Ministry of Economy, Trade and Industry
Software Metrics Advancement Project

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MITSUBISHI RESEARCH INSTITUTE, INC.

Research Center for Information Technology
Information System Technology Research Group

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1. Background and Purpose
2. Outline of the Project
3. The Guide for Visualization, Security and Improvement of System and Software Quality
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1. Background and Purpose (1)

Background

- In Japan, benchmarking activities for evaluating software projects related to metrics are performed, and quality management methods of software are provided by multiple organizations.
- However, definitions, computation formulas, measurement methods and evaluation methods, etc. depend on such organizations. Consequently, not all of the persons such as users and vendors cannot readily use them at the Software Life Cycle.

Software quality control methods based on measures
ISO/IEC9126 Series, SQuaRE Series, JIS X0129 (SQuaRE), JISC
Guidelines for Non-functional requirements :User Vender Collaboration Project II (UVCII), JUAS
The Grades standards for Non-functional requirements (NFR-Grade) , NFR-Grade Study Group
System development common reference for the reliability improvement (Common reference), IPA/SEC
Practical use of SLA in software development (SLA in software development), JEITA
SLA guidelines for Private Sector IT Systems (SLA guidelines), JEITA

Benchmarking reports
Software metrics Reports, JUAS
IPA/SEC White Papers on Software Development Projects in Japan, IPA/SEC
Report of software development for supplier -Part Ⅱ, ERA

1. Background and Purpose (2)

- Purposes
  - To improve the reliability at the Life Cycle of the information system and software, and form the social common recognition concerning the reliability.
  - To develop/improve software metrics which people in every footing beyond the organization can commonly handle and the environment for usage thereof by using software process metrics of groups and organizations, and assets related to software process metrics.
  - To create standards for having them widely known and used.

2. Outline of the Project (1)

- Establish the Product Quality Metrics WG and Process Metrics WG

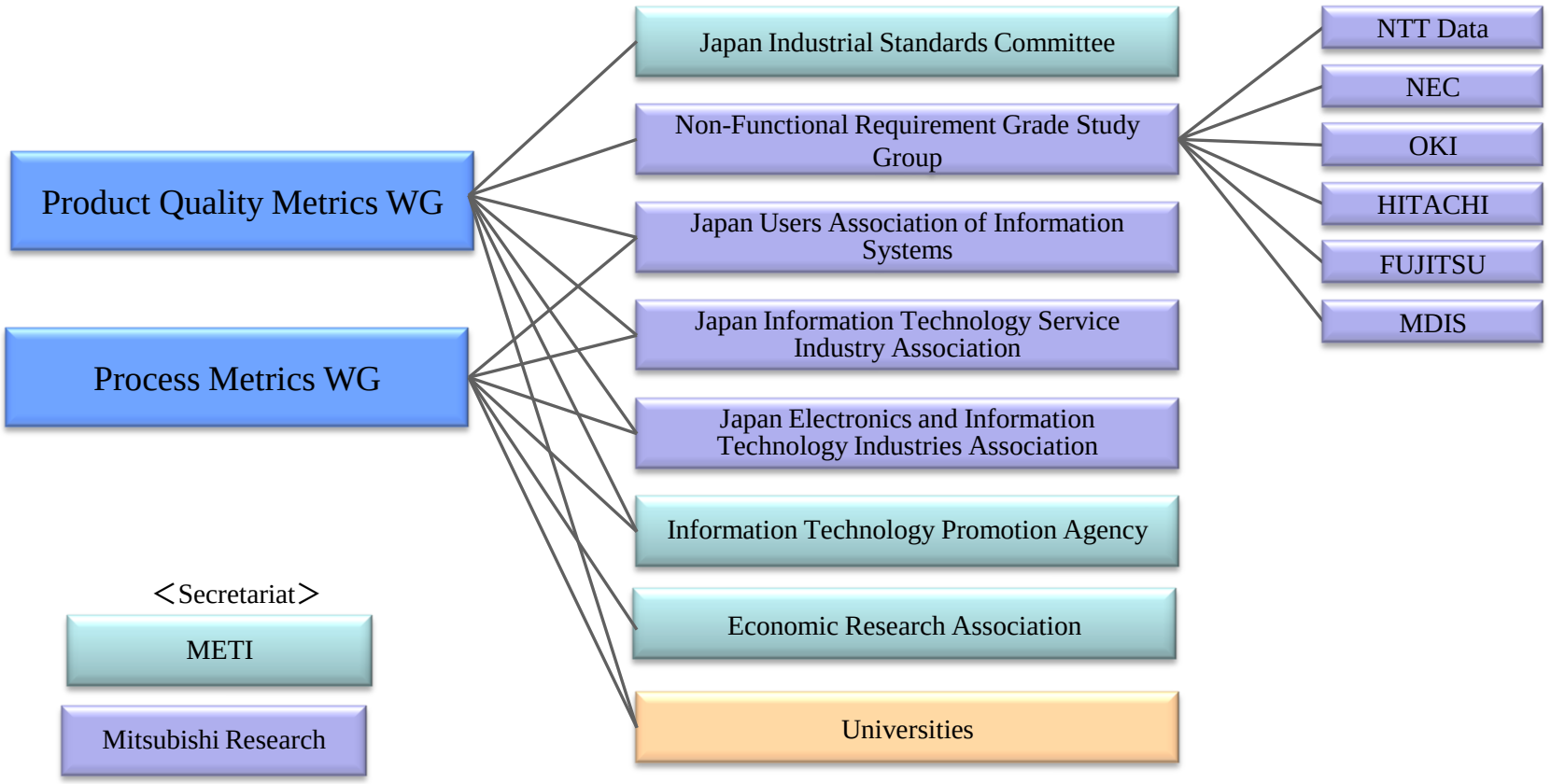
＜Product Quality Metrics WG＞

- Scope of WG
  - To establish the common recognition of the quality of the system and software fit for usage needs, and the metrics for achieving the quality
- Activities for the first year
  - To summarize domestic plural discussions on the quality guarantee of the system and software mainly in light of international standards, and assume the role of a guide for features of each content and mutual relations as well as the basis for the quality guarantee.

＜Process Metrics WG＞

- Scope of WG
  - To develop/improve the environment in which the system and software project can be analyzed and evaluated in an objective manner and with methods commonly applied.
- Activities for the first year
  - To summarize benchmarking data that you can currently use in Japan, and assume the role of a guide for their usage methods together with the basis for the quantitative management and points to note.

2. Outline of the Project (2) Structure for Implementation



Structure for Implementation of the Software Metrics Advancement Project

Ind. Gov. Acad.

3. The Guide for Visualization, Security and Improvement of System and Software Quality

Product Quality Metrics WG

Software Metrics Advancement Project

http://www.meti.go.jp/policy/it_policy/softseibi/metrics/product_metrics.pdf
(Japanese only)

Purpose of the Guide and its Summary

- Purpose
  - To establish the common recognition about the quality of the system and software fit for usage needs and the metrics to realize the said quality.

- Outline
  - Summarizing multiple methods relating the quality of software of Japan with international standards, and
  - Clarifying mutual relationships of such methods and features, and
  - Assume the role of a guide for respective usage methods and points to note.

