Software testing IN3240/4240

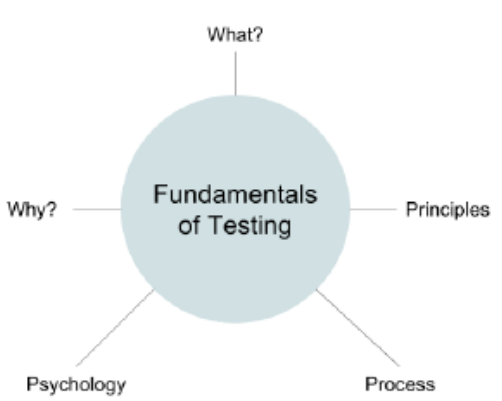
Chapter 03 – ISTQB syllabus

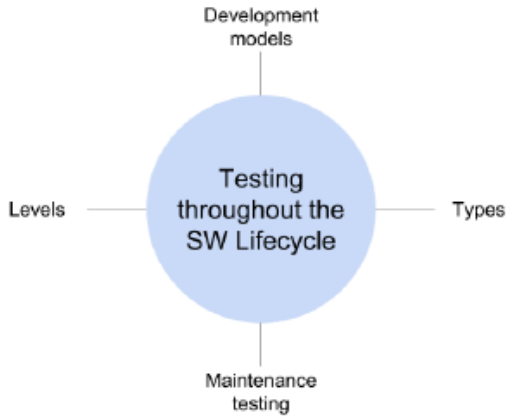
Static techniques

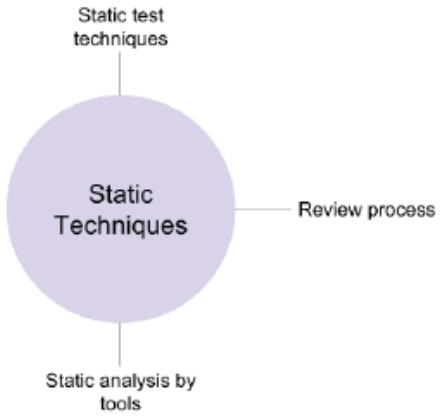
Static Techniques

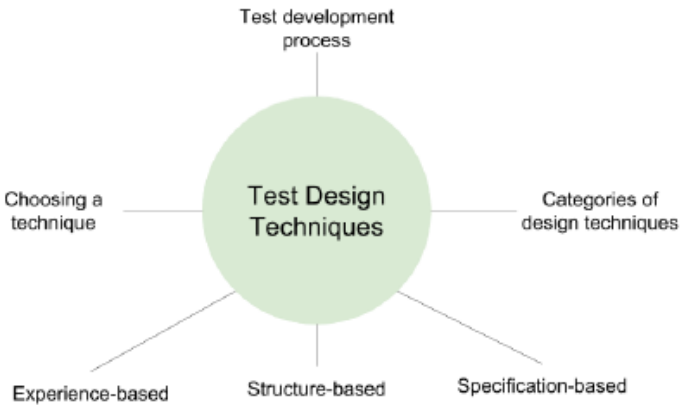
1. Static techniques and the test process
2. Static analysis by tools
3. Review process

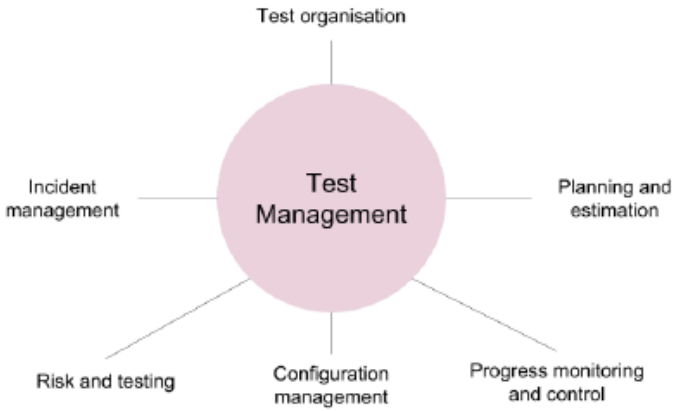
An Overview

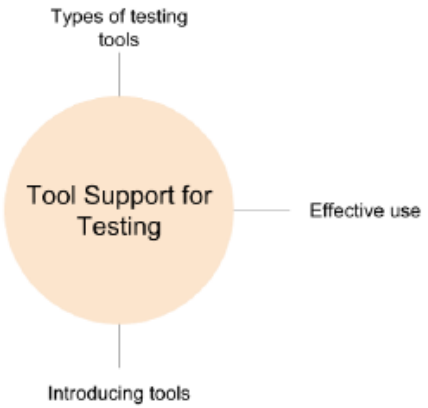

What?
Why?
Fundamentals of Testing
Principles
Psychology
Process

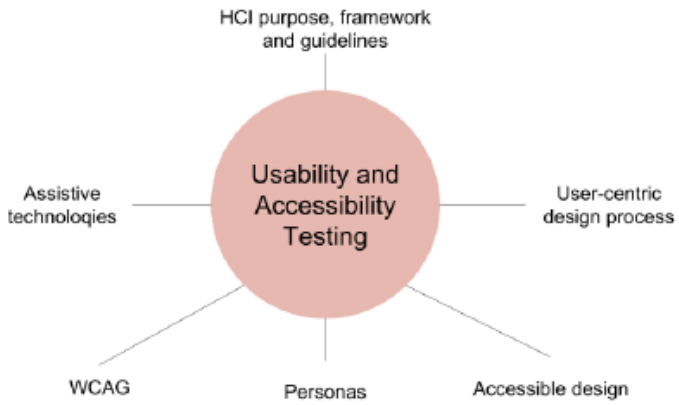

Development models
Levels
Testing throughout the SW Lifecycle
Types
Maintenance testing

