



IT-309 SYSTEMS INTEGRATION & ARCHITECTURE 1

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Lecture 5- Testing Life Cycle & Techniques

03

Test Plan Creation



How to create test plan?

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Test Types

Terms:

- Black-box testing
- Code coverage
- Functional testing
- Interoperability testing
- Load testing

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- Maintainability testing
- Performance testing
- Portability testing
- Reliability testing
- Security testing
- Stress testing

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- Structural testing
- Usability testing
- White-box testing



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Background

A test type is focused on a particular test objective, which could be any of the following:

- A function to be performed by the software
 - Specified by a process flow model, a state transition model, or a plain language specification

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- A non-functional quality characteristic, such as reliability or usability
 - Specified by a performance model or a usability model
- The structure or architecture of the software or system
 - Specified by a control flow model or a menu structure model

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- Change related
 - i.e., confirming that defects have been fixed (confirmation testing) and looking for unintended changes (regression testing)

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Testing of Function (Functional Testing)

- WHAT the system does?
- Functional tests are based on functions and features (described in documents or understood by the testers) and their interoperability with specific systems
- May be performed at all test levels

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- Specification-based techniques may be used to derive test conditions and test cases from the functionality of the software or system
- Considers the external behavior of the software (black-box testing).

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Types of Functional Testing

- Security testing
 - Investigates the functions (e.g., a firewall) relating to detection of threats, such as viruses, from malicious outsiders.

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- Interoperability testing
 - Evaluates the capability of the software product to interact with one or more specified components or systems.

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Non-functional Testing

- Non-functional testing includes, but is not limited to, performance testing, load testing, stress testing, usability testing, maintainability testing, reliability testing and portability testing.
- It is the testing of “HOW” the system works.

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- May be performed at all test levels
- Describes the tests required to measure characteristics of systems and software that can be quantified on a varying scale, such as response times for performance testing.
- Considers the external behavior of the software and in most cases uses black-box test design techniques to accomplish that.

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Structural Testing

- Structural (white-box) testing may be performed at all test levels.
- Best used after specification-based techniques, in order to help measure the **thoroughness of testing** through assessment of coverage of a type of structure.

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- Tools can be used to measure the code coverage of elements, such as statements or decisions.
- Structural testing may be based on the architecture of the system, such as a calling hierarchy.

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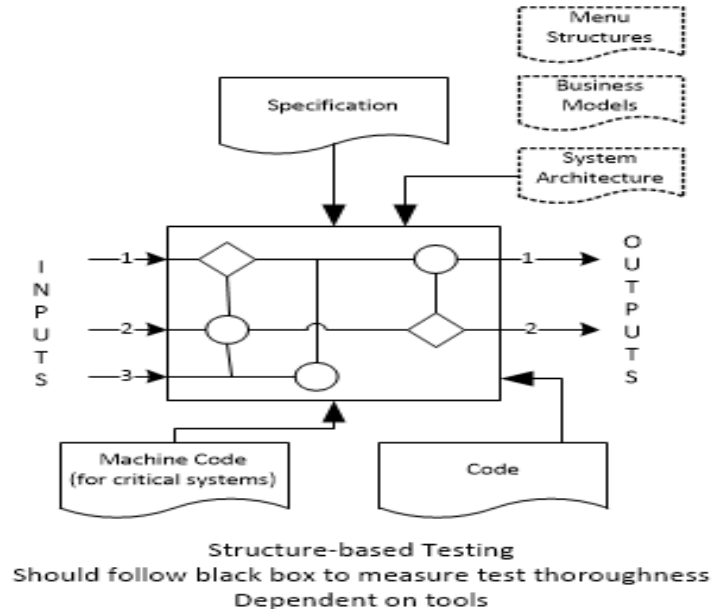
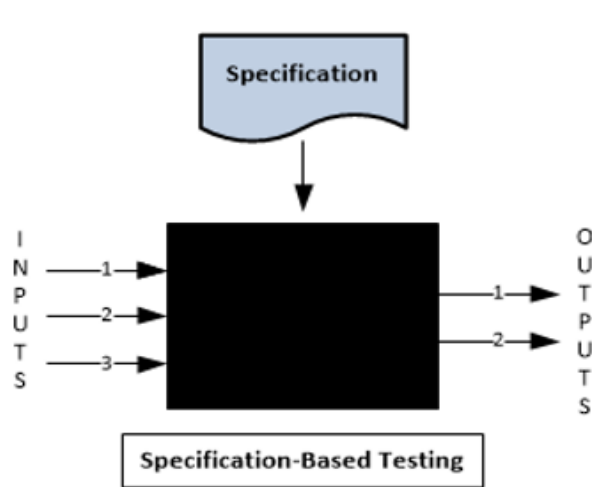
- Structural testing approaches can also be applied at system, system integration or acceptance testing levels (e.g., to business models or menu structures).

