case, not only the weekly progress meeting, but also inter liaison manager's unofficial meetings such as design coordination meetings, intensive QA session etc. were held continuously. Also the face-to-face meetings were proactively held in approximately one month frequent, and it was effective to clarify each other's design policies and requirements. As a conclusion compares to Indonesia's project, neither requirement changes nor severe delay was occurred during India's case.

5. Challenges for Next Phase

There are 2 challenges regarding next phase, 1) quantitative evaluation regarding effectiveness of liaison manager, and 2) recruitments of liaison manager.

5.1 Quantitative Evaluation of Liaison Manager

It is evaluated only 1 case each. Also as described in following section, required skills for liaison manager is very high hence not only the assignment, but also the risks of hiring high skill members which commonly costs higher than other members.

It is necessary to evaluate clearly whether liaison manager is effective enough for global project despite its high cost, and giving formulas to calculate appropriate costs of liaison managers from difficulties and scales of the project.

5.2 Liaison Manager Acquisition

To perform liaison manager's tasks, it is required 1) political coordination skills and 2) communication skills in high level. Hence it is required to hire the person who has skill set to fulfill requirements.

1) Political Coordination Skills

It is true that liaison manager will have full-support from its project manager. However, as shown in section 3.3, liaison manager have lack of "official power" in many cases. Since liaison manager does not have "official power", e.g. task assignment, schedule control, etc., liaison manager can easily isolated from his/her own organization.

Therefore, liaison manager required the high skill of political coordination to propose action plans and meet the conclusion among the organizations.

2) Communication Skills

Liaison manager is the gateway of other organizations. Hence it is required to get the picture of own organization's progress and if any things happen, liaison manager needs to contact respective team/organization appropriately. To manage these operations smoothly and avoid the conflictions between organizations, it is required very high communication skills.

6. Conclusion

In global projects, there are cases that multiple project managers are assigned in organization wise. In such cases, it is very difficult to build the team as whole project, not the organization wise.

In these cases, it is effective to assign the liaison manager in each project to make inter-organization communication smoothly, avoid misunderstandings and reduce the project risk.

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Reduction of Marine Operational Cost by Mixed Loading in a Submarine Cable Project in the Western Pacific Region

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Recently the Total Cost of Ownership (TCO) optimization for submarine cable projects has become very important, and NEC has had to execute projects in a highly efficient manner. In particular, drastic cost reductions in the marine operational portion has become mandatory by any means. NEC completed a submarine cable project (hereinafter called Project-A) in the Western Pacific region during Y2016-Y2017 and I was appointed as project manager of Project-A. To successfully complete Project-A under this situation, I and my team had to search for other vessels which would be in the region during the project implementation. We finally succeeded to arrange a suitable vessel working on another project (hereinafter called Project-B), using mixed loading to minimize the cost of the vessel. NEC made efforts to achieve the smooth execution of all marine operations such as cable loading, transit to the site, marine installation and so on among the two different projects, by mutually informing the current situation, planned activities and pre-notice, as required. In the event, our team faced difficulties to proceed with cable landing activities at a common landing site consecutively among the two projects though, both projects proceeded well by cooperation in advance, such as various means of sharing information between two projects and pre-announcements to the cable system Purchasers in a timely manner. As a result of the mixed loading of cables into one cable ship, finally, I and our team could manage the two projects' cable laying schedule and avoid the anticipated schedule conflict. This paper describes what NEC did during the project implementation to overcome this situation, and to make the project a success.

Keywords and phrases: Laying Operation, Cost Reduction, Submarine Cable, Mixed Loading

1. Introduction

NEC has been closely involved in the submarine telecom cable industry as a turnkey project supplier for more than 40 years, and has constructed a tremendous number of submarine cables all over the world.

Project-A to which I refer in this paper is one such experience of NEC, it is a turnkey basis submarine network project connecting islands in the Western Pacific region with submarine cables. NEC won the project at the beginning of 2016 after tough competition among the industry. In addition, NEC had to aim to complete the project more efficiently in terms of TCO. Reducing the cost of marine operations was really crucial because it was a dominant factor in the total cost.

I start by explaining how I could manage the marine operation cost in Project-A.

2. About Project-A and target of cost reduction

2.1 Project brief

Project-A is a project connecting 4 islands in the Western Pacific region with submarine telecom cables. The total length of Project-A is almost 300km.

Items contracted in Project-A comprise the following:

1) Marine operations including cable laying operation, marine survey and land operation
2) Wet Plant including submarine optical fiber cable and branching units
3) Project management including acquisition of permits

The project did not contract any in-station equipment such as Terminal Station Equipment (TSE), Network Management System (NMS) or Data Communication Network (DCN). The project period was expected to be less than 16 months.

2.2 Cost distribution of items included in Project-A

The cost distribution of the above items is shown in Table 1. The marine operation was around 60% of the total project cost. The cost of marine operation is usually dominant in the most submarine cable projects and Project-A was no exception. In addition, since Project-A did not require any repeaters, terminal station equipment, power feeding system or land cables to landing stations, actually the marine cost became more than half of the project cost.

The wet plant cost was the second highest and the remaining part was for project management, including the negotiation and acquisition of national and local permits to land the cable. The cost of wet plant consisted of submarine cables and branching units and the design was completely fixed before the contract signing, therefore drastic cost reduction could not be expected during manufacturing in the project implementation stage.

The project management part always varies on a project-by-project basis, and there should have been a chance to reduce its cost, however its distribution in the total cost was rather low, so drastic impact of overall cost reduction could not be expected.

Table 1 Cost distribution of the contracted items

Item	Cost Distribution in Project-A
Marine Operation	60%
Optical Cable	30%
Others (Management, Permit and etc)	10%
Total	100%
(Note) Marine Operation consists of; - Laying main cable including mobilization cost (60%) - Survey (20%) - Land operation (20%)	

Needless to say, to manage the project cost, we have at first to focus on the largest part of the cost breakdown. As I mentioned, the largest part was the marine operation and it consisted of three parts, namely: laying of the main cable including the mobilization and demobilization cost of a vessel; marine survey works, and land operation. The distribution of those parts were 60%, 20% and 20% respectively at project commencement.

2.3 Target of cost reduction

Table 2 shows the initial target of cost reduction for Project-A. From the situation described in section 2.2 above, I initially targeted a 20% cost reduction for the marine operation part, especially for the costs of main cable laying including mobilization/demobilization. This would be expected to be realized by negotiation with a vessel company who would carry out the laying operation to achieve reductions in the unit daily cost, fuel cost, by consolidation of the laying period by accelerating the laying speed, and so on. If this target could be achieved, an overall 12% cost saving could be made for Project-A.

However this was challenging to realize for the following reasons:

- Daily cost and fuel cost would depend on the current cost of oil and nobody could predict it easily.
- Cable laying speed would depend on seasonal factors such as weather and so on.

Table 2 Initial target of cost reduction

Item	Cost Distribution in Project-A	Result of Cost Reduction	Cost Distribution after completion
Marine Operation	60%	25%	45%
Optical Cable	30%	-	30%
Others (Management, Permit and etc)	10%	-	10%
Total	100%		85%

Given the above situation, a cost reduction might be achieved depending on negotiation with a vessel company, but on the other hand I started to think about any other ways which could enable drastic cost reduction.

As a matter of fact, NEC does not own vessels for marine operation (survey, cable laying and cable maintenance), so we always hire a vessel from a vessel operating company for these marine operations. This is a challenge for NEC to compete with suppliers who do own vessels: the mobilization and demobilization costs of a subcontracted cable ship are always large and they will become heavy in the case of a relatively small scale project such as Project-A. For this reason, I started to think about cost reduction for mobilization and demobilization. To achieve this goal I realized that I needed to perform mixed loading of the cables on a vessel operating on other project in the near vicinity of Project-A. In mixed loading, a vessel's cable tanks are loaded with cables for two or more different projects, and the vessel then carries out laying operations consecutively for the these projects. I started to look for a suitable vessel suitable for mixed loading with another NEC-led project in a region as close as possible to Project-A.

3. Finding a vessel for mixed loading and its completion

3.1 Original plan of work

Figure 1 shows the high level plan of work for Project-A.

The main activities were classified to the following four items;

1) Survey work including Desk Top Study (DTS) and actual Field Survey works
2) Manufacturing of Submarine Cable and Branching Unit (BU)
3) Marine Installation including Laying Operation and Land Works
4) Permitting

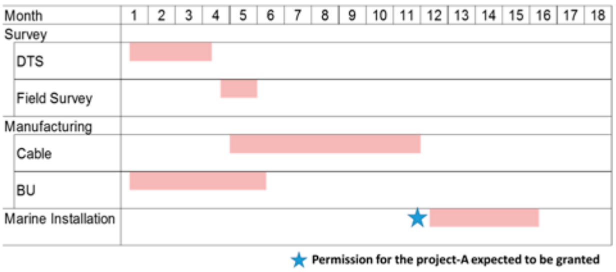

Figure 1 Original High Level Plan of Work for Project-A

Briefly, survey work would take 4 to 5 months, which the manufacturing of cables and BU would take around 11 months including loading into a vessel. In general, manufacturing of submarine cable should start based on Straight Line Diagrams (SLDs) which detail the suitable types of cable such as un-armored and/or armored (single or double), and their respective quantities. This information is normally finalized after survey work is completed, to reflect the survey findings: applicable water depth, seabed conditions and so on. However in this project, NEC would expect to start cable manufacturing based on the result of the DTS to shorten manufacturing time. In addition, marine operation including loading from the cable factory would expect to start consecutively right after cable manufacturing, and it would take around 4 months to complete the cable lay operation.

In addition, granting of the necessary permits was expected immediately before lay operation, i.e. around end of the 11^{th} month.

3.2 Suitable time for mixed loading and related arrangement

In accordance with the original plan of works shown in Figure 1, a suitable time for the mixed loading was the time slot between the 8^{th} and 11^{th} months from the contract coming into force. Needless to say, the most important thing was to find a second project which can be combined with Project-A, but in addition, we also needed to think about the order of loading between the two projects in accordance with the operation periods of these projects. The following consequences apply to the timing of mixed loading:

1) If the timing of mixed loading is advanced, we need to think about shortening the cable manufacture
2) If timing of mixed loading is delayed, we need to think about order of laying operation between the two different projects. This may cause delay of project completion.