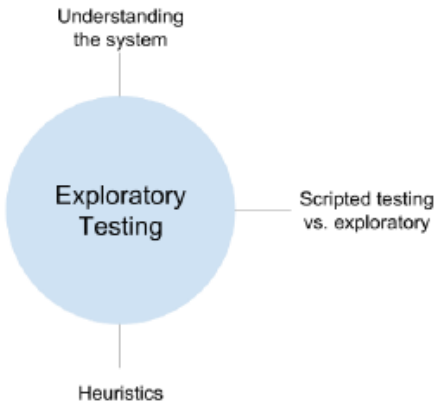

Static test techniques
Static Techniques
Review process
Static analysis by tools


Test development process
Choosing a technique
Test Design Techniques
Categories of design techniques
Experience-based
Structure-based
Specification-based


Test organisation
Incident management
Test Management
Planning and estimation
Risk and testing
Configuration management
Progress monitoring and control


Types of testing tools
Tool Support for Testing
Effective use
Introducing tools


HCI purpose, framework and guidelines
Assistive technoloqies
Usability and Accessibility Testing
User-centric design process
WCAG
Personas
Accessible design


Understanding the system
Exploratory Testing
Scripted testing vs. exploratory
Heuristics

Static Techniques

Know the difference between static and dynamic

Static testing



- Examination of code without executing it
- Can be applied to other work products

Dynamic testing



- Requires source code to be executed

1. Static Techniques and the Test Process

2. Review Process
- *2.1 Activities of a formal review*
- *2.2 Roles and responsibilities*
- *2.3 Types of reviews*
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- *2.5 Success factors for reviews*

3. Static Analysis by Tools

Static Techniques and the Test Process

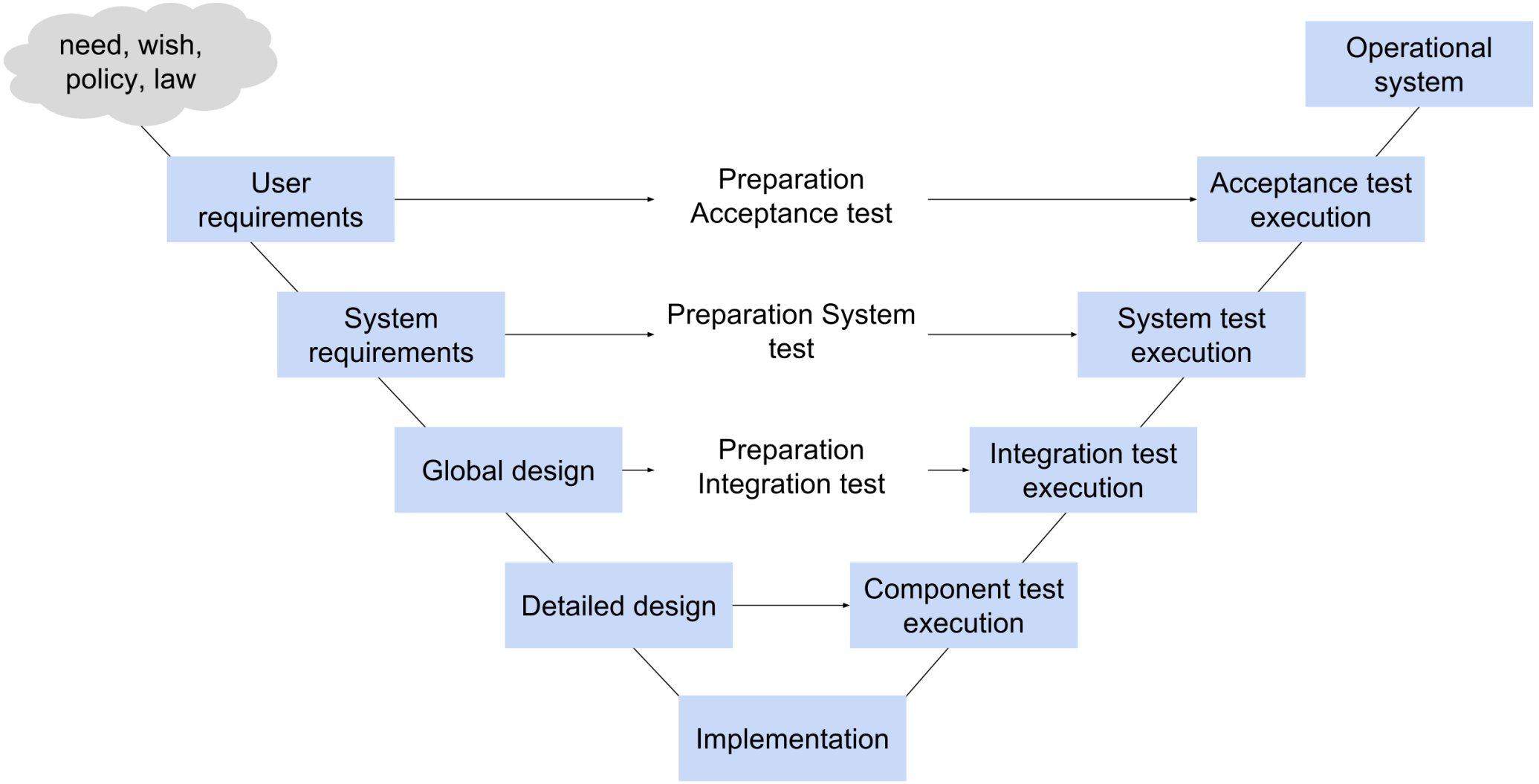
Dynamic testing - requires the execution of software under test.

