Chapter 1 - ISTQB Fundamentals of testing

1. Why is testing necessary?
2. What is testing?
3. Test principles
4. Fundamental test process
5. The psychology of testing

1. Why is testing necessary
- *1.1 Software system context*
- *1.2 Causes of software defects*
- *1.3 Role of testing in sw.systems*
- *1.4 Testing and quality*
- *1.5 How much testing is enough?*

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5. Psychology of testing
- *5.1 Independence test levels*
- *5.2 Tips and tricks*

Why is testing necessary?

Known disasters



The Ariane 5 rocket exploded as a result of integer overflow.
Photo: ESA

Known disasters

Mariner 1-krasj

NASA's Mariner program (1959–1963) launched a series of interplanetary space probes to investigate Mars, Venus, and Mercury. In 1962, the launch of Mariner 1 failed due to a programming error.

The author of the specification document for the control system overlooked the symbol for average, a bar, in a handwritten formula, $\bar{\dot{r}}_n$

so that the formula was replaced with $\dot{r}_n$

Instead of correcting for variations based on an average value, the control system attempted to correct for every small random variation. All of these pointless corrections ended up causing the rocket to crash.

Known disasters

Near-miss in manned space rocket

The Mercury program was the first manned American space program. The programming language used at the time was called Fortran, and in the code that calculated the rocket's trajectory, there was the following line:

```
    DO 17 I = 1.100
       :   :
17  CONTINUE
```

instead of

```
    DO 17 I = 1,100
       :   :
17  CONTINUE
```

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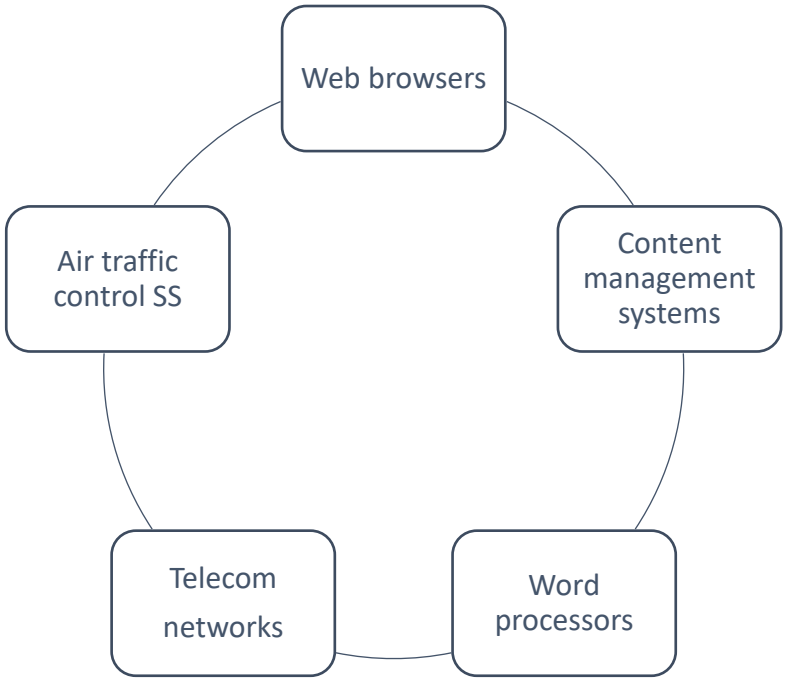
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Software systems context

- Software systems are an important part of life:



- Most people had experience with software not working as expected.
- If the SW system doesn't wok correctly, it can lead to problems like:
  - Loss of money
  - Loss of business reputation
  - Injury or death

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Diversity of users, situations and devices

User







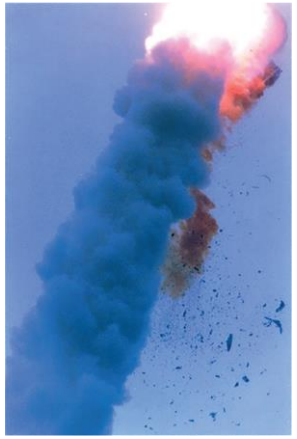
Preference

Age / Culture

Economy

Functional ability

Digital competence



Situation

Time





Place (work, transportation home, indoors/outdoors)