Consideration 1) above means that due to the time of loading commencement, I might have to accelerate the completion of cable manufacturing to fit to the loading commencement time. Consideration 2) means that order of loading between the two projects must not delay either projects' completion. On the other words, it was necessary not to impact the critical path of either project.

In the event, we found a suitable project (Project-B) which would plan to proceed with its laying operation right before that of Project-A. Figure 2 shows the planned schedule for Project-A and Project-B with mixed loading.

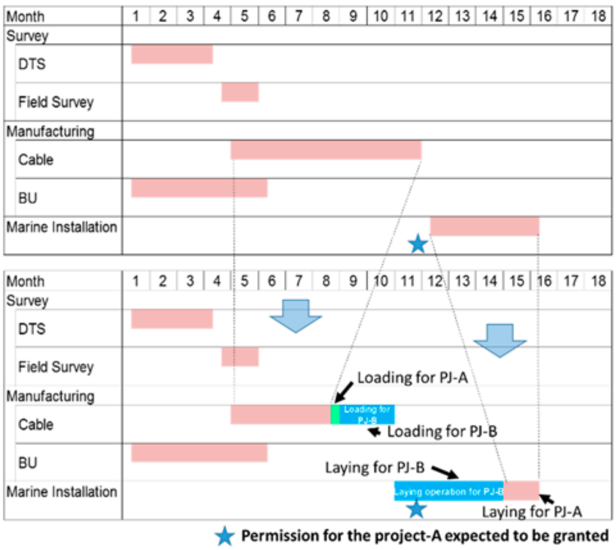

Figure 2 Planned schedule for Project-A and Project-B with mixed loading

Since the marine operation for Project-B (including transit to the operation site) was planned between the 11th and 14th months on the plan of work for Project-A, in other words it was planned right before the marine operation of Project-A, both project managers needed to plan the loading sequence as follows;

1) Cables for Project-A were the first to be loaded at the bottom of the vessel's cable tank.
2) Cables for Project-B were loaded second, above those for Project-A

Figure 3 shows the order of loading between the two projects.

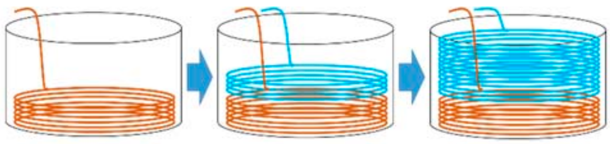

Figure 3 Order of mixed loading between Project-A and Project-B

As shown in Figure 2 and Figure 3, to achieve mixed loading, I had to achieve earlier cable manufacturing, specifically:

- Originally the manufacturing period of the cables for Project-A was planned from the 5th to the 11th month (7 months' duration)
- After the mixed loading was planned, the manufacturing period had to be squeezed to the 5th to the 8th month (4 months' duration)

Thanks to the manufacturing capability of the factory and the modest scale of Project-A, a reduction in the manufacturing period could be managed by close contact with the production management department of the factory. As a result, after loading, the vessel could depart to the sites in accordance with the planned schedule.

In addition to the above, the permitting schedule also should be taken into account. Project-A's permit was originally expected immediately before the lay operation, i.e. around the end of the 11th month of Project-A. This situation might put the granting of the permit on the critical path, potentially delaying the project if permit acquisition had an even a small delay. Thanks to this mixed loading, however, the impact of potential permitting delays became lower, as shown in Figure 2.

4. Operation management between Project-A and Project-B

4.1 Sequence of laying operation between Project-A and Project-B

Figure 4 shows the sequence of marine operations by the vessel between the two projects. This was essentially the reverse of the operational sequence at the time of mixed loading, meaning that the laying operation of Project-B came first, followed by Project-A.

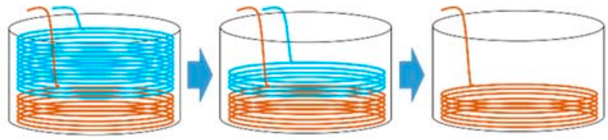

Figure 4 Sequence of laying operation between Project-A and Project-B

4.2 Risks and risk management during operations

From the viewpoint from Project-A, the most critical risk was the delay of Project-B due to factors such as:

- Slower installation than expected due to unforeseen operational reasons
- Vessel trouble
- Weather contingency
- Permitting delay

Therefore I and the project managers of Project-B discussed and shared the progress of each project, for example by exchanging daily reports, weekly reports, progress tables, and so on. It was the fact that the laying operation of Project-A was on the critical path of the combined project, since the laying operation of Project-B was put right before Project-A and the operation period of Project-A was slightly squeezed. However this had to be accepted by me as the project manager of Project-A, since this was a potential outcome of seeking cost reduction by the mixed loading between the two projects.

Figure 5 shows the actual schedule achieved for Project-A and Project-B after mixed loading. In the event, Project-B faced various issues during the marine operation period, such operational complications, vessel troubles and weather, and as a result the vessel was able to transit to Project-A around 1 month later than planned.

In addition, although it was not expected in the beginning, Project-B was subsequently modified to land at one of the same sites ('Landing-C') as Project-A. This required us to achieve agreement on the landing order between Project-A and Project-B. Fortunately the team of Project-B kindly notified us about the addition of Landing-C around one month beforehand, so we could plan how to manage the sequence of landing activity by the vessel between the two projects. Moreover, the permitting of Project-A was delayed, and it was expected to be granted at almost the same time as the landing of Project-B, so it was clear that the landing for Project-B would be before that for Project-A.

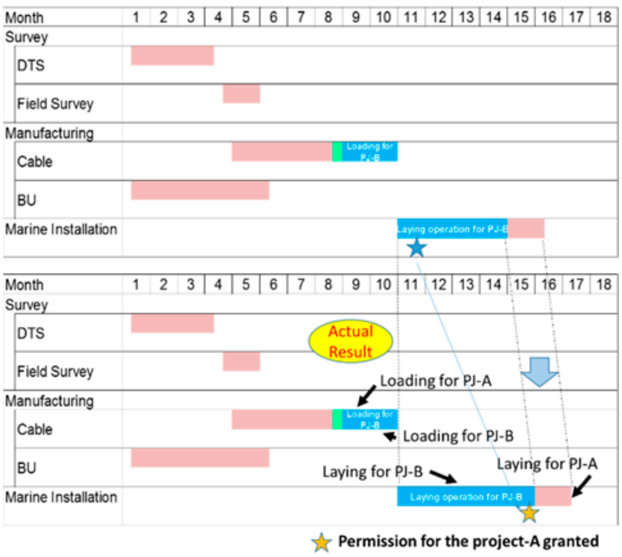

Figure 5 Actual result of schedule for Project-A and Project-B after mixed loading

I had previously notified the purchaser of Project-A that the laying operation would be carried out right after the landing of Project-B. Concerns were raised by the purchaser of Project-A, but through polite explanation I was able to get agreement from them and we subsequently achieved a smooth transition of vessel operations from Project-B to Project-A at Landing-C.

5. Result of the mixed loading

Table 3 shows the result of cost reduction for Project-A based on mixed loading. By adopting the mixed loading with Project-B, I achieved 35% of cost reduction of the marine operation by eliminating most of the mobilization and demobilization costs, and consolidating the operation period. This 35% cost reduction represented more than half of the main cable laying costs and brought about a 21% cost reduction in the total of cost of Project-A.

Although I did not touch on the survey and land operation in this paper, cost reductions in these areas might not have been greatly expected, due to environmental requirements (biological and archaeological) specific to this west part of Pacific Ocean. However in general the sharing of costs between multiple projects could apply not only to marine operation discussed above, but also survey works, land operations and so on, because all of such service part consists of mobilization/demobilization and other common service costs. If we can commission those services in one shot among various projects, it would provide effective cost reductions.

Table 3 Result of cost reduction by the mixed loading

Item	Cost Distribution in Project-A	Result of Cost Reduction	Cost Distribution after completion
Marine Operation	60%	35%	39%
Optical Cable	30%	-	30%
Others (Management, Permit and etc)	10%	-	10%
Total	100%		79%
(Note) Marine Operation consists of; - Laying main cable including mobilization cost (60%=>25%) - Survey (20%) - Land operation (20%)			

6. Conclusion

In case of a small scale of submarine cable project such as Project-A, cost management is really important for successful completion of the project, and using the mixed loading method among a few projects described in this paper is particularly effective. To realize mixed loading operation among projects, the following conditions are necessary:

- The timing of cable installation between projects overlaps or is close
- The cable tank of the installation vessel is large enough to accommodate cables for multiple projects

- The installation sites are geographically as close as much as possible

On the other hand, a fatal situation may result if there is a failure of smooth coordination between the projects. Thus, operation management of the vessel between the projects is really crucial and management methods should be well prepared and operated by all related people in the projects. The most important factor is to choose projects for mixed loading from those in which operations do not impact the critical path of others. This will bring effective management of marine operation.

Practical Use of ATA to Understand Member's Characteristics in Team Building

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Project manager should lead the project to the success. According to the survey that the Nikkei Business Online conducted in 2006, 54% of the success obstruction factor in the project originates in the "Team". Nowadays, there are a growing number of cases that includes temporary employees, contractors, offshore, global human resources in the project team. The project manager should promptly understand each member's characteristics. ATA (Active Team Analysis) that Active and Company proposes analyzes member's characteristics by 56 questions. In a certain system development project, a completion rate of the team task has improved up to 2.25 times as a result of using ATA. In this paper, I discuss effective methodology of team building, and I introduce the approach of understanding member's characteristics by ATA and the case where it demonstrated the effect.

Keywords and phrases: Team Building, Team Management, Active Team Analysis, Team Task

1. Introduction

A project manager must lead the project team to success on their project. However, there are many obstructive factors to success inhibit. According to the survey that the Nikkei Business Online conducted in 2006, 54% of the success obstruction factor in the project originates in the "Team". That is why the project manager must focus on solving problems and shortcomings within the team.

Nowadays, there are a growing number of cases that includes temporary employees, contractors, offshore, global human resources in the project team. Therefore, the project manager must manage these team members by understanding their individual characters. But, it is not easy to comprehend and manage various characters. The team members will often change within the system development project which runs in a short time period. It is difficult to calculate people's unique personal preferences.

So, what would be the best way to comprehend individual character? I would like to propose a solution to this problem with prompt and adequate measures. This is the application for team building by using ATA (Active Team Analysis) to analyze and comprehend each team member's character (Active and Company Ltd., 2013). There was an actual case of applying ATA to a project team that wasn't performing well the team showed 2.25 increase in their work progress.