Content	
Chapter 1	Concept of the quality assurance of the system and software
Chapter 2	Domestic activities on the quality assurance of the system and software
Chapter 3	Use of the benchmark report from the domestic activities for the quality assurance and use at the software life cycle
Appendix	Information on the benchmark reports on the quality assurance of the domestic system and software

Chapter 1 Concept of the Quality Assurance of the System and Software

- Outline
  - To explain the concept of the quality assurance activities from quality requirement definitions to quality evaluation using metrics based on international standards
- Effect
  - Can learn the basic concept of the quality guarantee and improvement of the system and software
- Content
  - 1.1. Influence of the system and software quality and the quality assurance
  - 1.2. Various standards related to the quality guarantee of the system and software
  - 1.3. Viewpoints for improving the quality of the system and software
  - 1.4. Concept of the Quality Life Cycle
  - 1.5. Quality model
  - 1.6. Concept of the quality measurement and quality gauging measure (metrics)
  - 1.7. Quality Life Cycle and quality measurement of the system and software
  - 1.8. Quality requirement
  - 1.9. Quality evaluation

Chapter 2 Domestic Activities on the Quality Assurance of the System and Software

- Outline
  - To summarize the activities of representative Japanese organizations that are discussing the quality assurance of the system and software relating metrics, and the features of such output reports.
- Effect
  - Can collect the activity information on the quality guarantee of the system and software performed in Japan. By obtaining the features between the activities and output reports, can select reference materials necessary for performing quality assurance activities.
- Content
  - 2.1. Major activities in Japan
  - 2.2. Comparison of features of domestic activities

Methods on Quality Assurance of System and Software, and IT Services in Japan

Methods	Purpose	Output Overview
UVC II (JUAS)	To enable users properly define non-functional requirement in a requirement specification sheet	■10 areas of non-functional requirements of information system, 230 indicators, definitions, measurement methods, measuring scales, computation formulas, interpretation methods ■How to handle indicators at the software process
The Grades Standards for Non-Functional Requirement (NFR-Grade S.G.)	To dissolve misunderstanding when users and vendors agree on non-functional requirements and enable both parties make a presentation /proposal	■Usage Guide (Usage Version, Comment Version) of "Non-Functional Requirement Grade" ■Grade Table on NFR of the system structure ■List of Items on NFR of the system structure ■Tree Diagram on NFR of the system structure ■Spread Sheet of NFR-Grade
Critical Infrastructure Reliability (IPA/SEC)	To prompt the introduction of the quantitative quality control mechanism of the software development, in particular, as one of the measures to improve the reliability of material infrastructure information system	■Profiling of the system and project ■Process evaluation metrics ■Product evaluation metrics ■Basic metrics
SLA in Software Development (JEITA)	To directly feed back the quality issues at the "system management/operation" to the "system development" and improve the quality of IT services by working on the SLA/SLM as the PDCA cycle that runs through the entire life cycle of the IT system	■"Quality evaluation indicator", "development/operation process coordination evaluation indicator" of product, process and resource at the software development
SLA Guidelines (JEITA)	To indicate evaluation indicators common to the SLA, enabling users and providers of IT services choose proper service level objectives.	■Service evaluation objectives ■IT process management evaluation objectives ■IT resource evaluation objectives ■SLO and SLA values of each of those put above

Features of the Methods from the Metrics Viewpoint

		ISO / IEC 9126 Series	UVCII	NFR-Grade	Critical Infrastructure Reliability	SLA in Software Development	SLA Guidelines
Object	**Software**	✓ (covered)	✓	partially ✓	✓	✓	N/A
	System	✓	✓	✓	N/A	N/A	N/A
	IT Service	N/A	✓	✓	N/A	✓	✓
	Ex.	N/A	N/A	✓	✓	N/A	✓
Deliverables on quality characteristics and metrics		(Internal/External/ QIU) Quality Model, Measures	NFR-measures	NFR-measures, NFR-Grade chart, NFR-tree diagram, NFR-item list for system infrastructure	Product Quality measures, In-process measures	Quality assessment measures Connect assessment measures	Level of (Service / IT process management / IT resource)
Quality characteristics handled [target]		[Product] Functionality, Reliability, Usability, Efficiency, Maintainability, Portability, [In Use] Effectiveness, Productivity, Safety, Satisfaction	[Product] Functionality, Reliability, Usability, Efficiency, Maintainability, Portability, [non-Product] Effectiveness, Restraint failure, Operationally, Technical Requirement	[Product] Availability, Performance, Expansibility, Operationally, Maintainability, Security, System environment, Ecology	[Product/Process] Dependability	[Product] Functionality, Reliability, Usability, Efficiency, Maintainability, Portability [Process] Maintenance situation, Enforcement situation [Resource] (developer) Ability, Qualification, (supplier) Certification	[Service, Process, Resource] Availability, Reliability, Performance, Expansibility, Maintainability, Security, Completeness, Correctness
Definition of metrics		✓	✓	✓	✓	✓	✓
Interpretation of measured value		✓	✓	✓	✓	N/A	✓
Measurement of reference value		N/A	N/A	✓	✓	N/A	✓
Usage process, scene		ISO/IEC25030 and 25040 provide usage methods	When defining NFR	When handling NFR at each process of planning, requirement definition and development of SLCP	When managing at each period of before task, after the task and after completion of the project	When determining service level objectives (SLO) on a development project	When determining the content of SLA
Usage guide		✓	N/A	✓	N/A	✓	✓

Chapter 3 Quality Assurance Activity and Usage at Software Life Cycle

- Outline
  - Summary of each method in light of the following perspectives:
    - Quality characteristics, metrics of the ISO/IEC9126Series and the Quality Life Cycle
    - Usage scenes in the Software Life Cycle
- Effect
  - Can obtain reference information of the quality model, metrics handled in the quality requirement definitions in the quality assurance of the system and software based on the ISO/IEC9126 Series.
  - Can obtain information on the usage of output reports per phase of the Software Life Cycle and that based on the evaluation results of the system reliability requirement level (system type).
- Content
  - 3.1. Summary in light of the quality guarantee activity of the system and software
    - Summary in light of quality characteristics, measures
    - Summary in light of the entire quality life cycle
  - 3.2. Summary in light of the Software Life Cycle
    - Summary in light of the Software Life Cycle
    - Summary in a case where the system type is taken into account

Summary of Quality Characteristics and Measures (1)

- How the ISO/IEC 9126 Series (JIS X 0129-1) respond to External/Internal Quality characteristics and measures

JIS X 0129-1	Quality Characteristics	Quality Sub-Characteristics	UVC Ⅱ	NFR-Grade	Critical Infrastructure Reliability	SLA in Software Development
Internal/external Quality Characteristics	Functionality	Appropriateness	✓			✓
		Accuracy	✓			✓
		Mutual operability	✓			✓
		Security	✓	◎		✓
		Functionality compliance	✓	△		✓
	Reliability	Maturity	✓	◎	✓(partially△)	✓
		Fault tolerance	✓	◎		✓
		Recoverability	✓	◎		✓
		Reliability compliance	✓	△		✓
	Usability	Understandability	✓			✓
		Learnability	✓	△		✓
		Operability	✓			✓
		Attractiveness				✓
		Usability compliance	✓	△		✓
	Efficiency	Time behavior	✓	◎		✓
		Resource utilization	✓	◎		✓
		Efficiency compliance	✓	△		✓
	Maintainability	Analyzability	✓	◎		✓
		Changeability	✓	◎		✓
		Stability	✓			✓
		Testability	✓	◎		✓
		Maintainability compliance	✓	△		✓
	Portability	Adaptability	✓	△		✓
		Installability	✓	◎		✓
		Co-Existence	✓	△		✓
		Replaceability	✓			✓
		Portability compliance	✓	△		✓

To quality characteristics, ◎provides metrics and reference values, ✓provides metrics only, △provides reference info on metrics

Summary of Quality Characteristics and Measures (2)

