Technische Universität
Kaiserslautern

o1o1seda o1o1oo

software engineering dependability

Software Quality Assurance
Software Inspections and Reviews

Contents

- Definitions
- Why software inspections?
- Requirements for inspections
- Inspection team
- Inspection phases

Definitions

Manual quality assurance in three variants

- Review through sending documents to the review team members
  - Fast, cheap, flexible, low performance
- Structured walkthrough
  - Medium use of resources and moderate performance
- Fagan inspection
  - Expensive and time consuming, but efficient and effective

Definitions

- Software inspection
  - Manual quality control of a product
  - Small group of participants with defined roles
  - Aims at the detection of faults, not at finding the solutions
  - Requires a functioning development process
  - Executed as a formal process
    - Input and output criteria
    - Defined inspection phases
    - Skilled participants
    - Collection and analysis of inspection data including feedback to the inspection process
    - Fault documentation
    - Objectives for the results (e.g. Fault detection rates, inspection rate)
- An inspection can be executed in every phase of a software development (inspection of the requirements, inspection of the design, inspection of the source codes, inspection of test cases)

Definitions

- Reviews
  - “Review” refers to methods which are no formal inspection. Partially, review is used in the literature as a generic term for all manual test methods (formal inspection included)
  - Often not only focused on the efficient detection of faults, but also as a means for
    - decision making
    - solving of conflicts (e.g. concerning design decisions)
    - exchange of information
    - brainstorming
  - Normally no formal procedure exists for the execution and the choice of the participants as well as their roles
  - Often no record and analysis of review data
  - Often no quantitative objectives

- Comparison of efficiency and effectiveness of different inspection and review techniques according to Thaler and Utesch

Review techniques	Efficiency (faults / person hour)	Effectiveness (faults / kNLoC)
Comment technique	0.05	0.1
Walkthrough	0.08	0.8
Software inspection	0.17	7.8

- Comparison of efficiency and effectiveness of different inspection and review techniques according to Thaler and Utesch

Review techniques	NLoC	faults	Effort (person hours)	Efficiency (faults / effort)	Effectiveness (faults / kNLoC)
Software inspection	11909	87	501	0.17	7.3
Walkthrough	176391	226	2680	0.05	1.3
Developer test	188300	334	6112	0.08	1.8

Definitions

- The main differences between reviews respectively walkthroughs and formal software inspections are:
  - Inspections have the sole aim to detect faults efficiently and effectively
  - Inspections are done as a defined process

Why Software Inspections?

- Many quality characteristics – e.g. understandability, changeability, informational value of identifiers and comments – are testable only manually
- Undetected faults from the definition and design phase later cause high consequential costs
- As inspections are executed in a team, the knowledge base is enhanced
- Implementation of the principle of external quality control
- Delivery of high-quality results to the subsequent software development phase (milestone)
- Responsibility for the quality is assigned to the whole team

Why Software Inspections?

- Manual testing of products is a useful complement of tool supported tests
- The compliance to standards is permanently monitored
- Critical product components are detected early
- Every successful inspection is a milestone in the project
- Every member of the inspection team becomes acquainted with the work methods of his colleagues
- As several persons inspect the products, the authors try to use an understandable style
- Different products of the same author contain fewer defects from inspection to inspection
- It turned out that functioning inspections are a very efficient means for quality assurance

Requirements for Inspections

- The required time has to be scheduled ➔ project planning
- The participants have to be skilled w.r.t. inspections
- The procedure of the inspections has to be written down and their observance has to be controlled
- The project has to be done well-structured and controlled
- There has to be a quality management process with defined quality objectives
- **The results of inspections must not be used in personnel evaluation**
- The period between registration and execution of an inspection has to be short, i.e., inspections are executed with high priority

Inspection Team

- Moderator
  - Accepted specialist with special training as moderator
  - Chairs meeting and controls that the inspection is executed according to the scheduled procedure
- Author (editor)
  - Is responsible for the correction of faults detected during the inspection and normally has generated the product to be tested
  - The author is never the moderator, reader or recorder
- Reader
  - Leads the inspection team through the session
  - Has to be able to describe illustratively the different parts of the work

Inspection Team

- Recorder
  - Notes and classifies all faults and supports the moderator with the making of the remaining reports
- Inspectors
  - All members of the inspection team (also the moderator, author, reader, and recorder) are inspectors whose aim has to be the detection of faults
  - Further inspectors can be, e.g.
    - project members from the same project
    - consultants (standards!)
    - system specialists
- Size of the review team: 3 to 7 members

