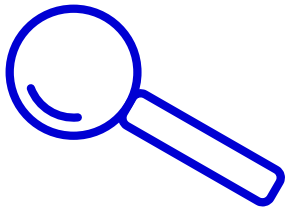
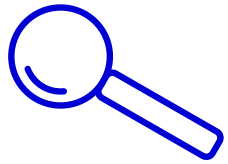
Requirements Engineering I

Chapter 9

Validating Requirements



Chapter roadmap



9.1 What to validate

Content, work products and context

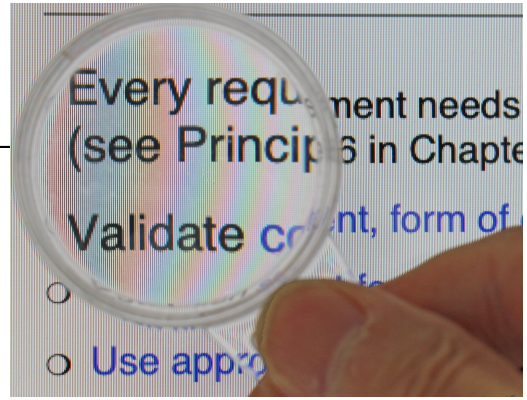
9.2 Requirements validation techniques

The how-to

9.3 The role of acceptance testing

Closely related to requirements validation

9.1 What to validate



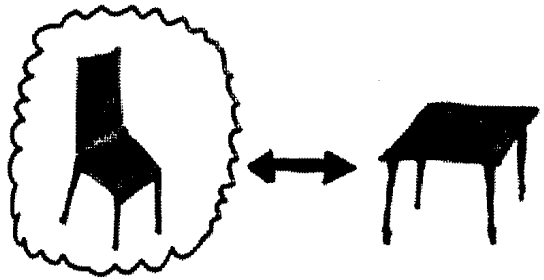
Every requirement needs to be validated
(see Principle 6 in Chapter 2)

- Content:
  - Stakeholders' desires and needs adequately covered?
  - Requirements agreed?
- Work products: Requirements documented well?
- Context: Assumptions reasonable?

Important validation aspects

- Involvement of the right stakeholders
- Separating the identification and the correction of defects
- Validation from different views
- Repeated / continuous validation
- Use appropriate techniques

Validation of content



Identify requirements that are

- Inadequate or wrong
- Incomprehensible
- Incomplete or missing
- Ambiguous

Also look for requirements with these quality defects:

- Not verifiable
- Unnecessary
- Infeasible
- Premature design decisions

Validation of content: Agreement

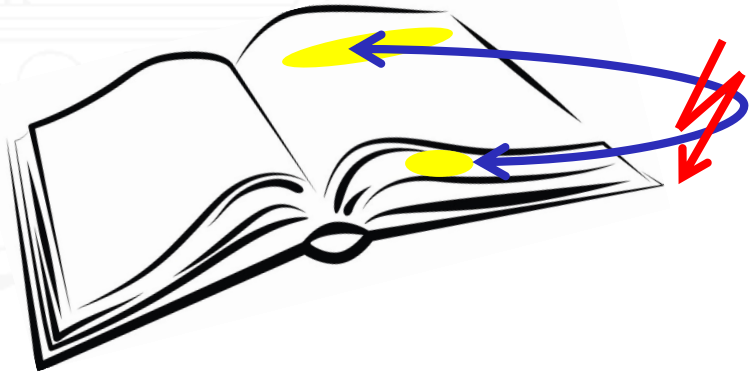
- Requirements elicitation involves achieving consensus among stakeholders having divergent needs
- When validating requirements, we have to check whether agreement has actually been achieved
  - All known conflicts negotiated and resolved? → Chapter 4.4
  - For all requirements: have all relevant stakeholders for a requirement agreed to this requirement in its documented form?
  - For every changed requirement, have all relevant stakeholders agreed to this change?

Validation of requirements work products

Scope: checking the requirements work products (e.g., a systems requirements specification or a collection of user stories) for formal problems

Identify requirements that are

- Inconsistent with each other
- Missing
- Non-conforming to documentation rules, structure or format
- Redundant
- Badly structured
- Hard to modify
- Not traceable



Context validation

- Context assumptions reasonable?
- Mappings from context phenomena to system inputs / outputs adequate?
- Can we reasonably argue that the domain requirements will be met when the system will be built and deployed as specified in the requirements?

9.2 Requirements validation techniques

Review

- Main means for requirements validation
- Walkthrough: author guides experts through the specification
- Inspection: Experts check the specification
- Author-reviewer-cycle: Requirements engineer continuously feeds back requirements to stakeholder(s) for review and receives feedback

Construction of other work products

- Acceptance criteria / test cases help disambiguate / clarify requirements
- Writing user manuals or creating models for textual requirements may help identify missing or wrong requirements

Requirements validation techniques – 2

Prototyping

- Lets stakeholders judge the practical usefulness of the specified system in its real application context
- Prototype constitutes a sample model for the system-to-be
- Most powerful, but also most expensive means of requirements validation – GenAI may help here

Simulation/Animation

- Means for investigating dynamic system behavior
- Execute specification and visualize it by animated models

Testing (when evolving an existing system)

- A/B testing
- Classic alpha and beta testing of source code

Requirements validation techniques – 3

Requirements Engineering tools (typically ML/AI-based)

- Finding gaps and contradictions
- Identifying ambiguous or non-verifiable requirements
- Checking conformance with templates or document forms

Formal Verification / Model Checking / Model Analysis

- Formal proof of critical properties
- Automated, systematic and comprehensive test of critical properties (when proofs are not tractable)

Reviewing practices

- Paraphrasing
  - Explaining the requirements in the reviewer's own words
  - Checking AI-generated summaries for adequacy
- Perspective-based reading
  - Analyzing requirements from different perspectives, e.g., end-user, tester, architect, maintainer,...
- Playing and executing
  - Playing scenarios
  - Mentally executing acceptance test cases
- Checklists
  - Using checklists for guiding and structuring the review process

Mini-Exercise

Consider the chairlift access control case study. How can you validate the following requirements (1) during RE, (2) prior to the deployment of the system?

(a) “The system shall prevent skiers from using the chairlifts without a valid ticket.”

(b) “The reaction time from sensing a valid card to issuing an ‘unlock for a single turn’ command shall be shorter than 0.5 s.”

(c) “As a skier, I want to load a ticket that I bought online to my access card, so that it is fast and convenient for me and I do not have to queue at a ticket counter.”

9.3 The role of acceptance testing

DEFINITION. Acceptance – The process of assessing whether a system satisfies all its requirements.

DEFINITION. Acceptance test – A test that assesses whether a system satisfies its requirements.

Requirements and acceptance testing

Requirements engineering and acceptance testing are naturally intertwined

- For every requirement, there should be at least one acceptance test case
- Requirements should be written such that acceptance tests can be written to verify them (→ verifiability)
- Acceptance test cases can serve
  - for disambiguating requirements
  - as detailed specifications by example → acceptance criteria for user stories

Choosing acceptance test cases

Potential coverage criteria:

- Requirements coverage: At least one case per requirement
- Function coverage: At least one case per function
- Scenario coverage: For every type scenario / use case
  - All actions covered
  - All branches covered

- Consider the usage profile: not all functions/scenarios are equally frequent / important