

# Guide for Visualization, Security and Improvement of System and Software Quality

March 2010  
Software Metrics Advancement Project  
Product Quality Metrics WG

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## Introduction

Expectations for the system and software that realizes various services are mounting in business and social life. People are now strongly aware of the fact that the system and software quality exerts a large influence not only to individuals but also to the society because some large-scale system failures happened in recent years. Such background makes us ask what the quality that should be equipped with the system and software is, and requires to visualize the quality that adapts to constrains such as user needs, usage scenes and delivery cost and to ensure it like services of other industries.

Under such circumstances, there are several discussions on the quality of the system and software. The most representative one is international standards ISO/IEC 9126 Series (JIS X 0129-1) by ISO/IEC JTC1<sup>1</sup>. The ISO/IEC 9126 Series has provided guidelines on the quality of software products since 1990's. The standards have been developed as the ISO/IEC 25000 SQuaRE Series at present, and its applicable scope or models have been elaborated. Secondly, Japanese organizations, the Japan Users Association of Information Systems (JUAS, incorporated association) and the Non-Functional Requirement Grade Study Panel (a voluntary organization of six private companies) have presented deliverables concerning presenting in a spec sheet quality characteristics and quality requirements responding to user needs. Also, the Study Group of the Critical Infrastructure Information System Reliability of the Information Technology Promotion Agency, Japan, Software Engineering Center (IPA/SEC, incorporated administrative agency), against a background where the effect of system orders has been becoming more serious to the society day-by-day, discusses metrics that should be controlled responding to the reliability requirement level to the system (system profile). In addition, the Japan Electronics and Information Technology Industries Association (JEITA, incorporated association) has presented deliverables related to the quality of IT services in operating the system and software.

However, diversified arguments are included in discussions on requirement specifications of the system and software quality, those on visualization of the quality using metrics and those related to the quality of operational services, with some common portions but also with some portions that are peculiar to organizations due to different background of the discussion or its purpose. The diversification of the content related to the quality or metrics of the system and software brings a benefit of enriching choices of content that is suitable to various user needs or constrains. Meanwhile, however, features of each content or information on mutual relations have not been explained, therefore, fixing the quality under the common recognition and realizing it is difficult.

Consequently, the Guide, aiming at the establishment of the common recognition of the quality of the system and software, will review plural discussions in Japan related to the quality of the system and software in light of international standards and clarify features and mutual relationships of respective content including discussions on the quality of IT services. Also, we will explain usage methods and points to note of such information and assume the role as a guide for such matters.

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<sup>1</sup> Joint Technology Committee of the International Organization for Standardization and International Electrotechnical Commission

The Guide is comprised of as shown below and can be used for each purpose.

<How this Guide is structured>

### **1. Concept of the Quality Assurance of the System and Software**

[Content] Concept of the quality assurance activity covering from the quality requirement definition of the system and software to the quality evaluation with metrics is explained based on international standards.

[Effect] You can learn the basic concept about the quality assurance and improvement of the system and software.

### **2. Quality Assurance Activity of the System and Software relating Japanese Metrics**

[Content] Representative organizational activities of Japan that are discussing the quality assurance of the system and software relating metrics and the features of their deliverables are summarized.

[Effect] You can collect activity information relating to the quality assurance of the system and software in Japan and select reference materials necessary for conducting the quality assurance activity depending on the features between activities and deliverables.

### **3. Usage of Output Reports of Domestic Activity for the Quality Assurance and Use at the Software Life Cycle**

[Content] It exhibits usages of deliverables of domestic activity according to the concept of the quality assurance, and usage scenes at the Software Life Cycle.

[Effect] You can obtain reference information of quality models and metrics that are treated in quality requirement definitions at the quality assurance of the system and software. You can collect information on usages of deliverables at each phase of the Software Life Cycle and also those of deliverables based on the evaluation result (system type) of the system reliability requirement level.

We hope that the information based on the practices of industries as exhibited in this Guide will make a contribution to the improvement of life cycles of systems and help Japan contribute to the activity of international standardization concerning the system and software.

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Software Metrics Advancement Project  
Product Quality Metrics WG

Members of Software Metrics Advancement Project  
Product Quality Metrics WG

(Titles Omitted)

Member	Motoei Azuma	ISO/IEC JTC 1/SC 7/WG 6, Faculty of Science and Engineering, Waseda University
	Toshihiro Komiyama	ISO/IEC JTC 1/SC 7/WG 6, NEC Corporation
	Akihiro Tamaki	Japan Users Association of Information Systems (incorporated association)
	Chiharu Tsunoda	Japan Users Association of Information Systems (incorporated association)
	Takako Hirayama	Japan Users Association of Information Systems (incorporated association)
	Yasuo Naruse	Non-Functional Requirement Grade Study Panel, Fujitsu Limited
	Shingo Kamiya	Non-Functional Requirement Grade Study Panel, NTT Data Corporation
	Hiroyuki Yamashita	Information Technology Promotion Agency (incorporated administrative agency)
	Kenji Kobayashi	Information Technology Promotion Agency (incorporated administrative agency)
	Noriko Mike	Information Technology Promotion Agency (incorporated administrative agency)
	Makoto Nonaka	Toyo University
	Yuichiro Okada	Japan Electronics and Information Technology Industries Association (incorporated association), NEC Corporation
	Michio Ohara	Japan Information Technology Service Industry Association (incorporated association),
Secretariat	Tetsuya Umehara	Information Services Industry Division, METI
	Hiroaki Kamoda	Information Services Industry Division, METI
	Yasushi Ishigai	Mitsubishi Research Institute, Inc.
	Daisuke Toyoshima	Mitsubishi Research Institute, Inc.
	Kazuhiko Ikeda	Mitsubishi Research Institute, Inc.
	Masae Yamamuro	Mitsubishi Research Institute, Inc.

(As of the end of March, 2010)

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## Definitions of Terminologies

- System

An aggregate of persons, machinery and methods who/which are organized to implement a mass of certain functions. A synthesis comprised of diversified, interactive and specialized structures and sub-functions. A group or sub-system that is connected via a certain interaction or interdependency, which executes a horde of operations but functions as a single unit<sup>2</sup>.

- Software

Computer programs, procedures, rules relating computer system operations, and documentations and data thereof in most cases.

- Metrics (Quality Measurement Method)

Metrics refer to a scale to measure quantitatively the degree to have required quality characteristics or sub-characteristics and the methods to measure it (including functions for obtaining measuring values and its calculation methods), which contains element data whose results can be directly obtained with making a measurement (Base Measure) and indicators whose results can be gained through incorporating element data (Derived Measure) and computing it. Particularly, a method to seek element data is comprised of scales and measurement methods, which is called Narrowly-Defined Metrics.

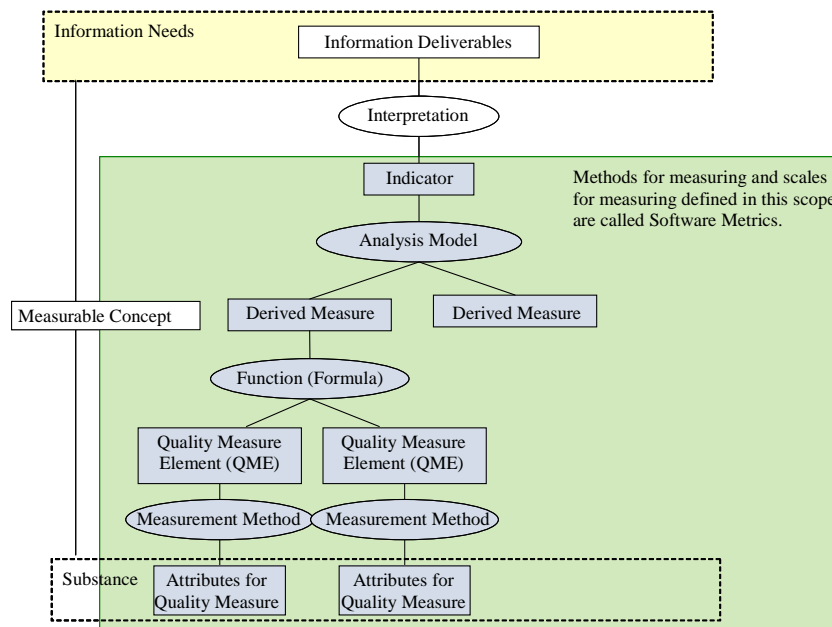


Chart Definition of the Software Metrics (Revisions have been made to an information model of JIS X0141 measurement to make this chart)

<sup>2</sup> ANSI (American National Standards Institute) N45.2.10-1973

Table:Example of Information Model of Measurement

Information needs	Evaluates the quality of the deliverables at the stage of coding	
Measurable Concept	Quality of the deliverables	
Indicator	Defect density of design	
Model	Calculates an average of the process and control limit using a defect density value	
Criteria for Judgment	Continuous survey is required for the result outside the control limit	
Derived Measure	Defect density based on reviews	
Function of measurement	Divides the number of defects by size per specification	
Base Measure	Size of specification	Number of defects in specification
Measurement method	Counts pages of specification	Counts defects cited in the problem description sheet
Type of measurement methods	Objective	Objective
Yardstick	Whole numbers from zero to infinity	Whole numbers from zero to infinity
Type of yardstick	Yardstick of proportion	Yardstick of proportion
Measurement unit	No. of pages	No. of defects
Attribution	Body text of the specification to be reviewed	List of defects extracted from reviews
Substance	Specification	Problem description sheet

- Quality Requirement

Concerning the quality of system, software and IT services, terms or performance necessary for users. Terms or performance which a system or system constituent element must achieve and hold to satisfy a contract document, written standards, specifications or other documents officially required. A mass of all the requirements will form a foundation for the subsequent development of systems or system constituent elements.

- Quality requirement specification, compiling quality requirements in a specification

Quality requirement specification is a document in which quality requirements are compiled in a spec sheet. It may be a part of the requirement specification or an independent document from the function requirement specification.

Compiling quality requirements in a spec sheet refers to defining function requirements first of all, and defining requirements for each quality characteristic based on the specification of the quality requirements. Compiling clearly quality requirements in a spec sheet will clarify the targets of the development, making the operations easier to do.

- Quality characteristic

Quality characteristic is an aggregate of attributions of software used for defining and evaluating the quality of software. Quality characteristic is further detailed to several levels as quality sub-characteristics. JIS X 0129-1 defines six quality characteristics; Functionality, Reliability, Usability, Efficiency, Maintainability and Portability.

- Quality model

The quality model refers to a model which has hierarchically developed the quality of the

target product as quality characteristics from various viewpoints.

- Quality assurance

A type of all the planned and structural activities<sup>3</sup> for an item or a product to gain enough trust by adapting to defined technical requirements. In this Guide, it means various activities of defining quality requirements with quality models and metrics, designing processes necessary for fulfilling the required quality, measuring the quality and making evaluations on it.

- Software Life Cycle

A period which starts in coming up with an idea of software and ends in the time the products goes out of use.

The Guide, with reference to the Common Frame<sup>4</sup>, covers the planning phase, requirement definition phase, system/software requirement definition phase, basic/detail design phase, construction/unit test phase, test phase, transition/operation preparing phase and operation/management phase.

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<sup>3</sup> ANSI/IEEE Std 730-1981

<sup>4</sup> Software Engineering Center, Software Engineering Center (incorporated administrative agency); “Common Frame 2007 (2nd version)” Ohmsha, 2009

## 1. Concept of Quality Assurance of System and Software

Today, we are living in a highly networked information society, and computers are forming an essential part of our daily lives. Computers are used in extremely diversified fields. In case a system using computers (computer applying system) has a defect, it may cause a serious damage to human lives and social living; what the quality that should be materialized with a system is being questioned.

Under such circumstances, concerning the quality assurance for the system and software (activities to define the quality requirements with quality models and metrics, design processes necessary for realizing the required quality, measure the quality and evaluate it), not only international standard-setting organizations<sup>5</sup> but also entities of several industries in Japan have compiled standards or guides.

In this Chapter, we will show, based on international standards, the concept of the quality assurance of the system and software, the outline of the effect which the quality of the system and software gives to users and necessity of the quality assurance, information on various standards related to the quality assurance, points of notes for improving the system software quality and elements in assuring the quality.

English translation is omitted in this Chapter.
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<sup>5</sup> ISO/IEC JTC1/SC7 has handled hosts of international standards relating the software quality, and now is expanding its targets to the system and service. SC7 is comprised of a number of Working Groups, while SC7/WG6 compiled and issued the ISO/IEC 9126 series and 14598 series that are related to the quality of software products, and currently, has consolidated these and is publishing in sequence as the ISO/IEC 25000 SQuaRE series.