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Black and White Box Testing

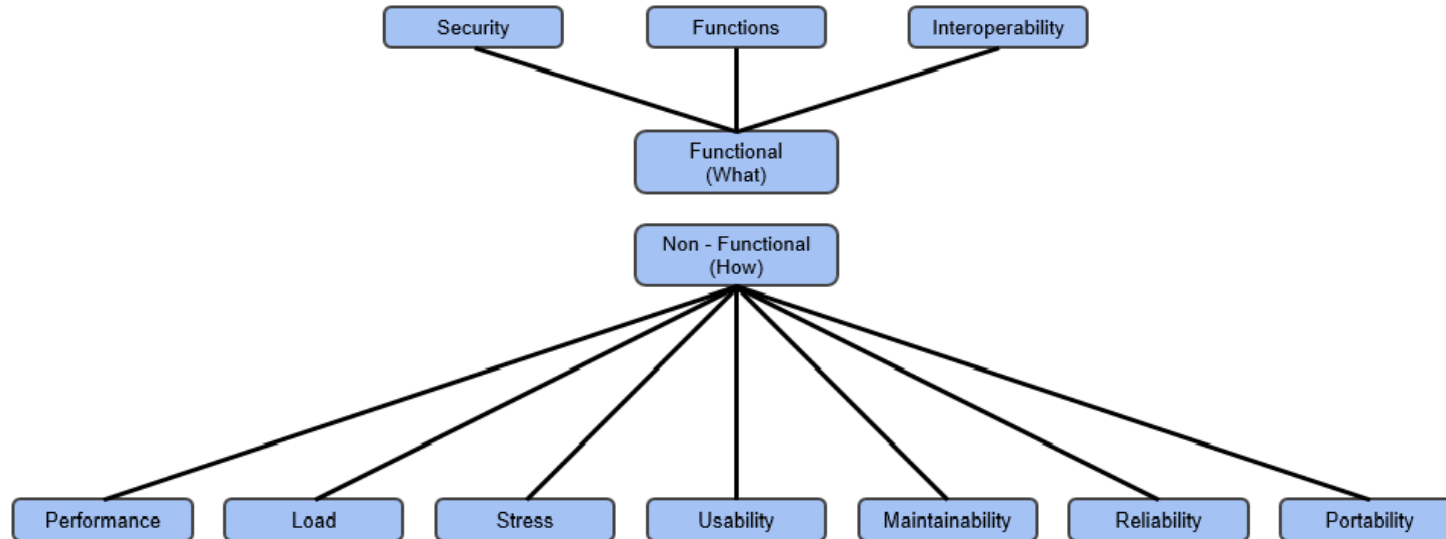


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Functional and Non-Functional Testing



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Testing Related to Changes : Re-testing and Regression Testing

- Confirmation Testing
 - After a defect is detected and fixed, the software should be re-tested to confirm that the original defect has been successfully removed.

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- Debugging (locating and fixing a defect) is a development activity, not a testing activity.
- Regression testing
 - The repeated testing of an already tested program, after modification, to discover any defects introduced or uncovered as a result of the change(s).

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- Performed when the software, or its environment, is changed.
- The extent of regression testing is based on the risk of not finding defects in software that was working previously.

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Testing Related to Changes : Re-testing and Regression Testing

- Tests should be repeatable if they are to be used for confirmation testing and to assist regression testing.