- How the ISO/IEC 9126 Series（JIS X 0129-1）in use responds to quality characteristics and measures

JIS X 0129-1	Quality Characteristics	Quality Sub-Characteristics	UVC Ⅱ	NFR	Critical Infrastructure Reliability	SLA in Software Development
When quality characteristics are used	Effectiveness	—		◎		
	Productivity	—		△		
	Safety	—		◎		
	Satisfaction	—				

To quality characteristics, ◎provides metrics and reference values, ✓provides metrics only, △provides reference info on metrics

Summary of Quality Characteristics and Measures (3)

- Quality Characteristics and Evaluation Indicators other than the ISO/IEC 9126 Series（JIS X 0129-1）

Method	Quality [sub] Characteristics	Definition	Evaluation Indicator (Metrics, Others)
UVC Ⅱ	Restraint failure	In particular, ability to prevent an occurrence of a failure at the development and management of highly reliable information system and contribute to the prevention of its expansion at the time when it occurred	Quality evaluation value Operational quality ratio
	Effectiveness	Ability to create the effect as planned and be able to evaluate it	ROI Claims from customers Satisfaction of users
	Operability	Meaning the operability of not the product but the computer center	Ratio of the time to provide services Ratio of an intervention operation Ratio of occurrences of operational errors in measures for failures Ratio of actual days to planned days until restoration in case of a local disaster
	Technical requirement	Pre-determined basic framework or mechanism of info system from the view of the organizational policy and maintenance of total consistency as a firm. Or, a requirement that is studied and decided within the project based on NFR.	System realization method Software configuration System development process User interface requirement Project management tool
SLA in Software Development	Maintainability [Easiness of maintainability] [Measures for failures] [Availability]		Clarity of operational conditions Trouble detection ratio Transfer procedures during the normal period

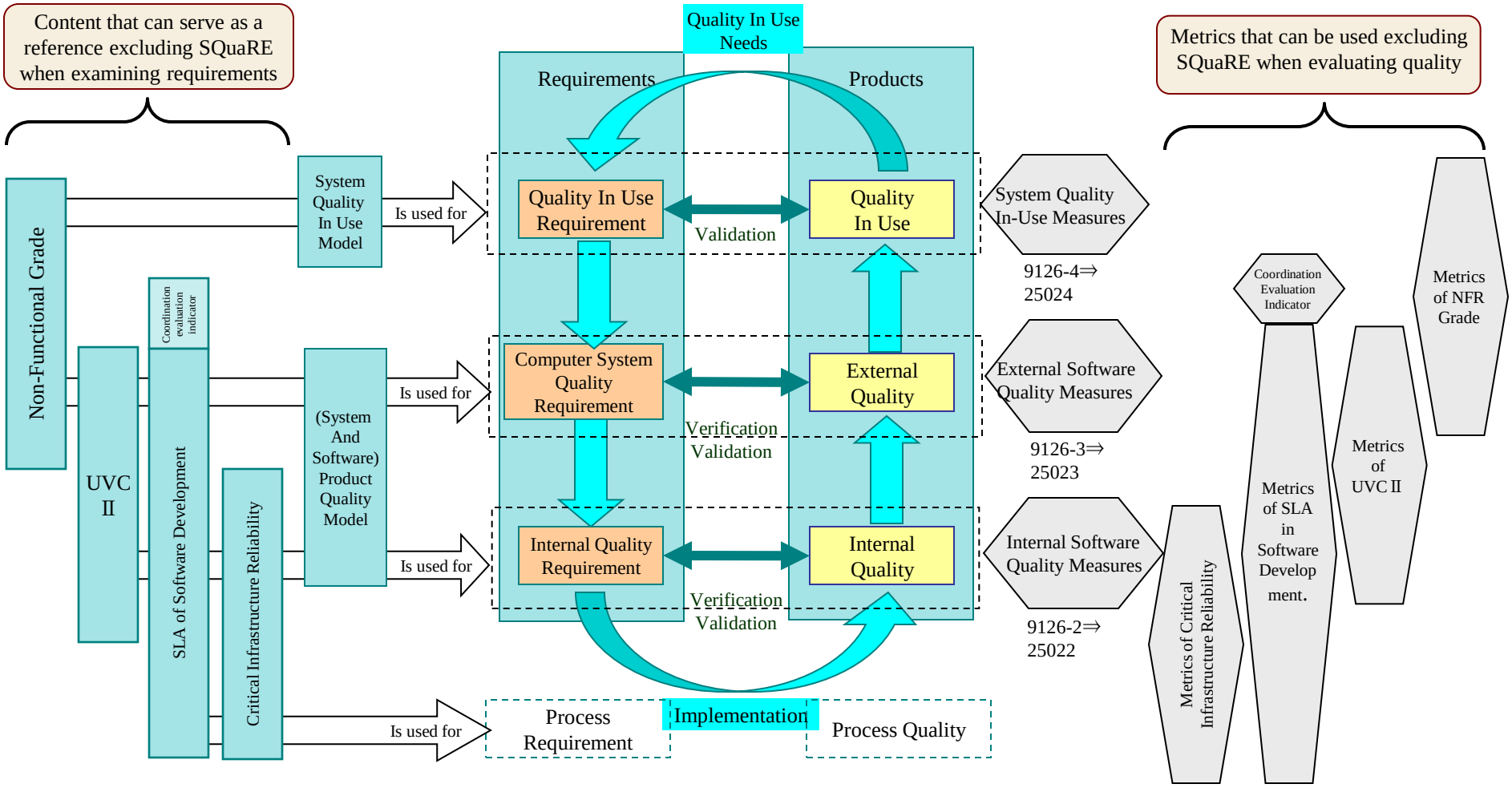
Summary of Quality Characteristics and Measures (4)

- Examples of Quality Characteristics and Evaluation Indicators for Service, Process and Resource

