Ministry of Economy, Trade and Industry [METI], Japan

Product Quality Metrics WG Activities in 2010

Software Metrics Advancement Project

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MITSUBISHI RESEARCH INSTITUTE, INC.

Research Center For Information Technology

Contents

1. Fiscal Year 2010 Summary of Achievements

Product Quality Metrics WG
METI Software Metrics Advancement Project

1.1 Background and Objectives

■ Background

- ■ The ISO/IEC 9126 series provides common metrics as International Standards.
- ■ In fact, various metrics are used and defined by industry for product quality by referring to the ISO/IEC 9126 series.
  - ● UVC II (JUAS), Non-functional requirements grades* (IPA), etc.

    (*)The NFR grades guide (in english) will be shown on the website.(URL: http://www.ipa.go.jp/index-e.html)
- ■ As a result, there is no common method of determining and measuring the quality (product quality) of information systems and software, and there is no common awareness that such method is needed.

■ Objectives

- ■ To establish a common awareness that information systems and software require quality measures.
  - ● To enable quality information systems and software to be realized, handed over, and used in accordance with the needs of the users.
  - ● To make explicit the contents of services and the quality level that balances risk and cost, and to achieve that level.
- ■ To accelerate IT Innovation, so that Japan's safe and reliable systems are disseminated in the global market.

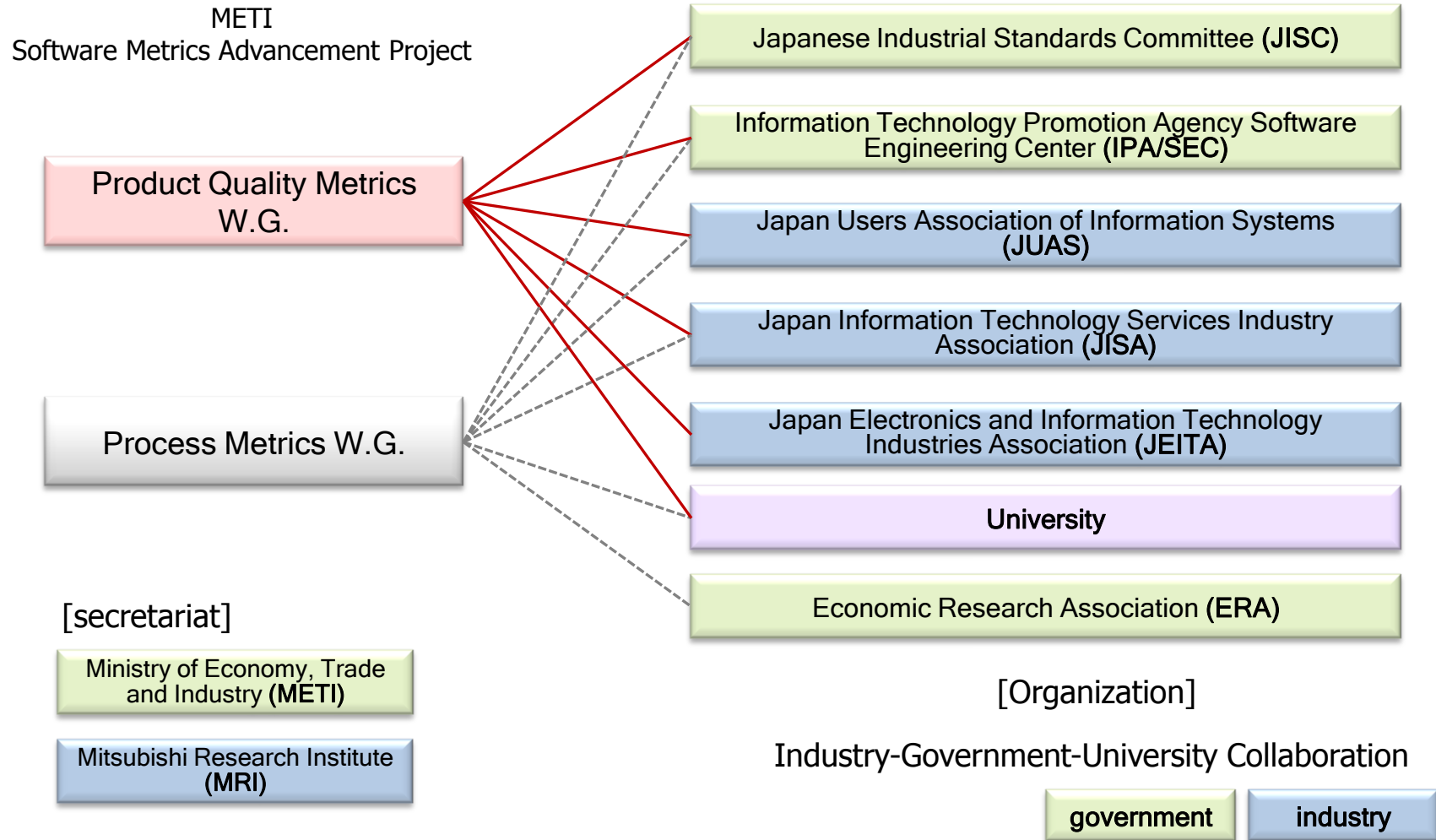# 1.2 Objectives and Details of Activities

■ Objectives of Activities

  ■ Develop **the following environment** and promote activities

    ● **The developer meets the quality needs of users considering the quality life cycle**

    ● **The acquirer (evaluator) evaluates quality using metrics that are shared with the developer**

■ Detail of Activities

  The following steps have been taken toward achieving the above objectives.

    ■ Survey of metrics usage examples

      ● **User's needs**, **quality requirements**, and **quality characteristics**

      ● **Status of metrics** being used

    ■ Report of survey results regarding metrics usage examples

      ● Details of **quality requirements** set in accordance with users' needs

      ● Methods to set **quality characteristics**

      ● **Practical metrics** that can be used to evaluate product quality

    ■ Promote **sharing and standardization of metrics**

Software Metrics Advancement Project Structure

METI
Software Metrics Advancement Project

Product Quality Metrics W.G.

Process Metrics W.G.

