Software Quality Management

Lecturer: Ngo Huy Bien
Software Engineering Department
Faculty of Information Technology
VNUHCM - University of Science
Ho Chi Minh City, Vietnam
nhbien@fit.hcmus.edu.vn

Objectives

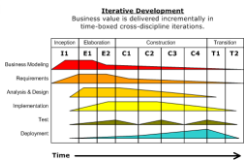
- To present software *quality characteristics*
- To specifying software *quality requirements* objectively
- To create *quality management plan*

References

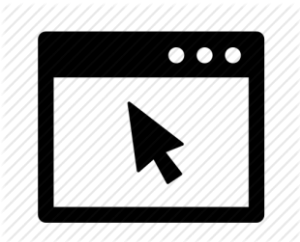
1. J.A. McCall et al.. Factors in Software Quality. 1977.
2. Robert T. Futrell et al.. Quality Software Project Management. 2002.
3. SHARI LAWRENCE PFLEEGER et al. Status Report on Software Measurement. 1997.
4. Paul POCATILU. IT Project Management Metrics. 2007.
5. G. Canfora et al. A Family of Experiments to Validate Metrics for Software Process Models. 2005.

Software Products and Process

What is *mechanism* for specifying the qualities or characteristics of the documents, or software, or process.



How to Measure Source Code and Application Quality?



External Quality Characteristics [1]

Characteristic – A condition which actively contributes to the quality of the software.

- *CORRECTNESS*. Extent to which a program satisfies its specifications and fulfills the user's mission objectives.
- *RELIABILITY* Extent to which a program can be expected to perform its intended function with required precision.
- *EFFICIENCY* The mount of computing resources and code required by a program to perform a function.
- *INTERITY* Extent to which access to software or data by unauthorized persons can be controlled.
- *USABILITY* Effort required to learn, operate, prepare input, and interpret output of a program.
- *MAINTAINAILITY* Effort required to locate and fix an error in an operational program.
- *TESTABILTY* Effort required to test a program to insure it performs its intended function.
- *FLEXIBILITY* Effort required to modify an operational program.
- *PORTABILITY* Effort required to transfer a program from one hardware configuration and/or software system environment to another.
- *REUSABILITY* Extent to which a program can be used in other applications - related to the packaging and scope of the functions that programs perform.
- *INTEROPEABILITY* Effort required to couple one system with another.

ISO 9126 Quality Characteristics [2]

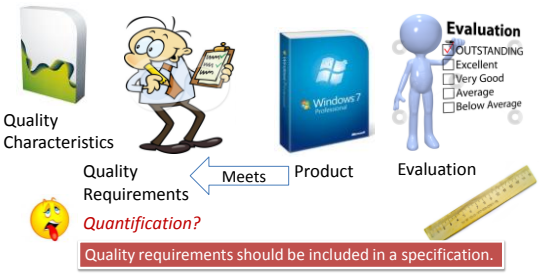
Quality Characteristic	Subcharacteristic
Functionality (Are the required functions available in the software?)	Suitability
	Accuracy
	Interoperability
	Security
Reliability (How reliable is the software?)	Maturity
	Fault tolerance
	Recoverability
Usability (Is the software easy to use?)	Understandability
	Learnability
	Operability
	Attractiveness
Efficiency (How efficient is the software?)	Time behavior
	Resource behavior
Maintainability (How easy is it to modify the software?)	Analyzability
	Changeability
	Stability
	Testability
Portability (How easy is it to transfer the software to another operating environment?)	Adaptability
	Installability
	Coexistence
	Replace-ability

Again, How to Measure Source Code and Application Quality?

- We have to turn our *vague ideas* about quality into something *measurable*.
- *Examples*:
  - Correctness (vague idea)
    - Test cases (measurable quantities)
      - Number of passed test cases (counts)
  - Usability (vague idea)
    - Time take to learn how to use system (measurable quantities)
      - Average of time of 100 users (counts)

What is Quality?

Quality is the degree to which a set of inherent characteristics fulfills requirements (need or expectation).



Quality requirements should be included in a specification.

What to Measure?

- Software Requirements Specification
- Software Design Specification
- Software Testing Specification
- Software Project Plan
- Software Risk Management Plan
- Software Risk Management Plan
- Software Quality Assurance Plan
- …
- *Software Project*
- *Software Development Process*
- *Environment*

Data Types (Scale)

- *Nominal Data*: The values are simply labels.
  - Males could be coded as 0, females as 1; marital status of an individual could be coded as Y if married, N if single.
- *Ordinal Data*: The values can be ranked. You can count and order, but not measure, ordinal data.
  - The difference in enjoyment expressed by giving a rating of 2 rather than 1 might be much less than the difference in enjoyment expressed by giving a rating of 4 rather than 3.
- *Interval Scale*: A scale of measurement where the distance between any two adjacent units of measurement (or 'intervals') is the same but the zero point is arbitrary.
  - The heights of tides, the measurement of longitude.

How to Measure Quality? [3]

- Describe the *entity* being measured.
- Describe *what* you want to find out.
- Describe *the attributes* you will measure and the set of possible resulting measures.
- Describe *how* to approach measuring the attributes.
- Have *standards* to compare against.
- *Example*:
  - Software application
  - Performance > Resource utilization
  - CPU utilization, memory utilization, response time
  - Run the application, start Task Manager, locate values
  - Max CPU utilization: 10%, max memory utilization: 200Mb

Product: What to Find Out and Measure?