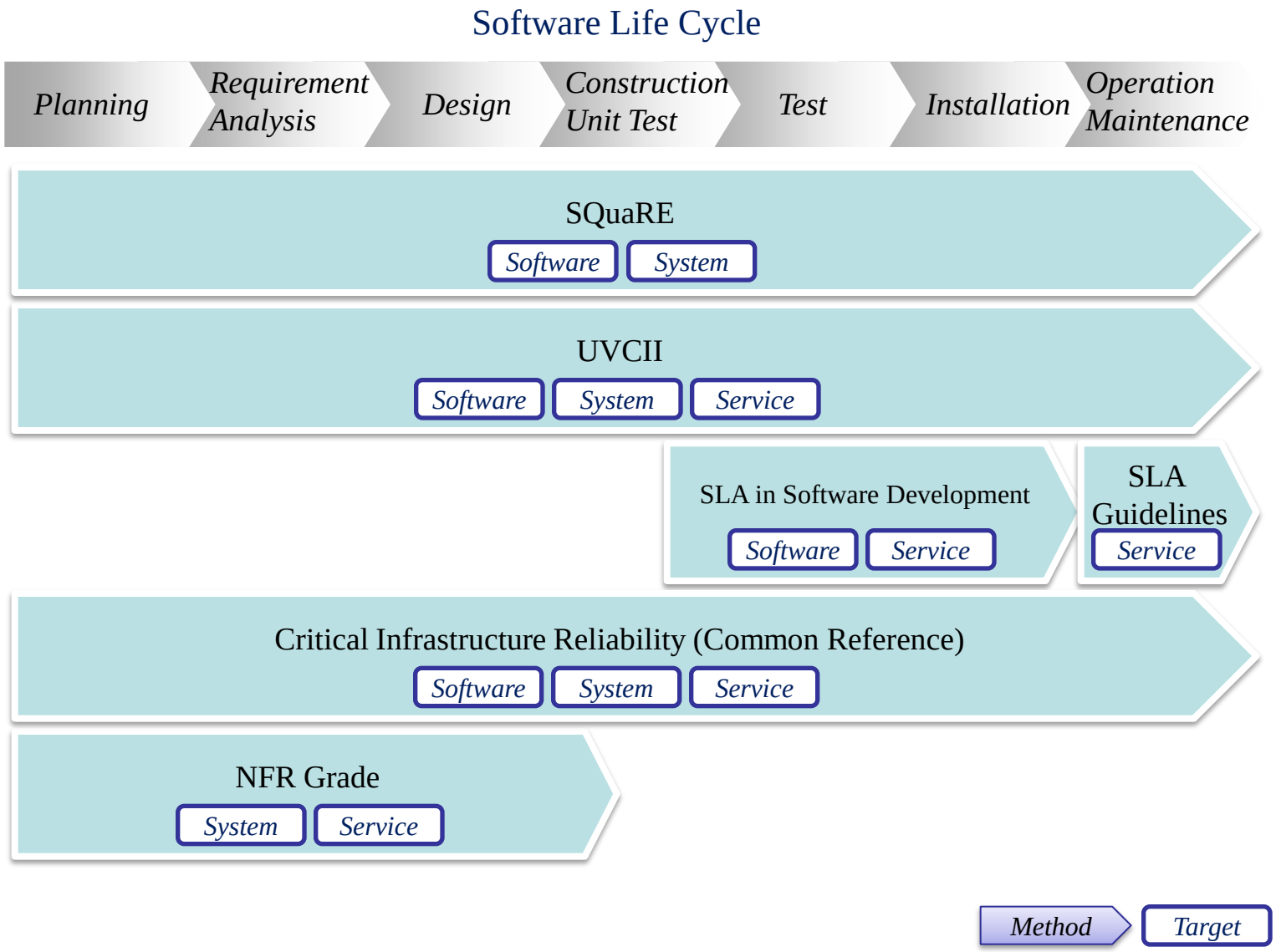
Method	Quality Characteristics [quality sub-characteristics]	Definition	Examples of Evaluation Indicators (metrics, others)
SLA Guidelines	Availability	Indicates whether a function or mechanism to continue and maintain operation so that services may not be provided due to various troubles is available or not	Operation ratio
	Confidentiality	N/A	Time to detect by a firewall
	Completeness	N/A	Number of packet loss among nodes
	Reliability	Indicates how accurately a system can provide required processing under a certain time and conditions	Mean time between failures (MTBF)
	Assuredness (Recoverability)	Refers to being able to restore to a normal condition if a system or an application suffers an unexpected failure of function	Restoration time
	Capability (Respondence)	N/A	Adherence ratio of online responsive time
	Expandability	Indicates whether a function or mechanism that can enhance the ability to provide services is available or not	Band capacity
	Maintainability (Period)	N/A	Time to exchange parts

Summary of Quality Life Cycle

- Positioning of Each Method at the Quality Life Cycle in the SQuaRE Series



Usage Scene of Each Method at Software Life Cycle (1)

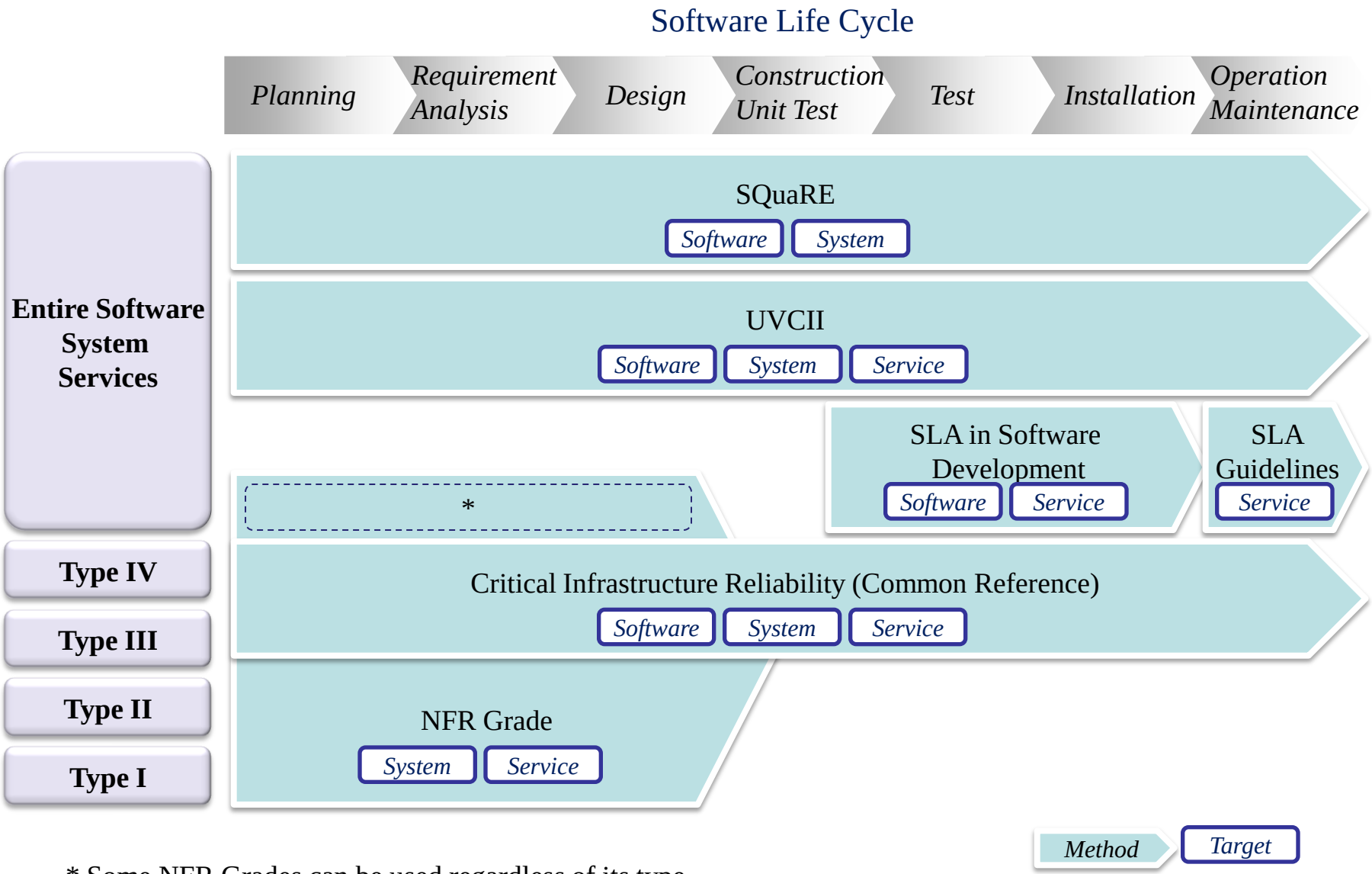


Reference: System Profiling

- Critical Infrastructure Reliability…Classifies the information system related to business applications into four-tier profiles from the less social impact during a failure
- NFR Grade…Defines model systems corresponding to Type I to Type III

Category		Impact on human lives	Estimated amount of damage	Social impact	Example
Type IV	System that affects human lives and gives a huge economic loss	Fatal accident	¥1 billion or more	Gives a serious impact on society	Air traffic control, medical control, space rocket control, structural computation of buildings, medical equipment control, emergency service net work, etc.
Type III	System with a serious social influence	Serious disaster	Less than ¥1 billion	Causes inconvenience to a lot of people, or gives large psychological impact to certain individuals	Critical infrastructure such as transportation, telecommunications, finance/securities and plant control
Type II	System with a limited social influence	Marginal	Less than ¥100 million	Marginal	Critical infrastructure such as broadcasting, administration, waters, buildings
Type I	System with almost no social influence	Almost none	Less than ¥10 million	Almost none	Services to people, benefit-related services, transactions between enterprises, etc.