In chapter 2, I explain awareness and elements when you practice effective team building. In chapter 3, I explain ATA which are methods to comprehend project member's characteristics. I state examples of actual cases that apply ATA in chapter 4 and evaluation of ATA in chapter 5.

2. Fundamental Knowledge of Team Management

2.1 Human perspective management

There are 2 perspectives to project management. One is logical project management where the project status is managed by quantitative conversion to numbers. The other is human perspective management taking into account human relations and motivation (Enokida and Matsuodani, 2004). The importance of human perspective management has been discussed in human relations theories by Mayo and Roethlisberger, behavioral science such as McGregor's Theory X and Theory Y and Likert's principle of supportive relationships, and Lewin's group dynamics. Since the early 1990's, human perspective management has begun to be studied in Japan as well. This trend indicates that a mere quantitative and mechanical management of projects is insufficient and that human perspective management is also necessary. Particularly in a high-context society such as Japan, human relation management is directly connected to the success or failure of projects.

What project managers should especially pay attention to in human perspective management is team management which consolidates team members and encourages the team to exert their capabilities. Team management is the key to directly and assuredly lead the project and organization to success. This is accomplished by motivating the members who play a vital role in promoting the project.

2.2 Team management

In the previous section, it was stated that team management is particularly important in human perspective management. Then, what type of motivation should project managers provide to the members in implementing team management? In this section, "Team" and "Team building" which are the targets of team management will be discussed.

(1) Team

The team has an objective and works to achieve the strategies and targets of the top level organization. The project manager who leads the team is expected to alter his leadership style according to the status of the team members and the progress of the task, in order to achieve the objective. In addition, within the team, there is an operation of group dynamics among members. Group dynamics refers to interaction within the group and factors which define the interaction. In other words, a superior team is not necessarily formed based on the gathering of superior personnel. Rather, as in a chemical reaction, through interaction among the members, a synergy effect may result, or the ability of the team may deteriorate through conflict or decline in morale.

How, then, does a superior team come to be formed? An essential element is "empowerment". Empowerment refers to a type of "impact on people" with the meaning "connecting people to motivate them". Empowerment affects the 3 physiological needs positioned at the top in Mazlow's hierarchy of needs, namely "social belonging", "esteem" and "self-actualization". Members of the team who are empowered act on the following incentives:

- A need to be able to express one's opinions and to have the awareness that others are listening to you.
- A desire to be treated with equal respect as an individual, regardless of such attributes as one's title, age, and work performance.
- A desire for self-satisfaction through work accomplishments or social contributions. A desire for self-establishment by converting one's recognition, thinking, beliefs into action and to work with other people.

In order to build a superior team, maintaining the motivation of members through empowerment is indispensable. When the members understand the goal of the team and are able to voluntarily engage in the realization and accomplishment of the goal with a degree of freedom and the right to voice their opinion with regard to one's allotted role, the team is able to maintain a high level of motivation and exert a high level of performance. Empowerment is a method of exercising influence so that the members act on their own volition and are strengthened by the continuous self-actualization. Therefore, in order to exercise empowerment, the project manager must accurately discern the characteristics of the members.

(2) Team building

Team building can be paraphrased as "creating an organization in which the distinctive qualities of each individual is utilized with unity, to efficiently and assuredly progress toward an objective". In a project, human psychology, such as "camaraderie" and "role awareness" play a vital part in the success or failure of a project (Yamakawa, 2015). It has also been indicated in previous studies that the introduction of team building has proved effective in achieving the objective of enhancing "team strength", which is the basis for the success of a project (Masuda, 2014).

Specifically, what are the necessary factors in implementing team building? The elements of team building are systematically organized in Figure 1.

Component		Content
Knowing the Team	Purpose	・To understand goal that the aim of team, and share it among the team.
	Achieve ment	・Setting importance for goal, and share it among the team.
Know about yourself	Charact eristics	・Understand your behavioral characteristics and ability. ・Understand your advantage and weak point.
	Role	・Understand a given role. ・Understand intentions of a given role.
Know about members	Charact eristics	・Understand member's behavioral characteristics and ability. ・Understand member's advantage and weak point.
	Role	・Understand a given role. ・Understand intentions of a given role.
Have a sense of ownership		・Understand that you are a member of the team. ・Understand that you will achieve results as a team.

Figure 1 Elements of team building

The project manager must accept the diversity of the team members, as well as to sufficiently and accurately grasp their characteristics. For efficient team building, it is desirable that both the leader and the members are actively involved and are working toward the implementation of each systematized element. The important point is that even when implementing a practical team building method, the theory which constitutes the basis for team management must be understood. Even a superior team building method cannot be effective if it is not implemented according to the theory.

In the next chapter, the method to grasp the characteristics of team members, which is the foundation in carrying out effective team building, will be discussed.

3. Proposal

3.1 ATA

ATA (Active Team Analysis) is an analysis framework to grasp the characteristics of the members. ATA is a method of analyzing the behavioral characteristics of team members based on 56 questions proposed by Active and Company. This method solves the problem of functional difficulty facing Japanese companies in recent times in which the members are becoming increasingly diversified, and the homogeneous organizational operation which has been traditionally a prerequisite for Japanese companies is no longer effective.

The members participating in the team, whether consciously or unconsciously, are seeking to find their respective roles. It is not difficult to find their role among those with similar hobbies, philosophies or preferences. However, within the project team to which they were summoned, there is a tendency for members to seek their required role within the team, even if that role is not their field of expertise, or even if that role does not enable them to fully utilize their characteristics. Regarding this trend, with focus on individual "strengths and weaknesses" evident in the behavioral characteristics of the members when becoming a part of a team, and the "roles" they spontaneously take on within the team, the ATA makes the following 8 subdivisions. "Table 1 Eight types that ATA classify" shows the details.

Table 1 Eight types that ATA classify

Type	Sign	Characteristic	Role within a team
Company Maker	CM	Conservative, Obedient, Unexpectedness	Create work procedures and methods based on idea and plan devised, implement organizationally and effectively plan determined.
Coordinator	CO	Gentleness, Confident man, Modest	Make sure potential of team member by understanding member's strengths and weaknesses, and make the most of it, consider the way to coordinate in order to be able to advance toward a goal.
Shaper	SH	Extreme tension, Sociable, Dynamic	Make an arrangement that team's efforts will be applied. Pay sufficient attention to establish purpose and priority, construct method of Report and pattern which is about discussion and work in the team.
Plant	PL	Individualism, Honest, Unorthodox	Pay particularly attention to come up with new ideas and strategies about major issue. And, seek out solutions to the problem that faces the team.
Resource Investigator	RI	Diplomatic, Enthusiastic, Curious, Communicative	Report the survey about the other team's thought and new fact, a source of information. Take the necessary contacts with outsider for the team, and in charge of negotiations after the fact.
Monitor Evaluator	ME	Calmness, Intellectual, Prudent	By analyzing the problem and evaluating ideas and suggestions, keep watch team so that team always can make a balanced decision.
Team Builder	TB	Relatively sociable, Gentle, Sensitive	Help other team members, and become a reinforcing member to compensate for the shortage. Promote communication among members, emphasize team spirit.
Completer Finisher	CF	Diligence, Disciplined, Loyalty, Worrier	Be actively involved with work that particularly need to pay attention. Try to sustain a sense of tension within the team.

3.2 Characteristic analysis framework in ATA

ATA prepares 8 questions for each of the 7 sections. In each section, the respondent makes a weighted scoring for the item which best describes their behavior so that the score totals 10 points. The questioner tallies the score and analyzes which of the 8 types is the most applicable for the respondent, thus determining the characteristics of that individual. Examples of questions used in the ATA are shown in Figure 2.

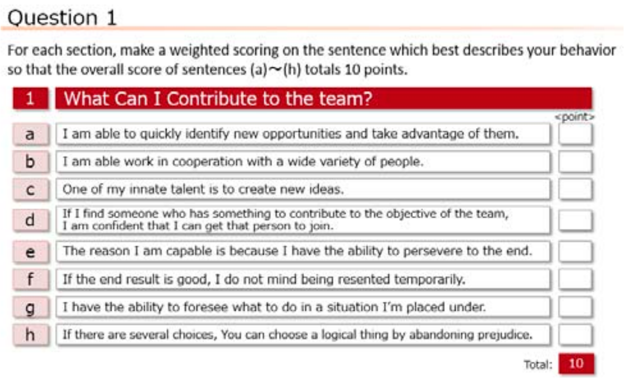

Figure 2 Examples of questions

4. Practicality of ATA

4.1 Project summary

The project taken up as an example is a web system development project. It started in May 2013 with a planned release in October. However, in the process of the development, the development scale expanded to 10 times the initial estimation, and delay in the release became inevitable. It became a large-scale project with exceeding 100 members at its peak.

4.2 Project status

In managing the project, issues which require attention and are discussed are costs (man-hours), time and information (requirements and specifications, etc.). Logical project management methods using numbers are widely used. However, many projects are influenced by external factors and are frequently subject to unforeseen circumstances. In such cases, it is not uncommon for matters to fall beyond recovery with merely initially-planned risk measures.

The project given as an example proceeded while running the risk of having vague specifications due to external factors, consequently falling into a vicious cycle. The following project management was implemented to solve the problem, however, the problem could not be overcome.

In order to grasp the development progress status, WBS was made more detailed, resulting in an increase of tasks and a 5-fold increase in development team members in order to cope with the tasks. In addition, because members worked several tasks in parallel, the tickets which are work units became too complicated and disorderly. The development team members were forced to guess the specification, implement and modify it. Due to such situations, the clear objective within the team could not be shared and empowerment could not be exerted. The motivation of members declined, resulting in the deterioration of the team's ability.

At the end of September, the author participated in the project as a program development member. Transition in the number of team tasks over 3 months from September and the number of developers engaged in the programming is shown in Figure 3.