Weather

Situation





Emotion



Device











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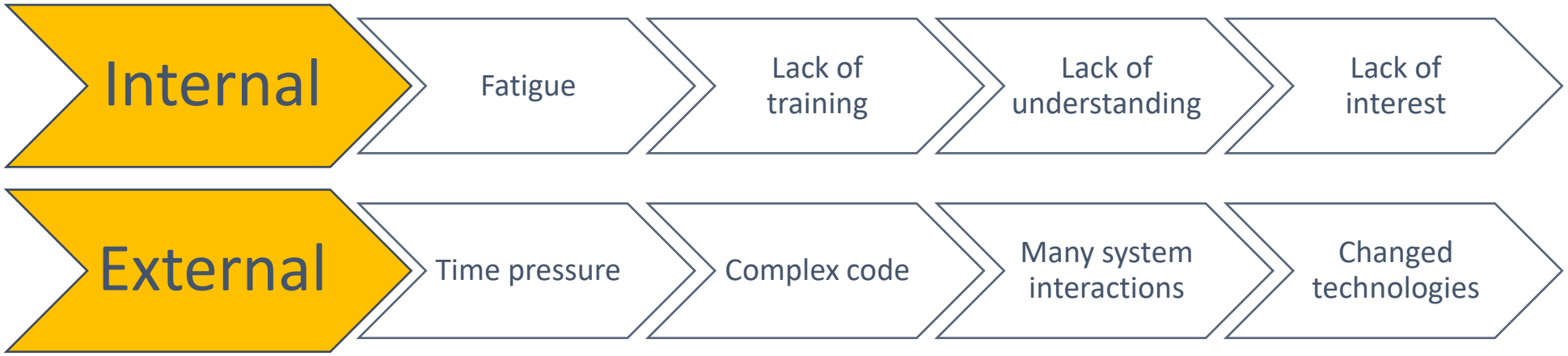
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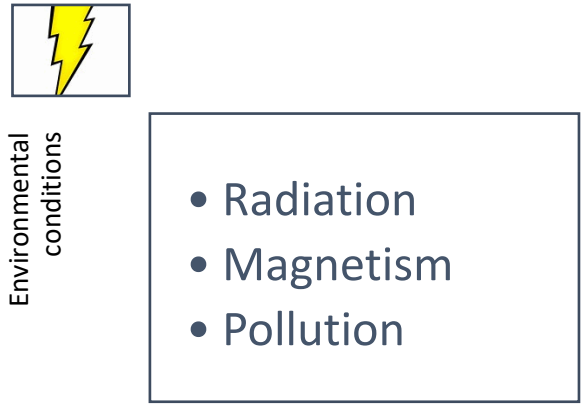
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Causes of software defects

Human errors



Non-controllable events (e.g. environmental conditions)



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Causes of software defects

Both causes of errors produce defects (= faults, bugs) in the code.

- Defects, if executed, may result in failures of the SW system (the system will fail to do what it should).

- Failures can affect seriously the users of the SW system, i.e.:
  - Break pedal not working
  - Miscalculations in financial SW systems