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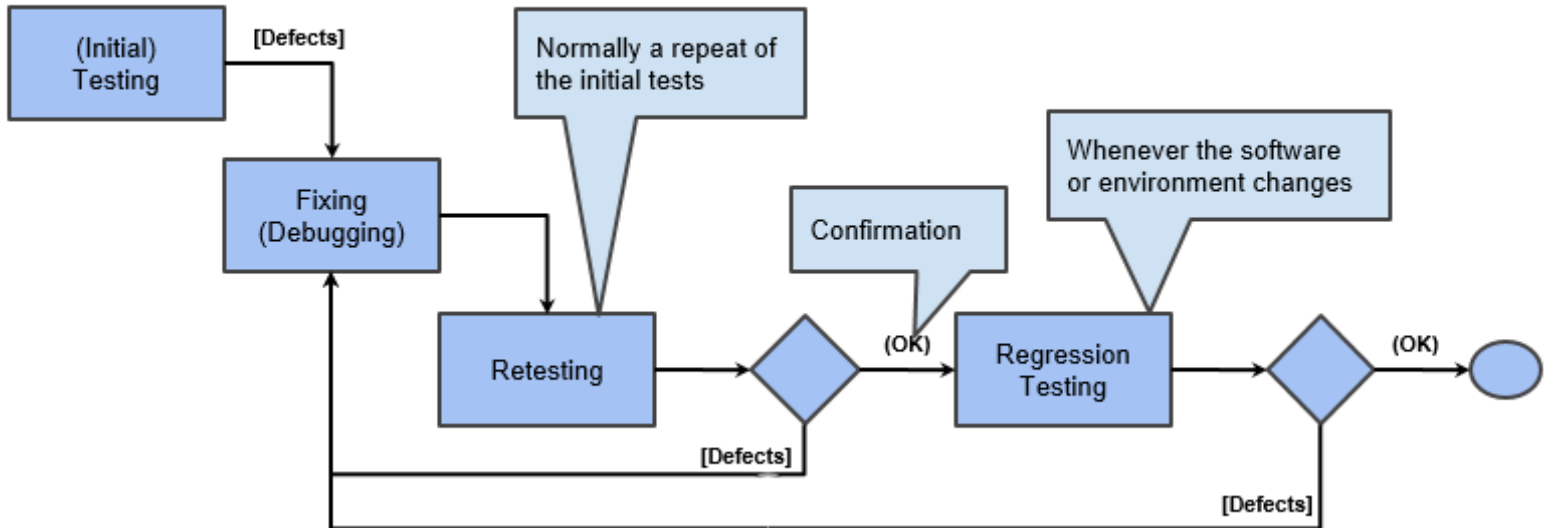
- Regression testing may be performed at all test levels, and includes functional, non-functional and structural testing.
- Regression test suites are run many times and generally evolve slowly, so regression testing is a strong candidate for automation.

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Testing, Retesting and Regression Testing



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Testing, Retesting and Regression Testing

- Applies at all test levels
- Repeatable tests are useful for retesting and regression testing
- Automated tests are especially useful for regression testing`

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Maintenance Testing

Terms

- Impact Analysis
- Maintenance Testing

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Background

- Maintenance testing is done on an existing operational system, and is triggered by modifications, migration, or retirement of the software or system.

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- Modifications include
 - Planned enhancement changes
 - Corrective and emergency changes
 - Changes to environment (upgrade to OS, db, or COTS)
 - Patches to correct newly-exposed vulnerabilities