## 2. Domestic Activities relating the Quality Assurance for the System and Software

Some organizations are currently studying the quality assurance and improvement of system, software and IT services with metrics in Japan. Although the details of such reviews are in principle in accordance with JIS X 0129-1, the discussions are being made while assuming specific target users and the scope depending on activity purposes. Therefore, the quality characteristics, metrics or usage processes that are handled are respectively in different situations.

Consequently, in Chapter 2, we will pick up major organizations that are discussing the system and software related to metrics, and the quality assurance of IT services, and show features of respective organization's activity purposes, target users, scope, deliverables, the way how to think of quality and basic usage processes. In addition, features of each organization and their deliverables will be compared and different points will be explained.

### 2.1 Major activities in Japan

#### 2.1.1. Target organizations in this Guide

Table 2-1 is a result of having selected from target major entities that discuss the system and software on metrics and the quality assurance of IT services and have produced deliverables.

First of all, we can pick up among major organizations ISO/IEC JTC 1/SC 7/WG 6<sup>6</sup>, which is engaging in international standardizing activity of the quality evaluation technology of the software products. Among Japanese organizations, SC 7/WG 6 Small Committee that has been established at the Information Standard Research Committee of the Information Processing Society of Japan (incorporated association) is deliberating standards. Also, the Japan Users Association of Information System (JUAS, incorporated administrative agency), and the Non-Functional Requirement Grade Study Panel (Non-Functional Grade Study Panel)<sup>7</sup> that visualizes requirements of persons who place orders for system platforms are each making efforts to “visualize” non-functional requirements. The Information Technology Promotion Agency of Japan, Software Engineering Center (IPA/SEC) (incorporated administrative agency) discusses the quantitative control of the quality using metrics of critical infrastructure system. The Japan Electronics and Information Technology Industries Association or JEITA (incorporated association) discusses usages of SLAs on various metrics from “planning/development of systems” to “management/maintenance of systems”, aiming to improve IT services.

From the following paragraph onwards, the features of representative organizations described as above will be presented per entity.

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<sup>6</sup> ISO/IEC JTC 1 (Joint Technology Committee of the International Organization for Standardization and the International Electrotechnical Commission), SC 7 (software technology), WG 6 (Evaluation & Metrics)

<sup>7</sup> It released their final version on February 25, 2010. As of March 2010, they are conducting operations for transferring itself to IPA/SEC.

Table 2-1 Major Organizations that Performs Activities of the Quality Assurance for the System and Software relating Metrics, and IT Services

Organization	Purpose	Name of Results (simplified name)	Outline of Results	Activity Status as of March 2010
ISO/IEC JTC1/SC 7/WG 6 Information Standard Survey Committee, Information Processing Society of Japan (incorporated association) (SC 7/WG 6) <a href="http://www.itscj.ipsj.or.jp/">http://www.itscj.ipsj.or.jp/</a>	To define requirements of the quality of software products and systems, develop international standards or technical reports for measuring and evaluating.	ISO/IEC 25000 System and software product Quality Requirements and Evaluation <b>(SQuaRE)</b>	International standards of the quality of system and software products	Engaging in activities toward the issuance of ISO/IEC 25010, ISO/IEC 25021, ISO/IEC 25040, ISO/IEC 25045
METI: Info Services Industry Div. NTT Data Institute of Management Consulting, Inc. Japan Users Association of Information Systems (JUAS, incorporated association) <a href="http://www.juas.or.jp/">http://www.juas.or.jp/</a>	To enable users define properly non-functional requirements in the requirement spec sheet	User Vender Collaboration: Report on Research Project II “Guidelines for Non-Functional Requirement Specification Definition” <b>(UVC II)</b>	Non-functional requirements of 230 objectives that user firms should define and the “Guidelines for Non-Functional Requirement Specification Definition” that gives commentary to the objectives	Have been conducting promotional activities to make the content widely known since 2009
Non-Functional Requirement (Grade) Study Panel that visualizes requirement of persons placing orders for system platforms <a href="http://www.nttdata.co.jp/nfr-grade/">http://www.nttdata.co.jp/nfr-grade/</a>	To eliminate misunderstanding when reaching agreement on non-functional requirements between users and vendors, enabling both of them present or make proposals	Usage Guide for Non-Functional Requirement Grade Grade Table on Non-Functional Requirements of System Structure List of Objectives on Non-Functional Requirements of System Structure Tree Diagram on Non-Functional Requirements of System Structure <b>(Non-functional Requirement Grade)</b>	Method that enables customers and development vendors share the recognition on non-functional requirements	Released the final version on Feb. 25, 2010. Ceased activities with the release of the final version and was dissolved.
Information Technology Promotion Agency, Japan, Soft Engineer Center (IPA/SEC, incorporated administrative agency) ( <a href="http://sec.ipa.go.jp/">http://sec.ipa.go.jp/</a> )	As a measure to improve reliability of the critical infrastructure info system, to promote the introduction of quantitative quality control mechanism in software development, in particular	Report of the Critical Infrastructure Information System Reliability Panel <b>(Critical Infrastructure Reliability)</b>	System profiling responding to the requirement level of reliability, quantitative quality control and the guide for conducting measures toward the realization of high reliability at stages of planning/construction/management/ maintenance of the critical infrastructure info system	The achievement of activities for fiscal 2008 and 2009 are open to public. Scheduled to integrate such content and activity results of fiscal 2010 and later to compile “The Guide to Implement Measures for Improving Critical Infrastructure Info System Reliability”
Japan Electronics and Information Technology Industries Association (JEITA, incorporated association) Solution Service Business Committee <a href="http://www.jeita.or.jp/">http://www.jeita.or.jp/</a>	To feed back quality issues at “system operation/ maintenance” by working on SLA/SLM as a PDCA cycle that covers the entire Life Cycle at the IT system of IT services directly to “system development” process, aiming to upgrade the quality of IT services	Survey Report II on Solution Services for FY2008 Survey Report concerning the Expansion of the Area Where SLA is Applied <b>(SLA on Software Development)</b>	Guide that has shown the usage of SLA as evaluation indicators of the service quality and application of SLM by expanding the application of SLA/SLM from “system operation/ maintenance” process to “system development” process	For fiscal 2009, engaged in survey/research activity on SLA of viewpoints of employers/users. The result is set to be published as a report in April 2010.
Japan Electronics and Information Technology Industries Association (JEITA, incorporated association) Solution Service Business Committee <a href="http://www.jeita.or.jp/">http://www.jeita.or.jp/</a>	To indicate common evaluation indicators of SLA, enabling users and providers of IT services select proper service level objectives	SLA Guidelines of IT Systems for the Private Sector (third edition) <b>(SLA Guidelines)</b>	Guide that presents SLA’s common evaluation indicators in the private sector in three categories of “service”, “process” and “resource” as well as indicates how to compile procedures for SLA	For fiscal 2009, engaged in survey/research activity on SLA of viewpoints of employers/users. The result is set to be published as a report in April 2010.

## 2.1.2 SC 7/WG 6 (ISO/IEC25000SQuaRE Series)

The following is the features of international standards related to the quality of system and software products such as ISO/IEC 25000 “System and software product Quality Requirements and Evaluation (SQuaRE)” of SC 7/WG 6.

SC 7/WG 6 (SQuaRE)	
Activity purpose	<ul style="list-style-type: none"> <li>• To help persons who develop software products and those who acquire them compile quality requirements in a specification sheet and make an evaluation</li> <li>• To compile quality requirements of software products in a specification sheet, make measurements thereof and establish standards for evaluation</li> <li>• To include quality models comprised of two sections in order to fit the quality that a customer defines to attributions of development processes. Besides, to provide a measure that is desirable to measure the quality attributions of software products, which developers, acquirers and appraisers can use.</li> </ul>
Target users	<ul style="list-style-type: none"> <li>• Developers, acquirers, evaluators and users of the system and software</li> </ul>
Scope (Points to be discussed)	Discussing the quality of the system and software products, the quality in use
Outline of the deliverables	<ul style="list-style-type: none"> <li>• ISO/IEC25000 Series; System and Software product Quality Requirements and Evaluation (SQuaRE) <ul style="list-style-type: none"> <li>• ISO/IEC 2500n Quality Management Dept.</li> <li>• ISO/IEC 2501n Quality Model Dept.</li> <li>• ISO/IEC 2502n Quality Measurement Dept.</li> <li>• ISO/IEC 2503n Quality Requirement Dept.</li> <li>• ISO/IEC 2504n Quality Evaluation Dept.</li> <li>• ISO/IEC 25050 ~ ISO/IEC 25099 SQuaRE Expansion Dept.</li> </ul> </li> </ul>
Outline of the deliverables relating approach on quality, quality characteristics and metrics	<ul style="list-style-type: none"> <li>• Common models Based on the SQuaRE general reference model, quality life cycle model of software products and quality model structure, it presents the external/internal quality model, the quality model in use, the data quality model and the quality metrics.</li> <li>• External/internal quality model (ISO/IEC 9126-1) It defines Functionality, Reliability, Usability, Efficiency, Maintainability and Portability, and defined sub-characteristics for each.</li> <li>• Quality model in use (ISO/IEC 9126-1) Has defined as quality characteristics of products that are being used or developed Effectiveness, Productivity, Safety and Satisfaction Level.</li> <li>• Data quality model (ISO/IEC 25012) It defines Accuracy, Completeness, Consistency, Credibility, Currentness, Accessibility, Compliance, Confidentiality, Efficiency, Precision, Traceability, Understandability, Availability, Portability and Recoverability.</li> <li>• Quality metrics (ISO/IEC 9126-2,3,4) It defines metrics for each quality characteristic.</li> </ul>
Basic usage process of deliverables	The process of the quality requirement definition using quality measures has been provided in ISO/IEC 25030 while the quality evaluation process is provided in ISO/IEC 25040 (being prepared as a revised version of ISO/IEC 14598-1).

### 2.1.3 JUAS (UVC II)

The following is the features relating User Vender Collaboration: Report on Research Project II “Guidelines for Non-Functional Requirement Specification Definition” (UVC II) of the Japan Users Association of Information Systems (JUAS, incorporated association).

	JUAS and others (UVC II)
Activity purpose	<ul style="list-style-type: none"> <li>• To enable users accurately define non-functional requirements in a requirement spec sheet in developing an information system</li> </ul>
Target users	<ul style="list-style-type: none"> <li>• Persons who are in a position to describe a requirement spec sheet in developing an information system at a user company</li> <li>• Can contain persons in charge of tests or reviews as well in the target users in order to confirm whether all the defined requirements have been realized in the information system at the stage of verification</li> <li>• In addition to such direct users, project managers, who are striving indirectly to clarify requirement spec definitions at the system development and maintenance day and night and further bother themselves on clarification of roles at the requirement spec phase, can also be target users</li> </ul>
Scope (Points to be discussed)	<p>Discussing 10 areas of non-functional requirements of the company information system</p> <p>The 10 areas below listed are included in this scope:            Quality of information system (Functionality, Reliability, Usability, Efficiency, Maintainability, Portability), Disorder Controllability, Effectiveness, Operability, Technical Requirement</p>
Outline of the deliverables	<ul style="list-style-type: none"> <li>• 230 indicators in 10 areas</li> <li>• Definitions, measurement methods, measuring scale, computation formula and comprehension methods per indicator</li> <li>• How to handle indicators at each software process from the requirement definition to the maintenance/operation</li> </ul>
Outline of the deliverables relating approach on quality, quality characteristics and metrics	<p>Has established as areas of non-functional requirements of the information system 10 areas; Functionality, Reliability, Usability, Efficiency, Maintainability, Portability (the above mentioned are quality of information system), Disorder Controllability, Effectiveness, Operability, Technical Requirement.</p> <p>(The quality of the information system has been derived from JIS X 0129-1 (ISO/IEC 9126-1), others have been added by JUAS on its own).</p>
Basic usage process of the deliverables	<p>To be used separately for the preparatory stage for use and the actual usage stage.</p> <p>(1) Preparatory stage for usage            Select important indicators/necessary indicators for the company’s information system and position them as “non-functional requirements that are sure to be defined when it develops a new information system”.</p> <p>(2) Actually used stage            Describe in a requirement spec sheet defined indicators and values which the defined indicators should realize in the information system as non-functional requirements. And confirm whether the non-functional requirements described at the stage of the requirement specification have all been materialized at the verification stage, including functional requirements.</p>

#### 2.1.4. Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)

The following are the features relating “the Non-Functional Requirement Grade Usage Guide, the Grade Table on Non-Functional Requirement of System Structure, the List of Objectives on Non-Functional Requirement of System structure, the Tree Diagram on Non-Functional Requirement of System Structure” of the Grade Study Panel of Non-Functional Requirement that Visualizes Requirements by Persons who Place Orders on System Structure (the Non-Functional Grade Study Panel).

Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	
Activity purpose	<ul style="list-style-type: none"> <li>• To ensure that all is studied and the misunderstanding is resolved when users/vendors agree on non-functional requirements</li> <li>• To enable users present specific non-functional requirements immediately</li> <li>• To enable vendors make specific proposals on non-functional requirements and means to concrete them</li> </ul>
Target users	<ul style="list-style-type: none"> <li>• Persons in charge of both placing an order and receiving it who are involved in presenting, making proposals and determining non-functional requirements at scenes of requirement definitions, etc. out of the system development</li> </ul>
Scope (Points to be discussed)	Concerning non-functional requirements of the system structure, discussing the visualization of the level required by those who place orders and the methods to confirm between those who place orders and receive them.
Outline of the deliverables	<ul style="list-style-type: none"> <li>• “The Usage Guide (Usage Edition)” and “the Usage Guide (Commentary Edition)” that gives an explanation on usage methods of non-functional requirement grade, the way of thinking of each tool or definitions of terminologies, etc.</li> <li>• “The Grade Table” that exemplifies values of the level per model system about important non-functional requirement objectives from a user’s viewpoint</li> <li>• “The Item Table” that shows a list of non-functional requirements and the levels on which users/vendors should agree</li> <li>• Complementary tool “the Tree Diagram” that enables to read the Grade Table or Item Table like a bird’s-eye view</li> <li>• “The Non-Functional Requirement Grade Usage Sheet” that is provided in a spread-sheet format, which a user can use it as if he/she customizes the grade</li> </ul>
Outline of the deliverables relating approach on quality, quality characteristics and metrics	<p>It has elevated comprehensiveness by aligning and explaining requirement objectives in a systematic manner with handling six major objectives as a unit in order to have every user/vendor share the recognition based on the clarification of non-functional requirements on the system structure. Besides, it has contained the recognition gap between users/vendors by taking processes to agree step-by-step on detail non-functional requirement objectives of the Model System, Grade Table and List of Objectives.</p> <ul style="list-style-type: none"> <li>• It has established six major non-functional requirement objectives of Availability, Capability/Expandability, Operability/Maintainability, Transition, Security, System Environment/Ecology, defined middle-objectives and small objectives under major objectives (List of Objectives) and presented the Tree Diagram.</li> <li>• It has provided the Grade Table that defines the standard levels of non-functional requirement objectives per three model systems (system with almost no social impact / limited social impact / extremely large social impact)</li> </ul> <p>As the Panel handles quality requirements related to quality characteristics as a system, in particular, the portion of the system structure, it includes objectives not found in ISO/IEC 9126-1 that indicates quality characteristics mainly of software</p>

	Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)
	products. For example, it includes objectives concerning the system transition or operation, those related to the environment where the system is set or ecology.
Basic usage process of the deliverables	<p>It is assumed that the deliverables would be used in the process or activity that handles non-functional requirements in the planning process, requirement definition process and development process of the “Common Frame 2007”.</p> <p>Aims to share the recognition on non-functional requirements between users/vendors on the upper process (including cases where such recognition is described in documents such as RFP, requirement definition sheet and estimate proposal, or is included in agreed objectives as a system design contract). One example of the usage process is as follows: (from the Usage Guide).</p> <p>(1) Selection of the model system It extracts operation requirements related to the non-functional requirements and selects the model system that is closest from among model systems</p> <p>(2) Determination of the level of important objectives It determines the specific level of important objectives using the selection level shown in the model systems selected with the Grade Table for reference</p> <p>(3) Determination of the level of objectives other than important objectives It confirms the requirement level for all the objectives of non-functional requirements using the List of Objectives</p>

#### 2.1.5. IPA/SEC (Critical Infrastructure Reliability)

The following is the features relating the Report on the Critical Infrastructure Information System Reliability Group (Critical Infrastructure Reliability) of Information Technology Promotion Agency, Software Engineering Center (IPA/SEC, incorporated association).

	IPA/SEC (Critical Infrastructure Reliability)
Activity purpose	<ul style="list-style-type: none"> <li>• To secure and improve reliability of the information system that sustains the critical infrastructure business</li> <li>• To prompt the introduction of the quantitative quality control mechanism for software development of the critical infrastructure information system. Specifically, to verify via actual data system, profiling, common reference for quality control, and countermeasure check list based on analyses of disorder examples and confirm their effectiveness, and collect and compile reference information necessary for executing measures, for the purpose of applying it in the actual job sites of system development/operation</li> </ul>
Target users	<ul style="list-style-type: none"> <li>• System department of critical infrastructure enterprises and software development enterprises</li> </ul>
Scope (Points to be discussed)	It is discussing metrics that should be referred in each process of the planning, requirement definition, development and operation/management of critical infrastructure information system and its reference target value.
Outline of the deliverables	<ul style="list-style-type: none"> <li>• Profiling of the critical infrastructure information system</li> <li>• Item List of Measures for improvement of reliability</li> <li>• Metrics and reference values for the quantitative control (basic, product, process)</li> </ul>
Outline of the deliverables relating approach on quality, quality	For the purpose of improving the reliability of the critical infrastructure information system, it pays attention to features relating defects as software features, fixes process evaluation metrics and product evaluation metrics, and presents each definition, timing for measuring and methods to use, etc.

IPA/SEC (Critical Infrastructure Reliability)	
characteristics and metrics	
Basic usage process of the deliverables	<p>It compares the metrics measured at respective timing of (1) before the execution of task, (2) after the execution of task (or during being executed) and (3) after the completion of the project with the target values, and conducts quantitative quality control.</p> <p>The result of the analysis is fed back not only to the control of the said project but also the development process standard of the organization to make it improve the process. Make the result be reflected in the next or subsequent projects and efforts will be made toward continuous improvement.</p>

### 2.1.6 JEITA (SLA for Software Development)

The following is the features relating the “Survey Report II on Solution Services for Fiscal 2008 – Survey Report on Expansion of the Scope Where an SLA is Applied (SLA on Software Development)” of the Japan Electronics and Information Technology Industries Association (JEITA, incorporated association).

JEITA (SLA for Software Development)	
Activity purpose	<ul style="list-style-type: none"> <li>• To work on the PDCA cycle that feeds back quality issues of IT services which become visible in the “system management/maintenance” process to the “system development” process by applying an SLA/SLM to the whole life cycle of IT system and improve the quality of IT services</li> </ul>
Target users	<ul style="list-style-type: none"> <li>• Those who contract out software development services and those who take charge of such services</li> <li>• Those who contract out IT operation services and those who take charge of such services</li> </ul>
Scope (Points to be discussed)	<p>Discussing the SLA on the next development process</p> <ul style="list-style-type: none"> <li>• Common Frame 2007 System requirement definition Software requirement definition, design of methods, detail design, programming, software linkage, qualification confirmation test, system linkage, system qualification confirmation test</li> <li>• Reliability improvement model contract System design Software design, programming, software test System linkage, system test, introduction reception test</li> <li>• Coordination with “the SLA Guidelines” also to be realigned</li> </ul>
Outline of the deliverables	<ul style="list-style-type: none"> <li>• Quality evaluation indicators for software development</li> <li>• Coordination evaluation indicators with the development process and operation/maintenance process</li> </ul>
Outline of the deliverables relating approach on quality, quality characteristics and metrics	<ul style="list-style-type: none"> <li>• The following “Quality Evaluation Indicators” on product, process and resource at the software development has been summarized.</li> <li>• Product ISO/IEC 9126-2 External quality : Item 5.3 (equal to the development process) ISO/IEC 9126-3 Internal quality : Item 6.4 (equal to the verification process)</li> <li>• Process Indicators related to status of improvement of status of implementation</li> <li>• Resources</li> </ul>

JEITA (SLA for Software Development)	
	<p>Capability of development staff, qualification of such staff, authentication of vendors</p> <p>It has summarized “the Development/Maintenance Process Coordination Evaluation Indicators” as indicators to make aware of the coordination to the SLA/SLM of the subsequent “system operation/maintenance” process in examining the SLA/SLM of the “system development” process and to let the two processes work together so that mutual SLM may be linked</p>
Basic usage process of the deliverables	<p>&lt;Usage methods of quality evaluation indicators&gt;</p> <p>The following process decides the service level objectives (SLO) from among the quality evaluation indicators on product process resources to be used.</p> <div style="text-align: center;"> <pre> graph TD     1(1 Decision of Phase) --&gt; 2(2 Choice of Possible SLOs)     2 --&gt; 3(3 Decision of SLOs)     3 --&gt; 4(4 Setup of target values)     4 --&gt; 5[Coordination with Service Providers]     5 --&gt; 6[Agreement on SLA]     4 -.-&gt; Revision  3     5 -.-&gt; Revision  4           </pre> </div> <p>&lt;Usage methods of Development/Operation Process Coordination Evaluation Indicator&gt;</p> <p>(1) Usage at a receiving test  Define checking objectives/standards before conducting a receiving test, and use them at the time of conducting the test.  Select checking objectives and standards from among indicators related to products of quality evaluation indicators and Development/Operation Process Coordination Evaluation Indicators. Further, the SLA on the software development and medium-term review/test results can be referred as well.</p> <p>(2) Usage at a operation test  Define checking objectives/standards before conducting an operation test, and use them at the time of conducting the test.  Select checking objectives and standards from among indicators related to products of quality evaluation indicators and Development/Operation Process Coordination Evaluation Indicators. Further, evaluation objectives that are scheduled to be agreed as the SLA for operation/maintenance can be referred as well.</p>

2.1.7 JEITA (SLA Guidelines)

The following is the features of “the SLA Guidelines for IT System for the Private Sector (third edition) of the Japan Electronics and Information Technology Industries Association (JEITA, incorporated association).

JEITA (SLA Guidelines)	
Activity purpose	<ul style="list-style-type: none"> <li>To show how to compile SLA's common evaluation indicators that private enterprises should agree in using IT services and an SLA and aim to use an SLA that can take a proper balance on cost/risk/service quality among IT service providers and users.</li> </ul>
Target users	<ul style="list-style-type: none"> <li>IT service providers, users</li> </ul> <p>(IT service providers are not always outsourcers such as IT vendors, but may be the IT division of a company in some cases. Likewise, IT service users are not limited to end users but may be the IT division)</p>
Scope (Points to be discussed)	<p>Discussing SLAs per form of IT service as listed below:  Network, collocation, hosting, IT structure operation outsourcing, outsourcing for business operation, application management outsourcing, full-outsourcing, business process outsourcing, maintenance service help-desk support service, security service</p>
Outline of the deliverables	<ul style="list-style-type: none"> <li>SLA process</li> <li>Service level objectives of 481, measurement methods, measurement units, selection standards, service level values (reference values) relating "service", "process" and "resource"</li> <li>SLA Introduction Check Sheet (approx. 800 evaluation objectives)</li> <li>Standard contract form</li> <li>Examples of four industries of manufacturing/finance/distribution/service</li> </ul>
Outline of the deliverables relating approach on quality, quality characteristics and metrics	<p>It has defined service level objective (SLO) and SLA values for each of IT service evaluation objective, IT process management evaluation objective and IT resource evaluation objective. Service level objectives are classified and realigned into Availability, Confidentiality, Completeness, Reliability, Assuredness, Capability, Expandability and the group of 8 objectives.</p>
Basic usage process of the deliverables	<p>&lt;SLA Preparation Process regulated in the SLA Guidelines&gt;</p> <pre> graph TD     S0[Step0: Self-assessment] --&gt; O0[SLA check list] --&gt; D0[Conduct a prior self-assessment of SLA objectives and analyze weak points]     S1[Step1: Selection of target industries] --&gt; O1[Classification of industries] --&gt; D1[Selection of the corresponding forms from currently targeted 10 industries]     S2[Step2: 選択の対象業務 (Selection of target operations)] --&gt; O2[Classification of operations] --&gt; D2[Selection of operations from currently targeted 10 operations (common/individual)]     S3[Step3: Selection of target services] --&gt; O3[List of services] --&gt; D3[Selection of the names of the services from currently targeted 8 services]     S4[Step4: Selection of effect] --&gt; O4[SLA Table (overall)] --&gt; D4[Taking into account business risk, select from among those with high effect degree to services]     S5[Step5: 選択の優先順位 (Selection of SLO)] --&gt; O5[SLA Table (detail)] --&gt; D5[Taking into account business cost, select minimal necessary objectives from the sections (requirement/indicator) and objectives (basic/individual)]     S6[Step6: 選択のSLO (Selection of level values)] --&gt; O6[SLA Table (detail)] --&gt; D6[Selection of standard values of target services (target values) from current business]     S7[Step7: 選択の値レベル (Indicator evaluation/verification)] --&gt; O7[ ] --&gt; D7[Compare whether the current business has an enough level value to the standard level of the target services and review the established value]     S8[Step8: Preparation of a contract] --&gt; O8[Standard contract form] --&gt; D8[Incorporate the determined SLA objectives and evaluation method in the contract]     S9[Step9: 作成の契約書 (Provisional operation)] --&gt; O9[Standard form of SLA agreement] --&gt; D9[Review the established SLA objectives and evaluation values and revise the SLA Agreement]     S10[Step10: Full-fledged operation] --&gt; O10[Standard form of SLA status report] --&gt; D10[Compile a report as the evaluation result of objectives described in the SLA Agreement]          S7 -- Revision --&gt; S6   </pre>

## 2.2. Comparison of Features of Domestic Activities

This paragraph compares major domestic activities that are discussing the system and software on metrics and the quality assurance of IT services, and clarifies common points and different points.