[secretariat]

Ministry of Economy, Trade and Industry **(METI)**

Mitsubishi Research Institute **(MRI)**

Japanese Industrial Standards Committee **(JISC)**

Information Technology Promotion Agency Software Engineering Center **(IPA/SEC)**

Japan Users Association of Information Systems **(JUAS)**

Japan Information Technology Services Industry Association **(JISA)**

Japan Electronics and Information Technology Industries Association **(JEITA)**

University

Economic Research Association **(ERA)**

[Organization]

Industry-Government-University Collaboration

government   industry

2. Survey of metrics usage examples

Product Quality Metrics WG
METI Software Metrics Advancement Project

2.1 Outline of the Survey

- Objective of the Survey
  - Clarifying the following things in terms of target systems domains
    - Relationship between **the needs in use**, **the product needs**, **the functional and non-functional requirements**, and **the quality characteristics**
    - **The status of metrics** being used

- Target System and Software
  - Classification of information system and software
    - ① Smart grids
    - ② Health care (medical, health, care giving)
    - ③ Agriculture (including: distribution and retail)
    - ④ E-commerce (E-money)
    - ⑤ Traffic (ITS)
    - ⑥ Contents (distribution of games, animation)
    - ⑦ Schools, education
    - ⑧ Disaster prevention
    - ⑨ Teleworking (information communication equipment enabling flexible working without restrictions of time or place)
    - ⑩ Others (information systems and software used in business or social activities other than the above)

- Method of Survey
  - Questionnaire survey
    - Each of the WG participating organizations (IPA/SEC, JUAS, JISA, JEITA, and JISC) recommended which companies to survey.
    - The response results are processed for anonymity and analyzed.

2.1 Outline of the Survey

- ■ Question Items
  - ■ **Profile of system and software products** (selection, description format)
    - ● Field of use of the system or software, outline of the system, architecture, type of processing, main actor and usage
  - ■ **Quality in Use characteristics** and **Product Quality characteristics** with emphasis on system and software products (selection format)
    - ● Selection from **ISO/IEC25010 (FDIS draft) quality characteristics**
  - ■ **Reasons for the importance** of these quality characteristics (descriptive format)
    - ● Important <u>needs in use (risks)</u>and <u>product needs (risks)</u>
    - ● <u>Quality requirements</u> provided for these needs (risks)

    Note: Here quality requirements indicate mainly functional and non-functional requirements.
  - ■ <u>**Metrics being used/would like to be used**</u> in order to achieve quality in use and product quality (selection format)
    - ● Selection of the metrics set being used by each organization from a table of metrics compiled for each quality characteristic
    - ● For product quality, select each phase after connection tests and unit tests
- ■ Analysis of Survey Results

Based on **ISO/IEC 25010 (FDIS draft),** analyze the details for both **quality in use** and **product quality**
  - ■ Trends in **important quality characteristics**
  - ■ Relationship between **important needs, quality requirements, and quality characteristics**
  - ■ **Practical metrics ranking** for achieving quality

2.1 Outline of the Survey

■ Number of questionnaires returned: Nine Cases (as of September 17th)

No. of Example	System, Software Product (outline)	Main Actors (user class)	Architecture	Form of Processing	Category	Responding Company
1	**Insurance product estimating and accounting system** (Support system for estimating insurance premiums and accounting for insurance representative offices)	Representative office employees, employees (Intermediate)	Main frame, client/server, intranet/internet	Interactive processing/real time processing, on-line transaction processing	Others (financial and insurance industries)	Acquirer
2	**EC site, cybermall** (Website on the internet that provides pages for multiple stores (e-stores) gathered into one site, that sells many products from the website)	Consumers, shops, own companies (Novice, Intermediate)	Intranet/internet, and others (mobile)	Batch processing, interactive processing and real time processing, on-line transaction processing	Others (financial and insurance industries)	Supplier
3	**Stock buying and selling system** (System that processes orders and contracts from securities companies, and processes and supplies transaction information and market information)	Securities companies, information vendors, employees, clearing systems (Intermediate, Expert, Other software system)	Client/server	On-line transaction processing	Others (financial and insurance industries)	Supplier
4	**Exit gate system using non-contact IC cards** (System that allows entry or exit from a gate by holding up an IC card that is charged with money)	Station staff, passengers, customers (Novice, Intermediate)	Autonomous Distributed	Batch processing, on-line transaction processing	Traffic (ITS)	Acquirer
5	**Agricultural information system** (System that associates various information with maps on farms, for prediction of growth, field information analysis, and production management)	Producers, buyers (Novice, Intermediate)	Client/server	On-line transaction processing	Agriculture	Supplier
6	**Power supply and customer information management system** (Electric power meter with communication function: System for using information obtained from smart meters for meter reading, settlement, sales activities, etc.)	Meter readers, employees (Intermediate, Expert)	Main frame, Client/server	Batch processing, on-line transaction processing	Smart grid	Acquirer
7	**System for supplying information to customers** (System for supplying contracted parties with various types of information such as campaigns, etc., in accordance with contract details or status of use)	Parties to contract, employees (Novice, Intermediate)	Intranet/internet	Interactive processing/real time processing	Others (electric power)	Acquirer
8	**Educational learning system for members, contents management system** (Web system in which members learn, and tutors follow to improve the member's ability, learning contents management system)	Members, tutors, administrators (Novice, Intermediate, Expert)	Intranet/internet	Batch processing, on-line transaction processing	School learning	Supplier
9	**System for supply and registration of various types of information** (system for supply of various kinds of information through the internet, document requests from users, entry for participation in events, etc.)	User (Novice)	Intranet/internet	Interactive processing/real time processing	Others (information supply)	Acquirer

2.2   Results for Quality in Use Metrics

- Trends in Quality in Use Characteristics
- Relationship between Product Important Needs, Quality Requirements, and Quality Characteristics
- Practical Metrics Ranking for Achieving Quality in Use