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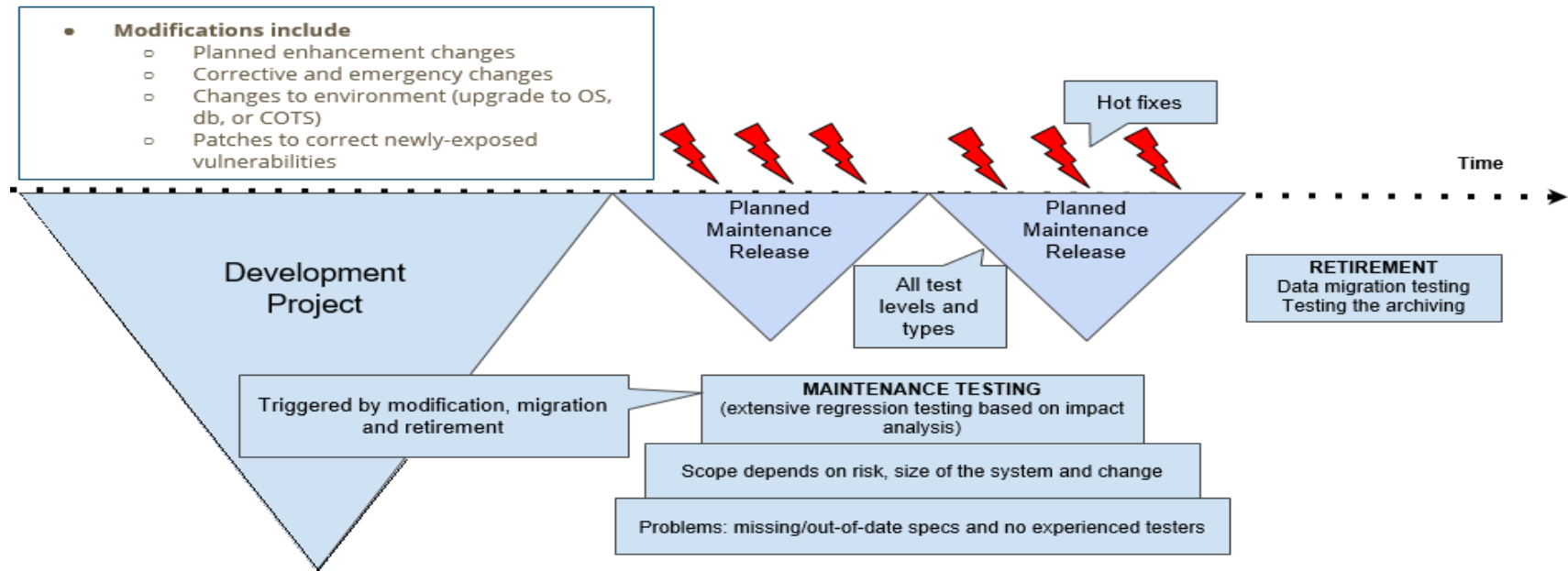
- Maintenance testing for the retirement of a system may include the testing of data migration or archiving if long data-retention periods are required.

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Maintenance Testing



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Static Techniques and the Test Process

Static testing techniques rely on the manual examination (reviews) and automated analysis (static analysis) of the code or other project documentation without the execution of the code.

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Static Testing

- Testing of a software development artifact (e.g. requirements, design or code), without execution of these artifacts (e.g. reviews or static analysis)

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Static Testing

Reviews, static analysis and dynamic testing are complementary and have the same objective - identifying defects

- Static test techniques find the defects directly
- Dynamic test techniques identify failures, from which defect are then found

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A way of testing software work products (including code) and can be performed well before dynamic test execution