### 2.2.1. Outline

#### (1) Outline of features of activity purposes, target users and scope

Features of activity purposes, target users and scope per targets' activity organization are shown in Table 2-2. The outline shown herewith is a summary of the detail described from 2.1.2 to 2.1.7.

Table 2-2 Features of Activity Purpose, Target Users and Scope

Entity (results)	Activity Purpose	Target Users		Scope (to be discussed)
		Users	Vendors	
SC 7/WG 6 (SQuaRE)	To present quality requirements of software, system in a spec sheet, support measuring and evaluation, and establish standards	Acquirer Evaluator User	Developer Evaluator	Quality of system and software products, quality in use
JUAS, etc. (UVC II)	To help users define non-functional requirements	Persons who are in a position to describe a requirement spec sheet Persons in charge of tests or reviews Project manager	Project manager	Non-functional requirement of the company information system
Non-Functional Grade Study Panel (Non-Functional Requirement Grade)	Help users/vendors reach an agreement on spec of non-functional requirement, help study means to realize it	Persons who place an order	Persons who accept an order	Presenting non-functional requirements of system structure in a spec sheet, means to realize it
IPA/SEC (Material infrastructure reliability)	Ensure and improve reliability of information system itself that sustains critical infrastructure business	System division of critical infrastructure	Software developer	Reliability of critical infrastructure information system
JEITA (SLA on software development)	Quality improvement of IT services of the overall life cycle of IT system	Those who contract out software development services	Those who take charge of software development services	SLA on development process
JEITA (SLA Guidelines)	Usage of an SLA between IT service providers and users to properly balance cost, risk and service quality of IT services	Users of IT services Providers of IT services (info system department)	Providers of IT services	SLA per IT service form

(2) Outline of features of the deliverables relating the quality assurance

Concerning features of the deliverables, targets of the quality assurance (which of the system, software and IT services is being discussed? Is there any specific example?), information related to quality characteristics or metrics that are provided and information in using the deliverables, the summary made with the pivot for adjustment shown in Table 2-3 of the activities of organizations is presented in Table 2-4.

Table 2-3 Pivot for Adjustment on the Outline of Output Reports relating Quality Assurance

Item of Pivot for Adjustment		Meaning of Pivot for Adjustment
Output Reports: Simple name (activity organization)		Shows official name of deliverables, simple name and activity organization
Features of deliverables		Shows features of deliverables
Items covered by quality assurance	Software	✓ : Has described quality assurance of software n/a : Has not described quality assurance of software * : Other
	System	✓ : Has described quality assurance of system n/a : Has not described quality assurance of system △ : Other
	IT services	✓ : Has described quality assurance of IT services n/a : Has not described quality assurance of IT services * : Other
	Example	Provides specific examples of system, software and IT services such as system profile
Information on quality characteristics, metrics	Features of quality characteristics, metrics	Shows features of deliverables from the view of quality characteristics and metrics
	Handling quality characteristics	Shows quality characteristics that are defined to target quality assurance
	Metrics definition	Explains the meaning of metrics
	Formula/measurement method	Shows the formula of metrics, meaning of elements used and measurement methods
	Comprehension of metrics evaluation	Explains the scope of allowable values of metrics, evaluation methods
	Metrics reference values	Indicates reference values of metrics for specific targets
Information for usage	Features of usage process	Shows features in using the deliverables
	Usage guide	Yes: Providing usage guide for deliverables No: Not providing usage guide for deliverables
Remark ■ Sources		Notes per deliverables, other information. Words put after ■ mark shows information source.

Table 2-4 List of Output Reports related to Quality Assurance in Japan

Name of Output Reports : <b>Simplified Name</b> (activity organization)	Features of Output Reports	Targets of Quality Assurance			Information related to Quality Characteristics, Metrics						Information for Use		Remark ■ Source	
		Software	System	IT services	Specific Example	Features relating Quality Characteristics, Metrics	Handling Quality Characteristics [Targets]	Metrics Definition	Formula, Measurement Method	Comprehension of Metrics Evaluation	Metric Reference Value	Feature of Usage Process		Availability of Usage Guide
ISO/IEC 25000 System and software product Quality Requirements and Evaluation : <b>SQuaRE</b> (SC 7/WG 6)	International standards for quality and evaluation of system and software	✓	✓	n/a	Nothing in particular	Common model, external/internal quality model, quality model in use, data quality model, quality metrics	[Product] Functionality, Reliability, Usability, Efficiency, Maintainability, Portability [Quality in use] Effectiveness, Productivity, Safety, Satisfaction Degree *1	✓	✓	✓	n/a	To be used in accordance with the process of quality requirement definition ISO/IEC 25030, the quality evaluation process ISO/IEC 25040	Yes	*1 ISO/IEC25010 FCD mentions the following quality characteristics (as of Mar. 2010) [Product]Function Adaptability, Execution Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, Portability [Quality in use] Effectiveness, Efficiency, Satisfaction Degree, Safety, Usage Status Comprehensiveness ■ Japanese Standards Association (incorporated foundation)
User Vender Collaboration: Report on Research Project II “Guidelines for Non-Functional Requirement Specification Definition” : <b>UVC II</b> (JUAS, etc.)	230 indicators, definitions, measurement methods, formulas, comprehension methods, how to handle indicators at each software process	✓	✓	✓	Nothing in particular	Indicators of 10 areas of non-functional requirements of info system (Functionality, Reliability, Usability, Efficiency, Maintainability, Portability) (above items: quality of info system), Disorder Controllability, Effectiveness, Operability, Technical Requirement)	[Product] Functionality, Reliability, Usability, Efficiency, Maintainability, Portability [Other than product quality] Disorder Controllability, Effectiveness, Operability, Technical Requirement	✓	✓	✓	n/a	To be used by dividing into a stage of preparing for usage and a stage to actually use it	No	■ Japan Users Association of Information Systems Association (JUAS, incorporated association))
Non-Functional Requirement Grade Usage Guide Grade Table on Non-Functional Requirement of System Structure List of Objectives on Non-Functional Requirement of System Structure Tree Diagram on Non-Functional Requirement of System Structure : <b>Non-Functional</b>	Guide for Usage, Grade Table, List of Objectives, Tree Diagram, Non-Functional Requirement Grade Usage Sheet	*	✓	✓	Almost no social impact (Type 1), limited impact (Type 2), extremely large impact (Type 3), system that gives impact on human lives or huge economic loss (Type 4)	Requirement objectives and Grade Table based on units of six major objectives of non-functional requirements concerning system structure that is systematically explained/separated	[Product] Availability, Capability/Expandability, Operability/Maintainability, Transition, Security, System Environment/Ecology	✓	✓	✓	✓	To be used in processes or activity that handles non-functional requirements in planning process, requirement definition process and development process in the Common Frame 2007	Yes	* In a case where it is included in system structure or it is handled simultaneously in studying system structure requirement, software is included. ■ Transferred to Information Technology

<b>Requirement Grade</b> (Non-Functional Requirement Grade Study Panel)														Promotion Agency, Software Engineering Center (IPA/SEC, incorporated administrative agency) , inclusive of copyright Downloadable from the Web site of the Study Panel now. Will be released from IPA/SEC in future.
Report on Critical Infrastructure Information System Reliability Study Group : Critical Infrastructure Reliability (IPA/SEC)	Profiling, countermeasure item test, metrics and reference values	✓	*	*		Process evaluation metrics and product evaluation metrics for critical infrastructure system	[Product] Reliability [Process] Reliability	✓	✓	✓	✓	Measure metrics at each point of (1)before executing the task, (2)after executing the task(or being engaged in executing it, (3)after the completion of the project, and control it by comparing them with target values	No	* Provide metrics on quality of software based on the study taking into account the quality of IT services and system ■ Web site of Information Technology Promotion Agency, Software Engineering Center (IPA/SEC, incorporated administrative agency)
Survey Report II on Solution Services for FY2008 Survey Report on Expansion of the Scope Where an SLA is Applied : <b>SLA on Software Development</b> (JEITA)	Quality evaluation indicators, coordination evaluation indicators	✓	n/a	✓	Nothing in particular	“Quality evaluation indicators” of product, process and resource at software development, “Development/operation process coordination evaluation indicators”	[Product] Functionality, Reliability, Usability, Efficiency, Maintainability, Portability [Process] Status of improvement, status of implementation [Resource] Capability of development staff, qualification of development staff, venter authentication	✓	✓	n/a	n/a	Determine service level objectives (SLO) based on quality evaluation indicators concerning product/process/resource during software development to use. Use development/operation process coordination evaluation indicators for acceptance tests and operation tests.	Yes	■ Japan Electronics and Information Technology Industries Association (JEITA, incorporated association)
SLA Guidelines for IT System for the Private Sector (third edition) : <b>SLA Guidelines</b> (JEITA)	SLA process, 481 service level objectives, measurement methods, measuring units, standards for selection, service level values, SLA Introduction Check Sheet, standard form for contract, reference examples	n/a	n/a	✓	Models of transportation, finance, manufacturing, construction, telecommunications, utility, commerce, real estate, and model that is common to industries	Service evaluation objectives, IT process management evaluation objectives, IT resource evaluation objectives, respective service level objective (SLO) and SLA values	[Service, process, resource] Availability, Confidentiality, Completeness, Reliability, Assuredness (Recoverability), Capability (Response), Expandability, Maintainability (Period)	✓	✓	✓	✓	Use the SLA Table when selecting the degree of effect of services, SLO or level values. Use standard form for contract when preparing a contract	Yes	■ Nikkei Business Publications, Inc.

## 2.2.2. Detail Comparison

Summarization of representative organizations that are discussing the quality assurance on metrics of the system and software in terms of common items (activity purpose, target users, scope, outline of deliverables, outline of deliverables from the view of quality characteristics/metrics, usage process of deliverables).

### (1) Activity purpose

The table below is the summary result of activity purposes of each organization.

Table 2-5 Activity Purpose

Entity (deliverables)	Activity Purposes
SC 7/WG 6 (SQuaRE)	<ul style="list-style-type: none"> <li>• To <u>help</u> persons who develop software products and those who acquire them <u>compile quality requirements in a specification sheet and make an evaluation</u></li> <li>• To <u>compile quality requirements of software products in a specification sheet, make measurements thereof and establish standards for evaluation</u></li> <li>• To include quality models comprised of two sections in order to fit the quality that a customer defines to attributions of development processes. Besides, to provide a measure that is desirable to measure the quality attributions of software products, which developers, acquirers and appraisers can use.</li> </ul>
JUAS, etc. (UVC II)	<ul style="list-style-type: none"> <li>• To <u>enable users accurately define non-functional requirements</u> in a requirement spec sheet in developing an information system</li> </ul>
Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	<ul style="list-style-type: none"> <li>• To ensure that <u>all is studied and the misunderstanding is resolved</u> when <u>users/vendors agree</u> on non-functional requirements</li> <li>• To enable <u>users present specific non-functional requirements immediately</u></li> <li>• To enable <u>vendors make specific proposals on non-functional requirements and means to concrete them</u></li> </ul>
IPA/SEC (critical infrastructure reliability)	<ul style="list-style-type: none"> <li>• To <u>secure and improve reliability of the information system</u> that sustains the critical infrastructure business</li> <li>• To <u>promote the introduction of the quantitative quality control mechanism</u> for software development of the critical infrastructure information system. Specifically, to verify via actual data system, profiling, common reference for quality control, and countermeasure check list based on analyses of disorder examples and confirm their effectiveness, and collect and compile reference information necessary for executing measures, for the purpose of applying it in the actual job sites of system development/operation</li> </ul>
JEITA (SLA on software development)	<ul style="list-style-type: none"> <li>• To <u>work on the PDCA cycle</u> that feeds back quality issues of IT services which become visible in the “system management/maintenance” process to the “system development” process by applying an SLA/SLM to the whole life cycle of IT system and <u>improve the quality of IT services</u></li> </ul>
JEITA (SLA Guidelines)	<ul style="list-style-type: none"> <li>• To show how to compile SLA’s common evaluation indicators that private enterprises should agree in using IT services and an SLA and aim to <u>use an SLA that can take a proper balance on cost/risk/service quality among IT service providers and users.</u></li> </ul>

(2) Target users

The table below is the summary result of target users per deliverables.