Static testing - manual examination and automated analysis of the code or documentation without execution of the software under test.

Reviews - a way of testing software products (including code) and can be performed well before dynamic test execution.

Static analysis tools analyze program code

The V-model


need, wish, policy, law
User requirements
System requirements
Global design
Detailed design
Implementation
Component test execution
Integration test execution
System test execution
Acceptance test execution
Operational system
Preparation Acceptance test
Preparation System test
Preparation Integration test

Static Techniques

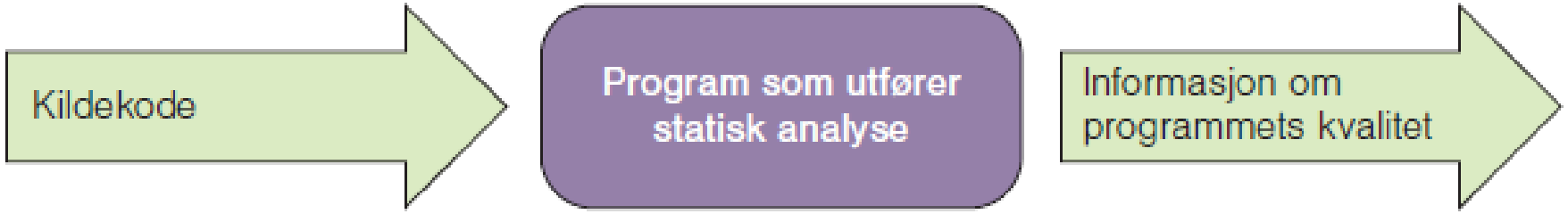
- Static and dynamic testing have the same objective: identifying defects.
- They are complementary.
- Compared to dynamic testing, static techniques find causes of failures (defects) rather than the failures themselves.

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Static Analysis by Tools



Static analysis is performed without actually executing the software being examined by the tool.

Static analysis tools analyze program code, as well as generated output such as HTML and XML.

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Static Analysis by Tools

Objectives of static analysis

Find defects and increase the quality of the

- software source code
- software models

***Note**! Static analysis finds defects rather than failures*

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Static Analysis by Tools

Typical defects discovered by static analysis tools include:

- referencing a variable with an undefined value
- inconsistent interface between modules and components
- variables that are never used
- unreachable (dead) code
- syntax violations of code and software models
- programming standards violations
- security vulnerabilities

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Static Analysis by Tools

Developers

Use static analysis before and during:

- Component testing
- Integration testing

Designers

Use static analysis during software modeling

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Static Analysis by Tools

Why is static analysis valuable?

- 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.
- 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.

1. Static Techniques and the Test Process

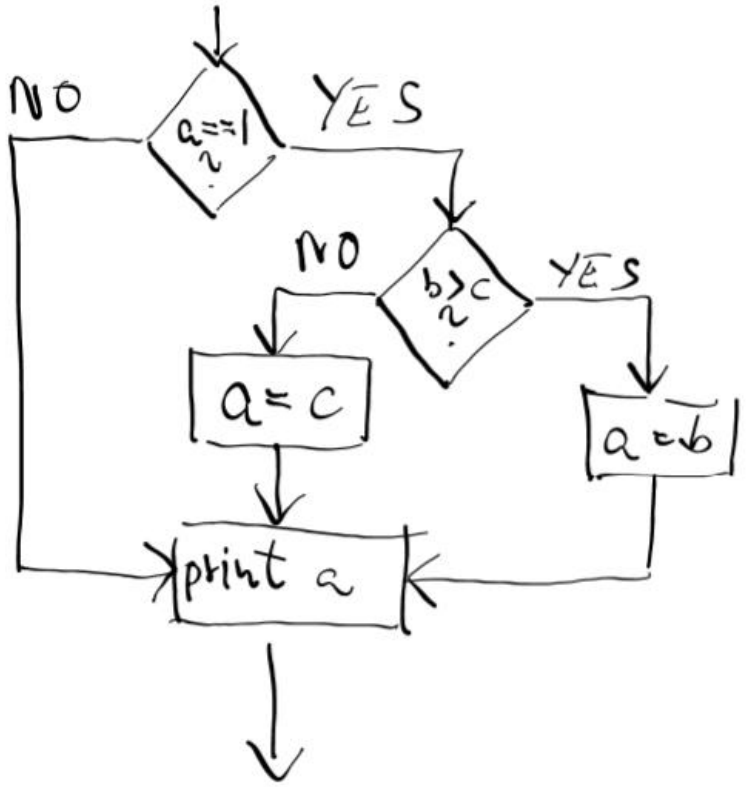
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3. Static Analysis by Tools

Static Analysis by Tools

Complexity can be measured in different ways, e.g. based on the number of decisions in the program (the number of binary decisions)

```
if( a == 1 )
{    if( b > c )
       a = b;
     else
       a = c;
}
System.out.println( a );
```



1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Static Analysis by Tools

Code structure

- Control flow structure

  The sequence in which the instructions are executed

- Data flow structure

  follows the trail of a data item as it is accessed and modified by the code

- Data structure

  The organization of the data itself , independent of the program (Array, list, stack, queue, tree, graph, …)

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Static Analysis by Tools

Coding standards

Recommended that existing **standards** should be adopted to save a lot of effort

- Naming conversions, e.g. class name should start with a Capital letter
- Access conversions, e.g. public/private
- Layout specifications, e.g. indents
- Set of programming rules, e.g. always check boundaries on an array when using it
- Checking tools supports code standards

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Static Analysis by Tools

Code metrics, e.g.