Usage Scene in Software Life Cycle (2) Taking System Profile into Account



* Some NFR Grades can be used regardless of its type.

4. The Guide for Usage of Published Data for Quantitative Management

Process Metrics WG

Software Metrics Advancement Project

http://www.meti.go.jp/policy/it_policy/softseibi/metrics/process_metrics.pdf
(Japanese only)

Intention and Summary of the Guide

- Intention
  - Aiming to develop/improve the environment in which you can analyze and evaluate the system and software projects from the viewpoints commonly available.

- Summary
  - To explain the expectation effect of the quantitative management and the usage of published data for the quantitative management.
  - To introduce the published data which you can use in Japan at present.
  - To explain the usage methods of these as well as points to note

Content	
Chapter 1	Basis of Quantitative Management
Chapter 2	Outline of Published Data
Chapter 3	Usage Methods of Published Data
Appendix	Metrics Relationship Diagram of Published Data Outline of Activities of Organizations in Japan

Chapter 1 Basis of Quantitative Management

- Outline
  - To explain the methods of the basic quantitative management, usage of published data.

- Effect
  - Can learn the basic of the quantitative management using published data.

- Content
  - 1.1. Expectation effect of the quantitative management
  - 1.2. Points to note of the quantitative management
  - 1.3. Promotion of the quantitative management using published data
  - 1.4. Points to note for using published data

Expectation Effect and Points to Note of the Quantitative Management

- Matters that you can do with the quantitative management (expectation effect)
  - Visualization of the quality of the product, project and process
  - Estimate of man-hours of the project, its progress, the scale and quality of the product
  - Planning of activities, its required man-hours, an implementation period and the quality included in the project
  - Proposals of measures for improvement with high relevancy, promotion of the development of such measures in the organization

- Points to note when performing the quantitative management
  1. Metrics has theories and technique.
  2. Use metrics that are in harmony with the purposes.
  3. Information which metrics express is part of the concept that you want to measure.
  4. Metrics is means, not a purpose.
  5. Perform the quantitative management based on the spontaneous intention of the organization.
  6. Strive for the establishment as an organization with conviction
  7. Kick-off from the easy-to-handle part.

Promotion of the Quantitative Management on Usage of Published Data and Points to Note

- Promotion of the quantitative management using published data
  - Matters that you can do by using published data

    (Organization with few experience of the quantitative management)
    - To estimate development man-hour, form a quality plan.
    - To select data items that should be stored in the organization.
    - To understand usage purposes and methods of metrics.

    (Organization that practices the quantitative management)
    - To grasp and compare the performance of own organization in the industry.
    - To grasp strong and weak points of own organization and fix the priority targets to be improved.

  - Points to note
    - Published data is reference information, and to continue relying on published data is not ideal.
    - Try to store data within own organization so that you can use the data within own organization.

- Notes for handling published data

  (1) Purposes or processes for compiling published data differ depending on those who provide published data
    - It is necessary to understand purposes of published data providers or such providers themselves.

  (2) Definitions of terminologies or metrics differ depending on published data
    - It is necessary to understand how published data providers define terminologies or metrics.

Chapter 2 Outline of Published Data

- Outline
  - Major organizations of Japan that provide benchmarking data, and their activities
  - Basic information (definitions of metrics, etc.) of provided benchmarking data (published data)
- Effect
  - Can select published data that is fit for own organization by obtaining domestic published data information
- Content
  - Basic information
    - Activity information of organizations that provide benchmarking data
  - Terminologies/definitions of published data
    - Terminologies, definitions which are different per published data
    - Relationship diagram of basic metrics, derived metrics per published data

Major Organizations that Provide Benchmarking Data in Japan

Provider	JUAS	IPA/SEC	Economic Research Association (ERA)
Benchmark Report	2009 Software Metrics Reports (user companies)	2009 White Papers on Software Development Projects in Japan	Report of Software Development for Supplier – Part II
Frequency	Once a year	Almost once a year	Once a year
Purpose	(1) By collecting and analyzing exhaustively data that can be used through the entire software life cycle from the view of system users, to present control indicators in order to realize high quality software (2) To present viewpoints or values of analyses for indicating with data targets or the current conditions in the software field	(1) By collecting newly various project data from companies every year, to continue stylized statistical analyses every year and improve the accuracy as a scale (2) By expanding targets of analyses depending on a certain issue or theme, to propose a new scale or a new approach to selecting issues	(1) To provide a person who place an order of a software development project with information that plays the role of a yardstick for estimating software development man-hour or cost (2) To provide a person who receive an order for a software development project with information that plays the role of a yardstick for evaluating the project data of own company
Target users	A person responsible for a company system (together with users/vendors) A project manager of a company system Staff at the quality management div. of a company system, and staff of the organization that performs such functions	Top executives of a company (user companies, vendor companies) Persons responsible for the operation div., info system div. Project manager, project leader Project management office, quality guarantee div.	Each project manager, etc. for persons who place/receive an order for a software development project

Outline of Published Data

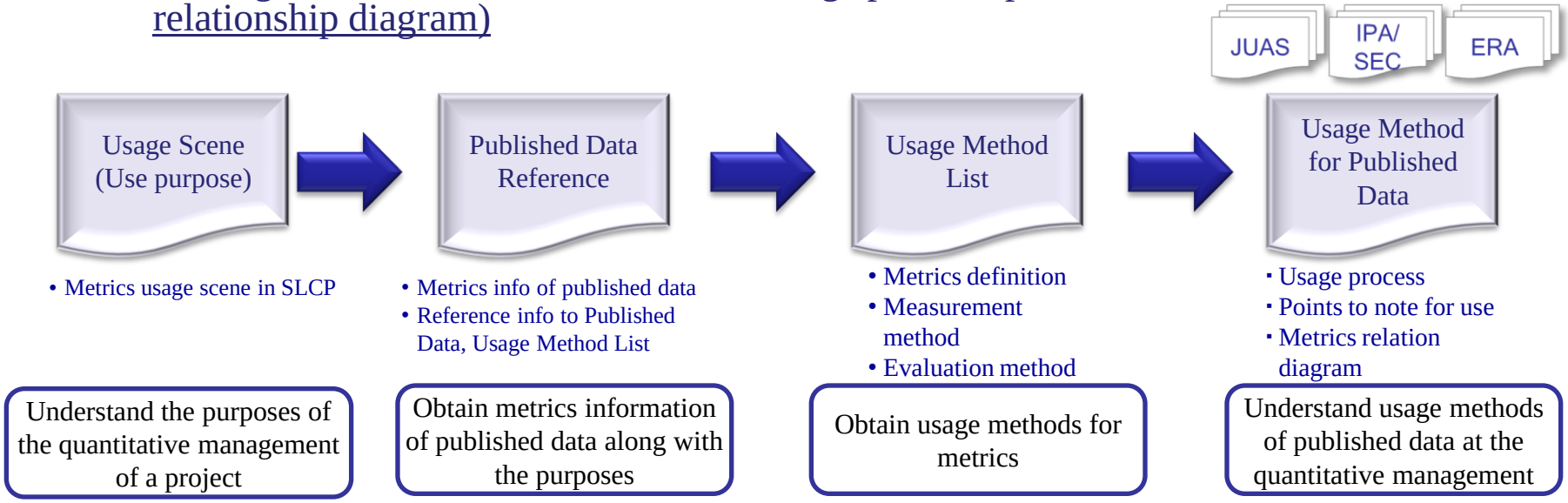
Benchmark Report	2009 Software Metrics Reports (user companies)	2009 White Paper on Software Development Projects in Japan	Report of Software Development for Supplier – Part II
Number of collected data (Latest Version)	435 Project (Development/management/ maintenance) Data	2,327 Project Data	173 Company Data
Outline	■Analytical result of profile of questionnaire data ■Analytical result of development survey (man-hour, construction period, total cost, system size, quality evaluation, productivity, etc.) ■Analytical result of maintenance survey (maintenance organization, staff, quality, construction period, estimate, satisfaction) ■Analytical result of operation survey (management level, organization, use of ITIL, personnel development, outsourcing, content of various kinds of management) ■Summary of survey results of development, maintenance and operation	■Collected data, analysis ■Profile of collected data ■Statistics of major elements of a project (FP scale, SLOC scale, construction period, man-hour, number of staff) ■Analysis of relations of man-hour, construction period and scale (man-hour and construction period, scale and man-hour, productivity) ■Analysis of reliability (FP scale and No. of failures (density), SLOC scale and No. of failures (density)) ■Analysis per process (construction period per process, man-hour, No. of cases where reviews are pointed out, No. of test cases, etc.) ■Analysis of budget and actual cost, productivity cross-analysis (analysis of plan and performance, analysis of productivity)	■Relation between man-hour and construction period, analysis per process (new development, renovation development) ■Analysis of relation between scale and man-hour ■Analysis of relation between scale and productivity (FP scale and FP productivity, FP scale per industry and FP productivity, etc.) ■Analysis of reliability (FP scale and No. of bugs, density of bugs, etc.) ■Analysis of estimate and performance (size/man-hour/construction period) ■Analysis of effect by contract form (estimates/actual values of FP/man-hour/construction period and contract forms)