Table 2-6 Target Users

Entity (deliverables)	Target Users
SC 7/WG 6 (SQuaRE)	<ul style="list-style-type: none"> <li>• Developers, acquirers, evaluators and users of the system and software</li> </ul>
JUAS, etc. (UVC II)	<ul style="list-style-type: none"> <li>• <u>Persons who are in a position to describe a requirement spec sheet in developing an information system at a user company</u></li> <li>• Can contain <u>persons in charge of tests or reviews</u> as well in the target users in order to confirm whether all the defined requirements have been realized in the information system at the stage of verification</li> <li>• In addition to such direct users, <u>project managers</u>, who are striving indirectly to clarify requirement spec definitions at the system development and maintenance day and night and further bother themselves on clarification of roles at the requirement spec phase, can also be target users</li> </ul>
Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	<ul style="list-style-type: none"> <li>• <u>Persons in charge of both placing an order and receiving it</u> who are involved in presenting, making proposals and determining non-functional requirements at scenes of requirement definitions, etc. out of the system development</li> </ul>
IPA/SEC (critical infrastructure reliability)	<ul style="list-style-type: none"> <li>• <u>System department</u> of critical infrastructure enterprises and <u>software development enterprises</u></li> </ul>
JEITA (SLA on software development)	<ul style="list-style-type: none"> <li>• <u>Those who contract out software development services and those who take charge of such services</u></li> <li>• <u>Those who contract out IT operation services and those who take charge of such services</u></li> </ul>
JEITA (SLA Guidelines)	<ul style="list-style-type: none"> <li>• <u>IT service providers, users</u> (IT service providers are not always outsourcers such as IT vendors, but may be the IT division of a company in some cases. Likewise, IT service users are not limited to end users but may be the IT division)</li> </ul>

(3) Scope (Subjects under Discussion)

The following is the summary result of major scopes being discussed by each organization.

Table 2-7 Scope (Subjects under Discussion)

Entity (Output Reports)	Scope (Subjects under Discussion)
SC 7/WG 6 (SQuaRE)	Discussing <u>the quality of the system and software products, the quality in use</u>
JUAS, etc. (UVC II)	Discussing 10 areas of <u>non-functional requirements of the company information system</u> The 10 areas below listed are included in this scope: Quality of information system (Functionality, Reliability, Usability, Efficiency, Maintainability, Portability), Disorder Controllability, Effectiveness, Operability, Technical Requirement
Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	Concerning <u>non-functional requirements of the system structure</u> , discussing the visualization of the level required by those who place orders and the methods to confirm between those who place orders and receive them.
IPA/SEC (critical infrastructure reliability)	It is discussing metrics that should be referred in each process of the planning, requirement definition, development and operation/management of <u>critical infrastructure information system</u> and its reference target value.
JEITA (SLA on software development)	Discussing the <u>SLA on the next development process</u> <ul style="list-style-type: none"> <li>• Common Frame 2007 System requirement definition Software requirement definition, design of methods, detail design, programming, software linkage, qualification confirmation test, system linkage, system qualification confirmation test</li> <li>• Reliability improvement model contract System design Software design, programming, software test System linkage, system test, introduction reception test</li> <li>• Coordination with “the SLA Guidelines” also to be realigned</li> </ul>
JEITA (SLA Guidelines)	Discussing <u>SLAs per form of IT service</u> as listed below: Network, collocation, hosting, IT structure operation outsourcing, outsourcing for business operation, application management outsourcing, full-outsourcing, business process outsourcing, maintenance service help-desk support service, security service

(4) Outline of deliverables

The following table is the summary result of the outline of deliverables.

Table 2-8 Outline of Output Reports

Entity (Output Reports)	Outline of Output Reports
SC 7/WG 6 (SQuaRE)	<ul style="list-style-type: none"> <li>• <u>ISO/IEC25000 Series; System and Software product Quality Requirements and Evaluation (SQuaRE)</u> <ul style="list-style-type: none"> <li>• ISO/IEC 2500n Quality Management Dept.</li> <li>• ISO/IEC 2501n Quality Model Dept.</li> <li>• ISO/IEC 2502n Quality Measurement Dept.</li> <li>• ISO/IEC 2503n Quality Requirement Dept.</li> <li>• ISO/IEC 2504n Quality Evaluation Dept.</li> <li>• ISO/IEC 25050 ~ ISO/IEC 25099 SQuaRE Expansion Dept.</li> </ul> </li> </ul>
JUAS, etc. (UVC II)	<ul style="list-style-type: none"> <li>• <u>230 indicators in 10 areas</u></li> <li>• <u>Definitions, measurement methods, measuring scale, computation formula and comprehension methods per indicator</u></li> <li>• <u>How to handle indicators at each software process</u> from requirement definition to maintenance/operation</li> </ul>
Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	<ul style="list-style-type: none"> <li>• “The Usage Guide (Usage Edition)” and “the Usage Guide (Commentary Edition)” that gives an explanation on usage methods of non-functional requirement grade, the way of thinking of each tool or definitions of terminologies, etc.</li> <li>• “The Grade Table” that exemplifies values of the level per model system about important non-functional requirement objectives from a user’s viewpoint</li> <li>• “The Item Table” that shows a list of non-functional requirements and the levels on which users/vendors should agree</li> <li>• Complementary tool “the Tree Diagram” that enables to read the Grade Table or Item Table like a bird’s-eye view</li> <li>• “The Non-Functional Requirement Grade Usage Sheet” that is provided in a spread-sheet format, which a user can use it as if he/she customizes the grade</li> </ul>
IPA/SEC (critical infrastructure reliability)	<ul style="list-style-type: none"> <li>• <u>Profiling</u> of the critical infrastructure information system</li> <li>• <u>Item List of Measures</u> for improvement of reliability</li> <li>• <u>Metrics and reference values</u> for the quantitative control (basic, product, process)</li> </ul>
JEITA (SLA on software development)	<ul style="list-style-type: none"> <li>• <u>Quality evaluation indicators</u> for software development</li> <li>• <u>Coordination evaluation indicators</u> with the development process and operation/maintenance process</li> </ul>
JEITA (SLA Guidelines)	<ul style="list-style-type: none"> <li>• SLA process</li> <li>• <u>Service level objectives of 481, measurement methods, measurement units, selection standards, service level values</u> (reference values) relating “service”, “process” and “resource”</li> <li>• <u>SLA Introduction Check Sheet</u> (approx. 800 evaluation objectives)</li> <li>• <u>Standard contract form</u></li> <li>• <u>Examples of four industries</u> of manufacturing/finance/distribution/service</li> </ul>

(5) Outline of deliverables relating view of quality, quality characteristics and metrics

The following table is the summary result of the outline of deliverables relating views of quality, quality of characteristics and metrics which each deliverable indicates.

Table 2-9 Outline of Output Reports relating View of Quality, Quality Characteristics and Metrics

Entity (Deliverables)	Outline of Output Reports relating View of Quality, Quality Characteristics and Metrics
SC 7/WG 6 (SQuaRE)	<ul style="list-style-type: none"> <li>• <u>Common models</u> Based on the SQuaRE general reference model, quality life cycle model of software products and quality model structure, it presents the external/internal quality model, the quality model in use, the data quality model and the quality metrics.</li> <li>• <u>External/internal quality model (ISO/IEC 9126-1)</u> It defines Functionality, Reliability, Usability, Efficiency, Maintainability and Portability, and defined sub-characteristics for each.</li> <li>• <u>Quality model in use (ISO/IEC 9126-1)</u> Has defined as quality characteristics of products that are being used or developed Effectiveness, Productivity, Safety and Satisfaction Level.</li> <li>• <u>Data quality model (ISO/IEC 25012)</u> It defines Accuracy, Completeness, Consistency, Credibility, Currentness, Accessibility, Compliance, Confidentiality, Efficiency, Precision, Traceability, Understandability, Availability, Portability and Recoverability.</li> <li>• <u>Quality metrics (ISO/IEC 9126-2,3,4)</u> It defines metrics for each quality characteristic.</li> </ul>
JUAS, etc. (UVC II)	<p>Has established as <u>areas of non-functional requirements</u> of the information system 10 areas; Functionality, Reliability, Usability, Efficiency, Maintainability, Portability (the above mentioned are quality of information system), Disorder Controllability, Effectiveness, Operability, Technical Requirement. (The quality of the information system has been derived from JIS X 0129-1 (ISO/IEC 9126-1), others have been added by JUAS on its own).</p>
Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	<p>It has elevated comprehensiveness by <u>aligning and reclassifying requirement objectives in a systematic manner with handling six major objectives as a unit in order to have every user/vendor share the recognition based on the clarification of non-functional requirements</u> on the system structure. Besides, it has contained the recognition gap between users/vendors by taking processes to agree step-by-step on detail non-functional requirement objectives of the Model System, Grade Table and List of Objectives.</p> <ul style="list-style-type: none"> <li>• It has established <u>six major non-functional requirement objectives</u> of Availability, Capability/Expandability, Operability/Maintainability, Transition, Security, System Environment/Ecology, defined middle-objectives and small objectives under major objectives (List of Objectives) and presented the Tree Diagram.</li> <li>• It has provided the <u>Grade Table that defines the standard levels of non-functional requirement objectives</u> per three model systems (system with almost no social impact / limited social impact / extremely large social impact)</li> </ul> <p>As the Panel handles <u>quality requirements related to quality characteristics</u> as a system, in particular, the portion of the system structure, it includes objectives not found in ISO/IEC 9126-1 that indicates quality characteristics mainly of software products. For example, it includes <u>objectives concerning the system transition or operation, those related to the environment where the system is set or ecology.</u></p>

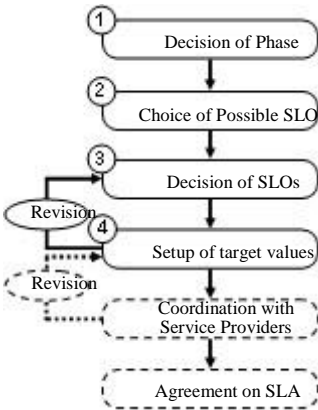
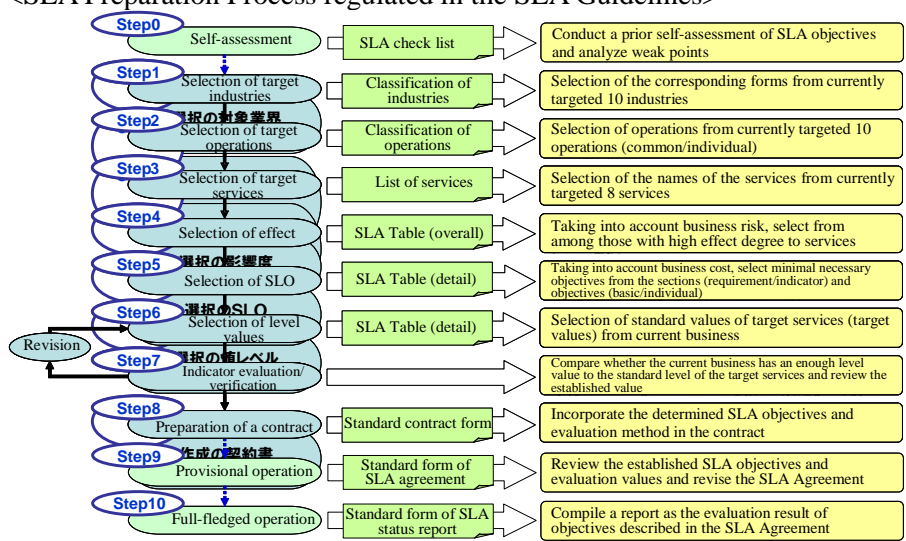
Entity (Deliverables)	Outline of Output Reports relating View of Quality, Quality Characteristics and Metrics
IPA/SEC (critical infrastructure reliability)	<ul style="list-style-type: none"> <li>• For the purpose of improving the reliability of the critical infrastructure information system, it pays attention to features relating defects as software features, fixes <u>process evaluation metrics and product evaluation metrics</u>, and presents each definition, timing for measuring and methods to use, etc.</li> </ul>
JEITA (SLA on software development)	<ul style="list-style-type: none"> <li>• The following <u>“Quality Evaluation Indicators”</u> on product, process and resource at the software development has been summarized.</li> <li>• Product ISO/IEC 9126-2 External quality : Item 5.3 (equal to the development process) ISO/IEC 9126-3 Internal quality : Item 6.4 (equal to the verification process)</li> <li>• Process Indicators related to status of improvement of status of implementation</li> <li>• Resources Capability of development staff, qualification of such staff, authentication of vendors It has summarized <u>“the Development/Maintenance Process Coordination Evaluation Indicators”</u> as indicators to make aware of the coordination to the SLA/SLM of the subsequent “system operation/maintenance” process in examining the SLA/SLM of the “system development” process and to let the two processes work together so that mutual SLM may be linked</li> </ul>
SLA Guidelines (JEITA)	<ul style="list-style-type: none"> <li>• It has defined <u>service level objective (SLO) and SLA values</u> for each of IT service evaluation objectives, IT process management evaluation objective and IT resource evaluation objective. Service level objectives are classified and realigned into Availability, Confidentiality, Completeness, Reliability, Assuredness, Capability, Expandability and the group of 8 objectives.</li> </ul>

(6) Basic usage process of deliverables

The following table is the summary result of basic usage process of deliverables of each activity.