Trends in Quality in Use Characteristics

- Trends in **Quality in Use Characteristics** (Selected Three or More Times in All the Examples)
  - **Important** Quality in Use Characteristics
    - **Effectiveness, Satisfaction (Usefulness, Trust), Freedom from risk (Economic risk mitigation), Context coverage (Context completeness)**
  - Quality in Use Characteristics **not selected at all**
    - **Satisfaction (Comfort), Freedom from risk (Health and safety risk mitigation), Context coverage (Flexibility)**
  - **Other Trends** (#: example number in the tables)
    - **Effectiveness**
      - Cases of effectively carrying out work using data processing
      - #5 Agricultural information system
    - **Satisfaction (Pleasure)**
      - Cases of providing the function of providing the desired information when desired over the web
      - #2 EC site, cybermall, #8 Educational learning system, #9 System for supply and registration of various types of information
    - **Freedom from risk (Economic risk mitigation)**
      - Cases of avoiding economic risk to users
      - #1 Insurance product estimating and accounting system, #2 EC site, cybermall, #3 Stock buying and selling system, #4 Exit gate system using non-contact IC cards
    - **Freedom from risk (Environmental risk mitigation)**
      - Cases of providing information for effective use of resources
      - #7 System for supplying information to customers (Electrical power company)

Important Quality in Use Characteristics (Results)

No. of Example	System, Software Product (Outline of quality requirement)	Effectiveness	Efficiency	Satisfaction				Freedom from risk			Context coverage	
		Effectiveness	Efficiency	Usefulness	Trust	Pleasure	Comfort	Economic risk mitigation	Health and safety risk mitigation	Environmental risk mitigation	Flexibility	Context completeness
1	**Insurance product estimating and accounting system** （Accurate calculation that does not confer economic risk）	✓						✓				✓
2	**EC site, cybermall** （To be able to buy what you want safely anytime）			✓		✓		✓				✓
3	**Stock buying and selling system** （To carry out domestic and overseas financial transactions at high speed, with high reliability and high safety）	✓			✓			✓				
4	**Exit gate system using non-contact IC cards** （Completeness of reading and writing data between the card and system, accurate and high speed processing of fare calculation）	✓		✓				✓				
5	**Agricultural information system** （Accurate data processing to permit efficient agricultural work）	✓	✓		✓							
6	**Power supply and customer information management system** （Accurately and effectively work with respect to the work objective）	✓		✓	✓							
7	**System for supplying information to customers** （To always provide new and appropriate information suitable for the individual）			✓						✓		✓
8	**Educational learning system for members, contents management system** （To provide effective and attractive information to learners, that can be used without stress）	✓				✓		✓				✓
9	**System for supply and registration of various types of information** （To be able to efficiently and pleasurably access the information desired）	✓		✓	✓	✓						
	Number of applicable examples	**7**	**1**	**5**	**4**	**3**	**0**	**5**	**0**	**1**	**0**	**4**

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Relationship between Important Needs, Quality Requirements, and Quality in Use Characteristics (1/2)

No. of Example	System, Software Product	Main Actors (User Class)	Important Needs, Risks	Quality Requirement	Quality in use characteristics	Sub characteristics
1	Insurance product estimating and accounting system	Representative offices, employees (Intermediate)	■ To avoid the risk of loss to the insurance contractor due to incorrect calculation of insurance premium	＜N/A＞	Effectiveness	Effectiveness
			■ To avoid the risk of imposing a loss on the insurance contractor by not being able to correctly calculate the insurance premium	＜N/A＞	Freedom from risk	Economic risk mitigation
			■ The insurance premium calculation and insurance accounting system uses information that is directly connected the customers' risk, so it must be used in a secure manner	＜N/A＞	Context coverage	Context completeness
2	EC site, cybermall	Consumers, shops, own companies (Novice, Intermediate)	■ Displays and correctly sells things the customer wants	■ Matching contents, search results display function	Satisfaction	Usefulness
			■ Has the impression of value and individuality	■ Point service, personalize, recommend	Satisfaction	Pleasure
			■Payment can be safely processed	■ Personal information protection, electronic settlements	Freedom from risk	Economic risk mitigation
			■ Can be used anywhere anytime from PC, mobile phone, smart phone, etc.	■Display function, screen composition	Context coverage	Context completeness
3	Stock buying and selling system	Securities companies, information vendors, employees, clearing systems (Intermediate, Expert, Other software system)	■Due to the internationalization and borderless development of finance, and the spread of PTS, etc., within Japan, if a useful system is not provided, there is a likelihood that transactions will drift overseas.	■Connection specification (protocol) determined after holding a working group meeting with securities companies ■Data can be processed	Effectiveness	Effectiveness
			■Securities companies' systems that connect to the stock exchanges' systems are constructed in accordance with the connection specifications of the stock exchanges. Therefore if the behavior of the system on the stock exchange side differs from the specification, the systems on the securities companies' side will not operate correctly, so there is a danger that a securities transaction may not be completed.	■ In design – test processes, requirement trace results are 100%	Satisfaction	Trust
			■ If the stock CB trading system stops or loses data, it will cause chaos in Japan's economy.	■Guarantee of proper data processing ■Data triplication ■Complete duplication of functions	Freedom from risk	Economic risk mitigation
4	Gate exit system using non-contact IC cards	Station staff, passengers, customers (Novice, Intermediate)	■Data consistency between the medium (card) and the system is necessary	■Data completeness	Effectiveness	Effectiveness
			■It is necessary to be able to pass smoothly through a gate with a simple operation even when crowded	■ Accurate and high speed processing of reading, writing, and fare calculation	Satisfaction	Usefulness
			■Must be able to continue operation even in a breakdown or disaster	■Autonomous distributed system configuration	Freedom from risk	Economic risk mitigation

Relationship between Important Needs, Quality Requirements, and Quality in Use Characteristics (2/2)

