Software Testing: REVIEW and INSPECTION
Software reviews are a “quality improvement processes for written material”.

Systematic Software Reviews
Systematic Software Reviews

Help support the objectives of:

- Project management
- Systems engineering
- Verification and validation
- Configuration management
- Quality assurance
Software Life Cycle

Reviews are applicable to software products throughout the software life cycle

- Requirements
- Design
- Coding
- Testing
- Maintenance
Common Attributes:

Systematic reviews have these attributes in common:

- Team participation
- Documented results of the review
- Documented procedures for conducting the review
Goal and Motivation:

By detecting defects early, and preventing their leakage downstream, the higher cost of later detection and rework is eliminated.
Basic Steps:

- Using a static analysis technique,
- Perform a visual examination of the software products
- Detect and correct:
  - Defects
  - Violation of design standards
  - Other problems
What is a Software Product

The term “software product” is used in a very broad sense to describe any document produced during the software lifecycle.
Examples of Software Products

Include:

- Contracts
- Installation plans
- Progress reports
- Software design descriptions
- Release notes
- Software requirements specifications
- Source code
What Is a Defect?

- Any occurrence in a work product that is determined to be incomplete, incorrect, or missing
- Any instance which a requirement is not satisfied (Fagan, 1986)
- Informal synonyms: bug, fault, issue, problem
Inspections vs. Reviews

The IEEE Standard for Software Reviews defines 5 types of review:

- Management Reviews
- Technical Reviews
- Inspections (Formal Peer Review)
- Walk-throughs
- Audits
Why 5 types?

Different types of reviews reflect differences in the goals of each review type.
Origins: Fagan’s Inspection

- Michael E. Fagan
- IBM, Kingston, NY laboratories
- Applied hardware statistical quality and process control methods to “ideas on paper”
Origins: Continued

- “Design and code inspections to reduce errors in program development” (1976)
- Inspections = improved quality + less cost
- Scope of application expanded
Performance

Reviews improve schedule performance
Reviews reduce rework.

- Rework accounts for 44% of development. Cost!
  - Requirements (1%)
  - Design (12%)
  - Coding (12%)
  - Testing (19%)

Reviews are *pro-active* tests.

- Find errors not possible through testing.

Reviews are training.

- Domain, corporate standards, group.
Quality Improvement

- Reviews can find 60-100% of all defects.
- Reviews are technical, not management.
- Review data can assess/improve quality of:
  - Work product.
  - Software development process.
  - Review process itself.
Quality Improvement Continued

- Reviews reduce total project cost, but have non-trivial cost (~15%).
- Early defect removal is 10-100 times cheaper.
- Reviews distribute domain knowledge, development skills, and corporate culture.
Industry Experience With Reviews

- **Aetna Insurance Company:**
  - FTR found 82% of errors, 25% cost reduction.

- **Bell-Northern Research:**
  - Inspection cost: 1 hour per defect.
  - Testing cost: 2-4 hours per defect.
  - Post-release cost: 33 hours per defect.

- **Hewlett-Packard**
  - Est. inspection savings (1993): $21,454,000

- **IBM**
  - C system software
  - No errors from time of first compile.
Measuring Impact

Return on Investment:

\[ \text{ROI} = \frac{\text{net savings}}{\text{Detection cost}} \]

- Net savings = cost avoidance - cost to repair now
- Detection cost = cost of preparation + cost to conduct
Details of the Five Types of Software Review
Management Reviews Overview

- Performed by those directly responsible for the system
- Monitor progress
- Determine status of plans and schedules
- Confirm requirements and their system allocation
- Or, evaluate management approaches used to achieve fitness or purpose
Management Reviews Overview Continued

Support decisions made about:

- Corrective actions
- Changes in the allocation of resources
- Or changes to the scope of the project.
Management Reviews Continued

Software products reviewed

- Audit Reports
- Contingency plans
- Installation plans
- Risk management plans
- Software Q/A
Management Reviews Roles

Required:

• Decision Maker
• Review Leader
• Recorder
• Management Staff
• Technical Staff
Management Reviews Outputs

Documented evidence that identifies:

- Project under review
- Review team members
- Review objects
- Software product reviewed
- Inputs to the review
- Action item status
- List of defects identified by the review team
Technical Reviews Overview

Confirms that product

- Conforms to specifications
- Adheres to regulations, standards, guidelines, plans
- Changes are properly implemented
- Changes affect only those system areas identified by the change specification
Technical Reviews Continued

Software products subject to technical reviews

- Software requirements specification
- Software design description
- Software test documentation
- Software user documentation
- Installation procedure
- Release notes
The roles established for the technical review

- Decision maker
- Review leader
- Recorder
- Technical staff
Technical Reviews Outputs

Outputs, documented evidence that identifies:

- Project under review
- Review team members
- Software product reviewed
- Inputs to the review
- Review objectives and status
- List of resolved and unresolved software defects
- List of unresolved system or hardware defects
- List of management issues
- Action item status
- Recommendations for unresolved issues
- Whether software product meets specification
Inspection (Formal Peer Reviews)

Confirms that the software product satisfies

- Specifications
- Specified quality attributes
- regulations, standards, guidelines, plans
- Identifies deviations from standard and specification

Failure to do so results in logging a defect
Inspections Continued

Software products subject to Inspections

- Software requirements specification
- Software design description
- Source code
- Software test documentation
- Software user documentation
- Maintenance manual
- Release notes
Inspections Roles