Chapter 3 Usage Methods of Published Data

- Outline
  - To develop/improve the environment for using major published data of Japan
    - Scenes where persons who place orders and users can use published data at the Software Life Cycle (usage scenes)
    - To summarize metrics of published data that serves as a reference per usage scene
    - To present usage methods of published data for the quantitative management and points to note
- Effect
  - Can know usage methods of published data
  - Can obtain usable published data per Software Life Cycle
- Content
  - Usage scenes of published data
  - Published data reference
  - Published data metrics table
  - Usage process of published data and points to note

Development/Improvement of Usage Environment of Published Data

- To provide contents that clarify when, how and which published data should be used in the quantitative management of a project.
  - To summarize scenes where published data can be used at the quantitative management per SLCP…Usage Scene
  - To provide reference information of published data per usage scene…Published Data Reference
  - To summarize metrics of 3 published data per usage scene…Usage Method List （Benchmarking Metrics Table）
  - To present points to note for using published data at the quantitative management …Usage Method for Published Data（usage process, points to note for use, metrics relationship diagram)



Environment toward Practical Use of Published Data for Quantitative Management

Published Data Usage Scenes (1) Persons Placing Orders

Software Life Cycle Process			Examples of Purposes of Quantitative Management by Persons Placing Orders
Phase	**Process**	**Activity**	
Entire	Acquisition	Preparation for contract and update	●Want to prepare for contract and negotiate with the supplier (person who receives the order)
	Management of changes in contracts	Survey analysis of effect	●Want to control changes of the contract and require a change if needed
			●Want to define requirements that should be realized on business (content of business, property, terminology and information given and received) and those related to schedule
Planning	Planning	Planning of systematization vision/scheme	●Want to compile a systematization vision, plan ●Want to make a proper estimate for internal explanation ●Want to review selections for acquisition ●Want to review a feasibility of the project
System/software requirement definition, basic/detail design, construction/unit test, test	Acquisition	Monitoring of suppliers	●Want to evaluate the quality of the deliverables ●Want to control the deviation of the contract content/planned values and actual figures (want to control budget and performance)
Transition/operation preparation (acceptance/completion)	Acquisition	Monitoring of suppliers	●Want to evaluate the quality of the deliverables
	Improvement	Process evaluation	●Want to evaluate the contract content and the performance, and evaluate the vendor
Operation/ maintenance	Operation	Evaluation of system operation	●Want to better it by monitoring and identifying problems of the system and improve convenience
	Maintenance	Grasping issues and analysis of revisions Implementation of revisions	●Want to understand problems and review making revisions, and examine appropriateness of the maintenance ●Want to analyze before making revisions, and decide the portions to be revised ●Want to evaluate the portions to be revised

Published Data Usage Scenes (2) Persons Receiving Orders

Software Life Cycle Process			Examples of Purposes of the Quantitative Management by Persons Receiving Orders
Phase	**Process**	**Activity**	
Entire	Supply	Planning	●Want to confirm requirements for various plans and examine selections to supply before concluding a contract
	Management of changes in contracts	Survey analysis of influence	●Want to conduct management of changes in contracts and require changes if needed
Planning	Planning	Planning of systematization vision/plan	●Want to confirm requirements of systematization plan (development, maintenance, operation, test, transition, environmental improvement, quality), and policies for purposes, means, staff, period, delivery date, equipment, cost, etc. which are subject to the systematization, and examine the feasibility
Requirement definition	Requirement definition	Definition of stakeholder requirements	●Want to clarify system requirements of function/non-function, etc. ●Want to confirm various target values in developing and set such values
System/software requirement definition, basic/detail design, construction/unit test	Confirmation of development/ appropriateness	Method design/software code preparation and test/appropriateness confirmation	●Want to control the deviation between the contract content/planned values and actual values (want to control budget and performance)
Preparation for transition/management (acceptance/completion)	Development	Introduction of software Support for accepting software	●Want to evaluate the quality of the deliverables
	Improvement	Evaluation of process	●Want to confirm the deviation between the contract content/planned values and actual values and evaluate whether the project is successful or not (want to manage budget and performance)
Operation/maintenance	Maintenance	Compilation of revision procedures	●Want to compile a maintenance plan
		Grasping problems and analysis of revisions Implementation of revisions	●Want to grasp problems in maintaining and examine conducting revisions ●Want to analyze in making revisions and determine the portions to be revised ●Want to evaluate the revised the portions
Regular	Control	Measurement	●Want to evaluate strong/weak points of the organization
None	Improvement	Process improvement	●Want to improve the process for the next project

Published Data Reference (Excerpt)