Inspection Team

- The minimal number of participants in inspections is 3 (moderator/recorder, reader, author)
- If only 3 persons form an inspection team, the moderator is always the recorder at the same time
- In every inspection there is an author
- The inspection team should be as small as possible (max. 7 persons). Everybody should bring in a unique expertise. Additional participants reduce the efficiency and effectiveness of the inspection
- Inspections are a Peer-to-Peer technique. Managers should not participate

Inspection Phases

- Planning: Organizational preparation
- Overview: The author informs
- Preparation: Every inspector prepares
- Inspection meeting
- Rework: Fault correction
- Follow-up: Inspection of the fault corrections

Inspection Phases
Inspection Planning

- Planning is done at the start of the project. Time, resources, involved persons, etc. must be assigned
- The author informs the moderator that his product is ready for inspection
- The moderator checks whether the product fulfills the input criteria (usually very simple things, like „no syntax errors“)
- If the product does not fulfill the input criteria the moderator informs the author about the required modifications
- Finally, the moderator invites

Inspection Phases Overview

- The overview is optional. It serves as information for the inspectors about the product. The following reasons may exist for an overview
  - The product is critical inside the project, i.e., it has a key position
  - The product is extensive, complex or is connected to numerous other positions
  - The used technology is new
  - etc.
- The overview normally takes roughly 2 to 3 hours
- Faults already detected during the overview have to be corrected before the material is distributed to the inspectors for preparation
- According to Fagan the working rate for the overview should be 500 NLoC (LoC without comment lines) per hour

Inspection Phases
Preparation of Inspection

- Every inspector individually prepares for the inspection meeting and formlessly notes down all detected faults and ambiguities
- For this purpose every inspector gets a complete set of the required documents
- The documents must not be changed until the review
- There should be a guide value for the preparation rate to schedule the preparation time
  - Too low values cause an insufficient knowledge of the inspectors during the inspection meeting
  - Too high preparation times reduce the efficiency
- The main objective of the preparation is the understanding of the product, not fault detection
- According to Fagan the preparation rate should be 125 NLoC/hour

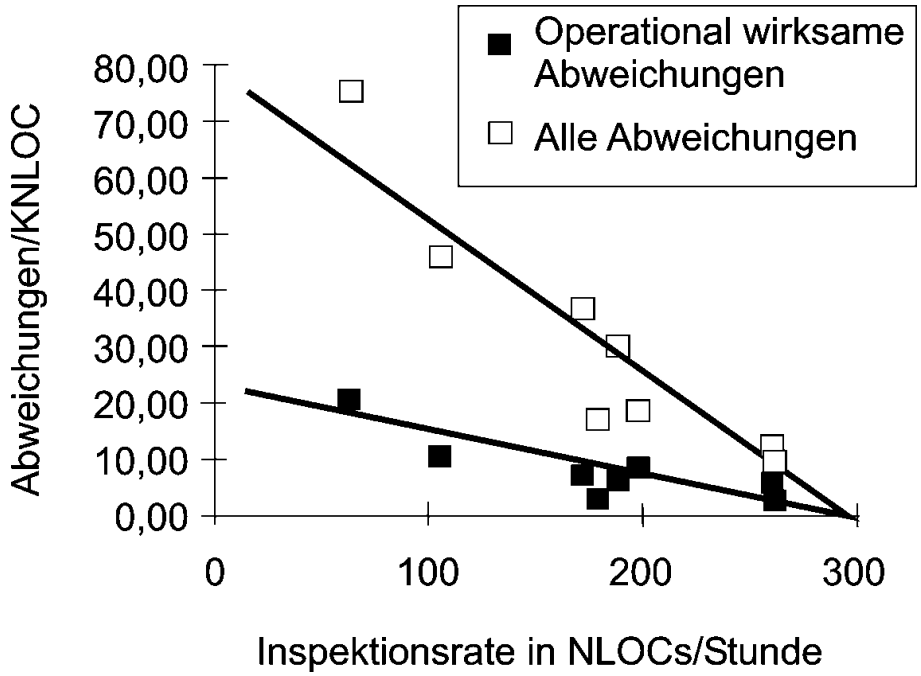
Inspection Phases
The Inspection Meeting

- The moderator introduces the agenda of the meeting and introduces the participants and their roles
- The reader reads through the documents explaining the content, with appropriate speed and piecewise
- The inspectors search for faults during the talk
- Discussions are allowed only concerning faults and their types. The moderator has to make sure that all inspectors concentrate on the fault detection
- Detected faults are classified if possible (type, priority) and noted by the recorder
- The author answers questions
- Checklists can facilitate and systematize the inspection

