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COLLEGE OF ENGINEERING  
AND COMPUTER SCIENCE

# Advanced Software Process

Part III: The Defined Process

## *10. Software Inspections*

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# Course Roadmap

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- 2. The Principles of Software Process Change
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# Software Inspections

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# Software Inspections

- Software inspections provide a powerful way to improve the quality and productivity of the SW process.
- This chapter provides overview and additional details are included in *Appendix C*.
- The software inspection is a peer review of a programmer's work to find problems and to improve quality.

# Software Inspections

- The fundamental objective of **inspections** is to **improve the quality of programs** by assisting programmers to **recognize and fix their own errors early** in the software engineering process.
- With large-scale, complex programs, a brief **inspection** by **competent co-workers invariably turns up mistakes** the programmers could not have found by themselves.
- An **error often starts with an early misconception** that is **repeated** in the design, the code, the documentation, and even the testing.

# Software Inspections

- Inspections help to motivate better work.
- When programmers know their work will be critically examined by their peers in an inspection, they are encouraged to work more carefully either to avoid being embarrassed by sloppy mistakes or through the pride of exhibiting a quality work product.
- By enlisting others in identifying their errors, programmers actually end up doing better work themselves.

# Software Inspections

- Inspections are **not magic** and they should not be considered a **replacement for testing**.
- But all software organizations should use **inspections** or **similar technical review methods** in **all major aspects of their work**.
  - Requirements, design, implementation, test, maintenance, and documentation

# Types of Reviews

- There are many different kinds of reviews and many different names for them, so it is important to draw some distinction.
- Types of Reviews [Table 10.1]
  - Management review
  - Technical review
  - Software inspection
  - Walkthrough



# Types of Reviews

- Management and technical reviews are generally conducted for management and typically provide information for management action.
- Inspections and walkthroughs, on the other hand, are peer examinations aimed at assisting the procedures in improving their work.

# Types of Reviews: Objectives

- Management review
  - Ensure progress
  - Recommend corrective action
  - Ensure proper allocation of resources
- Technical review
  - Evaluate conformance to specifications and plans
  - Ensure change integrity

# Types of Reviews: Objectives

- Software inspection
  - Detect and identify defects
  - Verify resolution
- Walkthrough
  - Detect defects
  - Examine alternatives
  - Forum for learning

# Types of Reviews

- **Inspection** is to **examine work technically** and **provide the producers with an independent assessment** of those product areas where **improvements** are needed.
- **Walkthroughs** are generally **less formal** and are **often conducted in an educational format**.
- **Inspections**, on the other hand, generally have a **formal format**, attendance is specified, and data is reported on the results.

# Types of Reviews

- Types of **work products** for **inspections**
  - Requirements
  - High-level design
  - Detailed design
  - Implementation
  - Test cases
  - Documentation

# Types of Reviews

- While there is almost no limit on what can be inspected, there is a question of cost.
- Where the cost of inspections does not seem warranted, a less formal walkthrough process is generally adequate.
- Technical reviews can also be used for such items as development and test plans.

# Inspection Objectives

- To find errors at the earliest possible point in the development cycle
- To ensure that the appropriate parties technically agree on the work
- To verify that the work meets predefined criteria
- To formally complete a technical task
- To provide data on the product and the inspection process

# Inspection Objectives

- Inspections also provide a host of secondary benefits:
  - Inspections ensure that associated workers are technically aware of the product.
  - Inspections help to build an effective technical team.
  - Inspections help to utilize the best talents in the organization.
  - Inspections provide people with a sense of achievement and participation.
  - Inspections help the participants develop their skills as reviewers.



# Basic Inspection Principles

- The inspection process follows certain basic principles:
  - The inspection is a formal, structured process with a system of checklist and defined roles for the participants.
  - Generic checklists and standards are developed for each inspection type and, where appropriate, they are tailored to specific project needs.
  - The reviewers are prepared in advance and have identified their concerns and questions before the inspection starts.

# Basic Inspection Principles

- The focus of the inspection is on identifying problems, not resolving them.
- An inspection is conducted by technical people for technical people.
- The inspection data is entered in the process database and used both to monitor inspection effectiveness and to track and manage product quality.

# The Conduct of Inspections

- **Inspection** should be conducted **at every point** in the development or maintenance process at which **intermediate products are produced**.
- Because they are **time consuming**, involve **people from several groups**, and use **scarce resources**, they **must be planned well in advance**.
- To guarantee that they are done, inspections must be an **explicit part of every project plan**.

# The Conduct of Inspections

## Basic Set of Inspections [Table 10.2]

Phase	Inspections	Walkthroughs	Technical Reviews
Requirements		Detailed requirements	Initial requirements
Plans			Development plan
Development	Detailed design Code	System design High-level design	
Publications		Draft publication Final publication	
Test		Test implementation	

# Inspection Participants

- The moderator (or inspection leader)
- The producers
  - The person(s) responsible for doing the work being inspected
- The reviewers (or inspectors)
- The recorder (or scribe)

# Inspection Participants

- While many more people may be interested in the inspection results, the purpose of the inspection is to assist the producers in improving their work.
- This can best be done by limiting attendance to five or six reviewers.
- The key point of this attendance list is that only technical peers attend.