Table 2-10 Basic Usage Process of Output Reports

Entity (Output Reports)	Basic Usage Process of Output Reports
SC 7/WG 6 (SQuaRE)	The process of the quality requirement definition using quality measures has been provided in ISO/IEC 25030 while the quality evaluation process is provided in ISO/IEC 25040 (being prepared as a revised version of JIS X 0133-1).
JUAS, etc. (UVC II)	<p>To be <u>used separately for the preparatory stage for use and the actual usage stage.</u></p> <p>(1)<u>Preparatory stage for usage</u> Select important indicators/necessary indicators for the company's information system and position them as "non-functional requirements that are sure to be defined when it develops a new information system".</p> <p>(2)<u>Actually used stage</u> Describe in a requirement spec sheet defined indicators and values which the defined indicators should realize in the information system as non-functional requirements. And confirm whether the non-functional requirements described at the stage of the requirement specification have all been materialized at the verification stage, including functional requirements.</p>
Non-Functional Requirement Grade Study Panel (Non-Functional Requirement Grade)	<p><u>It is assumed that the deliverables would be used in the process or activity that handles non-functional requirements in the planning process, requirement definition process and development process of the "Common Frame 2007".</u></p> <p>Aims to share the recognition on non-functional requirements between users/vendors on the upper process (including cases where such recognition is described in documents such as RFP, requirement definition sheet and estimate proposal, or is included in agreed objectives as a system design contract). One example of the usage process is as follows: (from the Usage Guide).</p> <p>(1) Selection of the model system It extracts operation requirements related to the non-functional requirements and selects the model system that is closest from among model systems</p> <p>(2) Determination of the level of important objectives It determines the specific level of important objectives using the selection level shown in the model systems selected with the Grade Table for reference</p> <p>(3) Determination of the level of objectives other than important objectives It confirms the requirement level for all the objectives of non-functional requirements using the List of Objectives</p>
IPA/SEC (critical infrastructure reliability)	<p><u>It compares the metrics measured at respective timing of (1) before the execution of task, (2) after the execution of task (or during being executed) and (3) after the completion of the project with the target values, and conducts quantitative quality control.</u></p> <p>The result of the analysis is fed back not only to the control of the said project but also the development process standard of the organization to make it improve the process. Make the result be reflected in the next or subsequent projects and efforts will be made toward continuous improvement.</p>

Entity (Output Reports)	Basic Usage Process of Output Reports
JEITA (SLA on software development)	<p>&lt;Usage methods of quality evaluation indicators&gt;            The following process <u>decides the service level objectives (SLO) from among the quality evaluation indicators on product process resources to be used.</u></p>  <p>&lt;Usage methods of Development/Operation Process Coordination Evaluation Indicator&gt;            (1) Usage at a receiving test  <u>Define checking objectives/standards before conducting a receiving test, and use them at the time of conducting the test.</u>            Select checking objectives and standards from among indicators related to products of quality evaluation indicators and Development/Operation Process Coordination Evaluation Indicators. Further, the SLA on the software development and medium-term review/test results can be referred as well.            (2) Usage at a operation test  <u>Define checking objectives/standards before conducting an operation test, and use them at the time of conducting the test.</u>            Select checking objectives and standards from among indicators related to products of quality evaluation indicators and Development/Operation Process Coordination Evaluation Indicators. Further, evaluation objectives that are scheduled to be agreed as the SLA for operation/maintenance can be referred as well.</p>
SLA Guidelines (JEITA)	<p>&lt;SLA Preparation Process regulated in the SLA Guidelines&gt;</p> 

### **3. Use of the Result of Domestic Activities for Quality Assurance and Use at Software Life Cycle**

In this Chapter, we will organize the way how the activity results of major organizations of Japan that are discussing the system and software relating metrics, and the quality assurance of IT services are linked to the Concept of Quality Assurance of System and Software and can be used, focusing on international standards. First of all, quality models and metrics that are used to decide quality requirements will be put in order in light of the ISO/IEC 9126 Series. Next, responses to the quality life cycle of the SQaRE Series for ensuring quality over the entire life cycle will be explained.

In addition, all the deliverables will be reorganized from the view of the Software Life Cycle that is defined in the Common Frame, assuming the actual usage of such activity results.

#### **3.1. Use of System Software in Quality Assurance**

##### **3.1.1. Use for Determining Quality Requirements**

When deciding quality requirements of the system and software and IT services, you have to fix a quality model responding to user needs as well as fix metrics that should be measured and controlled in order to evaluate the degree of the realization of quality characteristics of said quality model. The ISO/IEC 9126 Series provide information on basic quality characteristics and metrics in determining quality models or metrics. Meanwhile, each activity presents unique quality characteristics, metrics and reference values to a particular system and software and IT services, and such items can be referred when you examine specific content of quality requirements.

JIS X 0129-1 (ISO/IEC 9126-1) has defined as expressed in Chart 3-1 the internal quality model, the external quality model and the quality model in use.

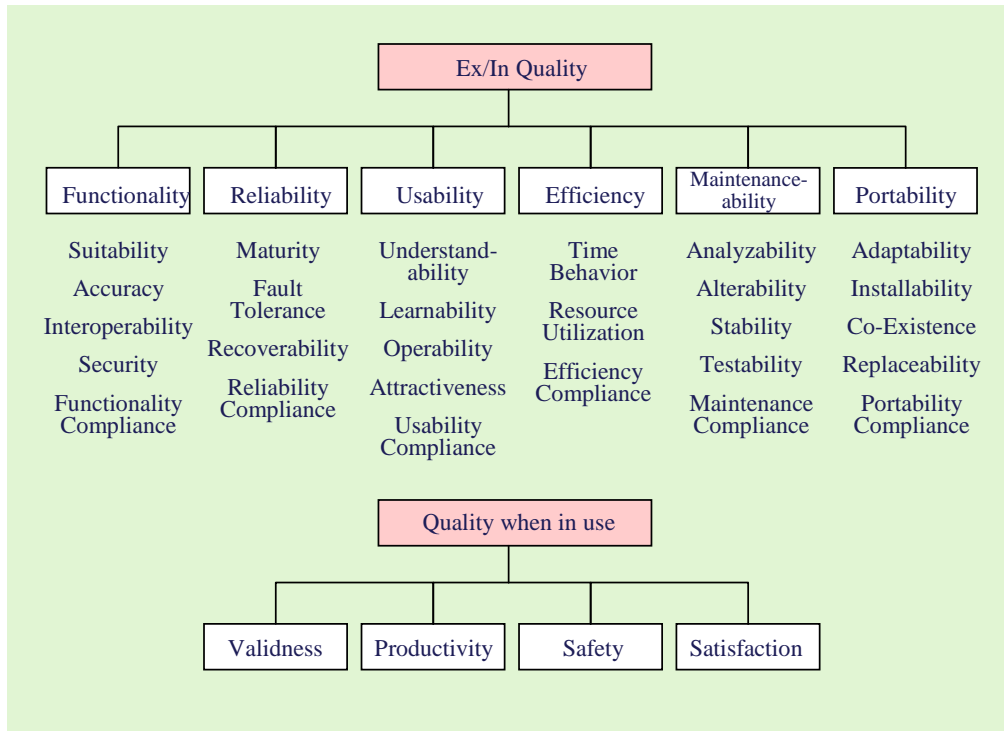


Chart 3-1 Quality Models of JIS X 0129-1 (ISO/IEC 9126-1)

How quality characteristics and metrics of the ISO/IEC 9126 Series (JIS X 0129-1) are responding to quality characteristics and metrics that are indicated in the deliverables of each activity is shown in Table 3-1.

Table 3-1 Status of How ISO/IEC 9126 Series (JIS X 0129-1) Responds to Quality Characteristics, Metrics

JIS X 0129-1	Quality Characteristics	Quality Sub-Characteristics	Status of Metrics, Reference Values, Provision of Reference Values			
			UVC II	Non-functional requirement grade	Material infrastructure reliability	SLA on software development
Ex/In Quality Characteristics	Functionality	Suitability	✓			✓
		Accuracy	✓			✓
		Interoperability	✓			✓
		Security	✓	⊙		✓
		Functionality Compliance	✓	△		✓
	Reliability	Maturity	✓	⊙	✓*1	✓
		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		✓	△		✓	
Quality characteristics in use	Validness	—		⊙		
	Productivity	—		△		
	Safety	—		⊙		
	Satisfaction	—				
Column for Remarks					*1 Partially providing reference values	
Remarks for compiling this table						
<ul style="list-style-type: none"> <li>Concerning non-functional requirement grade, please note that the responses are described taking into account the following possibilities; <ol style="list-style-type: none"> <li>Because non-functional requirement grade has been studied from the view of “system”, the meaning may be different from the definition of the original quality characteristics with the view of “software”.</li> <li>Because it targets system requirements that are determined prior to development, specific features may be different from quality characteristics (measurement method or evaluation method, etc.) that can be evaluated after development.</li> </ol> </li> <li>About the SLA Guidelines Because it handles quality characteristics for service, process and resource, the SLA Guidelines are excluded from the reclassification of this compilation.</li> </ul>						

Next, examples of major metrics at each activity per quality characteristics will be shown in Table 3-2.

Table 3-2 Examples of Major Metrics at Each Activity to Quality Characteristics (1 / 2)

JIS X 0129-1	Quality Characteristics	Quality Sub-Characteristics	Examples of Metrics			
			UVC II	Non-functional grade	Material infrastructure reliability	SLA on software development
Ex/In Quality Characte ristics	Functionality	Suitability	Excess degree of function, etc.	—	—	Function properness
		Accuracy	Density of check, etc.	—	—	Accuracy of computation
		Interoperability	Easiness of connection to other systems, etc.	—	—	Data exchangeability
		Security	Number of fraudulent accesses	Used in plural metrics of major objectives of security. Ex. metrics such as logging or target under scrutiny for dishonest practice (equipment)	—	Preventiveness of damage of data
		Functionality Compliance	Functionality Compliance Ratio	Whether there are internal regulations, rules, act, guidelines, etc. to be observed.	—	Functionality Standard Compliance
	Reliability	Maturity	Test density, etc.	Scope of availability confirmation, measurement frequency of performance test, scope of confirmation	Disorder density of test, etc.	Estimated potential disorder density
		Fault Tolerance	Avoidability of crash, etc.	Redundancy (equipment)	—	Avoidability of crash
		Recoverability	Average recovery time, etc.	Scope of recovery work or automatic disorder recovery	—	Availability
		Reliability Compliance	Reliability Compliance Ratio	Constrains when constructed	—	Reliability Standard Compliance
	Usability	Understanding	Definiteness of function, etc.	—	—	Completeness of description
		Learnability	Easiness of help access, etc.	Preparation level of manual, scope of methodized operations	—	Easiness of functional learnability
		Operability	Availability of default values	—	—	Consistency of operation in use
		Attractiveness	—	—	—	Attractive mutual operation
		Usability Compliance	Usability Compliance Ratio	Constrains when constructed	—	Usability Standard Compliance

Table 3-3 Examples of Major Metrics at Each Activity to Quality Characteristics (2 / 2)

JIS X 0129-1	Quality Characteristics	Quality Sub-Characteristics	Examples of Metrics				
			UVC II	Non-functional grade	Material infrastructure reliability	SLA on software development	
Ex/In Quality Characteri stics	Efficiency	Time Behavior	Throughput, etc.	—	—	Response time	
		Resource Utilization	Memory amount	Remaining power to further use the same equipment	—	Usage ratio of I/O equipment	
		Efficiency Compliance	Efficiency Compliance Ratio	Constrains when constructed	—	Efficiency Standard Compliance	
	Maintainability	Analyzability	Trace tool usage ratio, etc.	—	—	Trace audit ability	
		Changeability	Parameter modification success rate, etc.	Whether configuration management is done or change management is done	—	Change cycle efficiency	
		Stability	Sufficiency ratio of automatic recovery function, etc.	—	—	Success rate of changes	
		Testability	Mounting ratio of built-in test function, etc.	Whether patch is examined	—	Usefulness of built-in test function	
		Maintainability Compliance	Maintainability Compliance Ratio	Constrains when constructed	—	Maintainability Standard Compliance	
	Portability	Environmental Adaptability	Adaptability to organizational environment	—	—	Adaptability of data structure	
		Installability	Flexibility of introduction, etc.	Limited space to be set (machine room) or room to be expanded of the space for setting	—	Easiness of installment	
		Co-Existence	Usable coexistence	Whether parallel operation is possible	—	Usable coexistence	
		Replaceability	Continuity of function, etc.	—	—	Continuous use of data	
		Portability Compliance	Portability Compliance Ratio	Constrains when constructed	—	Portability Standard Compliance	
	Quality character istics in use	Effectiveness	—	—	—	—	—
		Productivity	—	—	—	—	—
Safety		—	—	—	—	—	
Satisfaction		—	—	—	—	—	

In addition to the quality characteristics of JIS X 0129-1, each activity's quality characteristics and metrics defined by the deliverables on their own will be presented as below per deliverables.