- Comments frequency
- Depth of nesting
- Cyclomatic complexity /complexity metrics.

1. Static Techniques and the Test Process

2. Review Process

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3. Static Analysis by Tools

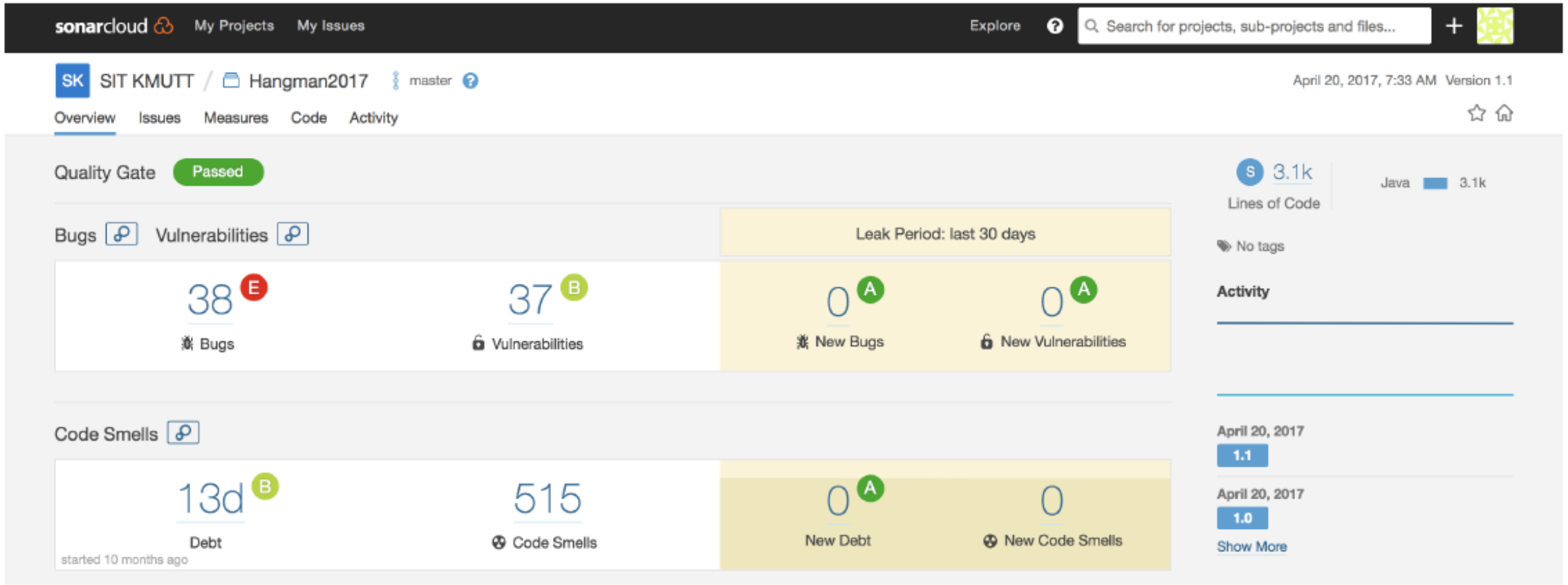
Static Analysis by Tools

Practical side

Static analysis tools may produce a large number of warning messages, which need to be well managed to allow the most effective use of the tool.

Example of Testing tools

sonarcloud



1. Static Techniques and the Test Process

2. Review Process
- *2.1 Activities of a formal review*
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3. Static Analysis by Tools

Reviews

Static testing - manual examination and automated analysis of the code or documentation without execution of the software under test.

Static analysis tools analyze program code

Reviews - a way of testing software products (including code) and can be performed well before dynamic test execution.

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3. Static Analysis by Tools

Reviews

Reason to make reviews

- Defects detected during reviews early in the life cycle are cheaper to remove than those detected while running tests.

- Reviews can find omissions, for example, in requirements, which are unlikely to be found in dynamic testing.

Tools (manual + tool support)

The main manual activity is to examine a work product and make comments about it.

1. Static Techniques and the Test Process

2. Review Process
- *2.1 Activities of a formal review*
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3. Static Analysis by Tools