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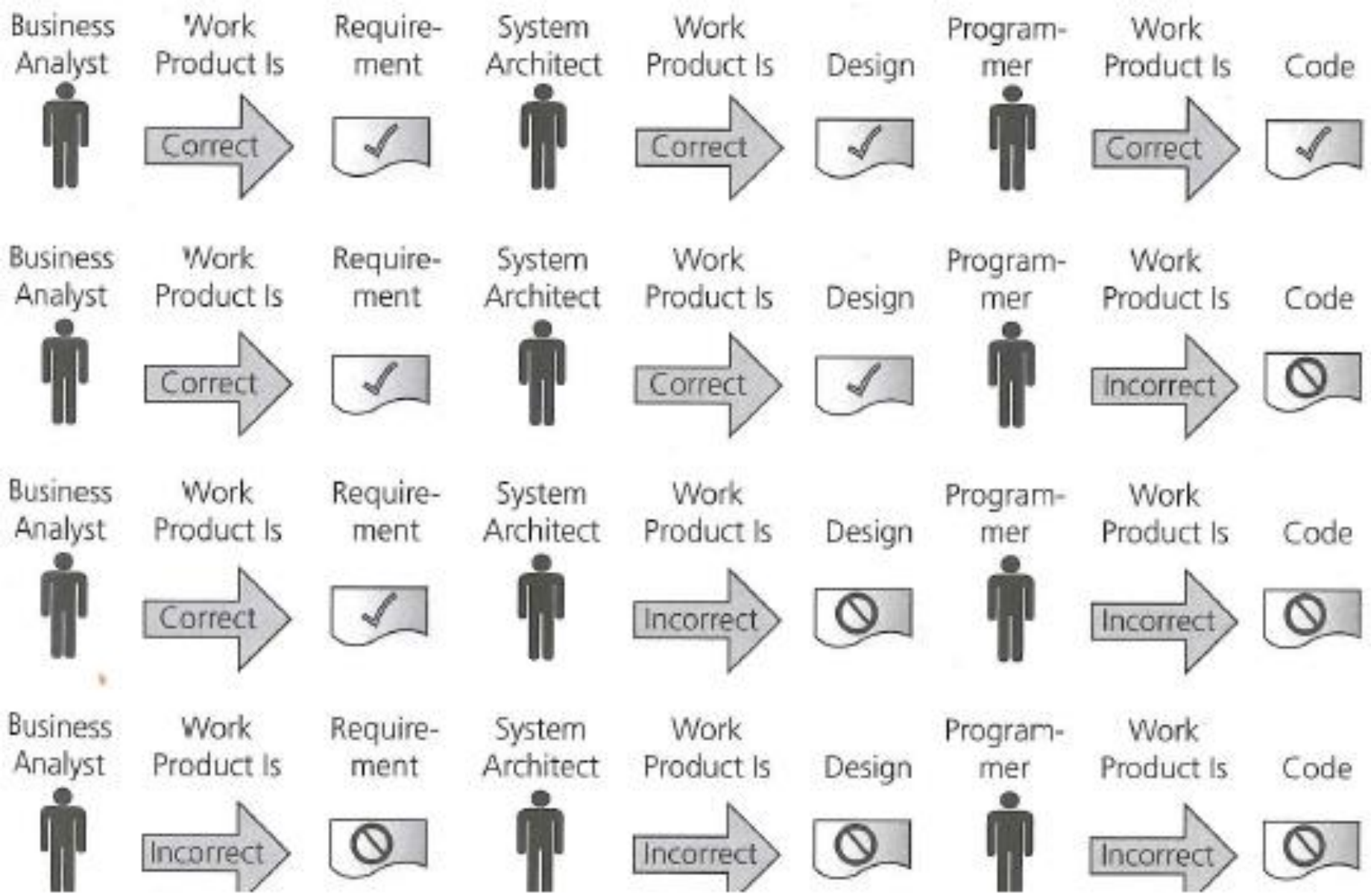
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Four typical scenarios