Table 3-4 Unique Quality Characteristics that UVC II Presents

Unique Quality Characteristics	Quality Characteristics	Definition	Quality Sub-Characteristics	Example of Metrics
UVC II	Disorder Controllability	Particularly, the ability to help prevent an occurrence of disorder in development and operation of highly reliable information system and prevent an expansion when it occurs	Prevention of an occurrence	“Quality evaluation value”, etc.
			Prevention of an expansion of disorder	“Operation quality ratio”, etc.
	Effectiveness	Ability to generate effect as planned and be able to evaluate it	Quantitative evaluation with convertibility	“ROI”, etc.
			Qualitative evaluation where conversion is difficult	“Number of claims from customers”, etc.
			Evaluation with general indicators	“Satisfaction degree of users”, etc.
	Operability	Meaning operability, not of product but of computer center	SLA	“Ratio of the time to provide services”, etc.
			Easiness of operation	“Ratio of intervention operation”, etc.
			Measures for failures	“Ratio of the number of mistaken operations in measures for failures”, etc.
			Measures for disasters	“Ratio of the days required for actual restoration to the planned number of days to restore a local disaster”, etc.
	Technical requirement	Basic framework or mechanism of information system that is beforehand decided from the viewpoint of the organizational policy as a company or retention of the entire consistency. Or, requirements that are examined and decided within the project based on non-functional requirements.	Realization method of system	“System realization method”
			System configuration	“Software configuration”, etc.
			System development method	“Process of system development”, etc.
			Development standard, standard	“User interface requirements”, etc.
			Development environment	“Project management tool”, etc.

Table 3-5 Unique Quality Characteristics Presented in SLA on Software Development

Unique Quality Characteristics	Quality Characteristics	Definition	Quality Sub-Characteristics	Example of Metrics
SLA on Software Development	Operability	—	Easiness of operation	Degree of clarification of operational terms
			Measures for failures	Trouble detecting ratio
			Availability	Transfer procedures during the normal period

The SLA Guidelines has defined quality characteristics for service, process and resource.

Table 3-6 Quality Characteristics of SLA Guidelines

Unique Quality Characteristics	Quality Characteristics	Definition	Quality Sub-Characteristics	Examples of Metrics
SLA Guidelines	Availability	Character that owns abilities of a function or mechanism to continue or maintain services so that such services may not be provided due to various troubles	—	Operation ratio
	Confidentiality	—	—	Time to detect of a fire wall
	Completeness	—	—	Number of packet losses among nodes
	Reliability	It indicates how accurately an IT system can provide required processing during a certain period and under certain conditions.	—	Mean Time Between Failures (MTBF)
	Assuredness (recoverability)	It refers to being able to restore to a normal condition if a system or an application suffers an unexpected failure of function such as a cessation of operation.	—	Restoration time
	Capability (response)	—	—	Adherence ratio of online responsive time
	Expandability	Function or mechanism that can enhance the ability to provide services	—	Band capacity
	Maintainability (period)	—	—	Time to exchange parts

### 3.1.2 Use in Quality Life Cycle

The Software Quality Life Cycle of the ISO/IEC 25000 SQuaRE Series is shown in the chart below. In the Quality Life Cycle, quality models and metrics are used in fixing quality requirements to Quality Needs in Use, and determining respective quality requirements of Computer System Quality Requirements (External Quality Requirement) and Internal Quality Requirements.

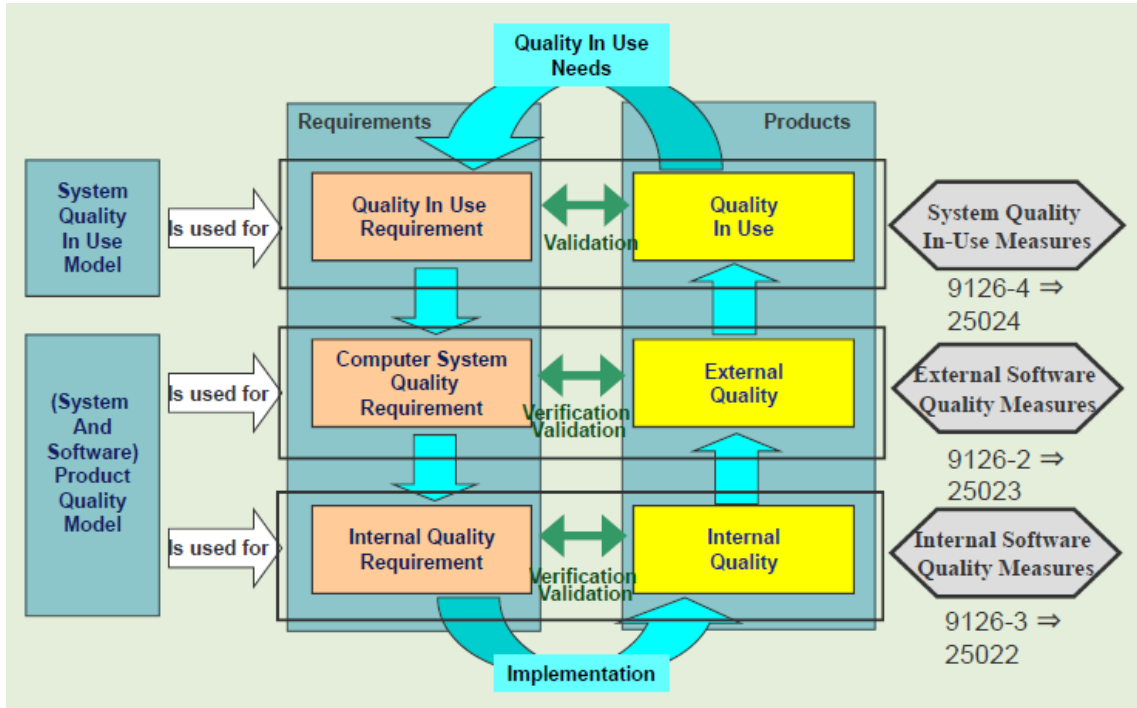


Chart 3-2 SQuaRE Series' Quality Life Cycle and Quality Model, and Measures (Metrics)

Reclassifying the responses to the Quality Life Cycle in accordance with the responsive result of each deliverables to the quality characteristics and metrics of Quality In Use, External Quality and Internal Quality shown in Table 3-1, we will have Chart 3-3.

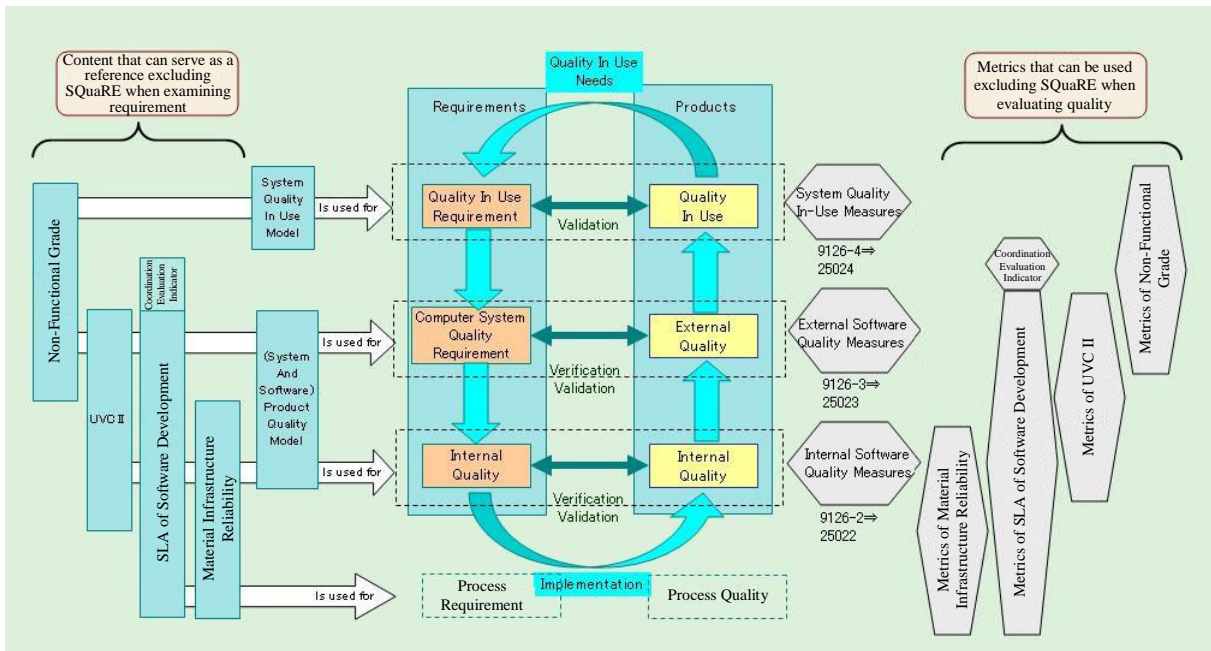


Chart 3-3 Correspondence of Quality Life Cycle and Domestic Activities at the SQuaRE Series

In determining Quality Requirement in Use, Computer System Quality Requirement (External Quality Requirement) and Internal Quality Requirement, some domestic deliverables can be used responding to a target besides the SQuaRE Series. For example, you can use the content of discussions or metrics of non-functional requirement grade for Quality Requirement in Use. The content of discussions or metrics of Non-Functional Requirement Grade, UVC II and SLA on Software Development can be used for External Quality Requirement. For Internal Quality Requirement, the content of discussions or metrics of UVC II SLA on Software Development and Critical Infrastructure Reliability are available. When you have decided the quality requirements, development process for realizing the detail must be verified. Concerning the development process, you can use as a reference SLA on Software Development, and discussion points or metrics of Critical Infrastructure Reliability.

### 3.2. Use at Software Life Cycle

#### 3.2.1. Timing of Use at Software Life Cycle

Chart 3-4 below is the summary result of the timing of usage of deliverables at the Software Life Cycle.

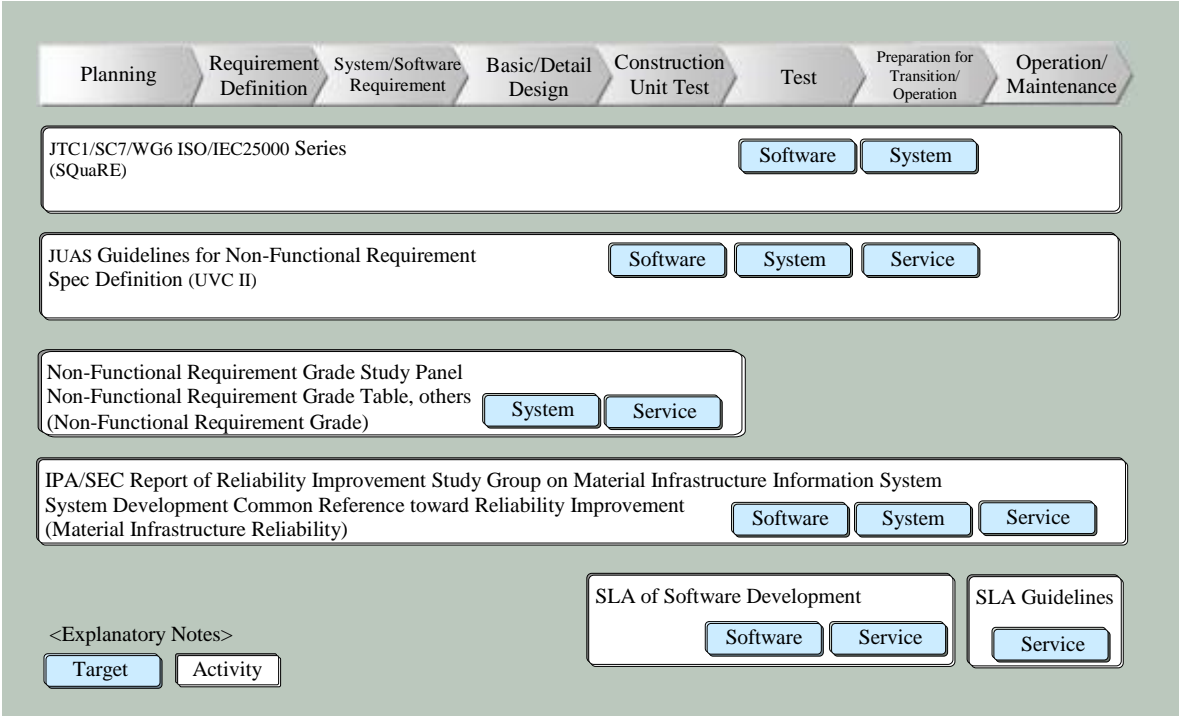


Chart 3-4 Usage of Output Reports at Software Life Cycle

In the Software Life Cycle of operation/maintenance from planning, the content of SQuaRE, UVC II and Critical Infrastructure Reliability can be used as a reference in their entire phases. However, the target of SQuaRE is limited to the system and software, while that of Critical Infrastructure Reliability is limited to the Critical Infrastructure Information System.