Reviews

Reason to make reviews

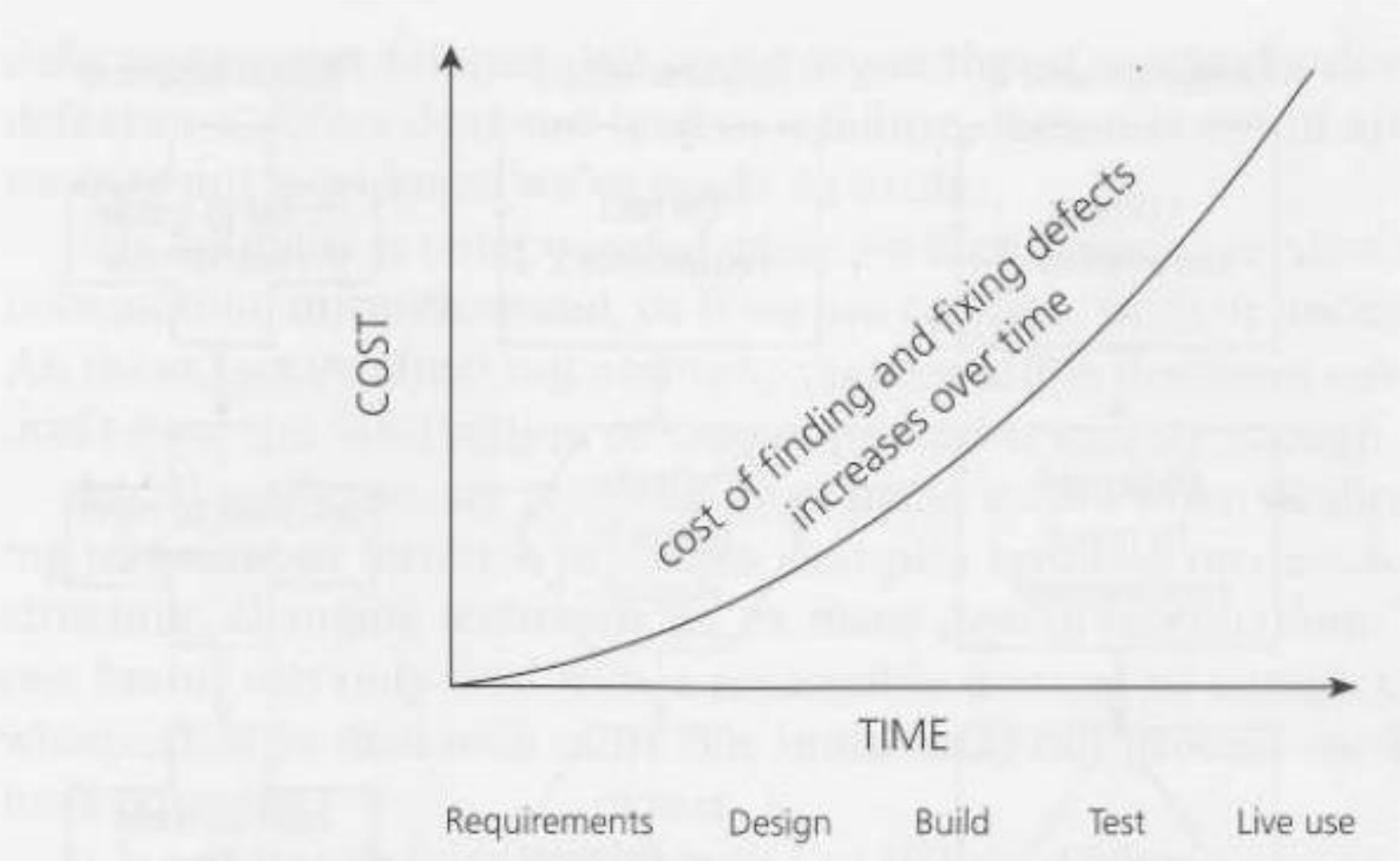
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