No. of Example	System, Software Product	Main Actors (User Class)	Important Needs, Risks	Quality Requirement	Quality in use characteristics	Sub characteristics
5	Agricultural information system	Producers, buyers (Novice, Intermediate)	■To harvest at the ideal time	■Determine the differences in dryness of the produce in each field using satellite images	Effectiveness	Effectiveness
			■To reduce the work in drying the produce after harvesting	■Possible to determine the dryness over a wide area without checking on site, by using satellite images	Efficiency	Efficiency
			■ It is necessary that the contents displayed by the system is consistent with the actual status	■ The relative dryness of the produce and the dryness estimated from satellite images should agree.	Satisfaction	Trust
6	Power supply and customer information management system	Meter readers, employees (Intermediate, Expert)	■Inconsistency with the objective of use will result in loss of validity of the work performed	■Consistency between the whole work flow and specification	Effectiveness	Effectiveness
			■The division responsible is sensitive to the status of use after start of operation	■Site receives demands for improvement from the division responsible	Satisfaction	Usefulness
			■Sales work has high priority	■Monitoring of operational status after start of operation	Satisfaction	Trust
7	System for supplying information to customers	Parties to contract, employees (Novice, Intermediate)	■The objective of this system is sales, so it is necessary that it should attract interest	■Individual customer authorization	Satisfaction	Usefulness
			■Provide an environment that delivers to customers effective use of limited resources (electrical power)(environmental conservation)	■To supply very fresh accurate information	Freedom from risk	Environmental risk mitigation
			■ Contribute to cost reduction by customers by effective use of limited resources (electrical power)	■ To supply very fresh accurate information	Context coverage	Context completeness
8	Educational learning system for members, contents management system	Members, tutors, administrators (Novice, Intermediate, Expert)	■To accurately display member's learning progress and results. Returns the appropriate response when being simultaneously used.	■Learning history function ■Results calculation function	Effectiveness	Effectiveness
			■Sustains member's learning improvement and continuous appetite for learning.	■Results display function ■Community function	Satisfaction	Pleasure
			■ Service provided continuously and can be used without stress so that members do not resign.	■Response requirement ■Simultaneous connection requirement	Freedom from risk	Economic risk mitigation
			■Provides correct right/wrong answers and results. Provides suitable curriculum.	■Educational materials distribution function	Context coverage	Context completeness
9	System for supply and registration of various types of information	User (Novice)	■Provides information wanted by users (appropriate for needs)	＜N/A＞	Effectiveness	Effectiveness
			■Supplies information that satisfies users	＜N/A＞	Satisfaction	Usefulness
			■The service (system) is easy to use and convenient for users	＜N/A＞	Satisfaction	Trust
			■Service (system) is fun to use (there are new discoveries)	＜N/A＞	Satisfaction	Pleasure

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Practical Metrics Ranking for Achieving Quality in Use

- Object: Metrics for Quality in Use characteristics having Important Trends in All Examples
- Displayed in the order of Number of Responses "Actually Used / Would Like to Use"

Effectiveness	Satisfaction		Freedom from risk	Context coverage
Effectiveness	Usefulness	Trust	Economic risk mitigation	Context completeness
Operation time (7) Reception time (7) Operation effectiveness (6) Operation completeness (6) Error frequency (6) Response time (6) Service time (6) Availability factor (6) Response time in job operation (5) Average availability factor (5) Availability factor control (5) Operation service time (5) On-line system availability factor (5) Medium operation response time (4) Maximum stoppage time (4) Ensuring seismic resistance/seismic isolation capability (4) Start up time (operation time) (4) Average availability factor (4) Batch processing normal completion rate (4) Job operation response time (3) Report form output response time (3) Maximum stoppage time (3) Medium operation response time (2) Report form output response time(2)	Satisfaction measure (6) User satisfaction (6) Service supply time band (interruption response) (5) Service supply time band (general inquiries) (5) Satisfaction question form (4) Free use of discretion (3)	Name value to users (5) Breakdown notification time (5) Breakdown recovery time (5) Aggregate reporting time (5) Breakdown restoration time (5) Restoration time (4) Breakdown rate (4) Patch application interval (3) Improved version/patch application interval (3) Improved version/patch application time interval (3) Asset management check cycle (3) Percentage of compliance with network breakdown restoration time (3) Detection time of virus infection countermeasure (3) Firewall detection time (2) Unauthorized access (IDS) detection time (2) Falsification detection (data falsification detection time) (2) Hardware breakdown rate (2)	Return on investment (ROI) (3) Software damage (2) Automatic measurement of qualitative effect (2) Number of complaints from customers (2) Proportion of revenue from new customers (2) Proportion of revenue from existing customers (2) Balance score card (BSC) (2) Comparison with other companies (benchmarks) (2) Loss of opportunity (2) IT asset investment (2) Economic damage (1) Discounted cash flow (DCF) (1) Proportion of the total manufacturing lead time (1) Proportion of lead time of individual processes (1) Number of late deliveries (1) Number of defective products (1) Real options (1) Economic damage (1)	Scope of risk countermeasures after start of operation (5) Scope of security patch application (5) Security patch application policy (5) Security risk review frequency (4) Risk countermeasure policy (4) Security patch application timing (4) Scope of review of security risk (3) Range of implementation of measures against malware (3) Implementation of real time scans (3) Seismic resistance (3) Installation space limitations (machine room) (3) Installation space limitations (office installation) (3) Reserve for expansion of installation space (3) Floor load (3) Compatibility with supplied electric power (3) Limitation in electrical power source capacity (3) Parallel operation electrical power (when moving) (3) Measures against power outage (3) Voltage fluctuations in envisaged installation location (3) Frequency fluctuations in envisaged installation location (3) Grounding (3) Temperature (band) (3) Humidity (band) (3) Air conditioning performance (3) Reserve to expand same equipment (3) Equipment life cycle time (3)

* Numbers in brackets indicate the number of replies. Likewise below.