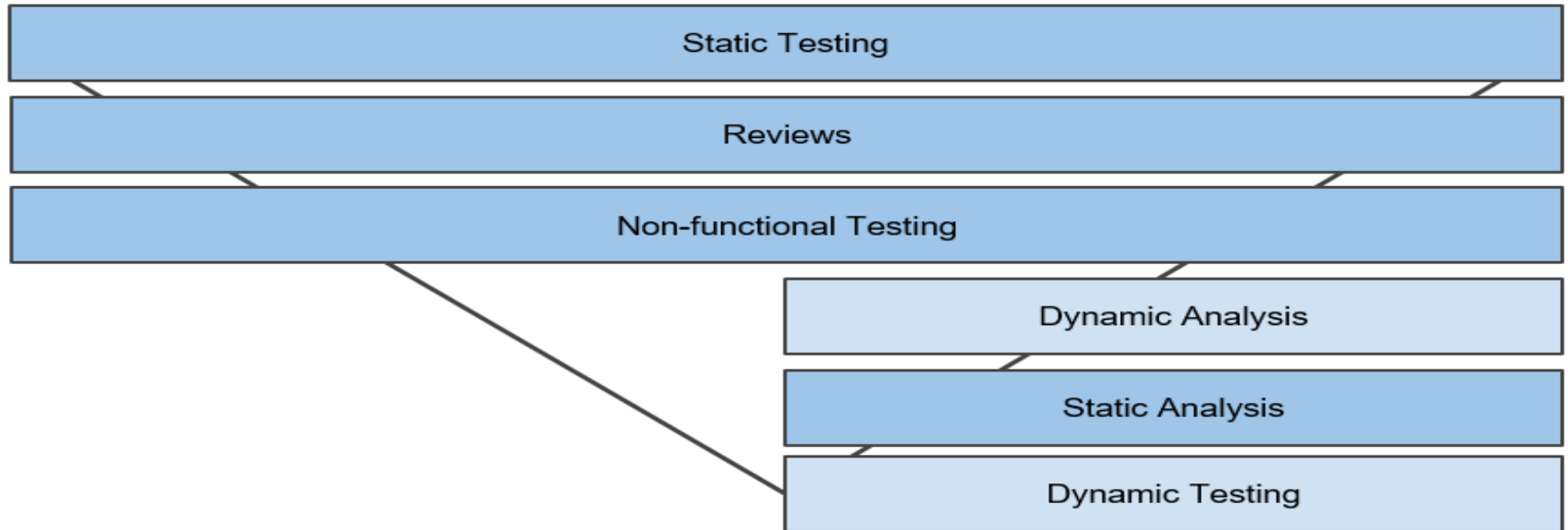
- Defects detected during reviews early in the life cycle (e.g., defects found in requirements) are often much cheaper to remove than those detected by running tests on the executing code.

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Test Types Across the Lifecycle



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Review Process

Terms

- Entry Criteria
- Formal review
- Informal review
- Inspection

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- metric
- Moderator
- Peer review
- Reviewer
- Scribe
- Technical review
- walkthrough

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Reviews

- Any software work product can be reviewed, including:
 - Requirements specifications, design specifications, code
 - Test plans, test specifications, test cases, test scripts
 - User guides or web pages

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- ***Benefits of reviews***

- Early defect detection and correction
- Development productivity improvements
- Reduced development timescales
- Reduced testing cost and time
- Lifetime cost reductions
- Fewer defects and improve communication

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Reviews - Typical Defects

Typical defects that are easier to find in reviews than in dynamic testing include:

- Deviation from standards
- Requirements defect
- Design defects
- Insufficient maintainability

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Reviews - Typical Defects

Typical defects that are easier to find in reviews than in dynamic testing include:

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- Incorrect interface specification

Reviews can find omissions

- For example, in requirements, which are unlikely to be found in dynamic testing

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Review Effectiveness

Reviews should be the single biggest, most cost-effective, contributor to overall delivered quality

- Reviews find defects whereas dynamic testing finds failures (so the defects are easier to remove)

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- Reviews can be used earlier in the life cycle and so there is less rework to do

