COST OF SOFTWARE QUALITY

SC4431 Selected Topic in Software Quality Improvement

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Cost of Software Quality

- Economic assessment of software quality development and maintenance
- Another class of software quality metrics where financial values are used as the measuring tool

Objectives of Cost of Software Quality Metrics

- Control organization-initiated costs to prevent and detect software errors
- Evaluation of the economic damages of software failures as a basis for revising the SQA budget
- Evaluation of plans to increase or decrease SQA activities or to invest in a new or updated SQA infrastructure on the basis of past economic performance

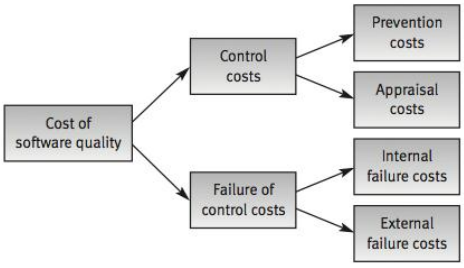
Software Quality Metric Application

- Compare actual performance figures with
  - Control budgeted expenditures (for SQA prevention and appraisal activities)
  - Previous year's failure costs
  - Previous project's quality costs
  - Other department's quality costs

MODEL OF COST OF SOFTWARE QUALITY

Classic Model of Cost of Software Quality

- Costs of control
  - Prevention Costs
  - Appraisal Costs
- Costs of failure of control
  - Internal Failure Costs
  - External Failure Costs



Prevention Costs

- Investments in
  - establishing a software quality infrastructure
  - updating and improving that infrastructure
- Regular implementation of SQA preventive activities
- Control of the SQA system through performance of:
  - Internal quality reviews
  - External quality

Appraisal Costs

- Reviews
- Costs of software testing
- Costs of assuring quality of external participants

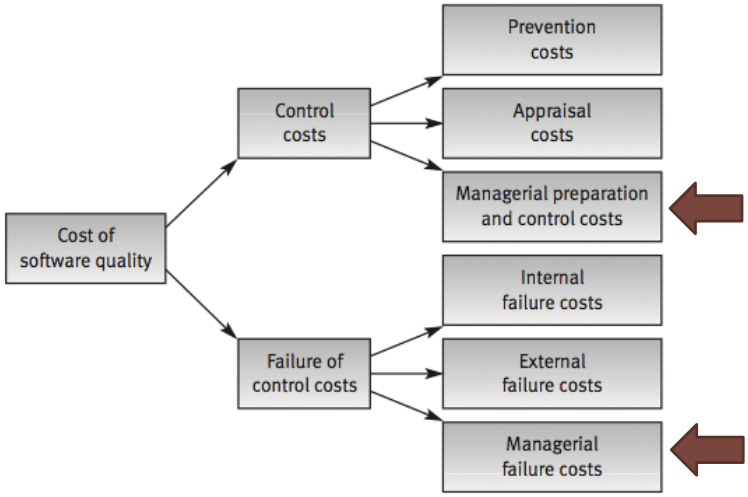
Internal Failure Costs

- Costs incurred when correcting errors that have been detected by design reviews, software tests and acceptance tests performed before system installation at customer sites.
- Corrections and checks initiated by team reviews are not considered internal failure costs.
- Example:
  - Costs of redesign or design corrections subsequent to design review and test findings
  - Costs of re-programming or correcting programs in response to test findings

External Failure Costs

- Costs of correcting failures detected by customers or maintenance teams after the software system has been installed at customer sites.
  - Overt external failure costs
  - Hidden external failure costs
- Example
  - Resolution of customer complaints (during the warranty period)
  - Correction of software bugs during regular operation.
  - Correction of software failures after the warranty period is over (even if it's not covered by the warranty)
  - Damages paid to customers in case of a severe software failure detected during regular operation.

Extended Model of Cost of Software Quality



Managerial Preparation and Control Costs

- Costs associated with activities performed to prevent managerial failures.
- Example
  - Costs of carrying out contract reviews
  - Costs of preparing project plans (quality plans and review)
  - Costs of periodic updating of project and quality plans
  - Costs of performing regular progress control of internal software development efforts.
  - Costs of performing regular progress control of external participants' contribution to the project

Managerial Failure Costs

- Can be incurred throughout the entire course of software development, beginning in the pre-project stage.
- Connected to failed attempts to estimate the appropriate project schedule and budget.
- Example
  - Unplanned costs for professional and other resources (underestimation)
  - Damages paid to customers as compensation for late completion (unrealistic schedule & insufficient and inappropriate team members)