2.3 Results for Product Quality Metrics

- Trends in Product Quality Characteristics
- Relationship between Product Important Needs, Quality Requirements, and Quality Characteristics
- Practical Metrics Ranking for Achieving Product Quality

Trends in Product Quality Characteristics

- Trends in **Product Quality Characteristics** (Selected Five or More Times in All the Examples)
  - **Important** Product Quality Characteristics
    - **Functionality (Functional correctness), Performance efficiency (Time-behaviour), Compatibility (Interoperability), Usability (Appropriate recognisability, User interface aesthetics), Reliability (Maturity, Fault tolerance), Security (Confidentiality, Integrity)**
  - Product Quality Characteristics **not selected at all**
    - **Compatibility (Co-existence), Usability (accessibility), Maintainability, Portability**
  - **Other Trends** (#: example number in the tables)
    - **Functionality (Functional correctness), Performance efficiency (Time-behaviour)**
      - Almost all cases
    - **Usability (User interface aesthetics)**
      - Cases where easy to understand output results and use of output results are required
      - #1 Insurance product estimating and accounting system
      - #5 Agricultural information system
      - #7 System for supplying information to customers
      - #9 System for supply and registration of various types of information
    - **Reliability (Availability)**
      - Cases where stable operation is strongly required in order to do the proper activity in the proper time
      - #1 Insurance product estimating and accounting system
      - #3 Stock buying and selling system
      - #5 Agricultural information system

Important Product Quality Characteristics (Results) (1/2)

No. of Example	System, Software Product （Outline of quality requirements）	Functional suitability			Performance efficiency		Compatibility		Usability			
		Functional completeness	Functional completeness	Functional appropriateness	Time behaviour	Resource utilisation	Interoperability	Appropriateness recognisability	Learnability	Operability	User error protection	User interface aesthetics
1	**Insurance product estimating and accounting system** （Accurate calculation that does not confer economic risk）		✓		✓	✓				✓	✓	✓
2	**EC site, cybermall** （To be able to buy what you want safely anytime）		✓		✓		✓	✓				
3	**Stock buying and selling system**（To carry out domestic and overseas financial transactions at high speed, with high reliability and high safety）		✓		✓			✓				
4	**Exit hate system using non-contact IC cards** （Completeness of reading and writing data between the card and system, accurate and high speed processing of fare calculation）	✓	✓				✓					
5	**Agricultural information system** （Accurate data processing to permit efficient agricultural work）		✓		✓			✓		✓		✓
6	**Power supply and customer information management system** （Accurately and effectively work with respect to the work objective）		✓	✓	✓							
7	**System for supplying information to customers** （To always provide new and appropriate information suitable for the individual）		✓		✓		✓					✓
8	**Educational learning system for members, contents management system** （To provide effective and attractive information to learners, that can be used without stress）		✓		✓		✓					
9	**System for supply and registration of various types of information** （To be able to efficiently and pleasurably access the information desired）		✓		✓			✓	✓			✓
	No. of examples	1	9	1	8	1	4	4	1	2	1	4

Important Product Quality Characteristics (Results) (2/2)

No. of Example	System, Software Product （Outline of quality requirements）	Reliability				Security				
		Maturity	Availability	Fault tolerance	Recoverability	Confidentiality	Integrity	Non-repudiation	Accountability	Authenticity
1	**Insurance product estimating and accounting system** （Accurate calculation that does not confer economic risk）		✓	✓	✓	✓	✓		✓	
2	**EC site, cybermall** （To be able to buy what you want safely anytime）			✓	✓					✓
3	**Stock buying and selling system**（To carry out domestic and overseas financial transactions at high speed, with high reliability and high safety）		✓	✓				✓		
4	**Exit hate system using non-contact IC cards** （Completeness of reading and writing data between the card and system, accurate and high speed processing of fare calculation）	✓		✓		✓	✓			
5	**Agricultural information system** （Accurate data processing to permit efficient agricultural work）	✓	✓							
6	**Power supply and customer information management system** （Accurately and effectively work with respect to the work objective）					✓	✓			
7	**System for supplying information to customers** （To always provide new and appropriate information suitable for the individual）						✓			
8	**Educational learning system for members, contents management system** （To provide effective and attractive information to learners, that can be used without stress）	✓				✓				
9	**System for supply and registration of various types of information** （To be able to efficiently and pleasurably access the information desired）	✓		✓	✓	✓	✓			
	No. of examples	4	3	5	3	5	5	1	1	1

Relationship between Product Important Needs, Quality Requirements, and Quality Characteristics (1/4)

No. of Example	System, Software Product	Main Actors (User Class)	Important Needs, Risks	Quality Requirements	Product quality characteristics	Sub characteristics
1	Insurance product estimating and accounting system	Representative offices, employees (Intermediate)	■Representative office properly prints the application form necessary for the insurance contract	■Proper insurance premium calculation, link to accounting system	Functional suitability	Functional completeness
			■Representative offices complete operations within fixed criteria when calculating insurance premiums or accounting.	■ Each system is required to respond by return to the center	Performance efficiency	Time behaviour
			■ It is important that many systems are related, and that the system as a whole operates efficiently by distributing resources	<N/A>	Performance efficiency	Resource utilisation
			■No information	<N/A>	Usability	Operability
			■ It is necessary that the insurance premium calculation data performed by the representative office be linked without error to the accounting system	<N/A>	Usability	User error protection
			■ The representative offices can account consistently and without error insurance contracts and accounting	■Prescribed by screen HMI	Usability	User interface aesthetics
			■It is necessary to supply to representative offices in accordance with the prescribed service time	<N/A>	Reliability	Availability Fault tolerance Recoverability
			■ It is necessary to prescribe the limitation of access to data by representative offices, and ensure the handling of personal information.	■Information not used by a representative office cannot be seen	Security	Confidentiality
			■ Separation of operation and development is a requirement, it is necessary that the development side cannot access directly the actual data.	<N/A>	Security	Integrity
			■ It is necessary to be able to do a survey using a log to track false processing, etc.	<N/A>	Security	Accountability
2	EC site, cybermall	Consumers, shops, own companies (Novice, Intermediate)	■Achieve correct identification of individuals and safe payment	■Clearance, authorization	Functional suitability	Functional completeness
			■Present comfortable shopping	■Performance	Performance efficiency	Time behaviour
			■Increase the inter-availability of the service	■Purchasing history management, points allocation service, authentication	Compatibility	Interoperability
			■It is necessary that it be easy to search for the product you want	■Search, matching	Usability	Appropriateness recognisability
			■ It is necessary to maintain the revenue of shops, so advertisements must be continuously provided	■FailOver	Reliability	Fault tolerance
			■It is necessary to protect the personal information of consumers	■Back up	Reliability	Recoverability
			■It is necessary to correctly authenticate individuals	■Authorization	Security	Authenticity

Relationship between Product Important Needs, Quality Requirements, and Quality Characteristics (2/4)