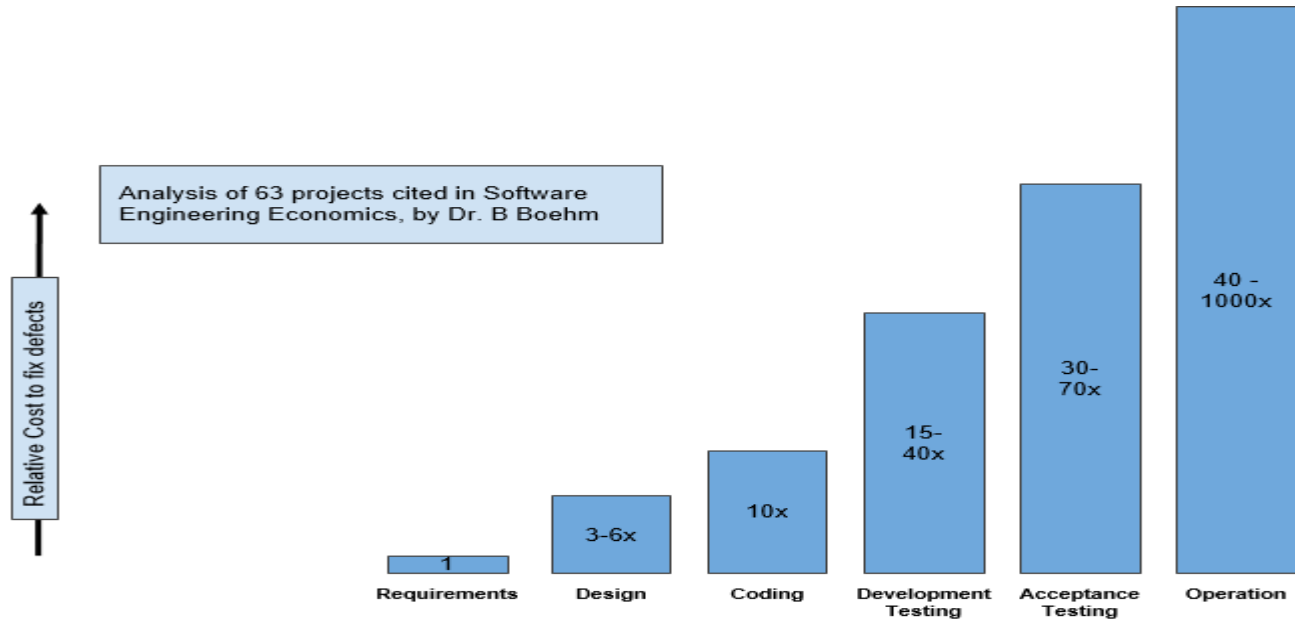
The 'best' defect detection rate reported for reviews of development is about 95%

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Cost of Fix and Rework



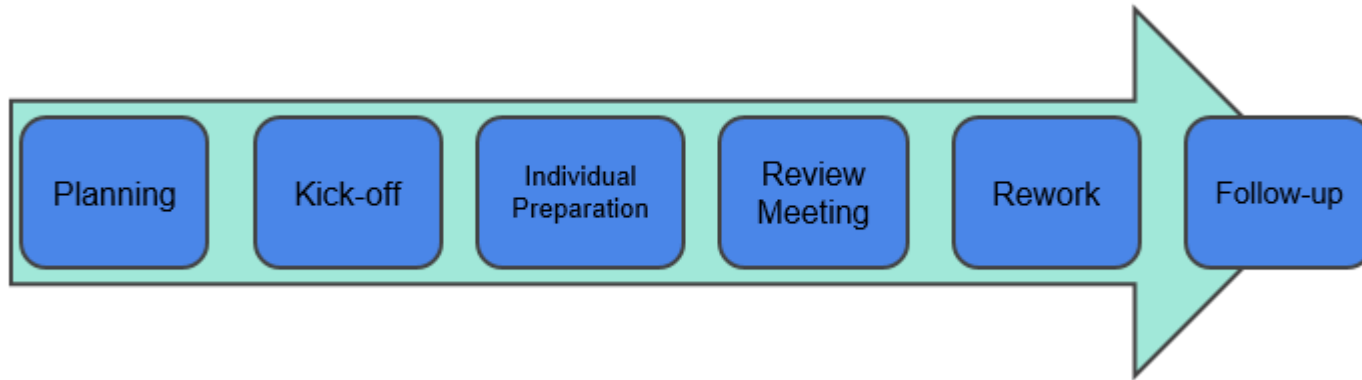
The cost of fixing defects increases dramatically the later it gets