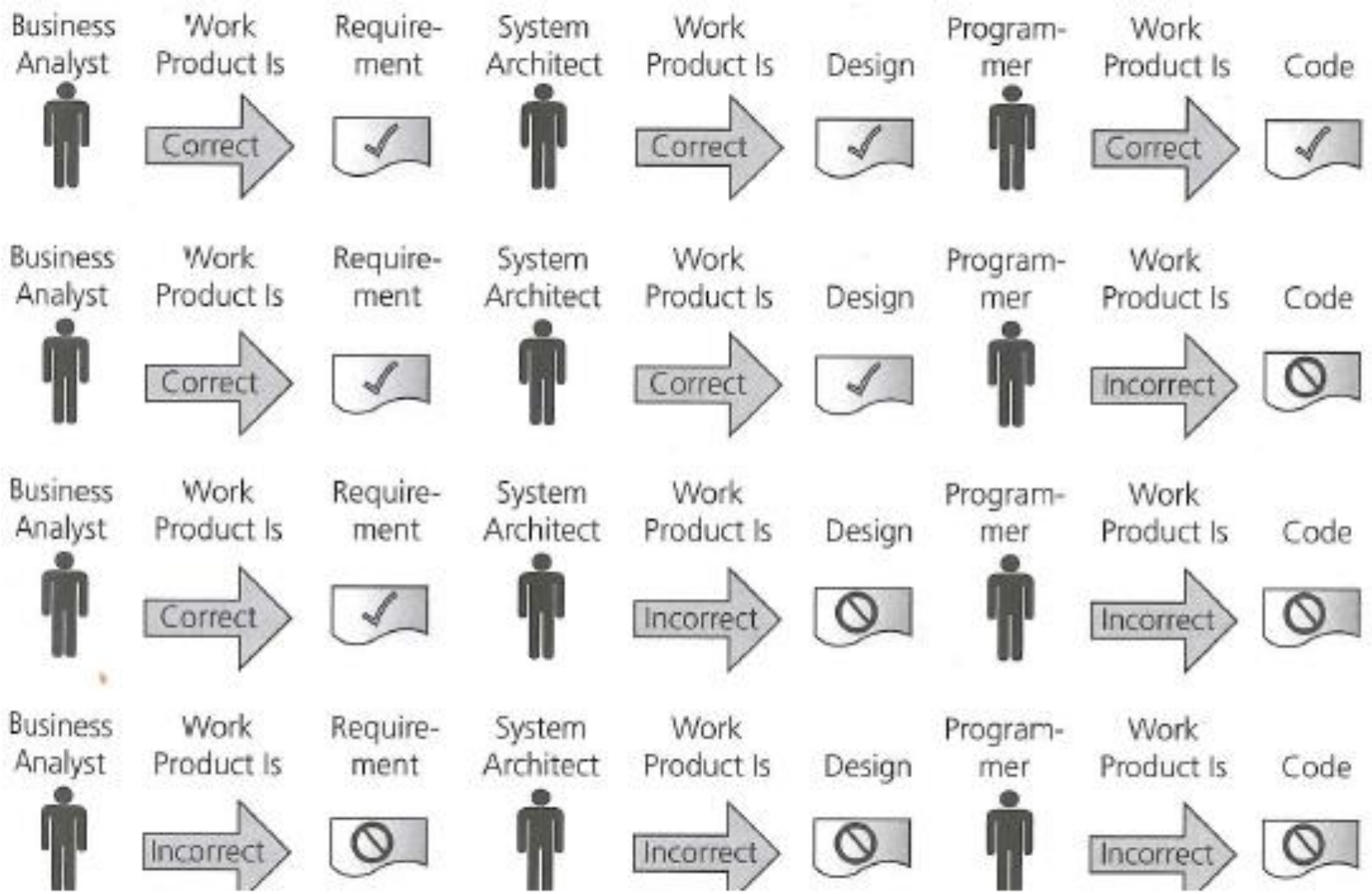
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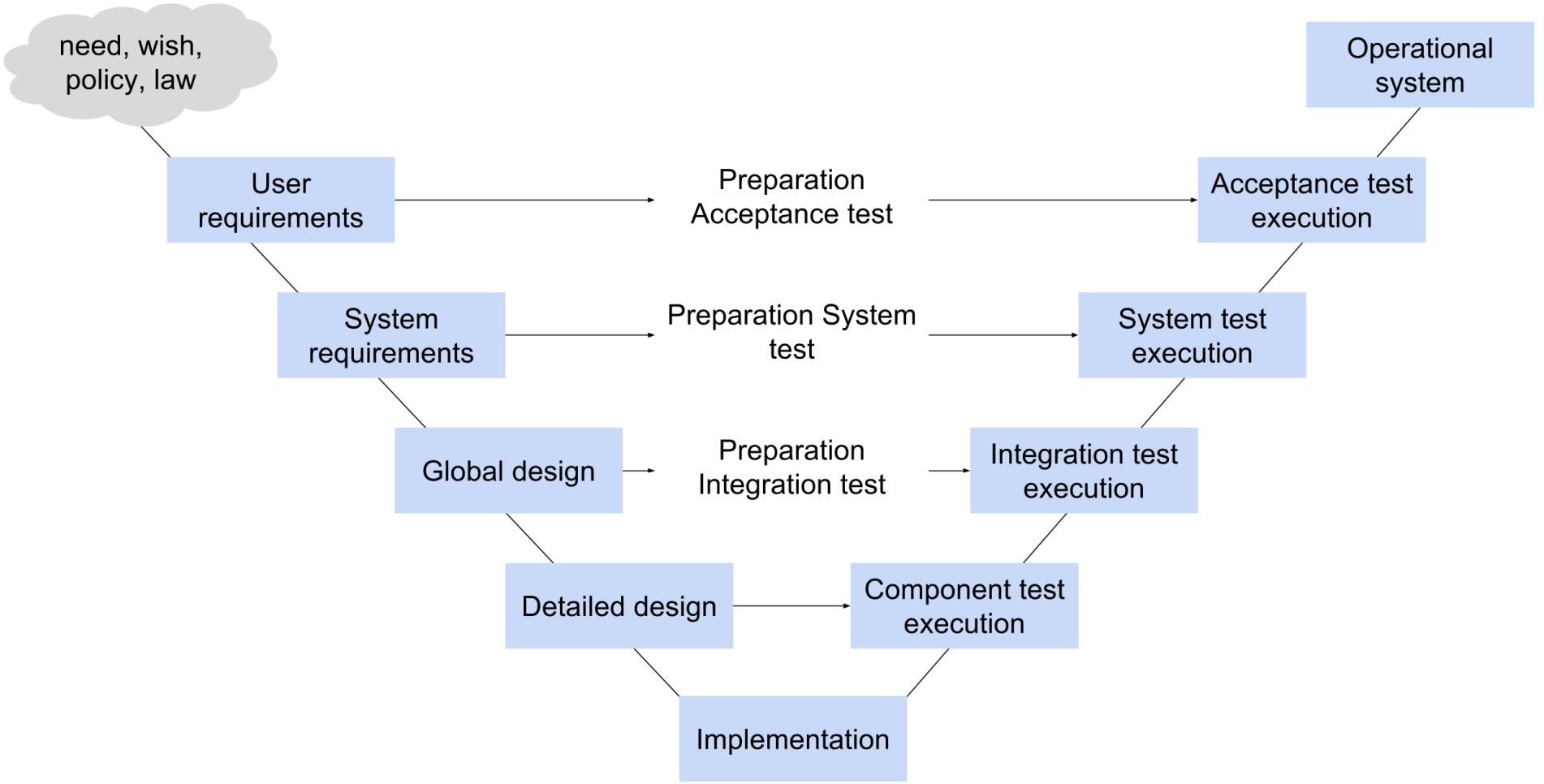
Cost to repair



