An investigation on the software metrics to promote best practices for reliability improvement

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Japan Information Technology Services Industry Association

Agenda

1. Background and objectives
2. Cases of practical uses of the software metrics for reliability improvement
3. Correspondence to “A Guideline for IT systems reliability”
4. Summary of the practical uses of the software metrics in the development/operation processes
5. Future challenges

1. Background and Objectives

- Background
  - As influence on the ordinary social life and company activities by the information system failures are getting more serious, industries and governments are demanded to build more reliable information systems and policies:
    - Response by industries (suppliers and IT user companies)
      - Quantitative management to maintain and improve reliability of information systems during development, maintenance and operation
    - Response by governments
      - Issue “A Guideline for IT systems reliability” (METI)
- Objectives
  - Aggregate metrics to systematically manage development, maintenance, and operation, where activities depend much on experiences
  - Propose and promote reliability activities in the IT industries
    - Best practices of the use of management metrics regarding reliability activities
    - Management metrics corresponding to government guidelines

Overview of the investigation

- Collect best practices on the use of management metrics regarding reliability activities
- Present sets of metrics, usages, and cases
- Correspond to “A guideline for IT systems reliability” (METI)
- Arrange the set of software metrics process by process

- Any types of organizations can use the set of software metrics for their quantitative management activities aiming at reliability improvement.

Organization Type
Organizations which intend to start making use of reliability management metrics just from now on
Organizations which have already started using them, but are still struggling to deploy them
Organizations which has already deployed them enough
Organizations which consider to incorporate “A Guideline for reliability of IT systems“ issued by METI

2. Cases of practical uses of the software metrics for reliability improvement

- 8 corporations (JISA members)
- 13 cases

Corporation	Number of Metrics and Measurements		
	Development	Maintenance	Operation
NTT DATA CORPORATION	100 <case1>	—	13 <case11>
JASTEC Co., Ltd.	192 <case2>	—	—
Daiwa Institute of Research Ltd.	29 <case3>	—	—
DTS CORPORATION	8 <case4>	—	1 <case13>
TOKIO MARINE NICHIDO SYSTEMS Co., Ltd.	206 <case5>	—	104 <case10>
Nomura Research Institute Ltd.	66 <case6>	23 <case8>	40 <case12>
Hitachi Software Engineering Co., Ltd.	54 <case7>	—	—
NS Solutions Corporation	—	62 <case9>	—
The Number of Case Studies	7 cases	2 cases	4 cases

※include the measurement item.

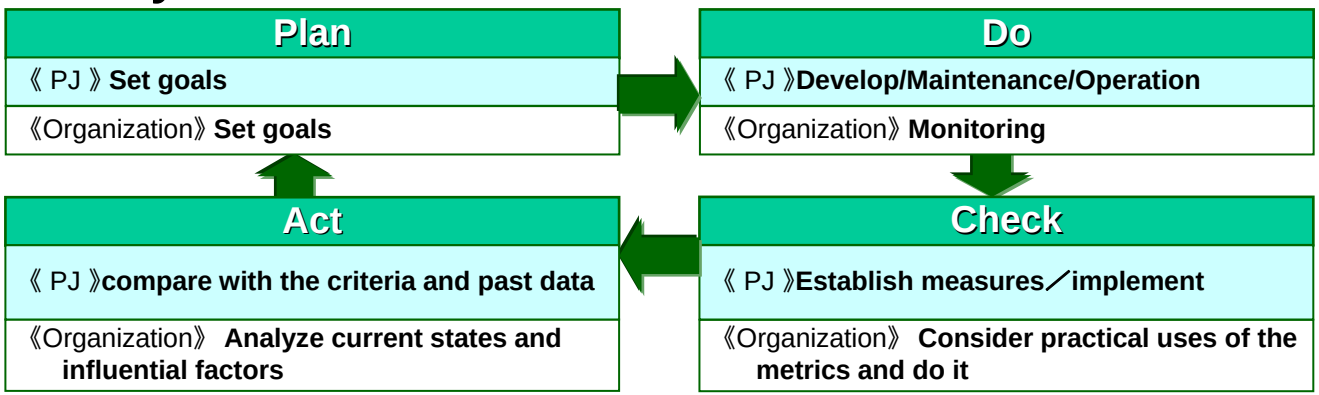
The effects by the use of software metrics