# Inspection Participants

- The **moderator** is not the **manager** of the work being reviewed, and neither are any of the other participants.
- The inclusion of **managers** changes the inspection process and distorts the participants' objectivity.
- Regardless of the manager's behavior, the participants will feel that **it is they who are being reviewed rather than the product.**

# Inspection Participants

- Inspection data is gathered to see how well the project is progressing, not to evaluate the people.
- Since reviewers are human, however, they are subject to error, and managers need to study the inspection data to see where improvements are needed.



# Preparing for the Inspection

- The full inspection process consists of a preparation phase, the inspection itself, and some post-inspection activity.
  - The producers and their manager decide that the product is ready for inspection.
  - The inspection participants are identified, the inspection entry criteria are prepared, and the supporting materials are produced for the opening meeting with the entire inspection group.

# Preparing for the Inspection

- The **moderator** opens this meeting with a **brief statement of the subject to be inspected**, the **inspection objectives**, and, if needed, an **overview of the inspection process**.
- The **moderator** then provides a copy of the **inspection package** to each of the participants.
- Following this introductory meeting the **reviewers individually prepare** for the inspection.
- During preparation the **reviewers record their time and the errors identified on the error log form**.

# The Inspection and Post-Inspection Actions

- In conducting **the inspection meeting**, the **moderator** first checks to see if **all participants are prepared** and obtains copies of any preparation reports not already submitted.
- The **producer(s)** then **review each major error** either to clarify why it is not an error, to understand what the reviewer(s) meant, or to accept it.
- Pertinent **data on each error is recorded**.

# The Inspection and Post-Inspection Actions

- After discussing all major errors, the product is briefly reviewed to identify any other areas of confusion or concern.
- Based on the inspection results, and after asking the reviewers for their views, the moderator decides whether a re-inspection is required.
  - Sample Re-inspection Criteria [Table 10.3]

# The Inspection and Post-Inspection Actions

- Sample Re-inspection Criteria [Table 10.3]
  - Inspection rates unusual:
    - Inspection time per LOC too short
    - Inspection time per LOC too long
    - Too many errors per programmer hour
    - Too few errors per programmer hour
  - Error data out of line:
    - Too many minor errors, and too few major errors (preoccupied with details)
    - Too many major errors
    - Unusual error distribution
    - Too low a percent of errors found during preparation
  - Other:
    - Any module with more than N errors (N set in project plan)
    - Any module with persistently high error rates
    - The reviewers suggest a reinspection
    - The moderator suggest a reinspection
    - The testers suggest a reinspection
    - The module contains uninspected changes.

# The Inspection and Post-Inspection Actions

- Following the inspection, the **producer(s)** fixes the identified problems and either **reviews** the corrections with the moderator or in a **re-inspection**.
- As the final inspection action, the **moderator** makes sure that **the inspection results and data** are inserted in **the process database** and that **management** is **informed** that the inspection has been successfully **completed**.

# Inspection Training

- Moderator training courses are absolutely essential.
- The moderators need a complete grounding in the principles and methods of inspection before they can do a competent job.
- This gives them the basic skills and helps to provide the self-confidence needed to lead such a potentially contentious activity.

# Inspection Training

- As for the participants, training is also highly desirable.
- If a competent moderator is available, however, the software professionals can often learn how to be inspectors by participating in well-run inspections.



# Inspection Training

- Courses should teach **inspection principles** and provide **practice sessions** with the **checklists and methods** involved.
- After the initial moderator training needs have been met, it is then desirable to **broaden the training program** to include all **potential inspection participants**.

# Reports and Tracking

- There are several reasons for **gathering data** and **making reports** on the inspection process.
  - It is essential to track **inspection completions** to ensure they are done as required.
  - Much can be learned about **inspection effectiveness** from a brief study of the data gathered.
  - **Inspection metrics** and **data gathering** are discussed in more detail in Chapter 15.
  - Inspection Report [Table 10.4]
  - Inspection Summary [Table 10.5]

# Reports and Tracking

- Inspection Report [Table 10.4]
  - Project
  - System name
  - Moderator
  - Meeting type (overview, reinspection, requirements, design, code)
  - Number of inspections, inspection duration
  - Total number of reviewers, inspection prep time
  - Total lines inspected, pages of diagrams
  - Disposition (accept, conditional, reinspect)
  - Reviewers
  - Producers
  - Recorder

# Reports and Tracking

- Inspection Summary [Table 10.5]
  - Project, System name
  - Moderator
  - Meeting type (overview, reinspection, requirements, design, code)
  - Major errors, minor errors (function, interface, data, logic, i/o, performance, maintenance, standards, documentation, human factors, syntax, other)
  - Distribution (project manager, QA, process group, producers, review coordinator)

# Other Considerations

- Since well-run inspections require intense concentration from all participants, they can be very tiring.
- As a result, inspection sessions should generally not exceed about two hours.
- Inspections involving the same people should not be scheduled back-to-back since the participants will often be too tired to be fully productive.