Phase	Process	Activity	Usage Scene	2009 Software Metrics Reports (Simply called : Soft) Enterprise IT Trend Survey 2009 (Simply called: Enterprise IT) (JUAS)			2009 White Paper of Quality Data (IPA/SEC)			FY2008 Report of Software Development for Supplier – Part II (ERA)		
				Metrics	Code No.	Reference	Metrics	Code No.	Reference	Metrics	Code No.	Reference
Entire	Acquisition	Preparation for contract and update	Want to prepare for contract and negotiate with a supplier	•Unit price (man month)	JUAS-u1	Soft P44～, P109～	•Scale, man-hour with confidence belt	SEC-u1	Chapter 6.4, 6.6	•Standard man-hour	ERA-u1	3-(2)
				•Unit price (KLOC)	JUAS-u2	Soft P120	•Ratio of actual man-hour per process	SEC-u2	Chapter 8.1	•Standard construction period (man-hour and construction period)	ERA-u2,3	1-(1), 2-(1)
				•Unit price (FP)	JUAS-u3	Soft P123, 124				•FP Productivity	ERA-u4	4-(1)
				•Standard construction period	JUAS-u4	Soft P52				•Standard FP Productivity	ERA-u5	4-(6)
				•Deviation of construction period	JUAS-u5	Soft P53, 54						
				•Target/defect ratio	JUAS-u6	Soft P64～						
	Control of changes in contracts	Survey analysis of influence	•Want to control changes in contract content and require changes as necessary				•Man-hour and construction period with confidence belt	SEC-u3	Chapter 6.3			
			•Want to define requirements that should be realized on business (business content, properties, terminologies, information that you give or receive) and those related to schedule				•Man-hour – construction period, man-hour – scale with confidence belt	SEC-u4	Chapter 6.3, 6.4, 6.6	•Man-hour ratio per process	ERA-u6	1-(5), 2-(5)

SLCP　Target　JUAS　IPA/SEC　ERA

Scenes that use published data in a project

Metrics responding to usage scenes, reference codes in the Usage Method List and reference sources for published data

Usage Method List (1) Item

- Summarize metrics of 3 published data per usage scene in SLCP
  - Compile the list for each person who place an order or receive an order
  - Provide it with an excel sheet
- Items on the Usage Method List

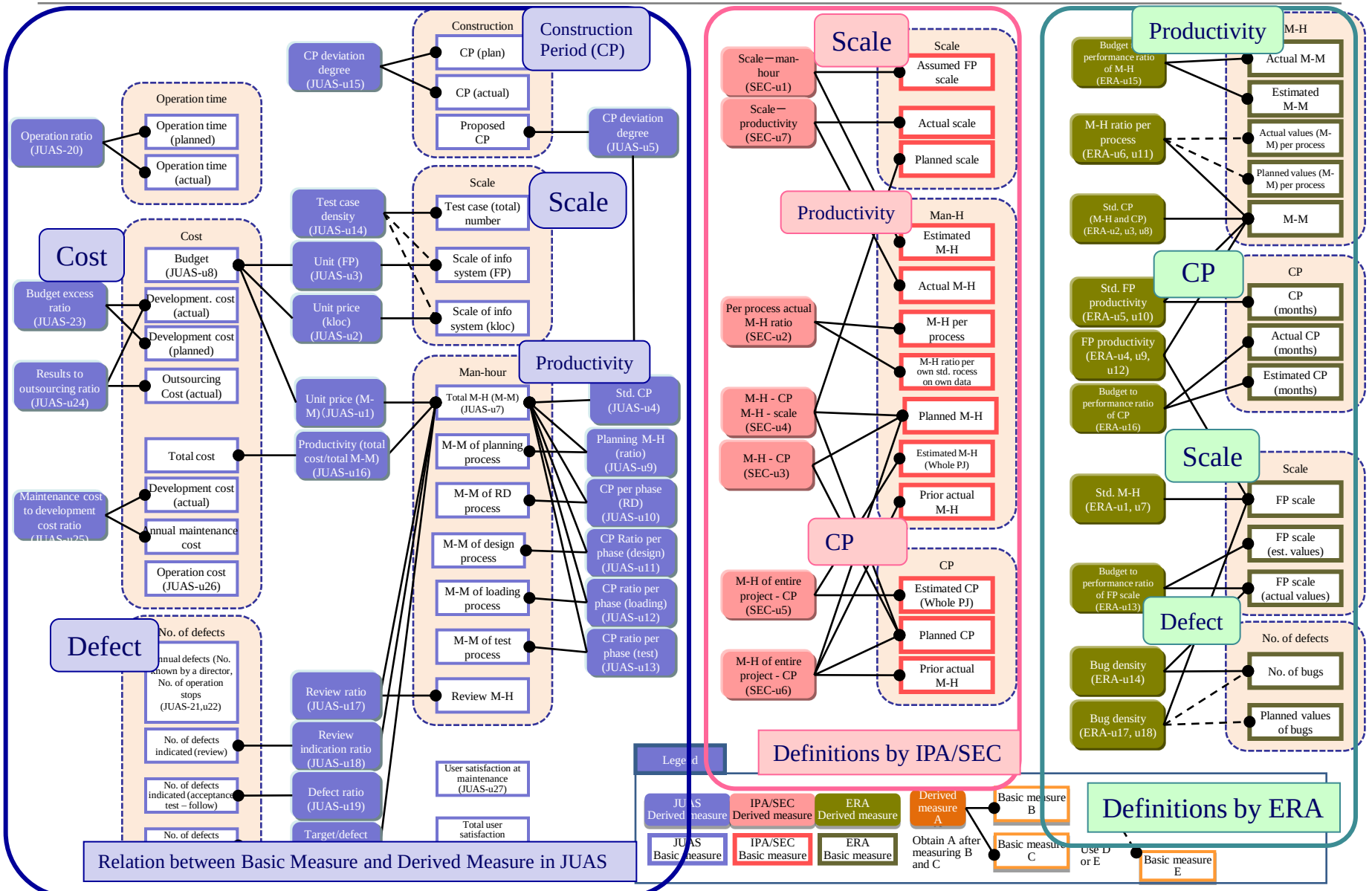
Item	Meaning
Software life cycle process	Indicates phase, process and activity of the Common Frame 2007.
Usage scene	Indicates the content which published data can use as a usage purpose per Software Life Cycle Process.
Name of metrics of published data	Presents names of metrics which the provider of the published data has defined.
Provider of published data	Organization that provides relevant metrics as published data.
Code No.	Code No. of the published data reference. Names of the providers of the published data (JUAS/SEC/ERA) – Viewpoint (u: person who place an order/v: person who receives an order) No. (a number given to each provider of the published data) (Ex.) JUAS-u1: metrics No.1 of the published data provided by JUAS to those who place orders
Purpose of application	Shows with a question form where a reply is obtained by using metrics
Method of application	Shows the outline when an application is made
Formula to measure metrics of published data and definitions of data elements	Indicates formulas of metrics defined in the published data, and explains data to be used.
Information on provided published data	Indicates the content of the published data that is provided
Interpretation of metrics of the published data	Indicates the scope of allowable values of metrics of published data, standards for judgment or way of thinking
Input source, measurement method of metrics of the published data	Indicates major sources and measurement methods of data (base measure) that is prepared for using the published data
Usage method of published data	Indicates usage methods of the published data and points to note in use.
Reference information	Indicates reference sources of the published data

Usage Method List (2) (Example)

Software Life Cycle Process			Usage Scene			Name of Metrics of Published Data	Provider of Published data	Code No.	Application Purpose	Application Method	Formula to measure metrics of published data and definitions of data elements		
Phase	Process	Activity	Purpose (outline)	Category	Purpose (detail)				Describe a question to get a reply by applying a measurement method (a question asking ≒X).	Describe the outline of the application	Formula to measure metrics (x) of the published data	Definition of data elements that a person who places orders measures (prepares)	Definition of data elements that a person who receives orders measures (prepares)
Entire	Acquisition	Contract preparation and update	Want to prepare for contract and negotiate with a provider	Man-hour plan	Both sides agree on the deviation between the assumed FP and estimated man-hour	Scale – man-hour	SEC	SEC-u1	Where does the assumed man-hour stand in the confidence belt toward the assumed FP size?	Decide whether the estimated man-hour falls on the confidence belt and verify the properness.	Confidence belt 0%= Scope where Element B can take at 0% probability to Element A. X=(A,B) Plotted point	Man-hour - construction period distribution chart of a project by own company data with confidence belt A=Assumed FP size	B=Estimated man-hour