- Effects reported by 12 Cases

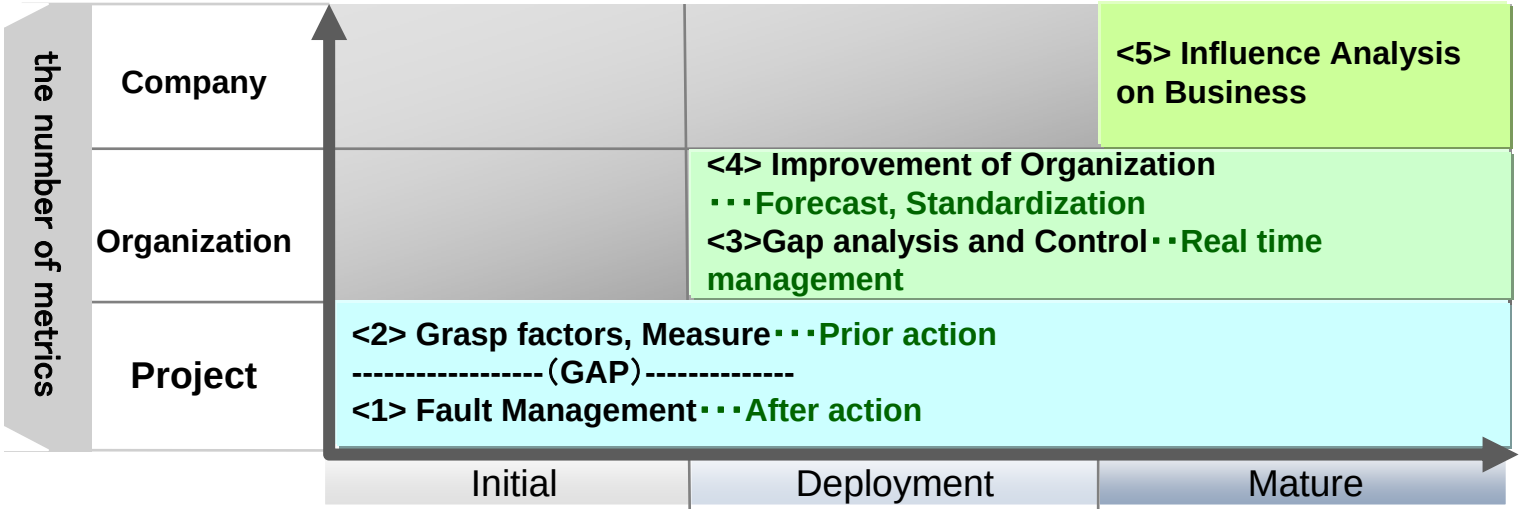
Effects on	Summary
Reliability	●Decrease of failures〈case1〉 ●Surely improve reliability〈case6〉 ●In comparison with the state around 2000, failures decreased more than 90%〈case10〉 ●Human mistakes reduced to almost zero.〈case12〉
Project Management	●Understand important factors on the sources of bugs〈case10〉 ●Grasp quantitative effect on productivity by development activities〈case5〉 ●Recognize significant effects of detecting failures at earlier processes 〈case3〉 ●Detect project risks earlier and decrease large-scale projects failures 〈case7〉
Organization Management	●Grasp characteristics of organizations by time serial analysis〈case1、9〉 ●Implement change management and promote blanket contracts 〈case2〉 ●Improve accountabilities for the policy of quantitative management 〈case5〉 ●Able to explain the states of whole processes, and easy to correspond to inspection〈case10〉 ●Reduce labor costs for operation 〈case12〉

Practical Use of Software Metrics

- PDCA cycle



- Steps for introduction



Practical Approach to Software Metrics

- Basic tips of use
  - Review metrics continuously, conduct time serial analysis
  - Small start
  - Select metrics according to objectives and maturity of organizations
  - Reduce loads for measurement activities
  - Feedback the data to field people, evaluate positive activities, deploy company-wide
- Development and Operation
  - Firstly grasp all the errors and the sources
  - Conduct review and inspection
  - Analyze influential factors
  - Change management
  - Practical use of metrics at the upper phases
- Communication with the customer, subcontractor
  - Mutual understanding, an agreement on the use of the software metrics with customers and subcontractors
  - Detect and minimize risks by periodical meetings
  - Control quantity of changes

3. Correspond to “A guideline for IT systems reliability”

“A Guideline for IT systems reliability”

issued on 2006.6 Ministry of Economy, Trade and Industry

<Purpose>

Implement reliability and safety that information systems should primarily maintain

<Contents>

What stakeholders must and/or are desired to observe to implement reliability and safety during the life cycle of IT systems

- The guideline shows “What”.
- We show “How” by collating software metrics with the guideline.