No. of Example	System, Software Product	Main Actors (User Class)	Important Needs, Risks	Quality Requirement	Product quality characteristics	Sub characteristics
3	**Stock trading system**	Securities companies, information vendors, employees, settlement systems (Intermediate, Expert, Other software system)	■If a function does not operate as envisaged, there is a danger that data will be processed incorrectly, and the market will be thrown in to confusion.	■In the design and testing process, the requirement trace results shall be 100%	**Functional suitability**	**Functional completeness**
			■If data is processed incorrectly, confidence in the Tokyo market will be greatly damaged.	■ In the design and testing process, the requirement trace results shall be 100% Quality evaluation according to test frequency, bug frequency	**Functional suitability**	**Functional completeness**
			■ As issuing of orders from securities companies becomes mechanized, funds will flow to markets in other countries if data is not processed at high speed.	■Processing of new order receipt: 2 milliseconds	**Performance efficiency**	**Time behaviour**
			■ If it is not possible to provide a system that satisfies the customers' needs, there is a possibility that funds will flow out of the Tokyo market.	■ Connection specification (protocol) determined after holding a working group meeting with securities companies	**Usability**	**Appropriateness recognisability**
			■ The market could be thrown into confusion by incorrect orders from securities companies or faults in the systems on the securities companies' side.	■Order quantities are checked for appropriateness, and an error is raised if the number of orders is greater than a fixed quantity. A procedure to cut communication has been prepared in preparation for systems running wild on the security companies' side.	**Usability**	**Appropriateness recognisability**
			■System stoppage = Tokyo market stoppage.	■ Availability 99.999% or higher	**Reliability**	**Availability**
				■Complete duplication of hardware.	**Reliability**	**Fault tolerance**
			■ If there is a change or cancellation after notification of receipt of an order from a securities company or notification of completion of a contract, confidence in the Tokyo market will be greatly damaged.	■ Notification after synchronization of data triplication	**Security**	**Non-repudiation**
4	**Exit gate system using non-contact IC cards**	Station staff, passengers, customers (Novice, Intermediate)	■ Because receipt of the correct fare and high speed processing are necessary conditions for passing the gate.	■ Accurate and high speed processing of reading, writing, and fare calculation	**Functional suitability**	**Functional completeness**
			■ Consistency of data between the medium (card) and the system is necessary	■Data completeness	**Functional suitability**	**Functional completeness**
			■ Necessary to be capable of mutual use with other operators	■Interchangability	**Compatibility**	**Interoperability**
			■System stable operation necessary	■Redundant system, autonomous distributed	**Reliability**	**Maturity**
			■ Because the number of daily transactions is large, and the effect of operation stoppage is large.	■Redundant system, autonomous distributed	**Reliability**	**Fault tolerance**
			■Necessary to prevent leakage of personal information	■ Encryption technology, operation management	**Security**	**Confidentiality**
			■Necessary to prevent data falsification	■Encryption technology, operation management	**Security**	**Integrity**

Relationship between Product Important Needs, Quality Requirements, and Quality Characteristics(3/4)

No. of Example	System, Software Product	Main Actors (User Class)	Important Needs, Risks	Quality Requirement	Product quality characteristics	Sub characteristics
5	**Agricultural information system**	Producers, buyers （Novice, Intermediate）	■To provide accurate information to users	■ The produce relative dryness and the dryness estimated from the satellite images shall agree	**Functional suitability**	**Functional completeness**
			■ Because the users need to reduce the effort for drying the produce after harvesting	■Provides the relative dryness for each field	**Performance efficiency**	**Time behaviour**
			■ The system output results should be valid and appropriate for the users	■ The produce relative dryness and the dryness estimated from the satellite images shall agree	**Usability**	**Appropriateness recognisability**
			■ Support the work operations of users	■ Function to output the analysis results in accordance with the objective of use (combination units, product type units, etc.)	**Usability**	**Operability**
			■ System output information should be easy to decipher by the users	■Display analysis results differentiated by color (with legend)	**Usability**	**User interface aesthetics**
			■Safe operation without breakdown is necessary	■ 24-hour operation	**Reliability**	**Maturity**
			■Necessary to operate properly during the produce harvesting season	■ 24-hour operation	**Reliability**	**Availability**
6	**Power supply and customer information management system**	Meter readers, employees （Intermediate, Expert）	■ The system handles important parameters concerning demand actions	■ Fee settled based on the meter reading value	**Functional suitability**	**Functional completeness**
			■ The number of end users is very large, so if the objective is not achieved, the effect is very serious	■ All to satisfy the specification defined by the department responsible	**Functional suitability**	**Functional appropriateness**
			■ It is used for very busy work such as in call centers, etc., so high performance is required	■ Server internal response to be within 3 seconds per one transaction	**Performance efficiency**	**Time behaviour**
			■ It is important to take measures so that customer information cannot be deciphered even if a work terminal is accidently lost	■ After encrypting the data containing the personal information contained within the work terminal, a measure is taken to prevent it from being decrypted by human hand	**Security**	**Confidentiality**
			■ The system handles customer information, so it is necessary to strictly control authorization for different work	■ Restrict access to screens other than those for the work being undertaken	**Security**	**Integrity**
7	**System for supplying information to customers**	Parties to the contract, employees （Novice, Intermediate）	■ Supply very fresh and accurate information	■Authenticate customers and provide unique information.	**Functional suitability**	**Functional completeness**
			■Supply very fresh and accurate information	■ Search for the target information (authentication information and work information) at high speed from among a large quantity of data.	**Performance efficiency**	**Time behaviour**
			■Link to various in-house systems in accordance with the sales objective	■ Integrate (convert) the communication format and means between systems.	**Compatibility**	**Interoperability**
			■Effectively convey the information provided	■Adopt standard technology.	**Usability**	**User interface aesthetics**
			■Information supplied unique to an individual	■Individual authentication of customers.	**Security**	**Integrity**

Relationship between Product Important Needs, Quality Requirements, and Quality Characteristics(4/4)