- *Size*
  - Lines of code
  - Number of components
- *Quality*
  - Performance
  - Correctness
  - Scalability
  - Modifiability
  - Usability
- *Defects*
- *Documentation*

Project: What to Find Out and Measure? [4]

Category	Metrics
Productivity	The number of lines of code/modules/classes/deliverables etc. developed on time unit or per resource
Quality	Project complexity Portfolio complexity The degree of client or executive management satisfaction by completing the project objectives
Deliverables	The ratio between the achieved deliverables and the planned deliverables The number of reworks because of no concordances between the specifications and the results
Costs	Statistics regarding different costs categories Project portfolio value
Resources	Statistics regarding resources usage Statistics regarding resources costs Statistics regarding resources loading and distribution

Process: What to Find Out? [5]

Maintainability Sub-characteristic	Definition
Analyzability	Easiness shown by the model in discovering errors or deficiencies and in guessing the parts that should be modified.
Understandability	Easiness with which the model can be understood.
Modifiability	Easiness with which the model can be modified, for possible errors, a specific modification request or new requirements.

Process: What to Measure?

Metric	Definition
NA	Number of activities of the software process model
NWP	Number of work products of the software process model
NPR	Number of roles which participate in the process
NDWPIn	Number of input dependences of the work products with the activities in the process
NDWPOut	Number of output dependences of the work products with the activities in the process
NDWP	Number of dependences between work products and activities NDWP(PM) = NDWPIn(MP) + NDWPOut(MP)
NDA	Number of precedence dependences between activities
…	…

People: What to Find Out and Measure? [4]

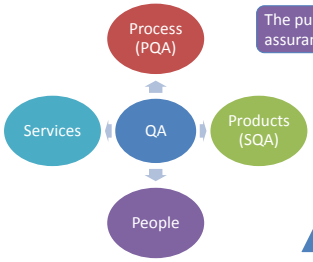
Metric	Subjective evaluation
Social abilities	Use well known models
Personnel experience	The years of experience in the project's specific field.
Degree of satisfaction	Sum of the degree of satisfaction for each requirement / total number of requirements
…	…

Quality Management

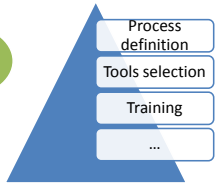
- The *product*, *project*, *process*, and/or environment selection
- The quality *requirements*
- The *methods* to evaluate products and process
  - Qualitative (WHAT, WHY): subjective
  - Quantitative (HOW MANY, IS BETTER): objective

Quality Assurance

QA is the part of quality management focused on *providing confidence* that quality requirements will be fulfilled.

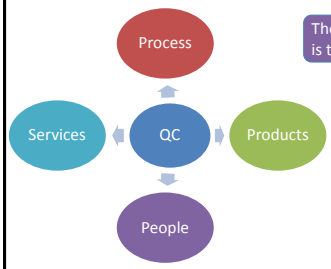


The purpose of quality assurance is to prevent defects.

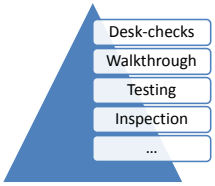


Quality Control

QC is the part of quality management focused on *fulfilling quality requirements*.



The purpose of quality control is to detect defects.



Software Quality Assurance Plan

- Purpose
- Reference documents
- Management
- Documentation
- *Standards, practices, conventions, and metrics*
- *Software reviews*
- *Test*
- *Problem reporting* and corrective action
- *Tools*, techniques, and methodologies
- Media control
- Supplier control
- Records collection, maintenance, and retention
- *Training*
- Risk management
- Glossary
- SQAP change procedure and history

The IEEE 730-2002

IEEE

Why Quality Management?

- Improving *customer's satisfaction*
- Reducing *development cost*
- Reducing *maintenance cost*
- Required by some *standards (ISO, CMMI)*

QA/QC Hire (HP)

- Bachelor's Degree in Computer Science/Software Engineering or comparable.
- Solid understanding of, and practical experience with software quality tools and processes (e.g. test planning, progress tracking, defect tracking, black box/white box testing, code coverage measurement, code complexity measurement, code analyzers, test automation, etc.).
- Knowledge of SW Engineering tools (e.g. source code revision control systems, build process, etc.).
- Thorough understanding of the entire Software Development process (using traditional waterfall-like development and/or agile/iterative development) in order to establish quality metrics and practices along the development cycle and not only in final product testing.
- Experience working with customers (understanding customer needs/expectations).

- *Define and measure product quality.*
- *Define and establish appropriate quality management processes and tools across the R&D organization.*
- *Work closely with the Development and QA teams to establish and execute appropriate practices to actually meet the defined quality goals.*
- *Work closely with the Management team to report on relevant quality metrics, and make recommendations as to whether a product is ready to be released to customers.*
- *Look for opportunities to increase product quality and team efficiency, and drive improvement programs across the entire development project.*

International Standards Organization

- ISO 9000 is a guideline that directs the user as to which set of documents to use and the interrelationship of quality concepts.
- ISO 9001, 9002, and 9003 deal with external quality assurance pursuits while ISO 9004 deals with internal quality assurance.
- ISO 9001 is used to ensure that quality systems are delivered by the supplier during several stages of creation (which may include design, development, production, installation, and servicing).

International Organization for Standardization
ISO
9001

Thank You For Your Time