Correspond to “A guideline for IT systems reliability”

The Guidelines		Case studies
Chapter	Section	items
Ⅲ.The software planning, development, maintenance, operation	(1) Project Planning	53
	(2) Development processes	268
	(3) Maintenance and Operation Processes	159
	(4) Recovery from System Failures	77
	(5) System Lifecycle Processes (general important notices)	182
Ⅳ.Technology	(1) Development methods and tools	10
	(2) Technology use and important notices regarding reliability and safety improvement	12
Ⅴ.Human, Organization	(1) Education and Human Resources	31
	(2) Organization Development	39
Ⅵ.Business Practices, Contracts, regal issues	(1) Clarification of the important matters in the contracts	3
	(2) Clarification of roles and the responsibilities during development	N/A

4. Summary of the practical use of the software metrics in the development/operation processes

- Arrange the set of software metrics by standard processes
  - Development / Maintenance

    “Software life cycle process - Japan common frame”; ISO/IEC 12207 conformant
  - Operation

    “ITIL v3”
- Summary in the <Development/Operation> process
  - Common Software Metrics
  - Systematic Use
  - Interesting Use

A set of common software metrics for Software Development

	Software Metrics	Examples
Review	**Defects rate**	The number of defects found per 1,000 lines of pseudocode, code, or per page.
	Re-inspection rate	The percentage of inspections that require reinspection.
	Inspection speed	The amount of pseudo-code, code or pages inspected in one hour of inspection time.
	Percentage of defects Found by Inspection	The percentage of all defects that are found using the inspection process.
	Review efficiency	The number of defects found during one inspection hour.
Test	**Test coverage**	Defined as the extent to which testing covers the product's complete functionality.
	Test case efficiency	The extent to which test cases are able to find defects.
	Number of defects	The total number of remarks found in a given time period/phase/test type that resulted in software or documentation modifications.
	Residual defect density	An estimate of the number of defects that may have been unresolved in the product phase.
Delivery	**Delivery success rate**	The percentage of cases that achieved delivery schedule within a fixed time period.
	Delivery delayed rate	The rate of total days of delay in completion of project per the contract days.

Systematic Use in Software Development

■A rigid framework to evaluate software development processes and products considering characteristics of both customers and software suppliers

Customer		Software Suppliers	
＜Importance Assessment＞		＜Risk Assessment＞	
●Publicity	●Operational standard	●System Information	●Technology
●Provided Information, Size	●Difficulty of technologies	●Terms of the contract	●Customer Information
●Expected reliability, performance	●Operation responsibility	●Estimation	●Schedule
●Importance of Data	●Versatility of the product	●Project Management	●Organization
●DBMS Size			

Development Process and Product				
＜Monitoring＞	＜Assessment＞	＜Review＞	＜Check＞	＜Error Management＞
●Cost ●Size ●Progress ●Quality	●Contract ●Plan、Size、Cost、Progress ●Specifications ●Concerns ●Quality	Same as common software metrics		

Systematic Use in Software Development

- A pricing system relevant to reliability
- By the system you can control factors which affect the size of development and productivity
  - Factors: quality, communication, conditions of software and hardware, size of change, etc.

- Scope
  - Development Process
    - Whole processes: Estimate, Contract, Progress, Achievement report, After the release
  - Organization
    - Development, Sales, Purchasing、etc.

Interesting Use in Software Development

- Control Change Requests
  - Prohibit change requests after development, in principle, and monitor the change
  - Establish a quantitative change monitoring method and control change expansion through cooperation between customers and suppliers
    - Size of development
      = New codes – gross deleted codes + net deleted codes + added codes
    - Suppliers periodically show the size of change to customers as an important metrics
    - Preparations for change alarm

- Analyze the gap between estimation and actual costs
  - Gap analysis when both estimation and actual costs have much uncertainty (start of a project, for example) is inappropriate.
  - Important thing is to get appropriate estimation and appropriate actual costs and analyze the gap between them at any time you can do it.
  - Make clear the responsibilities
    - Sales／Production／Purchasing

- Evaluate projects
  - Evaluate projects from the company-wide data set（average, variance, etc）
  - Find out average values the range of the company and the industries