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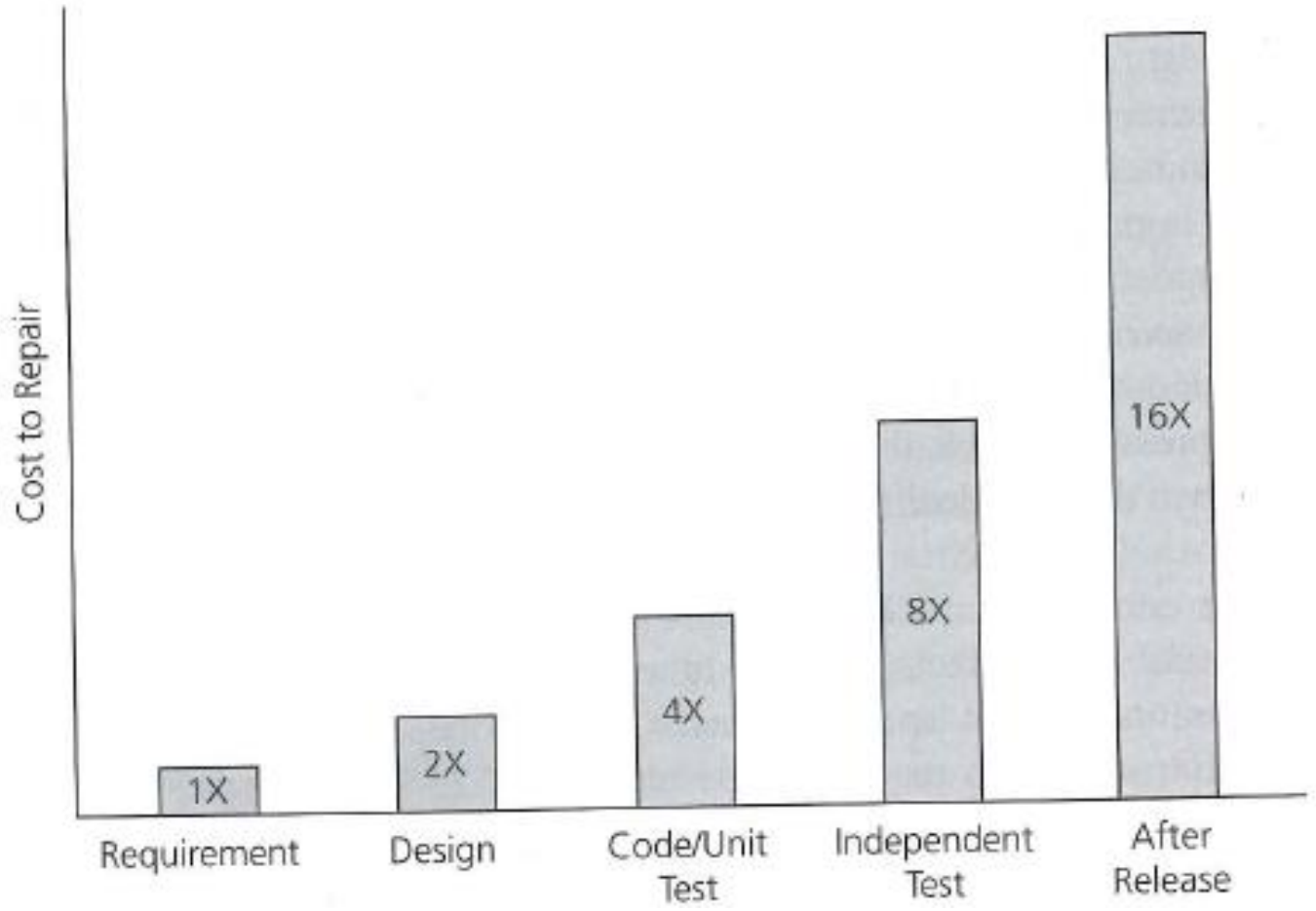
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Cost to repair



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Role of testing

- Testing has an important role in all stages of a SW product's life cycle:
  - Planning
  - Development
  - Maintenance
  - Operations

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Role of testing

- To reduce the risk of problems occurring during operation

- To check if the SW system meets:
  - legal requirements
  - industry specific standards

- To learn more about the SW system

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Testing …

…measures the quality the SW in terms of defects found

- Functional aspects
- Non-functional aspects (Reliability, Usability, Portability)

…creates confidence in the quality of the SW

- If it's properly tested and a minimum of defects are found

…teaches us lessons to apply in future projects

- By understanding the root causes of defects, processes can be improved. This can prevent defects from reoccurring.

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How much testing is enough?

It depends on:

Level of risk:

- Technical risks
- Business risks

Project constraints:

- Time
- Budget

- It's impossible to test everything!
- Testing should provide sufficient information for the stakeholders to make informed decisions about:
  - Release of the software
  - Next development steps, etc.

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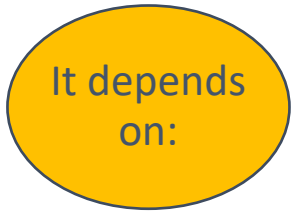
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Definition of testing

The **process of testing** all SW life-cycle activities:

- *both static and dynamic*,

concerned with:

- *planning, preparation and evaluation*

of :

- software products and related work products

to:

- determine that they satisfy specified requirements
- to demonstrate that they are fit for purpose
- and to detect defects.

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Definition of testing

Depending on the objectives of the test process, testing can be focused on:

- Confirming that the SW system meets the requirements
- Causing as many failures as possible
- Checking that no defects have been introduced during changes
- Assessing the quality of the SW (with no intention of finding bugs)

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Definition of testing

Depending on the objectives of the test process, testing can be focused on:

- Confirming that the SW system meets the requirements
- Causing as many failures as possible
- Checking that no defects have been introduced during changes
- Assessing the quality of the SW (with no intention of finding bugs)

1. Why is testing necessary
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Definition of testing

- Finding defects
  - reduces the probability of undiscovered defects
- Creating confidence in the level of quality
- Providing information for decision-making
- Preventing defects

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The seven test principles

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The test principles

P1: Testing shows presence of defects
- Testing can show that defects are present, but cannot prove there are no defects.
- Testing reduces the probability of undiscovered defects remaining in the software; but even if no defects are found, this is not a proof of correctness.