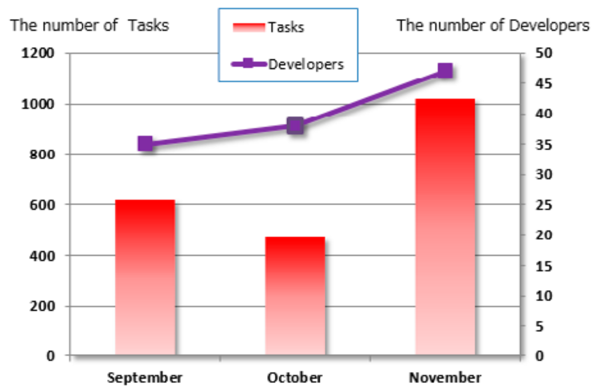

Figure 3 Situation of project tasks

From the end of December, the author took on the role as the development team leader. In order to achieve a breakthrough in overcoming the decline in the team's ability, the top priority was to empower the team members and manage them adequately. Therefore, taking into consideration the situation of the team, team management using ATA was executed.

4.3 Use of ATA

4.3.1 Implementation of ATA analysis

ATA analysis was implemented to boost the team's motivation and build a strong team. With the exception of one employee, all of the members who were invited to join the development team were programmers from partner companies. As a first step, the behavior characteristics, psychological thinking pattern, attitude toward work, likes and dislikes, etc. were examined. However, in view of the project situation, there was no time to leisurely evaluate each individual using a conventional communication technique. Therefore, in order to speedily and logically grasp the individual characteristics of the members, ATA analysis was implemented, and by analyzing the information obtained, the team building process began.

At the end of December when the author became the development team leader, ATA analysis was conducted on 16 development team members. Each person's tendency in interacting with others such as personality traits, attitude toward work, the role they excel in, within the team etc., were examined. For each member, based on the numerical data obtained from the ATA analysis, behavioral characteristics with especially significant values were extracted and divided into 8 types. The tallied results from the ATA analysis are indicated in "Table 2 ATA analysis results (self-examination by members. " For each member, double circles were placed on the 1st and 2nd highest scores, and as a supplement, circles were placed on the 3rd and 4th highest scores.

4.3.2 Idea in the extraction of ATA analysis results

In psychological behavior, people do not always manifest one immobile characteristic. Taking this aspect into account, the idea to extract "an especially significant type" and "next significant type" (items with a double circle in Table 2) was considered for each member. These 2 characteristics were regarded as the characteristics manifested by the member concerned, and this information was used for team building.

Table 2 ATA analysis results (self-examination)

Type	Sign	Team Member A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Company Maker	CM		◎	○	◎	◎		◎	○	○		○	○	○	◎		○
Coordinator	CO	○			○			○							○	◎	
Shaper	SH	◎		○	◎	○		○	○	◎	◎	◎	◎	◎	◎		◎
Plant	PL	○					◎				○					○	◎
Resource Investigator	RI			◎			○						◎			○	
Monitor-Evaluator	ME		○			◎	○		◎	◎	◎		○	◎	○		
Team Builder	TB	◎	◎	◎	○	○		◎				○				◎	○
Completer-Finisher	CF		○				◎		◎	○	○	◎		○			

In the ATA analysis, by sharing the results among team members, the members can grasp their own behavioral characteristics respectively. By sharing such behavioral characteristics, the idea is for members to be able to recognize the role they excel in, thus enhancing their sense of belonging to the team.

4.3.3 Utilizing the ATA analysis results

In view of utilizing the analysis results from the team leader's perspective, the results were used in the constitution of members in team building and task management of team members. Based on the classification of types, first of all, the area that a team member excels in was considered, and the system within the team (specification adjustment role or technical problem solving role with a sub-team leader or customer, etc.) was arranged. Next, effort was made so that each team member was given a task in which they excelled. Lastly, attention was given to how the leader should treat the member given a task (what to be aware of when making a request and what support should be given after the request) and this was used as an index to foster "camaraderie" and "role awareness" of the members for communication. "Table 3 Use of ATA analysis results" shows the details of the above.

4.4 Achievement from use of ATA

As a result of implementing team building through the use of ATA analysis results, productive results were attained. The sense of fatigue and weariness which permeated the development team were dispelled, and there was an increase in motivation among the members. The attitude of working together in unity toward the project goal of system release was observed. The main results are described below in detail.

Table 3 Use of ATA analysis results

Type/ Dist.	Use of ATA analysis results by team leader
CM 5	The number of CM-type members was the second largest after that of SH-type members. This was a universal feature for those having a certain amount of experience. Therefore, there is no specific way to give a special role to CM-type members, and on the contrary, for non-CM-type (inexperienced) members I made efforts to explain them concrete working plans and effective working methods.
CO 1	This is the type of myself (author). It was a notable feature of myself, and I decided to play this role by myself since there were no members who had significant CO. In addition, several members had both this feature and TB, so I gave a sub-leader's role to them.
SH 9	The number of SH-type members was the largest among all members. This team may have been exceptional since there was no other specimen, but SH may be a feature specific to programmers, I guess. For the members having more SH points, I clarified the purpose, deadline, direction of modification and so on rather than the role for the task when I gave it to them so that they could get to work comfortably. Such consideration improved their work efficiency.
PL 2	There were few members who had significant PL (this type may be uncommon for Japanese). I gave a role of an adviser, in the event of failures of unknown cause and technically difficult implementations, especially to the members with high technical skills among those members having relatively high PL points.
RI 2	Also there were few members who had significant RI, but several members had relatively high RI points. So, I almost always asked them to join the meetings to confirm or discuss specifications with clients, and gave them a role as a counter who leads specification coordination.
ME 5	ME-type members, when they perform the task I requested, frequently pointed out or reported the matters that I had not noticed by investigating impacts on a part other than the modified part I instructed (a part which may relate programmatically). Therefore, I tried to ask them to perform the modification task on a part having far-reaching impacts or on common functions.
TB 5	Deciding that TB is a natural inclination for a sub-leader, I asked TB-type members to focus on acting as a coordinator or an intermediary. In the event of serious failures and difficult challenges, however, I made efforts to actively support the members by hearing situations or supporting specification discussion, making particular attention to prevent the members from increasing their loads or bearing risks.
CF 3	I felt that the feature of CF-type members was conspicuous. As features shown in the left, CF-type members tend to be perfectionists and be particular about details, which contributed to slow their work pace. Therefore, I thoughtfully reduced the work amount (of the part in charge) for CF-type members, but as a mechanism, I asked them to take charge of difficult and important parts.

4.4.1 Manifestation of emergent cooperative work

As a result of executing team building, emergent cooperative work among team members became manifest. It is thought that due to the members and leaders having a good grasp of each team member's behavioral characteristics, the environment to act as a team was configured. Examples of emergent cooperative work are outlined below:

- By clarifying the division or roles, the boundary among members became clearer, thus enabling members excelling in cooperative work to take the initiative in helping others around them.
- Attention began to be given to tasks surrounding the required task, and corrections were made by internal recognition, leading to the lessening of task volume.
- Many vague specifications were previously interpreted individually, however, proactive opinion-exchange began to take place with the clarification of specifications as the goal.

4.4.2 Improvement in task completion

As a result of implementing team building using ATA, improvement was seen in the work ability of the team. This is indicated by an improvement in task completion in comparison to pre-team building implementation. Figure 4 is a graph shows the transition in task volume. In comparison to pre-team building implementation, a 2.25 fold increase in task completion (ticket completion amount/person) was observed post-implementation.

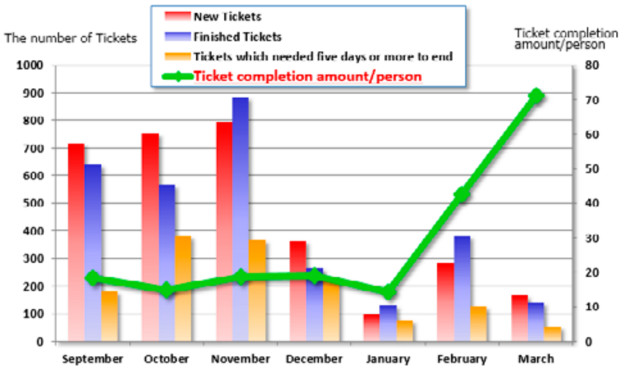

Figure 4 Transition in task volume

5. Evaluation

As a result of the enhancement in the team's ability and each member voluntarily engaging in work utilizing each one's unique characteristics through the implementation of team building, the system was released in March 2014 without incident. Based on the improvement in task completion after the implementation of team building, it is thought that grasping the characteristics of the members using ATA played a certain effective role in the success of the project.

This example is one in which team building using ATA was applied to a project after the problems became evident and the task volume increased significantly. Originally, team building was intended to be applied in the "formation period" of the team. In order to verify that the grasping of the characteristics of team members using ATA is effective in team building, in the next study, our intention is to conduct ATA analysis and characteristics evaluation of the members immediately after the start of the project.

6. Conclusion

By examples of utilization of this ATA, it was found that analysis method of ATA is able to use as a method to help grasping the characteristics of the members in team building. In addition, it is thought that ATA has a possibility which becomes the strategic method to make a team be activated effectively in a short time. However, it is also lacking in measurement of what kind of influence to have on a project specifically at the moment. In order to improve this point, it is expected to apply ATA in the long project begun from 2017, and we would like to proceed to verification for method of ATA utilization and a way of effect measurement.

In the past projects, there was a tendency not to pay much attention to methods and techniques to improve operation efficiency by logically analyzing team constitution and member's characteristics. This is due to traditional Japanese companies being a stereotypically insular, vertically and hierarchically divided organizations. It was thought that even if there were little diversity or differences in thinking among constituting members, and an efficient team could be formed without expending special effort. By carrying out the precise team building and empowering the team members, the project manager can create a team which continues growing and becoming more active with the emergent cooperation.

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Predictive Detection of Unprofitable Projects with AI

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An eradication of unprofitable projects is an essential theme in IT market. The IT market in recent years has diversified, and the tasks of PM and PMO also expand with that diversification. In companywide PMO that supports management of projects within the company, it is important to detect unprofitable projects at early phase. But it is difficult to monitor and management all of the large number of projects by limited personal resources. In Hitachi Solutions, Ltd. the companywide PMO monitors and manages each project by original classifying method called Management Level and PMO is devoting more resources to higher management level. For that reason, the above issue is more remarkable in projects with lower management levels. As a one of solutions to these issues, the authors developed a method to detect signs of unprofitable projects with Deep Learning, an advancing AI technology in recent years. We apply this method to actual projects in the company and confirmed the effectiveness of predictive detection of unprofitable projects. In this paper, we describe about the method of predictive detection of unprofitable projects with AI and the future issues.