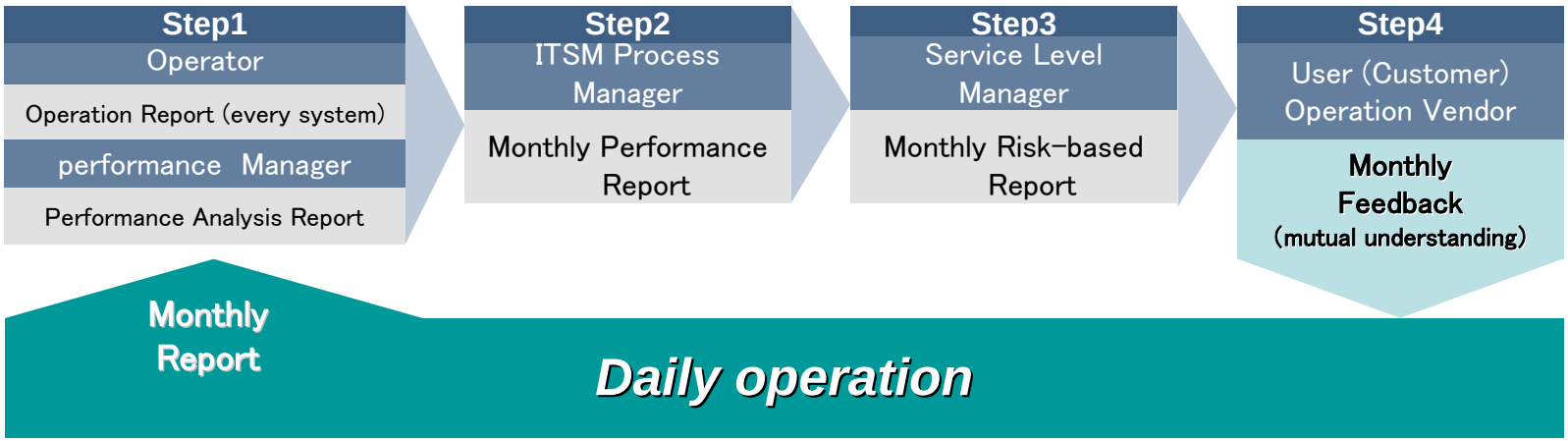
Set of common software metrics for Service Operation

	Software Metrics	Examples
Problem Management	The number of problems at the Online processing ,batch Processing, Delivery	The number, rate, comparison of the tendency (monthly)
Transfer Management	The number of registration (Job registration, monitoring registration, program registration)	Same as above
Operations Management	Online opening states (Rate of opening、special operation)	Same as above
	Online using states (Transaction volume, in comparison with last year data)	Same as above
	Batch jobs operating states (Operating job volume、special operation)	Same as above
	Service Delivery operating states (The volume of printing, maintenance, transportation)	Same as above
Performance Management	Online operating states (Resource used、delayed transaction)	Same as above
	Batch jobs operating states (On-time completion rate)	Same as above
Security Management	ID Management (Mainframes、Servers)	Same as above
	Physical Access Management	Same as above

Systematic Use in Service Operation

■Secure the common understanding and communication between customers and outsourcers (operator) about management level, by using the software metrics.

- Collect data and analyze them monthly, based on SLA agreed with customers
- Mutual understanding of monthly risk reports



Interesting Use in Service Operation

- Enforcement of various management according to the importance of systems
  - Make profiles that define the degree of importance for each system
  - Make use of the degree at various management activities
    - Service Level Management
    - Trouble Management

- Trouble management according to the degree of importance

  Trouble metrics

  ＝([Affected Object（Coefficient）]＋[Importance of business]) × [Quantity] × [Recurrence・Repetition-related Coefficient]

  - Classify troubles by 4 categories (slight, small, medium, significant) by trouble metrics.
  - Report troubles higher than “small” category quarterly to the board of directors of customers

Interesting Use in Service Operation

- Evaluate the state of ongoing activities required to continuously manage and maintain the IT Infrastructure so as to deliver and support IT Services at the agreed levels
  - Evaluate businesses monthly by software metrics

    《8 businesses》
    - Information Processing
    - Punching
    - Paper
    - Printing / Maintenance / Shipment
    - Maintenance service
    - Medium Making／Offer
    - Transportation
    - Operation
  - Evaluate achievements of outsourcers monthly

    《4 metrics》
    - Achievement
    - Quality of processes
    - Anti-security measures
    - Resources

5. Future Challenges

- Issues to be addressed
  - Metrics for acceptance testing to Evaluate Supplier-Developed Software
  - Prediction for the size of affected parts of the current system at the maintenance

- For International Standardization
  - Offer the set of software metrics to promote international standardization

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