# Other Considerations

- One inspection session a day is generally all that is advisable for any one individual.
- The moderator should check on this at the time the inspection is scheduled

# Other Considerations

- It is also helpful to **assign some inspectors to specific product areas** for the project duration.
- If the assignment is done early in the design phase and maintained for the entire project, **the inspector's growing product knowledge** will greatly facilitate **inspection productivity and quality**.
- It is wise to **include some new reviewers in each inspection**, so that they may **not** lose their ability to see the problems.

# Other Considerations

- It is **rarely desirable** to cover two different designs at the same time.
  - The work should be **split into two inspections**, even if each will take less than one hour.
- It is also wise to **focus on the quality of the result being produced** rather than on the number of errors being found.
  - **Errors are a fact of life that must be expected.**
  - The need is to **improve the methods and tools** the SW professionals use so the most prevalent error causes can be reduced or eliminated.



# Other Considerations

- Some types of errors cannot be found very efficiently by inspections.
- If, for example, a large number of minor errors were found during preparation, it is wise to discontinue the inspection and have the producers desk check their work more carefully before starting again.
  - It is often helpful to ask one or more of the more experienced reviewers to assist the producers while they recheck.
  - When reviewers become embroiled in minor details, they often overlook more important problems.

# Initiating an Inspection Program

- Inspections have been installed successfully in many organizations with very positive results.
- The way the inspection program is introduced, however, can have an important impact on its effectiveness.

# Initiating an Inspection Program

- The **AT&T Bell Laboratories** introduced inspections in conjunction with an extensive program of education and consultation (reported in 1984, 1986).
  - Select a **location and a key project** for the initial effort.
  - Introduce the concept of inspections to **the managers and key professionals** in a three- to five-hour overview session.
  - Form a **working team** with one or two project members to determine **training requirements**, develop **the needed forms and procedures**, and establish **the introduction plan**.

# Initiating an Inspection Program

- If trained moderators are not available, conduct a **two- to three-day moderator** training class.
- A **two-day developer workshop** is held to introduce the methods and obtain the support of the professional personnel who will use them.
- After a couple of months' experience in conducting inspections, a **management seminar** is held to outline the results and emphasize the need for continuing management support.
- Periodically, the inspection program is **assessed** and any indicated changes made.

# Initiating an Inspection Program

- After the initial project has obtained some early success, inspections are **introduced throughout the organization**.
- The final implementation step is to **incorporate the use of inspections into the organization's official development process and establish an SQA monitoring program to advise management whenever the established procedures are not followed**.

# Inspection Costs

- The effectiveness of inspections depends on the time and effort spent in preparing for and conducting them.
- Optimum inspection rates depend on the type of product involved and the skill and experience of the people doing them.
- Sample Rates for Software Inspections [Table 10.6]
- Relative Inspection Rates with Experience [Table 10.7]

# Inspection Benefits

- There are many examples of inspection quality and productivity benefits, and there are no documented cases of poor experience.
- This, of course, is partly due to people's natural reluctance to write about project failure.

# Inspection Benefits

- The cases in which inspections have **not been effective** have generally had **errors in the way they were conducted**.
- Either the preparation was **not adequate**, **too many people** were involved, the **wrong people** attended, or **too much material** was covered at one time.
- The biggest single problem is generally the combination of **management inattention** and **schedule pressure**.



# Inspection Benefits

- It is becoming clear, however, that **inspections can be highly effective** and that they should be widely used in software development and maintenance.
- The textbook includes many successful stories.
- COBOL program quality before and after code inspection [Table 10.8]
  - A dramatic improvement that can be expected at the initial use of inspection
- Error prevention or detection probabilities [Table 10.9]
  - What techniques could have been used to prevent or detect errors prior to program shipment?

# Inspection Benefits

- Clearly, **inspections** are an important way to **find errors**.
- Not only are they **more effective than testing** for finding many types of problems, but they also **find them earlier** in the program when the cost of making the corrections is far less.
- **Inspection** should be a **required part of every well-run software process**.
  - **Inspections** should be used for every software design, every program implementation, and every change made either during original development, in test, or in maintenance.

# Future Directions

- While inspections are highly cost-effective with the quality of the programs generally produced today, they are also labor-intensive.
  - Each inspection requires the concentrated involvement of a number of talented software professionals who together review each element of the product's design and implementation.
  - While newer, more productive techniques will likely be found, some form of inspections will undoubtedly be needed as long as SE remains a human-intensive process.

# References

Humphrey, Watts S., *Managing the Software Process*, The SEI Series in Software Engineering, Addison-Wesley, 1989. (29th Printing, May 2003) (ISBN 0-201-18095-2)