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ISTQB Formal Review Process

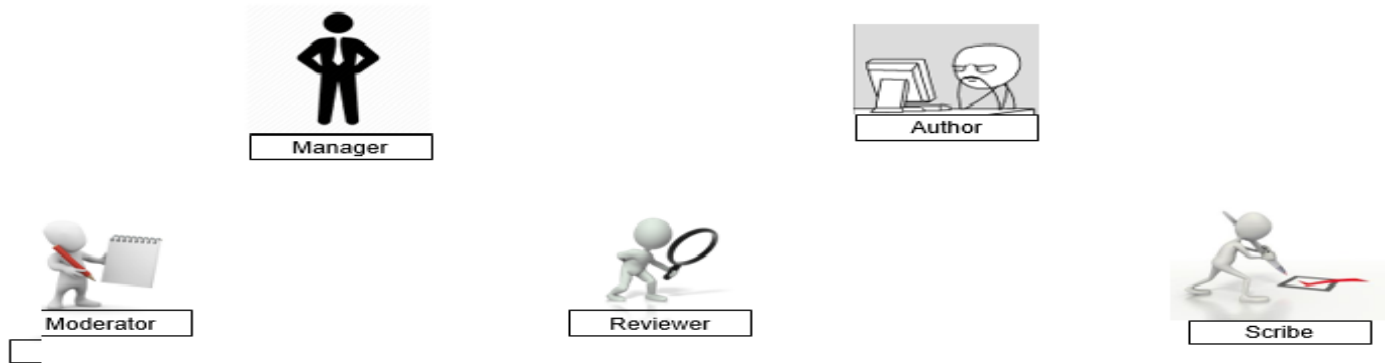


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Formal Review - Roles



Planning

Kick-off

Individual
Preparation

Review
Meeting

Rework

Follow-up

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Activities of a Formal Review

| Activities | Roles | Tasks |
|------------------------|--|--|
| | | (* only for more formal review types, like inspections) |
| Planning | Manager | <ul style="list-style-type: none">• Defining the Review Criteria• Selecting the personnel, allocating roles• *Defining the entry and exit Criteria• Selecting which parts of the documents to review (most critical; importance)• *Checking Entry criteria |
| Kick-off | Moderator Reviewers Author | <ul style="list-style-type: none">• Distributing documents• Explaining the objectives, process and documents to participants |
| Individual Preparation | Reviewers | <ul style="list-style-type: none">• Preparing for the review meeting by reviewing the document(s)• Noting potential defects, questions and comments |
| Review Meeting | Moderator Reviewers Author Scribe | <ul style="list-style-type: none">• *Discussion or logging with documented results or minutes• Noting defects, making recommendations regarding handling the defects, or making decisions about the defects• Examining/evaluating and recording during any physical meetings or tracking any group electronic communications |
| Rework | Author | <ul style="list-style-type: none">• Fixing defects found, typically done by the author• *Recording updated status |
| Follow-up | Moderator | <ul style="list-style-type: none">• Checking that defects have been addressed• Gathering metrics• *Checking on exit criteria |

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Roles and Responsibilities

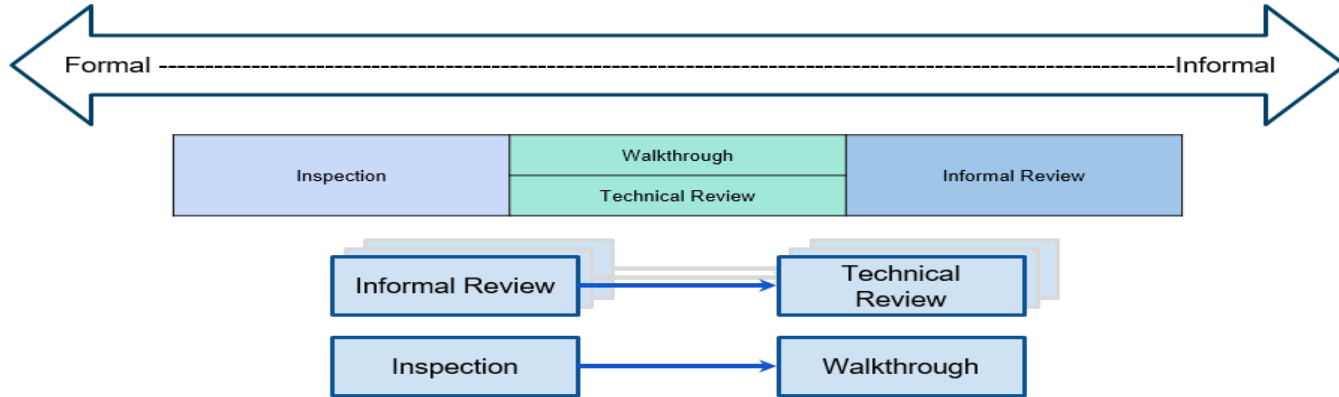
| Roles | Responsibilities |
|----------------------|--|
| Manager | <ul style="list-style-type: none">• Decides on the execution of reviews• Allocates time in project schedules• Determines if the review objectives have been met |
| Moderator | <ul style="list-style-type: none">• Leads the review of the document or set of documents• Plans and runs the meeting as well as follow-up after the review• Mediates between various points of view |
| Author | <ul style="list-style-type: none">• Writer or person with chief responsibility for the document/s to be reviewed |
| Reviewers | <ul style="list-style-type: none">• Individual with specific technical or business background• Identify and describe findings• Reviewers should be chosen to represent different perspective and roles |
| Scribe (or recorder) | <ul style="list-style-type: none">• Documents all the issues, problems, and open points that were identified during the meeting |