P2: Exhaustive testing is impossible
- Testing everything is not feasible. We use risks and priorities to focus on test effort.

P3: Early testing
- Testing should start as soon as possible in the development life-cycle and should be focused on defined objectives.

P4: Defect clustering
- A small number of modules contain most of the defects discovered during pre-release testing.

P5: Pesticide paradox
- If the same set of tests will be repeated over and over, it will no longer find new bugs.

P6: Testing is context dependent
- I.e. safety-critical SW is tested differently from an e-commerce site.

P7: Absence-of-errors fallacy
- Finding and fixing defects does not help if the SW system is unstable or does not meet the user's expectations.

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P1: Testing shows the presence of defects, not their absence

- Testing can show that defects are present, but cannot prove that there are no defects.

- Testing reduces the probability of undiscovered defects remaining in the software. However, even if no defects are found, this is not a proof of correctness.

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P2: Exhaustive testing is impossible

- Testing everything (all combinations of input and preconditions) is not feasible except for specific cases.

- We use risks and priorities to focus the testing.

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P3: Early testing saves time and money

- Testing activities should start as early as possible in the software or system development life cycle and should be focused on defined objectives.

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P4: Defect clustering – defects cluster together

- A small number of modules contains most of the defects discovered during pre-release testing.

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P5: Pesticide paradox

- If the same tests are repeated over and over again, the same set of test cases will no longer find any new bugs.

- To overcome this 'pesticide paradox', the test cases need to be regularly reviewed and revised, and new and different tests need to be written to investigate different parts of the software.

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P6: Testing is context dependent

- Testing is done differently in different contexts.

- For example, testing of safety-critical software is different from e-commerce site testing.

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P7: Absence-of-error fallacy

- Finding and fixing defects does not help if the software system does not fulfills users' needs and expectations.

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Fundamental test processes

- Test planning
- Test monitoring and control
- Test analysis
- Test design
- Test implementation
- Test execution
- Test completion

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Test planning, monitoring and control

Who, what , why, when and where

- A plan encompasses: what, how, when, by whom?
  - Scope, objectives and risk analyses
  - Test levels and types that will be applied
  - Documentation that will be produced
  - Assign resources for the different test activities
  - Schedule test implementation, execution, evaluation
- Control and adjust the planning to reflect new information, new challenges of the project.

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Analysis and design

- Review test basis:
  - Requirements
  - User stories
  - Product architecture
  - Product design
  - Interfaces
  - Risk analysis report
- Analysis: general test objectives are transformed into:
  - Test conditions
- Design:
  - Test cases
  - Test environments
  - Test data
  - Create tracebility

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Implementation and execution

- *Implement*:
  - Group tests into scripts
  - Prioritize the scripts
  - Prepare test oracles
  - Write automated test scenarios
- *Execute*:
  - Run the tests and compare results with oracles
  - Report incidents
  - Repeat test activities for each corrected discrepancy
  - Log the outcome of the test exectuion

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  - Prepare test oracles
  - Write automated test scenarios
- *Execute*:
  - Run the tests and compare results with oracles
  - Report incidents
  - Repeat test activities for each corrected discrepancy
  - Log the outcome of the test exectuion

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Test completion

- *Evaluate*:
  - Assess test execution against the defined objectives
  - Check if:
    - More tests are needed?
    - Exit criteria should be changed
- *Report:*
  - Write or extract a test summary report for the stakeholders.
- *Test closure activities*
  - To make test assets available for later use.

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A good tester needs:

- Curiosity
- Professional pessimism
- Attention to details
- Good communication skills
- Experience at error guessing

- To communicate defects and failures in a constructive way: fact-focused reports and review of findings

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- A certain degree of independence is often more effective at finding defects and failures. However, the developer can very efficiently find bugs in their own code.

- The level of independence in the testing depends on the objective of testing.

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Independence test levels

- Independence levels:

- Tests designed by the same person who wrote the code
- Tests designed by another person from the same team, but same organization
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Tips and tricks

- Be clear and objective

- Confirm that:
  - You have understood the requirements
  - The person who is going to fix the bug has understood the problem