APPLICATION OF A COST OF SOFTWARE QUALITY SYSTEM

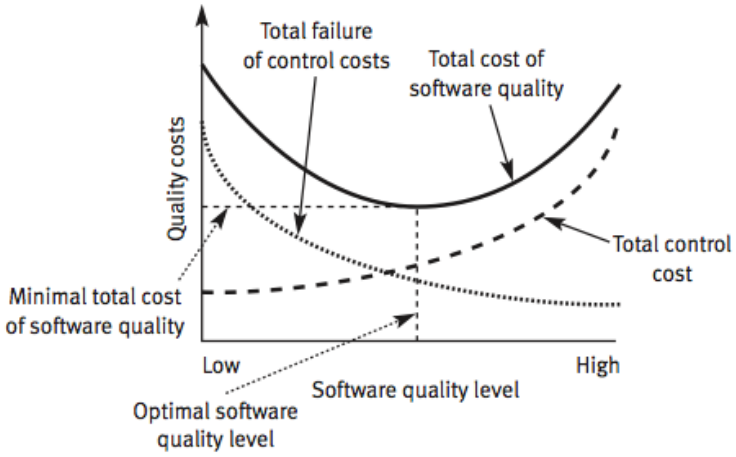
Requirements

- Definition of a cost of software quality model and array of cost items
  - Classic?
  - Extended?
- Definition of the method of data collection
  - Independent collection system?
  - Existing MIS?
- Application of a cost of software quality system, including thorough follow-up
- Actions to be taken in response to the findings
  - Rooted from cost of software quality balance concept

Example

Cost item	Cost of quality subclass
Head of SQA Unit (personnel costs)	50% prevention costs, 50% internal failure costs
SQA team member reviewing compliance with instructions (personnel costs)	Prevention costs
Other team SQA members (personnel costs)	Prevention and appraisal costs according to monthly personnel records
Development and maintenance team participation in internal and external SQA audits (personnel costs)	Prevention costs – recorded time spent on audits
Testing team – first series of tests (personnel costs)	Appraisal costs – recorded time spent
Testing team – regression tests (personnel costs)	Internal failure costs – recorded time spent
Development and maintenance team correction of errors identified by the testing team (personnel costs)	Internal failure costs – recorded time spent
Maintenance team correction of software failures identified by the customer (personnel costs + traveling costs to the customer's site)	External failure costs – recorded time spent
Regular visits of unit's SQA consultant (standard monthly fee)	Prevention costs
Unit's SQA consultant's participation in external failure inquiries (special invoices)	External failure costs
SQA journals, seminars, etc.	Prevention costs

Cost of Software Quality Balance by Quality Level



Cost of Software Quality Analysis

No.	Action	Expected results
1	Improvement of software package's help function	Reduction of external failure costs
2	Increased investment of resources in contract review	Reduction of managerial failure costs
3	Reduction in instruction activities yielding no significant improvement	Reduction of prevention costs with no increase in failure costs
4	Increased investment in training inspection team members and team leaders	Reduction of internal and external failure costs
5	Adoption of more intensive project progress control procedures	Reduction of managerial failure costs
6	Construction of certified list of subcontractors allowed to participate in the company's projects	Reduction of failure costs, especially of external failure costs
7	Introduction of automated software tests to replace manual testing with no substantial increase in testing costs	Reduction of internal and external failure costs

Causes of Problems
(Accuracy and Completeness of Quality Cost Data)

- Inaccurate and/or incomplete identification and classification of quality costs
- Negligent reporting by team members and others
- Biased reporting of software costs, especially of "censored" internal and external costs
- Biased recording of external failure costs due to indirect if not "camouflaged" compensation of customers for failures whose implications remain unrecorded as external failure costs.
  - discounted future services
  - delivery of free services
  - and etc.

Typical Causes for Delays and Associated Costs

No.	Action	Expected results
1	Improvement of software package's help function	Reduction of external failure costs
2	Increased investment of resources in contract review	Reduction of managerial failure costs
3	Reduction in instruction activities yielding no significant improvement	Reduction of prevention costs with no increase in failure costs
4	Increased investment in training inspection team members and team leaders	Reduction of internal and external failure costs
5	Adoption of more intensive project progress control procedures	Reduction of managerial failure costs
6	Construction of certified list of subcontractors allowed to participate in the company's projects	Reduction of failure costs, especially of external failure costs
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