Four typical scenarios



The V-model


need, wish, policy, law
User requirements
System requirements
Global design
Detailed design
Implementation
Component test execution
Integration test execution
System test execution
Acceptance test execution
Operational system
Preparation Acceptance test
Preparation System test
Preparation Integration test

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

The review process

Object of reviews

Any software work product can be reviewed, e.g.

- requirements specifications
- design specifications
- code
- test plans, test specifications, test cases, test scripts
- user guides
- web pages

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

The review process

Benefits

- early defect detection and correction
- development productivity improvements
- reduced development timescales
- reduced testing cost and time
- lifetime cost reductions
- fewer defects
- improved communication

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

The review process

Typical defects

- deviations from standards
- requirement defects
- design defects
- insufficient maintainability
- incorrect interface specifications
- inconsistencies, ambiguities, contradictions, omissions, inaccuracies, and redundancies in requirements

These defects are easier to find in reviews than in dynamic testing

1. Static Techniques and the Test Process

2. Review Process
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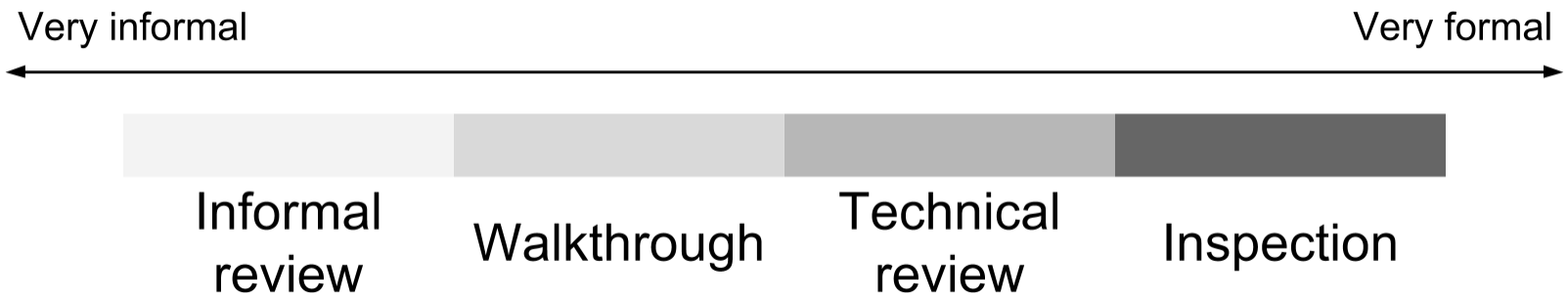
3. Static Analysis by Tools

The Review Process

- Activities of a formal review
- Roles and responsibilities
- Types of reviews
- Review techniques
- Success factors for reviews

The review process

Different types of reviews vary from:



very informal (e.g. no written instructions for reviewers) to very formal (i.e. well structured and regulated)

1. Static Techniques and the Test Process

2. Review Process
- *2.1 Activities of a formal review*
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3. Static Analysis by Tools

Review Process - Background

The formality of a review process is related to factors like:

- Risk
- Size of the project
- the maturity of the development process
- any legal or regulatory requirements
- the need for an audit trail

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Review Process - Background

The way a review is carried out depends on the agreed objective of the review:

- find defects and omissions
- gain understanding
- discussion and decision by consensus

1. Static Techniques and the Test Process

2. Review Process

- *2.1 Activities of a formal review*
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3. Static Analysis by Tools

Phases of a formal review

1. Planning
2. Initiate review - kickoff
3. Individual review – individual preparation
4. Issue communication and analysis - review meeting
5. Fixing and reporting - Rework and follow-up

1. Static Techniques and the Test Process

2. Review Process

- *2.1 Activities of a formal review*
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3. Static Analysis by Tools

1. Planning

-

a. Select the personnel

b. Allocate roles

c. Define the entry and exit criteria for more formal review types (e.g. inspection)

d. Select which parts of documents to look at

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

2. Initiate review - kickoff

-

a. Distributing documents

b. Explaining the objectives of the review and the review process

c. Explaining the documents to the participants

d. Checking and discuss entry/exit criteria

1. Static Techniques and the Test Process

2. Review Process

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3. Static Analysis by Tools

3. Individual review/preparation

Work done by each of the participants on their own before the review meeting, noting potential defects, questions and comments.

Each participants proposes the severity of the defects.

Severity classes: critical, major or minor

1. Static Techniques and the Test Process

2. Review Process

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3. Static Analysis by Tools

4. Issue communication and analysis

Review meeting

- Logging and discussion, with documented results or minutes
- The meeting participants may simply note defects, make recommendations for handling the defects, or make decisions about the defects.
- Decisions based on the exit criteria
- Examining, evaluation and recording

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

5. Fixing and reporting

Rework and follow-up

- fixing defects found, typically done by the author.
- check that defects have been addressed
- gather metrics, e.g.
  - number of defects found
  - number of defects found per page
  - time spent checking per page
  - total review effort
  - etc.

1. Static Techniques and the Test Process

2. Review Process
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3. Static Analysis by Tools

Roles and responsibilities

NB! One person may take one or more roles!

- The author
- Management
- The review leader
- The facilitator or moderator
- The reviewers
- The scribe (or recorder)

1. Static Techniques and the Test Process

2. Review Process

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3. Static Analysis by Tools

Author

- The writer or person with chief responsibility for the documents to be reviewed and the rework to be done.