Key Words & Phrases: Artificial Intelligence, Deep Learning, Unprofitable project, Predictive detection, PMO

1. Introduction

An eradication of unprofitable projects is an essential theme in recent harsh IT market because benefit accumulated by many projects is ruined by only one unprofitable project in many cases (Takahashi, 2010). Some major IT vendors are promoting some measures in order to solute this theme. The one of the measures is organizing “PMO” which judges projects strictly in each phase such as “before an order” or “phase end” and so on.

Our company, “Hitachi Solutions, Ltd.”, also organized “Companywide PMO” which manages and supports our company projects. PMO promotes an eradication of unprofitable projects. It has certain effect on the prevention of unprofitable projects by classifying the projects based on their scale or risks and monitoring projects which are decided to monitor selectively.

But, some projects fall into trouble status in the projects which are not targets of selectively monitoring by PMO. The main reason is difficulty of monitoring all projects, because there are many numbers of middle size projects in our company, and PMO assigns the most of resource to focused monitoring projects.

In addition, various following changes in the IT market accelerate diversity of project. For example, divergence of customer’s needs from urgent growth of IoT, faster service delivering is required by harsh completion among IT vendors and diversity of delivering by popularized CLOUD etc. The above matters demand for the project management to be diverse too. This is because of these reasons; project manager’s tasks have been increasing.

As shown in Figure 1, this background demands PMO being diverse, that is as increasing PM’s tasks, PMO’s tasks also have been increasing.

Figure 1 Diversity of Projects

There is the necessity that we consider about a motoring method for diverse projects and middle size projects which have difficulty that PMO monitor all. This paper proposes the risk management method by utilizing Deep Learning (DL) (LeCun et al., 2015) developing remarkable in these years.

2. Predictive Detection of Unprofitable Projects by AI

2.1 Current PMO’S problem and Aim of Utilizing AI

In Hitachi Solutions, we establish the original development rule. Our PMO promote a project management by the management method based on this rule.

In our company, many projects like IT system development given in trust from a customer or package product development are under way simultaneously. We established PMO organization that is independent of business sections and PMO promote a management based on the original development rule.

PMO manages each project by original classifying method named Management Level (ML). ML is classified to 5 levels by project scale or risks etc. and PMO manages and drives projects in each level of projects in different way. Figure 2 shows the management and driving way in each ML.

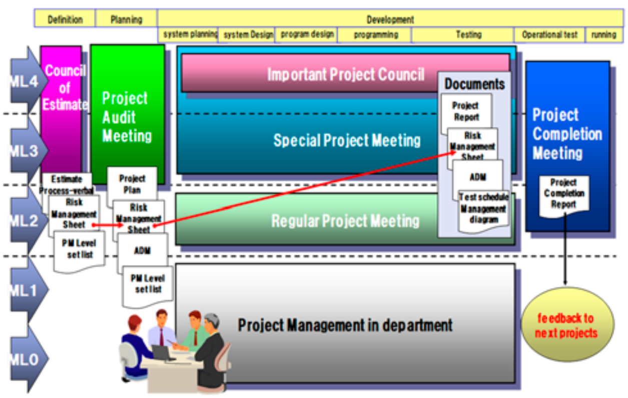

Figure 2 Management Map

This management method is the structure to plan and do early action by applying management process like management meetings or documents in each phase and ML, and doing early detection of management problems or risks.

Our company realized the above management method by developing original project management system. This project management system manage our management information unitarily like estimation, contracting, delivering, management document, cost information, and so on (Kamata et al., 2014).

This system gets various information about projects situation from each business system in our company. Figure 3 shows the outline of project management system.

PMO promote a trend survey of projects and an early detection of problems and risks by referring project information aggregated on this system as necessary. Especially, PMO assign our resource to monitor and support for over ML3 projects that our company select as important monitoring target.

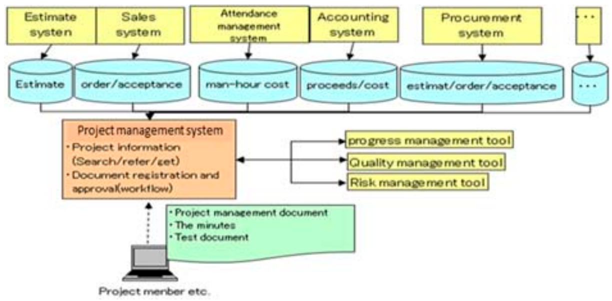

Figure 3 Project Management System

PMO do various activities to over ML3 project like project monitoring, grasping of the progress or cost by project management system, applying knowhow and tool, and so on. On the other hand, we stipulate on development rule that under ML2 projects are managed by each business unit on their own judgement. But there is a risk that under ML2 projects fall into unprofitable projects and those infect to our company performance. When unprofitable project or project which has a problem fallen into unprofitable project occurs, PMO change the ML to higher level like ML3, or ML4. PMO manages there as important monitoring target, but it is a countermeasure to fall behind because PMO makes a countermeasure after problems occurred. This makes the effectiveness of countermeasure PMO can be taken limited. For that reason, the method of detection before problems occurred, that is the predictive detection, is PMO's problem to be solved.

Another problem in our company PMO is the risk of overlooking because there is a gap between PMO members. Our management and monitoring process are unified based on the original development rule in ours company but There are the risks that PMO overlooks predictive of a trouble occurring and projects fall into unprofitable because the assessment and trouble detection etc. for projects depend on the skill or decision by each PMO member in many cases.

We grapple with a predictive detection of unprofitable projects in the ways that is analyzing of project data aggregated on the project management system and learning of the generation pattern of trouble projects by AI in order to solute the above issue.

This attempt aims the early detection of unprofitable indication and the prevention of overlooking with limited PMO resources. Moreover, we aim the effective of PMO's leveling by excluding of dependency on individual skills.

2.2 Development of AI technology

DL, which triggered the trend of AI in recent years, has been developed remarkably and new cases are appearing one after another. DL is an AI technology that enables data classification, image recognition, prediction, etc. by learning the features of data with a structure imitating the human brain. Automation of human's operation with DL is expected to create new business value.

DL came to be noticed at the ILSVRC of the image recognition contest in 2012 as a result of achieving a remarkably high precision than before (Krizhevsky et al., 2012). After that, DL has reached a level equal to or higher than that of human beings in applications (image recognition, speech recognition, games such as Go and Shogi, industrial use, etc.) that have been considered difficult for computers.

For example, in industrial applications, there are use cases where predictions of failures are detected by learning the time series data periodically sent from sensors attached to the machines. The applications detect predictions of malfunction by learning features of data before failure occurrence with DL.

3. Predictive Detection Model with DL

3.1 Apply policy of DL

Although the types of data are different, we thought DL could be applied because unprofitable projects in software development projects can be regarded as faults in machines. The reason is that it is possible to decide whether or not the project gets worse based on both the time series data and the static data like the detection of the failure sign of the machine. As mentioned above, the project data consists of static attributes such as ML and business type and time-series attributes such as personnel costs and business costs. If a project succeeds, personnel costs, business costs, etc. will continue smoothly, but if it is a trouble project that can be unprofitable, it is considered that signs of deterioration appear in time series attributes. Also, some of the static attributes set at the start of the project may contain data to distinguish between success and troubles. These data are learned with DL, and a model for discriminating between success and trouble is generated. In operation phase, if progress data of projects are input into the DL model, a score indicating whether the project will finally succeed or become a trouble project is output. PMO can efficiently monitor a huge number of projects within the company by focusing on the projects which are judged to be highly unprofitable by this score.

3.2 Target projects

ML2 projects targeted for detecting unprofitable signs were selected for the following two reasons. The first, it is difficult for PMO to monitor all ML2 projects because they are many numbers. The second, if ML2 projects become unprofitable, business loss will increase because ML2 projects are relatively large sales scale.

3.3 Target data

Table 1 shows the data in the project management system for our learning algorithm to determine unprofitable.

The static attributes are given at the start of the project and basically does not change until the completion of the project.

The time series attributes are updated monthly, and they change according to the progress status of the project.

Table 1 Learning Data (excerpt)

Type	attribute	remarks
Static	Business type (5 class)	Defined by our company's role in the project
	Social influence degree (5 level)	Defined by publicity, number of users, request reliability etc.
	Project preparation period	Period from project plan settlement to project start
	Project period	Project execution period up to its completion
Time series	Order amount	Order amount of project
	Development costs	Development costs of employees
	Outsourcing costs	Cost for project outsourcing
	Purchase cost	Purchase costs of IT materials
	Other costs	Travel cost etc.

Input data:

The input data is composed of static attributes and a time series attributes in the project management system. After examining the correlation with the end of the project and cleansing such as blank spaces and exclusion of low quality data, the usage attributes were decided.

Although the period from start to completion of the project varies from project to project, when learning data in DL, it is necessary to aggregate and normalize it for each progress rate. Figure 4 shows normalization by progress rate. The period from start to completion of the project is divided into ten equal parts and values from the progress rate of 10% to 50% in the time series attribute are reconstructed. When, inputting this data to the prediction model generated by DL, the final success / failure of the project is predicted at the progress rate of 50%.

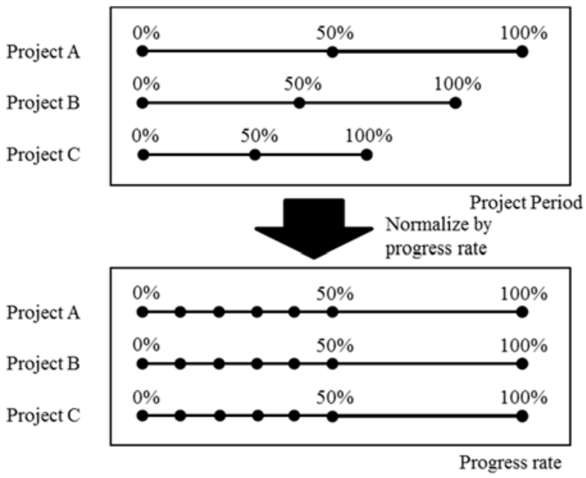

Figure 4 Normalize by Progress Rate

Output:

Projects are divided into three classes (great success, success, trouble) based on the difference between the profit at the completion of the project and at the time of estimation (Table 2). In this paper, trouble classes are defined as the projects with potential risks leading to unprofitable. In the learning phase, the correct value in the actual project is stored in the output layer. In the prediction phase, the predicted value of the classification class for the input project is stored in the output layer.

