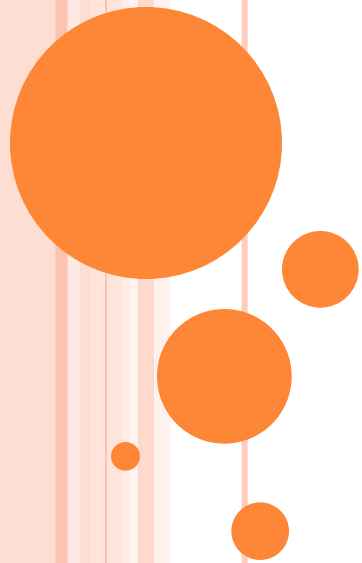


# SOFTWARE ENGINEERING

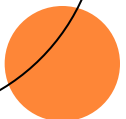


# *SOFTWARE QUALITY ASSURANCE*



## TOPICS COVERED

- *Quality Concepts*
  - *Quality*
  - *Quality Control*
  - *Quality Assurance*
  - *Cost of Quality*
- *Software Quality Assurance*
- *Software Reviews*
- *Formal Technical Reviews*
  - *The Review Meeting*
  - *Review Reporting and Record Keeping*
  - *Review Guidelines*
- *Formal Approaches to SQA*
- *Statistical Quality Assurance*
- *Software Reliability*
- *The SQA Plan*



## *Quality Concepts*

*Software quality assurance is an umbrella activity that is applied throughout the software process.*

*SQA encompasses:*

- (1) a quality management approach*
- (2) effective software engineering technology*
- (3) formal technical reviews*
- (4) a multi-tiered testing strategy*
- (5) document change control*
- (6) software development standard and its control procedure*
- (7) measurement and reporting mechanism*

*Quality --> refers to measurable characteristics of a software.*

*These items can be compared based on a given standard*

*Two types of quality control:*

- Quality design -> the characteristics that designers specify for an item.  
--> includes: requirements, specifications, and the design of the system.*
  
- Quality of conformance -> the degree to which the design specifications are followed. It focuses on implementation based on the design.*

## *Quality Control*

*What is quality control -- the series of inspections, reviews, and test used throughout the develop cycle of a software product*

*Quality control includes a feedback loop to the process.*

*Objective ---> minimize the produced defects, increase the product quality*

*Implementation approaches:*

- Fully automated*
- Entirely manual*
- Combination of automated tools and human interactions*

*Key concept of quality control:*

*--> compare the work products with the specified and measurable standards*

*Quality assurance consists of:*

- the auditing and reporting function of management*

*Goal --> provide management with the necessary data about product quality.*

*--> gain the insight and confidence of product quality*



## *Cost of Quality*

*Cost of quality --> includes all costs incurred in the pursuit of quality or perform quality related work*

*Quality cost includes:*

*- prevention cost:*

- quality planning*
- formal technical reviews*
- testing equipment*
- training*

*- appraisal cost:*

- in-process and inter-process inspection*
- equipment calibration and maintenance*
- testing*

*- failure cost:*

*internal failure cost:*

- rework, repair, and failure mode analysis*

*external failure cost:*

- complaint resolution*
- product return and replacement*
- help line support*
- warranty work*



## *Software Quality Assurance*

*Goal: to achieve high-quality software product*

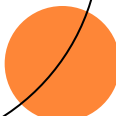
*Quality definition:*

*“Conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that expected of all professional developed software.”*

*Three important points for quality measurement:*

- Use requirements as the foundation*
- Use specified standards as the criteria*
- Considering implicit requirements*

*About quality assurance:*

- The first formal quality assurance and control function was introduced at Bell Labs in 1916 in the manufacturing world.*
  - During the 1950s and 1960s, the programmers control their product quality.*
  - During the 1970s, quality assurance standards were introduced first in military contract software development.*
  - In 1987, the extending definition is given in [SCH87].*
- 

## *SQA Group*

*Who involves quality assurance activities?*

*Software engineers, project managers, customers, sale people, SQA group*

*Engineers involved the quality assurance work:*

- apply technical methods and measures*
- conduct formal technical review*
- perform well-planned software testing*

*The SQA group's role -> serves as the customer's in-house representative*

*assist the software engineering team in achieving high-quality*

*The SQA group's responsibility:*

- quality assurance planning oversight, record keeping, analysis and reporting*

*The SQA group's tasks:*

- Prepare a SQA plan for a project*
- Participate in the development of the project's software process description*
- Review engineering activities to verify compliance with the defined process*
- Audits designated software work products to verify compliance the defined process*
- Ensure the deviations in software work and products according to a documented procedure*
- Records any noncompliance and reports to senior management*



# *Software Reviews*

*What is software reviews?*

- *a “filter” for the software engineering process.*

*Purpose: serves to uncover errors in analysis, design, coding, and testing.*

*Why software reviews?*

- *To err is human*
- *Easy to catch the errors in engineers’ work*

*A review --> a way to*

- *identify the needed improvements of the parts in a product*
- *confirm the improvement parts of a product.*
- *achieve technical work of more uniform, predicable, and manageable.*