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Types of Reviews



Reviews can be used alone or in combination, as shown above

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Review Types

Informal Reviews

- Inexpensive way to get some benefit
- Results may be documented or not
- Its usefulness is dependent on reviewer skills
- E.g. Pair programming or technical lead reviewing designs and code

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Walkthrough

- To learn, gain understanding, find defects
- Meeting led by author
- Take the form of scenarios, dry runs, peer group participation
- Open-ended sessions
 - Optional pre-meeting preparation of reviewers

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- Optional preparation of a review report including list of findings
- Optional Scribe (who is not the author)
- Vary in practice from quite informal to very informal

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Review Types

Inspection

- To find defects
- Led by trained moderator (not the author)
- Usually conducted as a peer examination
- Formal process based on rules and checklists

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- Defined roles
- Includes metrics gathering
- Specified entry and exit criteria for acceptance of the software product
- Formal follow-up process
- Inspection report including list of findings

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- Pre-meeting preparation
- Optional
 - Process improvement components
 - Use of a Reader

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Success Factors for Reviews

- Each review has clear predefined objectives
- The right people for the review objectives are involved
- Suitable review techniques are applied to achieve the objectives for the type and level of software work products and reviewers.

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- Training is given in review techniques, especially the more formal techniques
- Checklists or roles are used if appropriate to increase effectiveness of defect identification
- Defects found are welcomed and expressed objectively

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- People issues and psychological aspects are dealt with
- Testers are valued reviewers who contribute to the review and also learn about the product which enables them to prepare tests earlier

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- The review is conducted in an atmosphere of trust; the outcome will not be used for the evaluation of the participants
- Management supports a good review process
- There is an emphasis on learning and process improvement

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Static Analysis by Tools

Terms:

- Compiler
- Complexity
- Control flow
- Data flow
- Static analysis

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Static Analysis

- Purpose
 - find defects in software source code and software models (by tools)
- Performed without actually executing the software being examined

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- We can analyze
 - Program codes (e.g. control flow and data flow) - normally done by the programmers
 - Generated outputs such as HTML and XML

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- Software models - normally done by designers
- Find defects rather than failure

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Value (Benefits) of Static Analysis

- Early detection of defects prior to test execution

Early warning about suspicious aspects of the code or design by the calculation of metrics, such as a high complexity measure

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- Identification of defects not easily found by dynamic testing
- Detecting dependencies and inconsistencies in software models such as links
- Improved maintainability of code and design
- Prevention of defects, if lessons are learned in development

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Static Analysis - Typical Defects

- Referencing a variable with an undefined value
- Inconsistent interfaces between modules and components
- Variables that are not used or are improperly declared

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- Unreachable (dead) code
- Missing and erroneous logic (potentially infinite loops)
- Overly complicated constructs
- Programming standards violations
- Security vulnerabilities
- Syntax violation of code and software models



THANK YOU FOR LISTENING