Table 2 Project Classification

Classification	Difference in profit ratio (estimated - completed)
Great success	10% or more
Success	From -10% to 10%
Trouble	Less than -10%

3.4 Neural network structure

Figure 5 shows neural network modeled as project predictor. Each attribute in the input data is stored in the input layer. Three hidden layers consist of fully connected layers. In order to prevent over fitting, dropout (= 0.5) was set for each hidden layer. In the output layer, as shown in Table 3, values indicating classification classes of each project are stored. In the learning phase, the data of output layer is represented by a 1-hot vector storing 1 in the correct class and 0 in the incorrect class such as (y1, y2, y3) = (1, 0, 0). At the prediction phase, the score representing the prediction result of each class is stored as a value from 0 to 1.

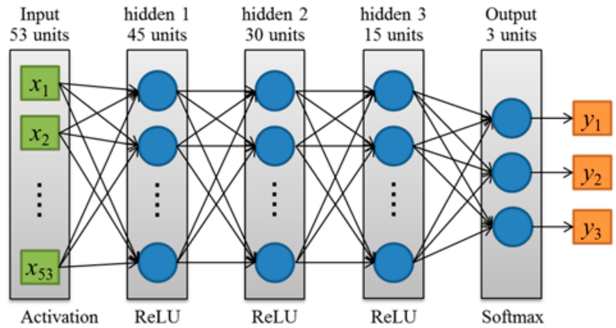

Figure 5 Neural Network Structure

Table 3 Output

Attribute	Meaning	Learning phase	Predicting phase
y1	trouble	1-hot vector with correct=1, incorrect=0	float value from 0 to 1
y2	success		
y3	great success		

4. Experiment and Evaluation

4.1 Quantitative evaluation

70% of past actual data was divided as training data for learning and 30% as test data for accuracy evaluation, and we experimented for effectiveness evaluation using these data. For evaluation criteria, Precision, Recall for each classification class and Accuracy for overall accuracy were used. Precision is calculated by TP / (TP + FP). In this formula, TP indicates the number of true positive data. FP indicates the number of false positive data. Recall is calculated by TP / (TP + FN), where TP and FN mean the number of true positive data and false negative data individually. Accuracy AC is calculated for all experimental data as follows;

$$AC = \frac{\sum_{i=1}^{n} TP_i}{P\ + N},$$

where P means the number of positive data, and N means the number of negative data, and n indicates total number of classes. Table 4 shows the evaluation result.

Table 4 Evaluation Result

Scale	Class			Average
	Trouble	Success	Great Success	
Precision	45.1%	91.1%	33.6%	56.6%
Recall	64.5%	75.3%	62.5%	67.4%
Accuracy				72.8%

We confirmed effectiveness of the forecast for the entire project with an accuracy of 72.8%. The predictions of unprofitable project which is the main subject in this paper were Precision 45.1% and Recall 64.5. As shown in Figure 6, this result means that our model detected 64.5% of actual trouble projects and 45.1% of predicted projects were correct. In PMO's work Recall is more important to prevent overlooking of unprofitable projects. In this point of view, although about half of the predicts are wrong, the prediction results can be regarded as effective for PMO's project management work because about 2/3 problem projects are automatically detected at 50% progress.

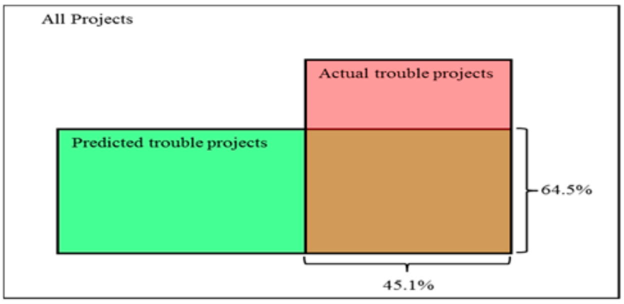

Figure 6 Venn diagram

4.2 Qualitative evaluation

We qualitatively evaluate this result by comparing with the prediction result and the each project data. There are following two evaluation points.

(1) Whether or not this method detect the unprofitable indication that PMO are able to detect easily.
(2) Whether or not this method detect the unprofitable indication that PMO overlooks in many cases.

Normally, PMO member monitor the cost transition of projects in project status as one of important point to detect prediction of unprofitable. In this point, this method is able to detect the projects getting cost worth above a central value at 50% progress. We are able to say achieving point (1) from above result.

Secondly, in terms of point (2), we were able to confirm that even projects which are generally overlooked by PMO members are included in trouble projects detected by AI. In normal projects, the cost transition are same as the planning cost but the transition of actual cost value in this project detected by AI was divergent at a lower than the planning cost. As a result of inspection, it was proved this transition was caused due to delay project start. This project was able to say this is easy to overlook by just paying attention to the degree of cost deterioration because this project is been able to judge as succeeding in cost reduction. This means the method has a certain efficacy in the point of (2).

On the other hand, it was clear that this method tend to overlook when a project has no clear trend like cost connecting to project result directly in the project attribute. However, as a result of detailed inspection of those kinds of projects, there are no predictions of deterioration in 50% progress and there are many cases the factor of deterioration occurred after 50% progress. We consider these cases are a limit of this attempt.

4.3 Total evaluation

Figure 7 shows this time result of the attempt detecting unprofitable prediction by utilizing AI.

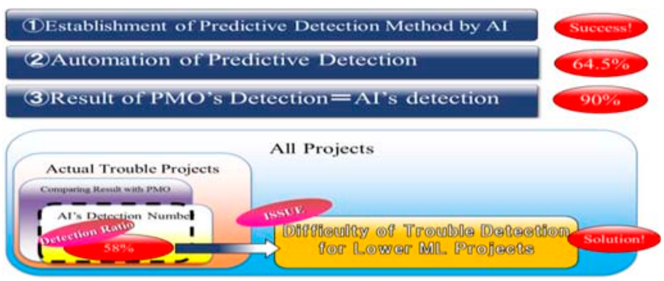

Figure 7 Trial Result

As described above, this time trial raises the ratio of problem detection to 58% for lower MLs projects aren't important monitoring target because of below reason.

(1) Achieved establishment of the predictive detection method.
(2) Detected trouble projects with an accuracy of 45% by automation of predictive detection.

(3) The detection ratio showing proportion that AI was able to detect trouble projects that PMO are able to detect easily.

5. Future Issues

When this method will be applied to actual PMO tasks in the future, we have to consider about the process to use it like a process of information sharing with projects detected unprofitable prediction. Moreover, there is a next challenge that improving detection accuracy by adding data to be learned and detection perspective to AI.

Especially, in the improving detection accuracy, we assumed we are able to improve it by adding new perspective. That is a perspective that AI didn’t learn in this trial and it is utilized to monitor prediction of unprofitable project by PMO. For example, PMO promotes project monitoring by using the perspective of standard phase ratio (SEC, 2016). Standard phase ratio means the statistic of the actual person-month ratio by each phase in software development projects. Table 5 shows standard phase ratio.

Table 5 Standard Phase Ratio

(New Developmet) (Ratio)

Phase	N	Minimum	P25	Median	P75	Maximum	Averege	SD
Basic Design	799	0.001	0.103	0.152	0.208	0.589	0.164	0.090
Internal Design	799	0.011	0.121	0.169	0.220	0.533	0.173	0.076
Coding	799	0.018	0.264	0.337	0.423	0.847	0.352	0.132
Combination test	799	0.002	0.120	0.169	0.223	0.588	0.178	0.087
Integration Test	799	0.000	0.071	0.117	0.177	0.564	0.132	0.086

Copylight 2016 IPA

(Improvement and Developmet) (Ratio)

Phase	N	Minimum	P25	Median	P75	Maximum	Averege	SD
Basic Design	871	0.002	0.098	0.145	0.196	0.582	0.152	0.081
Internal Design	871	0.002	0.114	0.157	0.204	0.759	0.165	0.080
Coding	871	0.009	0.225	0.314	0.408	0.934	0.323	0.141
Combination test	871	0.007	0.132	0.190	0.238	0.685	0.199	0.101
Integration Test	871	0.000	0.087	0.142	0.214	0.810	0.161	0.111

Copylight 2016 IPA

In this time trial, as mentioned above, project period from start to end was divided to 10 equal divisions and AI detect a prediction when project period reaches 50%. Moreover, the data to be learned in this time has no phase concept. For that reason, AI become detectable the prediction of unprofitable project like deviation of person-month from standard ratio in each phase by adding standard phase ratio to perspective and learning data and so on.

In this paper, we mentioned standard phase ratio as an example, we consider AI needs to make the perspective and know-how that PMO uses to monitor prediction of unprofitable project to improve the detection accuracy.

As future challenges, there is systematization of predictive detection for unprofitable projects by utilizing this method, improving detection accuracy and applying AI technology to another PMO tasks.

6. Conclusions

We developed the predictive detection method of unprofitable projects with AI in this time. As a result of validating effectiveness based on the data of actual projects in our company, we confirmed AI is able to detect approximately two-thirds unprofitable projects with an accuracy of about 50%.

About systematization, we consider it needs developing a series of flows from data collection, to learning with AI and alert of a result of predictive detection. In order to apply the predictive detection to the actual operation in PMO, it is required to realize more precise predictive management by letting the AI learns the viewpoint of the standard phase ratio, knowledge, project data, etc. Moreover, PMO has many issues other than predictive management for ML2 project targeted in this time attempt. We consider we need to promote solving issues with AI technology.

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Customer-Driven Government: Using Data and Open Source Software to Improve Service Delivery in Rwanda

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Rwanda is a country in the central and eastern part of Africa, essentially an agriculture based economy. For the last two decades its vision has been to move to a knowledge base economy-ICT Driven, therefore massive investments are made in Softwares to improve the way the government delivers its services. But based on an Audit report from April 2016, users don't necessarily always engage well with those Softwares. The Software Development Team in Information and Communication Technology Department of Rwanda Department Board is responsible to customize the software and deliver them to the customers. The team perform the work as an assembly line of a factory from customization, design, delivery and maintenance for several customer's products. Therefore, it is unclear who has the responsibility for the problem from the user perspective. In this paper, it is proposed project based "Customer Driven Process" from current Supply Chain type Process for achieving higher customer satisfaction in Rwanda. Following the changes in work processes, we shall proceed to automatize them with IT. Based on the results of this research, it is discussed how hundreds of institutions will receive higher quality Softwares and individually performs better and after we have enough results from the implemented system, we will evaluate the feasibility to propose Similar improvements to other organizations.