No. of Example	System, Software Product	Main Actors (User Class)	Important Needs, Risks	Quality Requirement	Product quality characteristics	Sub characteristics
8	Educational learning system for members, contents management system	Members, tutors, administrators （Novice, Intermediate, Expert）	■ Learning results are stored, so it is necessary to accurately display the pass/fail results. ■ It is necessary to accurately distribute and display the educational materials contracted for by the member.	■Results calculation function ■Learning history storage function ■Educational materials distribution function	Functional suitability	Functional completeness
			■ There is a possibility that large volume access could come in bursts depending on the time or time period, so it is necessary to reply with an appropriate response.	■ The time from receipt of a request from a terminal until return of the server processing result shall be within 5 seconds.	Performance efficiency	Time behaviour
			■It is necessary that the appropriate educational materials be distributed in accordance with information from CRM. It is necessary to send mails at the appropriate time band and timing.	■Data linking function ■Mail transmission function ■Points exchange function ■User information linking function	Compatibility	Interoperability
			■ Members should be able to use the service at any time when necessary	■System should operate 24 hours 365 days. However, this does not apply to system maintenance time.	Reliability	Maturity
			■ Necessary to prevent non-members from using the e-learning educational materials. It shall not be possible for persons other than the member themselves to look up results or refer to learning history information.	■Must take into account the protection of personal information ■Educational materials distribution function ■Member authentication function ■Contents management function	Security	Confidentiality
9	System for supply and registration of various types of information	User （Novice）	■Must operate without bugs in the correct status	＜N/A＞	Functional suitability	Functional completeness
			■ Necessary to ensure a response level in use that does not make users feel stress	＜N/A＞	Performance efficiency	Time behaviour
			■ Service (system) must satisfy the requirements of users	＜N/A＞	Usability	Appropriateness recognisability
			■ Can be used intuitively without referring to a manual or FAQ	＜N/A＞	Usability	Learnability
			■ Screen design has an integrated feel, but must be accepted by users	＜N/A＞	Usability	User interface aesthetics
			■Target system availability is 99.7%	＜N/A＞	Reliability	Maturity
			■High resistance to faults required	＜N/A＞	Reliability	Fault tolerance
			■Must recover in a short time when a breakdown occurs	＜N/A＞	Reliability	Maturity
			■Necessary to manage personal information	＜N/A＞	Security	Confidentiality
			■ Must block illegal access from outside, and guarantee the data	＜N/A＞	Security	Integrity

Practical Metrics Ranking for Achieving Product Quality (Down to Unit Tests 1/2)

- Subject: Metrics for Product Quality characteristics having Important Trends in All the Examples
- Displayed in the Order of Number of Responses for "Actually in Use / Wish to Use" in the Processes Down to Unit Tests

Functional suitability	Performance efficiency	Compatibility	Usability	
Functional completeness	Time behaviour	Interoperability	Appropriateness recognisability	User interface aesthetics
Accuracy (5) Calculation accuracy (4) Accuracy of manual description (3) Verification frequency (3)	Response time (7) Turn around time (6) Throughput (5) （When online system is used: ●）Response adherence frequency in normal times (4) （When batch system is used: ▼）Response adherence frequency in normal times (4) ● Response adherence frequency in peak times (3) ▼ Response adherence frequency in peak times (3) ● Processing ratio delay in normal times (3) ● Processing ratio delay in peak times (3) ▼ Processing ratio delay in peak times (3) Throughput (3) ● Response adherence frequency in degenerate times (2) ▼ Response adherence frequency in degenerate times (2) ● Processing ratio delay in degenerate times (2) ▼ Processing ratio delay in normal times (2) ▼ Processing ratio delay in degenerate times (2) Supply work (2) Processing time (1) Results checking and correction time (1) Recovery time (1)	Data convertibility based on data format (3) Interface consistency (protocol) (3) Ease of connection with other systems (2)	Functional clarity (4) Completeness of description (3) Capability of demonstration explanation (2) Functional understandability (2) Completeness of users document and / or help function (2) Constraint conditions during construction (1)	Attractive mutual interaction (2) Customizability of the external appearance of the user interface (1)

Practical Metrics Ranking for Achieving Product Quality (Down to Unit Tests 2/2)

- Subject: Metrics for Product Quality Characteristics having Important Trends in All the Examples
- Displayed in the Order of Number of Responses for "Actually in Use/Wish to Use" in the Processes Down to Unit Tests

Reliability		Security	
Maturity	Fault tolerance	Confidentiality	Integrity
Test plan appropriateness (5) Fault detection (4) Fault removal (4) Review instruction frequency (4) Number of review instructions (4) Bug frequency (4) Test coverage frequency (4) Test case frequency (4) Fault frequency in system tests (4) Fault convergence frequency (4) Fault removal frequency (4) Test frequency (4) Fault detection frequency (4) Fault occurrence frequency (4) Specification change frequency (4) Mistake frequency (3) Escape through frequency (3) Frequency of deviation from coding rules (3) Specification change convergence frequency (3) Pending events frequency (3) Control statement inclusion frequency (2)	Prevention of data damage (3) Avoidance of faults (3) Avoidance of mistaken operation (3) Back up format (3) Scope of data recovery (3) Test coverage frequency (3) Redundancy (equipment) (with respect to server fault) (2) Redundancy (equipment) (with respect to terminal fault) (2) Redundancy (equipment) (with respect to network configuration equipment fault) (2) Circuit redundancy (2) Redundancy of paths (2) Segment division (2) Redundancy (equipment) (2) Data integrity (2) Recovery policy (2) Degree of dispersion of storage locations (2) Scope of disaster measures (2) Quality evaluation value (2) Work period evaluation value (2) Degree of use of the required specification format (2) Frequency of inclusion of trace function between sub-systems (2) Preparation state of test environment (2) Risk mitigation frequency (2) System of testing and checking by a third party-1 (2) System of testing and checking by a third party-2 (instruction item checking ratio) (2) Frequency of implementation of defensive measures (2)	Access auditability (4) Data encryption (3) Accumulated data encrypted or not (2) Transmitted data encrypted or not (2) Key control (2)	Access controllability (4) Log acquisition (4) Prevention of data damage (3) Authentication of entities with management authority (3) Degree of operational limitation with respect to system measures (3) Establishment of management rules (3) Log storage period (3) Authentication of entities without management authority (2) Degree of operational restriction due to physical measures (2) Subject (equipment) of unauthorized monitoring (2) Subject (network) of unauthorized monitoring (2) Subject (intruder, unauthorized operation, etc.) of unauthorized monitoring (2) Communication control (2) Scope of detection of unauthorized communication (2) Measures against network congestion(2) Strengthening of measures by secure coding, web server settings, etc. (2) Checking interval (1) WAF introduced or not (1)