As the content of Non-Functional Requirement Grade mainly aims an agreement of non-functional requirements between a user and a vendor and verification of realization methods, you can use it for phases mainly from planning to system/software requirement definitions.

The SLA on Software Development is available for phases from Construction/Unit Test to Preparation for Transition/Operation, and for subsequent Operation/Maintenance phase, SLA Guidelines can be used.

### 3.2.2. Usage Allowing For System Classifications

Critical Infrastructure Reliability and Non-Functional Requirement Grade present types of specific information systems as quality evaluation targets.

According to Critical Infrastructure Reliability, information systems related to business applications are first classified into four-tier profiles (system profiling) of Type I, Type II, Type III and Type IV from the order of seriousness of social impact at the time of disorder, and after this procedure, its discussions move to focus on Type III and IV. Meanwhile, Non-Functional Requirement Grade divides the systems into three system types (system with almost no social impact, system with limited social impact and system with extremely large social impact) and has defined a typical model for each type.

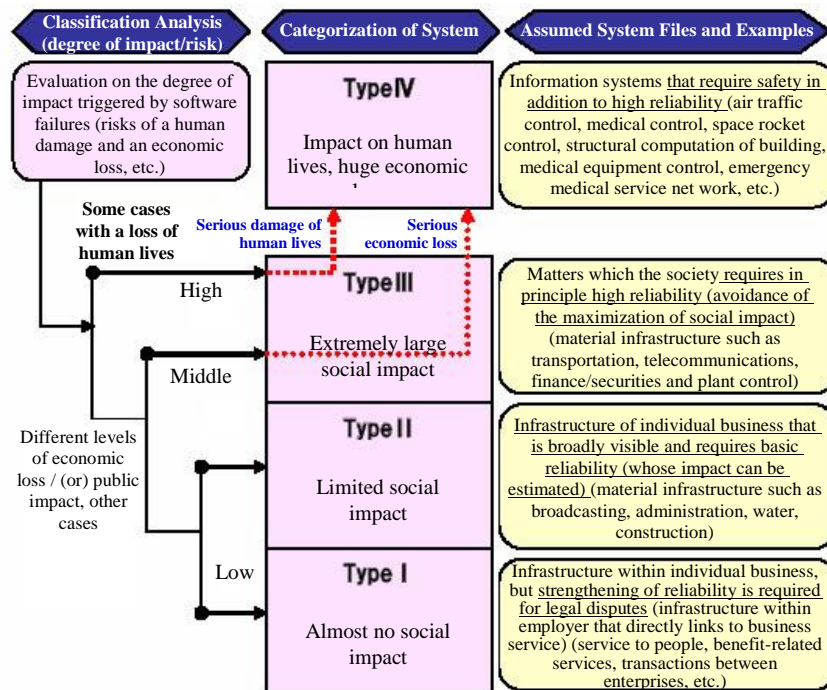


Chart 3-5 System Profiling of Critical Infrastructure Reliability<sup>8</sup>

Table 3-7 Relation of System Classification between Critical Infrastructure Reliability and Non-Function Requirement Grade

Critical Infrastructure Reliability	Non-Functional Requirement Grade
Type IV	System with large social impact
Type III	
Type II	System with limited social impact
Type I	System with almost no social impact

The summary result after allowing for system profile to Chart 3-4 is shown in Chart 3-6.

<sup>8</sup> “Report of Study Group of Material Infrastructure Information System Reliability”, April 2009. Part2, Chart 2-1, <http://sec.ipa.go.jp/reports/20090409.html>

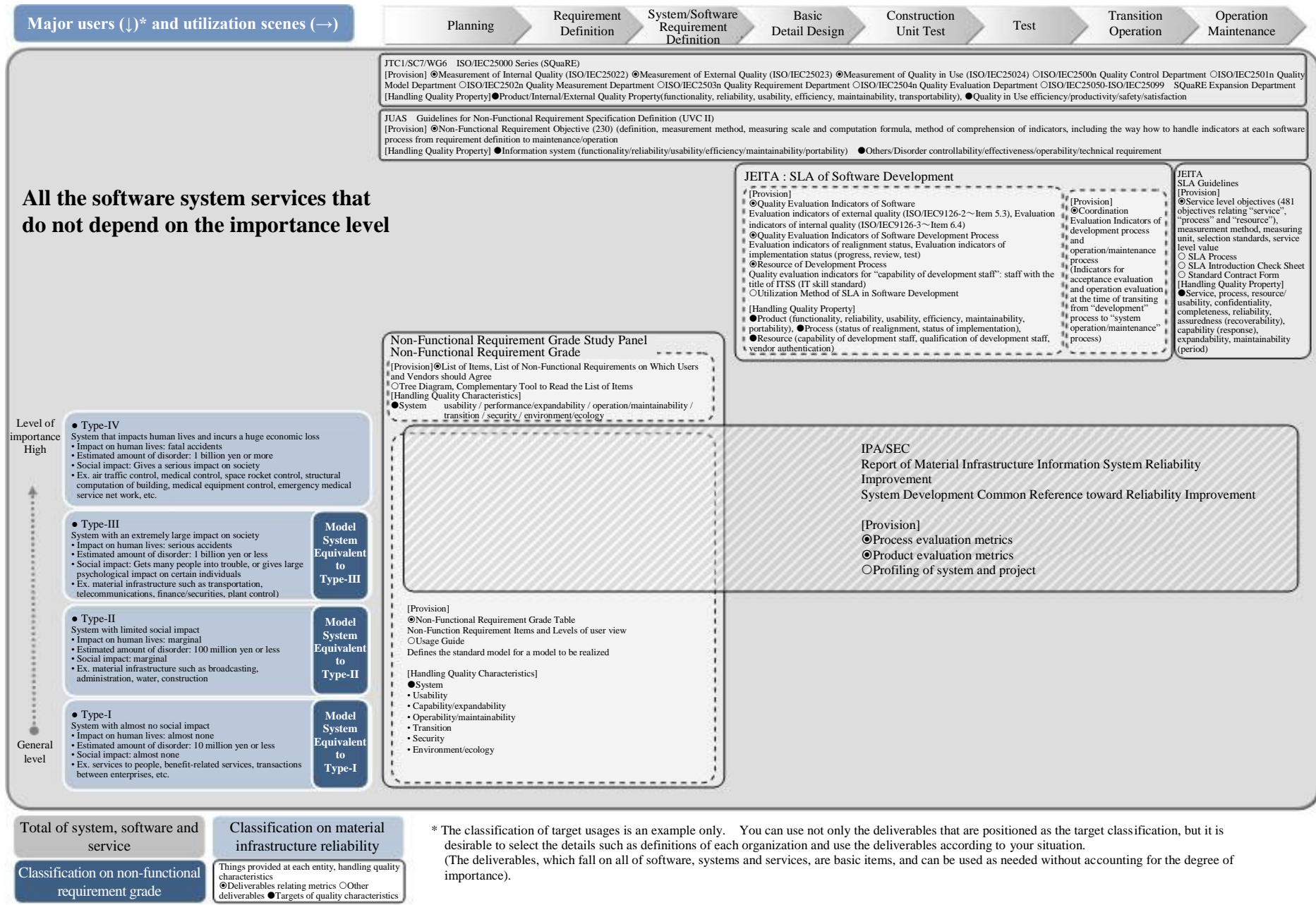


Chart 3-6 Usage of Output Reports in Software Life Cycle (incl. system profiling information)

(1) Use of deliverables from major targets for use

If you look at major targets for use in Chart 3-6, SQuaRE, UVC II, the SLA on Software Development, SLA Guidelines and part of Non-Functional Requirement Grade can be used to all of IT services, systems and software. Type III and Type IV of System Profile can apply Critical Infrastructure Reliability. In Type I, Type II and Type III of System Profile, Non-Functional Grade provides specific reference values, and their content is applicable in Type IV as well. The summary result of the deliverables that can be used as a reference to targets of quality assurance is presented in Table 3-8.

Table 3-8 Output Reports that Can Be Referred per Targets of Quality Assurance

Targets of Quality Assurance	Output Reports that Can Be Referred
All the IT services, systems and software that do not depend on the level of importance	SQuaRE UVC II SLA on Software Development SLA Guidelines Some Non-Functional Requirement Grade
Type III and Type IV of System Profile	Critical Infrastructure Reliability
Type I, Type II, Type III, Type IV of System Profile	Non-Functional Requirement Grade

(2) Use of deliverables from Software Life Cycle (usage scenes)

Phases of the Software Life Cycle in Chart 3-6 indicate that SQuaRE, UVC II and Non-Functional Requirement Grade are applicable from planning to requirement definition and detail design. For Construction/Unit Test to Preparation for Transition/Operation, SQuaRE, UVC II and the SLA on Software can be used. And the content of Critical Infrastructure Reliability is applicable on critical infrastructure. Service level can be studied with the coordination evaluation indicators between the SLA on Software Development and SLA Guidelines for Preparation for Transition/Operation, and with SLA Guidelines for Operation/Maintenance. Table 3-9 shows deliverables that can be referred at each phase of Software Life Cycle.

Table 3-9 Output Reports that are Referable to Each Phase of Software Life Cycle

Phase of Software Life Cycle	Referable Output Reports
Planning — Requirement Definition — System/Software Requirement Definition — Basic/Detail Design	SQuaRE UVC II Non-Function Requirement Grade
Construction/Unit Test — Test — Preparation for Transition/Operation	SQuaRE UVC II SLA on Software Critical Infrastructure Reliability
Preparation for Transition/Operation	Coordination Evaluation Indicator between the SLA on Software Development and SLA Guidelines
Operation/Maintenance	Reviewing service level in accordance with SLA Guidelines
Planning for Critical Infrastructure Information System — Operation/Maintenance	Critical Infrastructure Reliability

## **Conclusion**

Amid the increasing requests to visualize and ensure the quality that adapts to constraints such as user needs, usage scenes and operation cost at the back of expectations to the system and software and mounting consciousness to the importance of quality, organizations are discussing the quality assurance of the system and software related to metrics in Japan. However, such discussions are diversified. Some have common points but others are organization-specific due to differences in the background or purpose of such discussions. Consequently, it is difficult to determine the quality under the common recognition and realize it because features of their content and information of mutual relation has not been explained and studied.

Under such circumstances, the Product Quality Metrics Working Group of Software Metrics Advancement Project, aiming at the establishment of the common recognition of the quality of system and software, has studied discussions related to the quality of domestic systems and software in light of international standards, classified features of each content and mutual relations including discussions on the quality of IT services as well as summarized utilization methods and notes of such information, and collated the “Guide for Visualization, Security and Improvement of System and Software Quality”.

We will be much obliged if the summary results help determine the quality under the common recognition and make a contribution to the improvement of reliability of the System Life Cycle.

## Reference books

### <International standards>

ISO/IEC TR 12182:1998, Information technology -- Categorization of software  
ISO/IEC 14598-1:1999, Information technology -- Software product evaluation  
ISO/IEC 15026:1998, Information technology -- System and software integrity levels  
ISO/IEC 9126-1:2001, Software engineering -- Product quality- Part 1: Quality model  
ISO/IEC TR 9126-2:2003, Software engineering -- Product quality- Part 2: External metrics  
ISO/IEC TR 9126-3:2003, Software engineering -- Product quality- Part 3: Internal metrics  
ISO/IEC TR 9126-4:2003, Software engineering -- Product quality- Part 4: Quality in use metrics  
ISO/IEC 15939:2007, Systems and software engineering -- Measurement process  
ISO/IEC 25000:2005, Software engineering – Software product Quality Requirements and Evaluation (SQuaRE) – Guide to SQuaRE

### <JIS Standards>

JIS X 0129-1:2003 Quality of Software Products – 1st section: Quality model, Feb. 20, 2003, Japan Standards Association (incorporated foundation)  
JIS X 0133-1:1999 Evaluation of Software Products – 1st section: Overall Summary, Apr. 20, 1999, Japan Standards Association (incorporated foundation)  
JIS X 0134:1999 Integrity Level of Risk Constraint Posed on System and Software, Jul. 20, 1999, Japan Standards Association (incorporated foundation)  
JIS X 0141:2009 System and Software Technology – Measuring Process, May 20, 2009, Japan Standards Association (incorporated foundation)