Key Words and Phrases: Customer-Driven Business Model, Open-Source Software, Data-Driven Process, E-Government.

1. Introduction

Almost two decades ago, Rwanda had set its vision to provide a better environment to all its citizens, that vision has been called "Vision 2020".The content of that vision includes Human Resource Development, Good Governance, Private Sector development, Agriculture, Regional and international Integration with Emphasis on Gender Equality and Technology.

With protection of Environment, ICT is listed as a cross-cutting area of the vision 2020. Since the first draft of the vision in 2000, a lot of progress has been made but so many changes are still ahead for Rwanda to actually become a middle income country and after that a rich Economy. ICT is an enabler in providing better governance to citizens and potentially a helpful tool in providing more accountability, transparency, and efficiency. With an average growth of 8% per year between 2001 and 2015 according to the World Bank, Rwanda is moving quickly toward becoming a better place for its citizens, however the issue is how we can let technology help us. With the ambition of placing of itself as an ICT hub in Africa, it is necessary to do the changes more rapidly, with higher quality in order to see real results and benefits in a close future.

The Rwanda Development Board, through its ICT department is in charge of providing ICT solutions and advisory to more than 116 institutions in the country, including Ministries, local governments, and other Government Institutions. Each of those institutions in return provide different types of services to citizens. The purpose of this research is to provide to Rwanda Development Board through its ICT Department (RDB/IT) Note (1) a framework to optimize and maximize the benefits of Software for governmental institutions. As Argued by Kentaro Toyama in his book Geek Heresy, "Technology by itself only amplify underling human forces, get human forces right so that technology can have a positive impact". Meaning it is important to understand the needs and aspiration of users first to be able to provide relevant solutions.

In this research, we describe in details the planning phase of the project.

In This study, it is discussed how we can:
(1) Propose a customer-centered business models including data driven modules.
(2) How we can benefit from automatizing data collection and analysis using Open source software and the benefits of open source software.
(3) Proposing application method to customers focusing on RDB / IT software development.

2. Literature Review

In this chapter, “Customer Driven Supply Chain” is compared to “Traditional Supply Chain model”. It is also compared Open Source Software and commercial products. The concept of Data Driven supply will also be described with relation to customer driven model and case model introduced.

2.1 Traditional Supply Chain Model Vs Customer Driven Supply Chain

In this section, we make a comparison between the Traditional Supply Chain Model and the Customer Driven Supply Chain model. In the Traditional Supply Chain Model, the focus is made on the quantity of products that need to be delivered and the functionality of the software. But most of those decisions are made by the producers of the products. In the customer driven Supply Chain, decision are made based on customer input and all the organization is arranged to fit the customer needs.

Table 1 what it means to be consumer driven: Transforming the supply chain, IBM Corporation 2004, modified.

Characteristics	The Traditional Supply Chain Model	The Customer-driven Supply Chain
Model	Generic, “one size fits all”	Specialized, fit for purpose
Decision Making	Bases decision making on data that is old, batched and removed	Bases decision making on a real-time, store level view to consumer demand
Planning Cycle	Is characterized by planning cycles that limit responsiveness	Is characterized by flexible planning cycles, to an hourly or conceivably sub-hourly level
Collaboration and Visibility	Operates in a series of silos limiting collaboration and visibility	Is highly collaborative and integrated, with shared visit across the ecosystem
Supply Chain	Measures the optimization of internal supply chain metrics	Measures the supply chain on consumer impact

In the table above from IBM, it is compared Traditional Supply Chain Model and Customer-driven Supply Chain. In a Traditional Supply Chain Model there is one size fits all model for all clients, decisions are based on old data and is also characterized by fixed planning cycle which can limit collaboration and responsiveness. Finally it is also mostly based on internal supply metrics rather than customer’s metrics as in opposition the customer-driven supply chain model. The customer-driven supply chain model is specialized for each customer and make use of real time data to organize planning cycles which are more responsive and where visibility across the whole ecosystem is shared. The later supply chain is also measured in function of impact on customer.

For the purpose of this research, it is assumed that the model currently used in RDB/IT referred to as “Assembly line of factory” is similar to the referred as “Traditional Supply Chain Model” and will be used as reference for clarity purpose.

2.2 Data Driven Model

Data Driven model is in direct relationship with the customer driven model in the sense that it is about putting in place mechanism and system that allows to listen and observe customers.

According to a publication from the Asher project by the Harvard Kennedy School, Kansas City has been using data Analysis for service delivery improvement and has resulted in 20% customer satisfaction improvement in a period of 4 years from 2010 to 2014. They did install a 311 line where citizens could call Kansas City regarding the city different services. Every one of these call could receive a 3 questions follow-up survey asking the citizens to rate the call from unacceptable to excellent. In addition to a quarterly citizens surveys, Kansas City manages to improve its customer satisfaction index. The Silicon Valley giant Amazon uses customer data analytics tools to suggest new products based on past browsing history and also personalize each user page. Amazon’s CEO, Jeff Bezos, put the customer at the center of every business decision as mentioned by Forbes Magazine. Each year, the University of Michigan calculate the customer satisfaction index of the 225 American largest companies. Amazon bas been ranking among the top 10 of the list for several years. Amazon is also always at the top of the same list in the online retail category.

Equally, Companies like Google and Facebook uses analytics tools to keep analyzing every customer behavior and suggest new information or even collect more data. Google for example send notifications to mobile phone users asking to rank a place or to provide information about a visited place for example based on GPS information collected.

2.3 Use of IT and in particular Open source software for the Government.

Open source software for government is more and more being considered as a more viable option and many reasons are cited by Government Technology including: more flexibility with codes changes, bigger affordability comparing to commercial products, less dependency to vendors over time and easier, access to skilled labor as open source software are built by big community.

According to Open Source Initiative, Many government are already using these software like New Zealand, India, United Kingdom and the United State.

The graph below from ComputerEconomic.com shows the results of a survey on 228 enterprises product users on the advantages of open Source Software over commercial product.

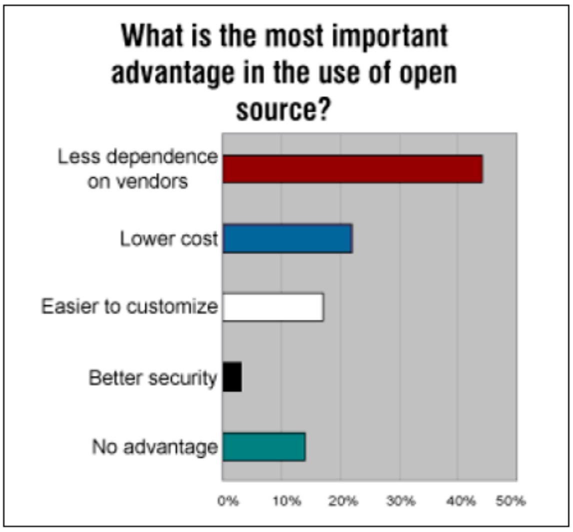

Figure 1 what is the most important advantage in the use of open source, Computer Economics (2005).

3. Methods

This research has formally started a year ago, with the purpose of improving customer's satisfaction for users who uses RDB/IT Softwares. Different Methods have been utilized to collect the data necessary to the pursuing of this research work. Observation was made from the RDB/ICT Department. Interview Methods was also used with the different levels of stakeholders involved in the project. And finally, a report from the Auditor General of State Finance in Rwanda dated from April 2016 has been a precious source of information in this work. The report will be discussed in sub section 3.2 of this paper. Other strategic documents stating how ICT project should be implemented in Rwanda have also been consulted. For interested readers, their list will be added in the appendix

3.1 Observation and Interviewing

From the end of 2013 to the end of 2016, for a period of 3 years, we have observed the processes and functioning of RDB/ICT especially the software Development Team. During that time, data was collected by interviewing and observation methods

Interactions with several stakeholders at all levels involved in different parts of the project. Stakeholders including In RDB/IT of course but also with several of the institutions, Ministries and Local Government.

The following questions are a sample of questions asked to the different agencies on the usage of software implemented by RDB/IT:

(1) What is your current business workflow?
(2) What bothers you most with the current situation?
(3) Which manual processes would you like to see automatized?
(4) Which Softwares would you rather use?

3.2 Audit Report on RDB/IT

"The OAG'S vision, mission and core values are built on the belief that those who are entrusted with public resources should be brought to account and are expected to use the resources transparently, efficiently, and there should be value for money within the laws of Rwanda." Quoted from the office of the Auditor General Rwanda's Website.

The office of the Auditor General has conducted a big Audit covering the period from 2009 to 2016. The report was published in April 2016 and covered the audit of Document Tracking and Workflow Management System/E-Mboni, DTWMS (Note 2), which is one of the biggest software deployment by RDB/IT. That report which included several resources including 39 institutions sampled, and the management of RDB/IT interviewed on different matters regarding the way the projects are implemented.

It is also discussed the audit findings on how the sampled institutions uses DTWMS. Data on system usages are also part of the report.

Audits Questions are as follows:

(1) How adequate was the implementation planning of the Document Tracking and Workflow Management System project?
(2) To what extent is RDB implementing the project and how does it monitor its utilization by users?
(3) To what extent is DTWMS utilized by public institutions?

Methods of Data Collections for the Audit are: Interviewing, Physical Verification and Documentary Review.

The 3 following point were part of the audit's main findings:

- Low usage of Softwares deployed by RDB/IT
- Delay in implementation by RDB/IT
- Lack of Key Performance Indicator for checking project progress.

4. Customer Driven and Data Driven Software Team

For the software development team to move from the supply chain model to the customer driven/data driven model, a different perspective is required in the way teams works. Meaning that each of the 116 institutions now have a team from the software development team looking after them. The other supporting part of the solution will be the technology used in capturing the user's input. In this chapter we will discuss about the two aspects and how they complements each other.

4.1 Human Resources Reorganization

The team in Rwanda Development Board, ICT Department is reorganized. The reorganization explained below allow Institutions to know who is responsible for their products. It also make clear who holds responsibility in case of issue.