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

The management

- Decides on the execution of reviews
- Assigning resources: staff, budget and time
- Determines if the review objectives have been met

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

The review leader

- Taking the overall responsibilities for the review
- Deciding who will be involved
- Works closely with both the management and the facilitator (moderator).

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

The facilitator or moderator

- leads the review of the document(s)
- planning the review
- running the meetings
- and follow-up after the meeting
- If necessary, the facilitator or moderator may mediate between the various points of view and is often the person upon whom the success of the review rests

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

The reviewers

-

- Individuals with specific technical or business background

- Identify and describe the findings in the product under review

Note: reviewers should be chosen to represent different perspectives and roles in the review process

Note: reviewers should take part in the review meeting

1. Static Techniques and the Test Process

2. Review Process

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3. Static Analysis by Tools

Scribe (or recorder)

-

- Documents all the issues, problems and open points that were identified during the meeting.

1. Static Techniques and the Test Process

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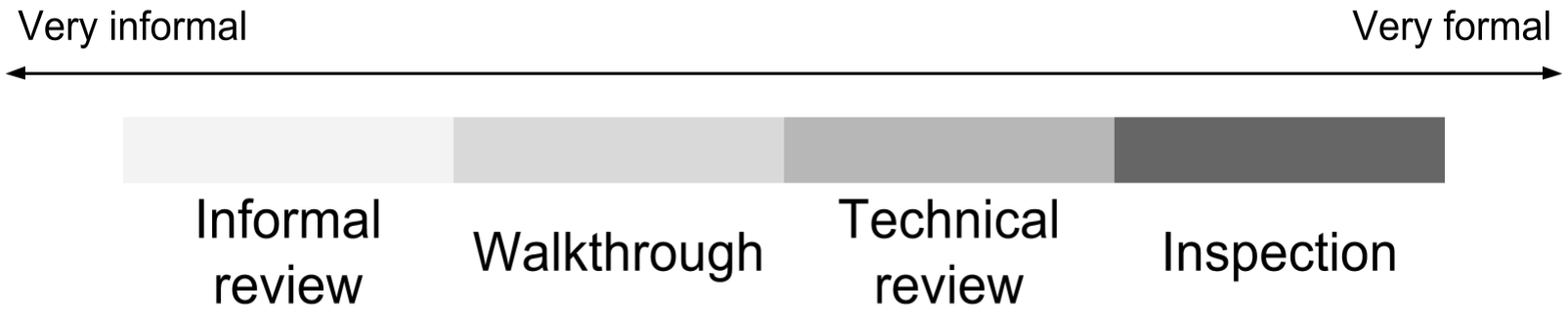
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3. Static Analysis by Tools

Types of reviews

1. Informal review
2. Walkthrough
3. Technical review
4. Inspections



1. Static Techniques and the Test Process

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3. Static Analysis by Tools

1. Informal review

Purpose

Inexpensive way to get some benefit

Form

Pair reviews; e.g. pair programming or a technical lead reviewing designs and code

Note: No formal process

Note: Optionally may be documented

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

2. Walkthrough

Purposes
- learning
- gaining understanding
- defect finding
- feedback

Form
- meeting led by author
- may vary in practice from quite informal to very formal
- stakeholders may participate

1. Static Techniques and the Test Process

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- *2.4 Review techniques*
- *2.4 Review techniques2.5 Success factors for reviews*

3. Static Analysis by Tools

3. Technical review

Purposes
- discuss
- make decisions
- evaluate alternatives
- find defects
- solve technical problems
- check conformance to specifications and standards

Form

May vary from very formal to informal peer review without management participation.

1. Static Techniques and the Test Process

2. Review Process
- *2.1 Activities of a formal review*
- *2.2 Roles and responsibilities*
- *2.3 Types of reviews*
- *2.4 Review techniques*
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3. Static Analysis by Tools

3. Technical review

- ideally led by trained facilitator or moderator
- documented, defined defect-detection process; includes peers and technical experts
- pre-meeting preparation
- optionally the use of checklists, review report, list of findings and management

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

4. Inspection

Purpose

Find defects

Form

- Usually peer examination led by trained facilitator or moderator (not the author)
- Formal process based on rules and checklists with entry and exit criteria
- pre-meeting preparation
- defined roles
- includes metrics
- inspection report, list of findings

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Review techniques

- **Ad hoc** reviewing
- **Checklist**-based reviewing
- **Scenario**-based reviewing and dry runs
- **Role**-based reviewing
- **Perspective**-based reviewing

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Success factors for reviews

Organizational success factors

- Have a clear objective
- Pick the right review type and technique
- Review material need to be keept up to date
- Limit the scope of review
- Enought time!
- Management support is critical

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Success factors for reviews

People-related success factors

- Pick the right reviewers
- Use testers
- Each reviewers does their review work well
- Limit the scope of the review and pick things that really count
- Defects found should be welcomed
- Review meeting are well managed

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Success factors for reviews

People-related success factors, *continues …*

- Trust is critical
- How you communication is important
- Follow the rules, but keep it simple
- Train participants
- Continuously improve process and tools
- **Just do it!**

1. Static Techniques and the Test Process

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3. Static Analysis by Tools

Success factors - approach

- Defects found are welcome and expressed objectively.
- Apply suitable review techniques for the type and level of software products.
- Use checklists or roles if appropriate to increase effectiveness of defect identification.
- Management supports a good review process (e.g. by incorporating adequate time for review activities).

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3. Static Analysis by Tools

Success factors - training and learning

- Training is given in review techniques, especially the more formal techniques, such as inspection.
- There is an emphasis on learning and process improvement