Info that published data provides (metrics, charts, tables)	Interpretation of metrics of published data		Input sources, measurement methods of data elements (Basic Measure)														Usage methods of published data		Reference info of published data
	Allowable metrics value	Excellent value/ status	RFP/RFQ	Quotation	Requirement spec	Contract	Plan	Specification	Source code	Review report	Test report	Implementation report	Operation (test) Report	User monitoring record	Others/remarks	Measurement methods	Usage methods of metrics/values (of published data)	Notes to use (published data)	
Man-hour – CP distribution chart with confidence belt But, if own entity's data is available, it is prioritized.		Coordinate X is between confidence belt.	✓	✓			✓									• FP scale: measurement on the IFPUG method • Man-hour: entire man-hour of vendor at 5 development processes (basic design to the total test process (vendor))	In a case of comparing in the same scale, if the presented estimated man-hour is off the reliability line (estimate of 0% probability), examine reasons for the deviation. If it can be explained by project properties, explanations of its properness considering the properties are given, and agree on it. If you cannot explain: (1) if the FP scale is the basis of the estimate and its accuracy has a problem, you need to pay attention due to possible effect to others (2) it may be reflected in man-hour as a buffer to risks. Clarify and share the risk, review how to handle risk and man-hour, and agree on them.	Confidence belt is not fixed, and so set it according to the status or performance of the company. Evaluation on own company data is ideal, but use SEC data instead if own data is not enough. However, stick to use it as reference values in this case. There are other reasons for deviation, so carefully examine it. Unit of man-hour is man-hour. Man-hour excludes that of a user.	2009 White Papers on the Quantitative Data Chapter 6.4、6.6

Metrics Relationship Diagram (Version of Persons Placing Orders)



Usage of Published Data at Quantitative Management

PDCA Cycle of Quantitative Management

◆(Scope) Quality estimate of product
◆(Selection of metrics) No. of bugs
◆(Confirmation of usage data)
Past data, published data (*)
◆(Establishment of evaluation standards)
Prior actual values, analytical values
Values in published data (*)

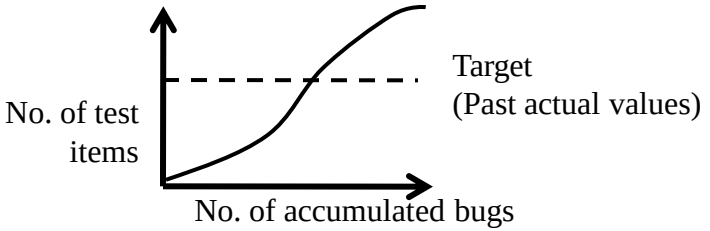
1. Implementation Plan

2. Acquisition of Metrics values

◆(Acquisition of metrics values)
Counting, summary counting of bugs

3. Analysis/ Evaluation

◆(Evaluation of metrics values)



4. Update/ revision

◆(Upgrade/revision while project is in execution)
Addition of the test items
◆(Upgrade/revision when project is finished)
<Project>
Improve future methods to execute a project based on the project evaluation
<Quantitative management>
Revise application scope, target values

(*) Usage of Published Data at Quantitative Management

- It is used as alternative data when actual data of the past has not been accumulated (as evaluation target).
- Confirm the positioning viewed from the industry in general by using values gained from multiple organizations within the industry.

Usage Process of Published Data at Quantitative Management

Activity	Process	Input	Content of Process	Output	Remarks
1. Implementation plan	Definition of scopes, roles	●Necessity, policy of explicit/implicit management	➢Define management purposes, requirements and the scope for management targets necessary for the success of the project. ➢Define roles for management.	●Purposes, requirements ●Target scopes ●Roles	Usage scenes of public data by persons who place/receive orders
	Selection of metrics	●Purposes, requirements ●Target scope	➢Select metrics that can be used for purposes, requirements and target scopes.	●Metrics	[3.1] Published Data Reference [3.2]Usage Method List
	Confirmation and acquisition of usable data (selection of published data)	●Purposes ●Metrics ●Published data groups	➢Confirm whether there is past actual data accumulated in the organization to metrics. ➢Select and acquire published data that can be used from plural published data for the purpose including cases where past actual data is not available.	●Actual data of the past ●Published data (metrics, data element definition)	[2.1] Basic information of published data [3.1] Published Data Reference [3.2]Usage Method List
	Establishment of evaluation standards	●Metrics ●Actual data of the past ●Published data	➢Establish evaluation standards in order to evaluate the results of metrics.	●Evaluation standards	[3.2] Usage Method List (interpretation of metrics/usage methods of published data)
2. Acquisition of metrics	Acquisition of metrics	●Definition of metrics of published data ●Scope of target	➢Measure the basic measure in accordance with fixed methods ➢Obtain metrics from the result of the measurement	●Result of the measurement ●Metrics values	[3.2]Usage Method List (input source of metrics/measurement method)
3. Analysis /evaluation	Evaluation of metrics values, usage process	●Evaluation standards ●Result of the measurement, metrics values ●Published data	➢Evaluate what kind of evaluation level metrics values are located in compared with published data and evaluation standards. ➢Evaluate whether metrics or management process was competent for achieving the purposes.	●Result of the evaluation of metrics ●Result of the evaluation of process	[3.2]Usage Method List (usage methods of published data)
4. Updating /revision	Updating/revision	●Result of the evaluation of metrics ●Result of the evaluation of process	➢Review points that should be improved from the result of the evaluation of metrics. ➢Study new usage of metrics from the result of the evaluation of process. ➢Accumulate the obtained results and prepare for future usages.	●Improvement plan of project ●Process improvement plan	

Points to Note in Usage Process of Published Data

1. Implementation Plan
   - Define measurable metrics that are fit for purposes, requirements and control targets of the quantitative management of own organization.
   - In case metrics and evaluation standards are gained from published data, obtain from published data that is suitable for own organization.

   <Reference information> **Usage scenes of published data of those who place/receive orders, published data reference, metrics relation diagram**
2. Acquisition of metrics values
   - Consider measurement methods defined in published data.

   <Reference information> **Usage Method List of Published Data**
3. Analysis/Evaluation
   - When using values of published data as an evaluation target, evaluate metrics values after correctly understanding the content of the values.

   <Reference information> **Usage Method List of Published Data**
4. Update/Revision
   - Review on how to respond in future based on the result of the evaluation.
   - Improve and review the quantitative management.
   - Store as benchmarking data of own organization metrics values and the results of analyses/evaluation.

5. Future Schedule

<Product Quality Metrics W.G.>

- W.G. Scope:
  - To establish the common recognition of the quality of the system and software responding to usage needs, and metrics for realizing the quality.
- Activities for the second year:
  - To conduct a survey research on product quality metrics that is management indicators for the product quality of the information system in a bid to establish system development methods that improve the system reliability and the efficiency of its development.
  - Specifically, to produce product quality metrics sets per field of the system and software that can evaluate the realization as required of the product qualities such as reliability and security (ex. material infrastructure system, enterprise core system).
  - To input to the ISO/IEC 25000 Series(25022,23,24).

<Process Metrics W.G.>

- W.G Scope:
  - To develop/improve the environment where the system and software project can be analyzed and evaluated objectively and from the common viewpoints.
- Activities for the second year:
  - To produce process metrics sets that can evaluate the degree of realization of the requirements on reliability, security, etc. and compile usage methods as the guides.
  - To put together drafts of operational rules of benchmarking data so that users can use the data based on the understanding of its compilation process.
  - To perform activities toward international standardization.