Each Institution has a whole team:

(a) Development Leader
(b) Software Engineering
(c) Quality Assurance Professional
(d) Technical Publication

The new communication flow allows more exchange between different stakeholders.

As it is today, the work was mostly organized according to software's development targets (According mostly to work Volume). That also mean delivering updates which from a technological perspective makes sense but with no use for the Institution at that moment in time.

As shown in the graphs below each institutions will be assigned a teams of people. The new setting will allow institutions, and in this case the client, to be the source of updates and new deployments by the team.

Figure 2 Team Re-organization

4.2 Toward a Data-Driven Decision Making

The second part of the solution relies on the use of technology. The purpose of the technology is be capture data from the user.

Data is captured in different forms, analyzed with the purpose of informing the software teams on the best actions to take. This is like simply observing the customer behavior in regard to his usage of the Softwares.

The Data that that is captured and analyzed is categorized in 4 types:

(1) All the Request support from institutions
(2) The systems usage monitoring
(3) User's surveys
(4) Trainings Taken by the Users.

Below is a Basic figure of the components included and analyzed by the platform to be used by RDB/IT.

4.2.1 Request Support Recorded and Analyzed

As already mentioned RDB/IT is also in charge of providing technical support and maintenance for the software they deploy. Request Support are all channeled through one system. The support request are classified by types. As it is now, Request support comes in various forms: phone calls, skype message, SMS to software development Members phone number, request for support sent by emails to software development member's emails, Personal Whastapp Account, Personal Facebook accounts are also a method used, RDB/IT Intranet and any other method judged efficient by institution requesting support.

Classification is made by:

(1) Support Request type
(2) Support Request Volume
(3) Institution type
(4) Institution Size

Classification is analyzed and based on results trainings is be tailored for each institutions and Support Request are responded to more proactively.

It's also allows to suggest more wisely updates for the systems but also to observe which institutions needs more attention and support. All the analysis is displayed in graphical forms and statistical analysis is also used for more accuracy.

This unique channel for request support makes it possible to follow up an institutions more efficiently.

4.2.2. Surveys

In the survey, it is necessary to ask customer's opinion about their current business model, in order to more wisely suggest more relevant Solutions. In cases where a big numbers of users is involved, surveys remains the most efficient way to connect with users and get their perspective.

It was proceeded by 10 likers. The questionnaires are as follows:

(1) How satisfied are you with the system?
(2) What should we improve?
(3) How fast do you receive support for your request?
(4) Which types of systems would you rather have?

This components of the system will allows users to express what they need. And then translated in an easy to understand formats like dashboards, it might help the management in RDB and the public Institutions to make informed decisions for a more efficient and productive future. Currently, there is no formal or informal methods in place to formally record and ask the institutions their perspectives on the Softwares.

4.2.3 System Usage monitoring

System usage monitoring part of the systems allows:

(1) To monitor how Softwares are used
(2) How frequently?
(3) By how many people?

This information is crucial in providing customized suggestions to the users and helping both RDB/IT and Customer's Institution's management makes precise and efficient decisions.

Usage Data also sampled in the auditor report, are already collected in a manual way which limit the analysis capacity. Through the platform, Graphical representations are made and reports are shared between concerned stakeholders.

Institutions with low or irregular systems usages are more visible thus can receive special attention from RDB/IT's Teams.

4.2.4 User Trainings

User Trainings are usually provided in person, generally in the customer environment and should remain a privileged way of providing training. But considering the big numbers of users to reach, online trainings must also be considered as a valid option.

The system include training content based on:

(1) The most frequently request support (or most frequently asked Questions)
(2) The survey's results
(3) Content decided by both RDB/IT and Customer's Institutions.

An online training platform already exist but its content could be enhanced by the public institutions feedbacks described above.

5. Target Product

In this chapter, it is described challenges and countermeasure, solutions overview, roles and responsibilities and future use.

5.1 Challenges and Countermeasure

The adoption of a new business model might prove itself to be new to the teams applying it. In fact success of this new business model mostly lies in the vision and the adoption of the model by the teams producing the Softwares.

In fact, a more customer centered vision might seems not especially new and the reality is that part of the teams might already consider itself customer centered in the way they do business.

The best way remains to deeply explain the benefits of a happy customer and continually work as a team. By more closely observing their customers, they might improve the customer satisfaction index but also gain a bigger customer loyalty. All of those being a promise of a more Innovative, proactive and prosperous team.

5.2 Solution Overview

This solution is a drastic change in the business model from a more product centered model to a customer driven. The platform will be sending emails with tips on systems usages (trainings) but also surveys the users, the system usage will be monitored and all the requests for support recorded, analyzed and categorized. As shown in the graph below, the data collected will be processed, through algorithm and models that data is turned in a format for example dashboards which is easier to use for decisions making. Teams also will work and are organized in customer centered units.

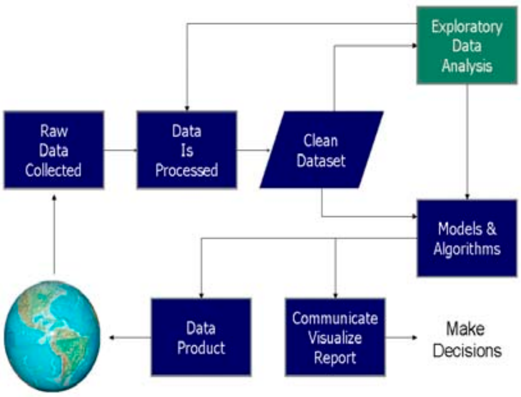

Figure 3 what is Data Driven Marketing and how to implement it in your business model, Premnath321 (2015)

5.3 Role of RDB/IT and Institutions in this project

This project is unique in its type for Rwanda and especially as an e-government initiative in Rwanda.
It will be analyzed the roles of RDB/IT and also the roles of the primary stakeholders in this project, software recipient or the public institutions. Systematic data collections and analysis is still new for RDB and its stakeholders and the roles of each one needs to be clearly defined:

Table 2 Roles repartition in the project

	Objectives	Roles
RDB/ICT	To drastically improve customer satisfaction in the Softwares (mostly public servants)	*To provide an interactive platform where customers feedback will be collected and analyzed. *With Proactivity and Innovation, produce new products and updates
Recipients Institutions	*To provide better service delivery to citizens *Use software to improve efficiency, transparency and accountability	*To actively express their needs and feedbacks through the provided platform.

5.4 Future Use

Rwanda is a fast growing economy with an average of 8% growth per year between 2001 and 2015 according to the World Bank. That number is justified by many measures but also by the ability of the country to adopt methods which proves to be successful.

This research was pursued with RDB/IT in mind, and in particular the software development team and the institutions using their software.
If the pilot produces successful results and actually improve customer satisfaction index measured in this particular project by Software usage Rate. (The customer satisfaction index currently not being formally measured). The customer driven Business model and the Data framework based on it might be presented as a successful method and be applied to other project facing difficulties achieving customer satisfaction in the government of Rwanda. The Rwanda Development Board through its ICT department has the mandate to act as an advisory entity in IT related matters for all other Public Agencies in Rwanda. If proven successful, this model could be exported to several program in the Software field but also all other field of work in the public sector.

As stated in the introduction, the vision 2020 covers several fields which are a central part of development for in the country. This model concerns e-governance but could as well be applicable to the other areas: Human resource development, private sector development, Agriculture, Regional and International Integration.

6. Expected Outcomes

In this chapter, we will discuss results expected of this research by the end of the project completion:
The expected outcomes are:

(1) Support time reduced from 3 business days to 24 hours.
(2) Training more accurately provided to users. System usage literacy raised by 20%.

(3) System Usage Rate improved by 30%.
(4) Updates and Customization on Softwares from 45 days in average to 15 days.
(5) Customer's preference will be recorded and shared as data to provide effective and rapid customization and increase customer satisfaction.
(6) Business Decisions made based on real time data.
(7) New Products and Softwares Updates are developed based surveys feedback and other system data

The Expected impacts are Customer satisfaction keeps raising and as a result better usage of provided Softwares by the 116 institutions resulting from a raised customer satisfaction. And in the same continuity, each one of those 116 institutions including ministries, local government and different public agencies provides a better service to citizens.
With the goal of achieving more accountability, transparency and efficiency met.

7. Conclusion

Governments as any other business needs to focus on more productivity, efficiency and high levels of delivery. The use of new technologies have proven that they can to be of a priceless help. With this research, we were able to show how to improve customer satisfaction index for service delivery in Rwanda by:
(1) Proposing a customer-centered business models including data driven modules.
(2) Demonstrating benefits from automatizing data collection and analysis using Open source software and grasping the merit of open source software.
(3) Proposing an application method to customers focusing on RDB / IT software development.
This model will allow to anticipate failure and to have tangible data for decision making.
Public delivery systems needs to become efficient for achieving development goals, quicker and better. In Fact, it should be considered normal especially in the case of a country which has the ambition not only of quickly putting itself out of poverty but by doing so to also place itself as an ICT hub and a leader in the area of service delivery and Industry.
By applying a customer driven Business model and a Data Driven model, users of software produced by RDB/IT are also gaining more controls over the software they use in their daily business life. It is expected to leads to better usage rates for government Softwares and e-government solutions delivery in general. That also imply an improved service delivery to citizens in all parts of the country.
The hope of this research is to contribute to a more customer driven/ data-driven Business environment in Rwanda.

Notes

Note 1) The ICT Department in the in Rwanda Development Board is in phase of becoming an independent public institutions. The name of the institutions is Rwanda Information Society Authority (RISA). At the time of this paper redaction, RISA is still a new Institution and most of the research has been done while the ICT Department still belonged to Rwanda Development Board, RDB/IT. To know more about the Vision of RISA, Please consult Smart Rwanda Master Plan 2015-2020 referenced in the Appendix Section or consult the section 5.4 of this paper for a briefed explanation.
Note 2) DTWMS refers to Document Tracking and workflow Systems or E-Mboni which is the System audited in the report from the Office of the Auditor General of State Finance in Rwanda.
It is also a big government software deployment in Rwanda. It has been deployed in 116 public institutions in Rwanda. For more information, the Audit report from the Auditor General of States Finances can be consulted by interested readers.

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Appendix

A. Rwanda Vision 2020

B. Second Economic Development and Poverty Reduction Strategy, EDPRS II

C. Smart Rwanda Master Plan 2015-2020

Author Index

Author Index

Author Index

Author Index

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