The roles established for the Inspection

- Inspection leader
- Recorder
- Reader
- Author
- Inspector
Inspections Outputs

Outputs, documented evidence that identifies:

- Project under inspection
- Inspection team members
- Inspection meeting duration
- Software product inspected
- Size of the materials inspected
- Inputs to inspection
- Inspection objectives and status
- Defect list (detail)
- Defect summary list
- Disposition of the software product
- Estimate of the rework effort and completion date
Walk-throughs

- Evaluate a software product
- Sometimes used for educating an audience
- Major objectives:
  - Find anomalies
  - Improve the software product
  - Consider alternative implementations
  - Evaluate performance to standards and specs
Walk-throughs Continued

Software products subject to walk-throughs

- Software requirements specification
- Software design description
- Source code
- Software test documentation
- Software user documentation
- Maintenance manual
- Release notes
Walk-throughs Roles

The roles established for Walk-throughs

• Walk-through leader
• Recorder
• Author
• Team member
Walk-throughs Outputs

The outputs of the walk-through

- Walk-through team members
- Software product being evaluated
- Statement of objectives and their status
- Recommendations made regarding each anomaly
- List of actions, due-dates, responsible parties
- Recommendations how to dispose of unresolved anomalies
- Any proposal for future walk-throughs
Audits

The purpose of an audit is to provide an independent evaluation of conformance of software products and processes to applicable:

- Regulations
- Standards
- Guidelines
- Plans
- Procedures
Systematic Software Reviews

Comparison of Review Types
(see handout, Annex B)

IEE Std 1028-1997
Review & Inspection Process

Materials, Methods, and Roles
Review Materials

- Source Document
- Checklist
- Supporting Documents
- Invitation
- Master Plan
- Issue/Defect Log
- Data Summary
Review Methods

- Synchronous
  - Traditional Approach
  - Meeting-based

- Asynchronous
  - Relatively new area
  - Meeting replaced with email (or other electronic) communication
Synchronous Review

- Most popular is the Fagan method
- Review is separated into 5/6 phases
  1. (Planning)
  2. Overview
  3. Preparation
  4. Inspection
  5. Rework
  6. Follow-up
Planning/Overview

- Reviewers are selected
- Roles are assigned
- Documents are distributed
- General review task is discussed
Review Roles

Roles for a Review

Leader
(Moderator)

Author
(Creator of document[s])

Inspectors
(Reviewers of document[s])

Scribe
(Recorder)
Roles: Leader

- Manages inspection
- Acts as moderator
- Determines document worthiness
- Identifies/invites reviewers
- Assigns roles
- Distributes documents
- Schedules meeting times/locations
Roles: Author

- Creates the document for review
- Assists with answering questions
- Typically not directly involved in review
- Makes corrections to document if necessary
Roles: Inspector/Reviewer

- Complete familiarization of document on time
- Review document(s) for defects
- Look for assigned defects (if appropriate)
- Make use of checklists or other supporting documents
- Contact leader early if problems arise or if the review might be a waste of time
Roles: Scribe/Recorder

- Records issues as they are raised
- Ideally not the moderator or reviewer
- Record information legibly
Preparation

- Reviewers acquaint themselves with the documents to be reviewed
- Need to be familiar with material in time for review meeting
Inspection/Review Meeting

- Review team attempts to locate defects
- Defects are not fixed at this point
- Meeting < 2 hours long!
Inspection/Review (cont.)

- Round-robin approach or Reader approach
- Scribe records all issues
  - Where defect was located
  - Why is it a defect (cite requirement or checklist)
  - Suggested severity level (Major, minor)
  - Do Not record names of reviewers with defect
  - Try to make visible to all participants (avoid duplication)
Rework

- Author receives defect log
- Identifies true defects vs. “false positives”
- Fixes defects, provides justification for false positive
Follow-Up

- Leader verifies all defects have been addressed
- Decides if document passes review or if another review is necessary
Synchronous Review Process
Synchronous/Meeting Review

**Pros**
- Synergy
- Education
- Scheduled Deadline
- Competition
- Minimize “false positives”

**Cons**
- Cost (lost production time vs. cost of defect)
- Difficult scheduling of time/location for widespread reviewers
Asynchronous Review

- Formal, Technical, Asynchronous Review Method (FTArm)
- Developed by Philip Johnson at Univ. of Hawaii
  - Phase 1: Select Personnel and Organize Documentation
  - Phase 2: Orientation of Participants to Assigned Task
  - Phase 3: Private Review
  - Phase 4: Public Review
  - Phase 5: Consolidation
- Communication not performed in traditional meeting
  - Email
  - Bulletin Board
FTArm Method

- **Pros**
  - Reviewers formulate opinions in private
  - Opinions are discussed in public and voted on
  - During public voting, less experienced reviewers can learn from more experienced reviewers
  - Additional defects can be uncovered during public phase
  - Compromise can be reached on opposing opinions
  - Suitable for wide-spread reviewers

- **Cons**
  - All ideas must be voted on
  - If compromise can not be reached, synchronous meeting should be used to reach one
Asynchronous Review Process

Entry

Product Documents

Email

Face-to-Face Planning/Overview

Private Review

Public Review

Rework

Reviewed Documents

Review Process

Product Documents

Rules/Checklist
Review Pitfalls

- Insufficient Preparation
- Moderator Domination
- Incorrect Review Rate
- Ego-involvement and Personality Conflict
- Issue Resolution and Meeting Digression
- Recording Difficulties and Clerical Overhead
References/Resources

References/Resources Continued