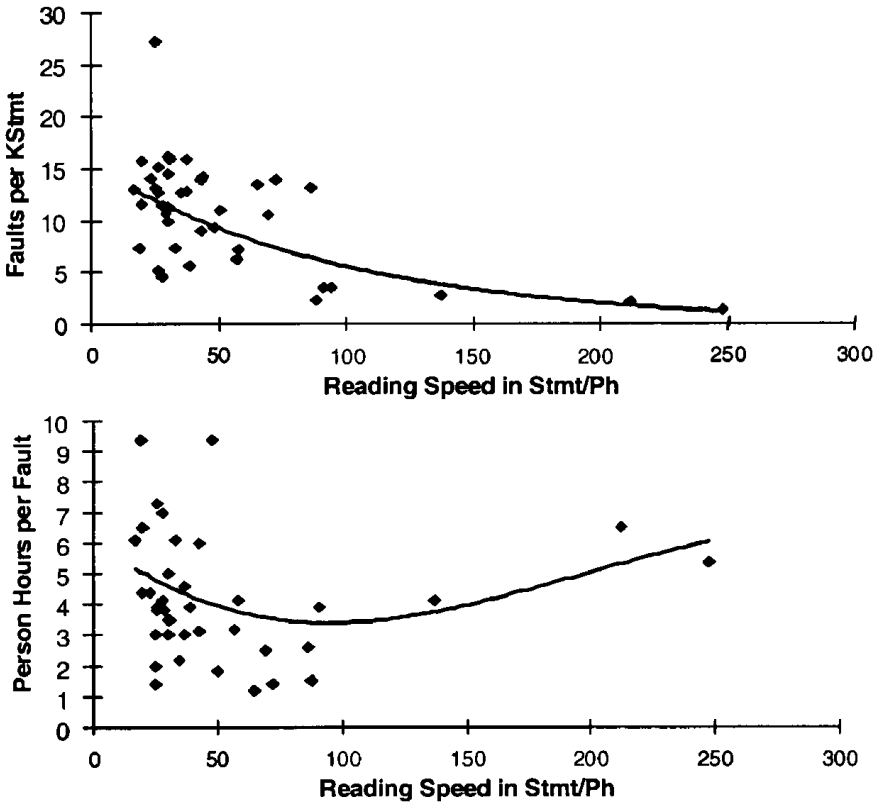
Inspection Phases
The Inspection Meeting

- The goal of the inspection is synergy for the purpose of fault detection. Maximum duration: 2 to 3 hours
- There should be a guideline for the inspection speed (e.g. NLoC/hour)
- It is determined whether the product is accepted, conditionally accepted or a reinspection is required
- According to Fagan the inspection rate should be 90 NLoC/hour
- The maximum inspection rate should not exceed 125 NLoC/hour

- Empirical results from Thaler and Utesch show that with a sinking inspection rate the effectiveness of an inspection rises



- Empirical data from Ebert shows that with a sinking inspection rate the effectiveness of an inspection rises
- With a sinking inspection rate the efficiency first rises to a maximum value and sinks with further sinking inspection rate
- According to Ebert to optimum lies at approximately 90 statements per person hour



Inspection Phases
Rework of Inspection

- The author corrects the faults listed in the inspection protocol
  - Fault correction
  - Initiation of a fault correction elsewhere if a correction by the author is not directly possible (e.g. faulty requirement detected in the code inspection)
  - It turns out that an assumed faulty position is correct. A comment of the author in the follow-up is necessary
  - It is possible that faults should not be corrected directly. The fault is then put into the change request system to be dealt with later
- The author gives the revised version of the product to the moderator, if the product was conditionally accepted in the inspection meeting or a reinspection is necessary
- If the product was accepted, this phase is completed. The product is brought under configuration control

Inspection Phases
Follow-Up of Inspection

- If the product was conditionally accepted during the inspection meeting the verification can be done, e.g., by the author and the reader alone
- If a reinspection was decided a conventional inspection meeting takes place that is focused on the faults
- Inspection reports are to be made

Literature

- Fagan M.E., Design and code inspections to reduce errors in program development, IBM Syst. J., No. 3, 1976, pp. 182-211
- Fagan M.E., Advances in Software Inspections, in: IEEE Transactions of Software Engineering, Vol. SE-12, No. 7, July 1986, pp. 744-751
- Ebert C., Improving the Validation Process for a Better Field Quality in a Product Line Architecture, Proceedings Informatik 2000, Berlin, Heidelberg, New York: Springer, 2000, S. 372 – 388
- Gilb T., Graham D., Software Inspection, Menlo Park: Addison-Wesley 1993
- Thaler M., Utesch M., Effektivität und Effizienz von Softwareinspektionen, in: Müllerburg et al. (Hrsg.), Test, Analyse und Verifikation von Software, GMD-Bericht Nr. 260, München, Wien: Oldenbourg, 1996, S. 183 – 196
- Yourdon E., Structured Walkthroughs, Englewood Cliffs: Prentice-Hall 1985