Practical Metrics Ranking for Achieving Product Quality (After Connection Tests 1/2)

- ■ Subject: Metrics for Product Quality Characteristics having Important Trends in All the Examples
- ■ Displayed in the Order of Number of Responses for "Actually in Use / Wish to Use" in the Processes <u>After Connection Tests</u>

Functional suitability	Performance efficiency	Compatibility	Usability	
Functional completeness	Time behaviour	Interoperability	Appropriateness recognisability	User interface aesthetics
Accuracy with respect to expectation (6) Accuracy of manual description (6) Calculation accuracy (5) Verification frequency (5) Accuracy (4)	Response time (8) Response time (average time to respond) (7) Response time (response time ratio in the worst case) (7) Throughput (7) Average throughput (6) Throughputat maximum load (6) Throughput (6) Turnaround time (5) Turnaround time (turnaround time ratio for the worst case) (5) Waiting time (5) （When online system is used: ●）Response adherence frequency in normal times (5) ● Response adherence frequency in peak times (5) ● Response adherence frequency in degenerate times (5) （When batch system is used: ▼）Response adherence frequency in normal times (5) ▼ Response adherence frequency in peak times (5) ▼ Response adherence frequency in degenerate times (5) ● Processing ratio delay in normal times (5) ● Processing ratio delay in peak times (5) ● Processing ratio delay in degenerate times (5) ▼ Processing ratio delay in normal times (5) ▼ Processing ratio delay in peak times (5) ▼ Processing ratio delay in degenerate times (5) Turnaround time(turn around average time) (4)	Data convertibility based on data format (2) Data convertibility based on frequency of success in trials by users (2) Ease of connection with other systems (2)	Functional clarity (3) Functional understandability (3) Completeness of description (2) Possibility of access to demonstration explanation (2) Possibility of access to demonstration explanation during use (2) Effectiveness of demonstration explanation (2) Input and output that can be understood (2) Constraint conditions during construction (2)	Attractive mutual interaction (4) Customizability of the external appearance of the interface (1)

Practical Metrics Ranking for Achieving Product Quality
(After Connection Tests 2/2)

- Subject: Metrics for Product Quality Characteristics having Important Trends in All the Examples
- Displayed in the Order of Number of Responses for "Actually in Use/Wish to Use" in the Processes After Connection Tests

Reliability		Security	
Maturity	Fault tolerance	Confidentiality	Integrity
Fault removal (6) Test comprehensiveness (6) Bug frequency (6) Test case frequency (6) Fault removal frequency (6) Review instruction frequency (5) Number of review instructions (5) System test fault frequency (5) Fault convergence frequency (5) Test frequency (5) Fault occurrence frequency (5) Test maturity (4) Mistake frequency (4) Test coverage frequency (4) Fault detection frequency (4) Specification change frequency (4) Pending events frequency (4) Mean time between failures（MTBF) (3) Frequency of deviation from coding rules (3) Specification change convergence rate (3) Escape through frequency (2) Control statement inclusion frequency (2)	Back up format (4) Preventability of data damage (3) Avoidance of function stoppage (3) Fault avoidance (3) Avoidance of mistaken operation (3) Redundancy (equipment) (with respect to server fault) (3) Redundancy (equipment) (with respect to network configuration equipment fault) (3) Circuit redundancy (3) Path redundancy (3) Segment division (3) Redundancy (equipment) (3) Scope of data recovery (3) Test coverage frequency (3) Risk mitigation frequency (3) System of testing and checking by a third party-1 (3) System of testing and checking by a third party-2 (instruction item checking ratio) (3) Frequency of implementation of defensive measures (3) Proportion of times disconnection was avoided (3) Frequency of occurrence of mistaken operations in measures against faults (3) Frequency of implementation of prevention training (3)	Access auditability (5) Transmitted data encrypted or not (4) Accumulated data encrypted or not (2) Key control (2)	Log acquisition (7) Establishment of management rules (6) Access controllability (5) Degree of operational limitation with respect to system measures (5) Log storage period (5) Strengthening of measures by secure coding, web server settings, etc. (5) Authentication of entities with management authority (4) Degree of operational restriction due to physical measures (4) Subject (equipment) of unauthorized monitoring (4) Subject (network) of unauthorized monitoring (4) Subject (intruder, unauthorized operation, etc.) of unauthorized monitoring (4) Communication control (4) Scope of detection of unauthorized communication (4) Measures against network congestion (4) Prevention of data damage (3) Authentication of entities without management authority (3) Checking interval (2) WAF introduced or not (2)

3.　Future Schedule

Product Quality Metrics WG
METI Software Metrics Advancement Project

Future Schedule

■ Objectives of Activities

  ■ Develop **the following environment** and promote activities

    ● **The developer meets the quality needs of users considering the quality life cycle**

    ● **The acquirer (evaluator) evaluates quality using metrics that are shared with the developer**

■ Future Activity

  ■ **Provide report** based on the survey results of metrics usage examples

    ● Details of **quality requirements** set in accordance with users' needs

    ● Method to set **quality characteristics**

    ● **Practical metrics** that can be used to evaluate product quality

  ■ **Promote sharing and standardization of metrics**

    ● Propose the metrics to **ISO/IEC 25022, 25023, 25024**

[INFORMATION] Product Quality Metrics WG Activities in 2009

2009 Report (in English)

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

http://www.meti.go.jp/policy/it_policy/softseibi/index.html#metrics

- **Activities for the first year (2009)**
  - To summarize domestic plural discussions on the quality assurance of the system and software mainly in light of international standards, and assume the role of a guide for features of each content and mutual relations as well as the basis for the quality assurance.

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

…Thank you