*Different types of reviews:*

- *Informal reviews:*

*informal meeting and informal desk checking*

- *Formal reviews: (design to an audience of customers, management, and staff)*  
*Walkthrough, inspection, and round-robin reviews*

*The terms “defect” and “fault” are synonymous*

*--> quality problems found after software release*

*Software “error” refers to a quality problem found b y engineers before software release*

## *Formal Technical Reviews (FTR)*

### *Objectives of FTR:*

- to uncover errors in function, logic, or implementation*
- to verify the software under review meets its requirements*
- to ensure that the software has been represented according to predefined standards*
- to develop software in a uniform manner*
- to make projects more manageable*

### *Purposes of FTR:*

- serves as a training ground for junior engineers*
- promote backup and continuity*

### *Review meeting's constraints:*

- 3-5 people involved in a review*
- advanced preparation (no more than 2 hours for each person)*
- the duration of the review meeting should be less than 2 hours*
- focus on a specific part of a software product*

### *People involved in a review meeting:*

- producer, review leader, 2 or 3 reviewers (one of them is recorder)*



## *Formal Technical Review Meeting*

### *The preparation of a review meeting:*

- *a meeting agenda and schedule (by review leader)*
- *review material and distribution (by the producer)*
- *review in advance (by reviewers)*

### *Review meeting results:*

- *a review issues list*
- *a simple review summary report (called meeting minutes)*
- *meeting decisions:*
  - *accept the work product w/o further modification*
  - *reject the work product due to errors*
  - *accept the work under conditions (such as change and review)*
- *sign-off sheet*

### *Review summary report (a project historical record) answers the following questions:*

- *what was reviewed?*
- *who reviewed it?*
- *what were the findings and conclusions*

### *Review issues list serves two purposes:*

- *to identify problem areas in the project*
- *to serve as an action item checklist (a follow-up procedure is needed)*



## *Review Guidelines (for FTR)*

*A minimum set of guidelines for FTR:*

- *Review the product, not the producer*
- *Set an agenda and maintain it*
- *Limit debate and rebuttal*
- *Enunciate problem areas, but don't attempt to solve every problem noted*
- *Take written notes*
- *Limit the number of participants and insist upon advance preparation*
- *Develop a checklist for each work product that is likely to be reviewed*
- *Allocate resources and time schedule for FTRs*
- *Conduct meaningful training for all reviewers*
- *Review your early reviews*



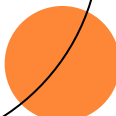
## *Statistical Quality Assurance*

*Statistical quality assurance reflects a growing trend throughout industry to become more quantitative about quality.*

*Statistical quality assurance implies the following steps:*

- Information about software defects is collected and categorized*
- An attempt is made to trace each defect to its underlying cause*
- Using the Pareto principle (80 percent of the defects can be traced to 20 percent, and isolate the 20 percent)*
- Once the vital few causes have been identified, correct the defects.*

*Causes of errors:*

- incomplete or erroneous specification (IES)*
  - misinterpretation of customer communication (MCC)*
  - intentional deviation from specification (IDS)*
  - violation of programming standards (VPS)*
  - error in data representation (EDR)*
  - inconsistent module interface (IMI)*
  - error in design logic (EDL)*
  - incomplete or erroneous testing (IET)*
  - inaccurate or incomplete documentation (IID)*
  - error in programming language translation of design (PLT)*
  - ambiguous or inconsistent human-computer interface (HCI)*
  - miscellaneous (MIS)*
- 

## *Statistical Quality Assurance*

*In conjunction with the collection of defect information, software developers can calculate an error index (EI) for each major step in the software engineering process.*

*After analysis, design, coding, testing, and release, the following data are collected:*

*$E_i$  = the total no. of errors uncovered during the  $i$ th step in the process.*

*$S_i$  = the no. of serious errors*

*$M_i$  = the no. of moderate errors*

*$T_i$  = the no. of minor errors*

*$PS$  = the size of the product at the  $i$ th step.*

*At each step in the software engineering process, a phase index ( $PI_i$ ) is computed:*

$$PI_i = w_s (S_i/E_i) + w_m (M_i/E_i) + w_t (T_i/E_i)$$

*Error index (EI) can be computed as follows:*

$$EI = (PI_1 + 2 PI_2 + 3 PI_3 + \dots + i PI_i) / PS$$

## *The SQA Plan*

*The SQA plan provides a road map for instituting software quality assurance.*

*Figure 8.5 presents an outline for SQA plans by IEEE [IEEE94].*

*Basic items:*

- *purpose of plan and its scope*
- *management*
  - *organization structure, SQA tasks, their placement in the process*
  - *roles and responsibilities related to product quality*
- *documentation*
  - *project documents, models, technical documents, user documents.*
- *standards, practices, and conventions*
- *reviews and audits*
- *test*      - *test plan and procedure*
- *problem reporting, and correction actions*
- *tools*
- *code control*
- *media control*
- *supplier control*
- *records collection, maintenance, and retention*
- *training*
- *risk management*