Requirements Engineering

Software Engineering

Andreas Zeller • Saarland University
Requirements Engineering

The Real World

Requirements Engineering

A description of what the system should do (but not how)
“Requirement”
Standard Glossary of Software Engineering Terminology

1. A condition or capability needed by a user to solve a problem or achieve an objective.

2. A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed documents.

3. A documented representation of a condition or capability as in (1) or (2).
What requirements are?

• Building blocks we use to describe what the system should do.

• Failure to meet a requirement jeopardizes the system success

• Well documented

• Consistent
Types of Requirements
Types of Requirements
Functional Requirements

- An action the product must take to be useful

The product shall allow to track individual payments of coffee servings
Nonfunctional Requirements

- A property or quality the product must have

The product shall be accessible in multiple languages (such as German and English)
Constraints

- *Global* requirements – on the project or the product

The product shall be available before March 1st.
Analysis vs Design

- Analysis = *what* the software should do
  - Software functionality
  - Software properties
- Design = *how* it should do it
Up-front RE

- “We must know [exactly] what to build before we can build it”
- classical engineering viewpoint
- leads to...
Waterfall Model
(1968)
Waterfall Model
(1968)

Communication
- project initiation
- requirements gathering

Planning
- estimating
- scheduling
- tracking

Modeling
- analysis
- design

Construction
- code
- test

Deployment
- delivery
- support
- feedback
Why requirements are important?

“The hardest single part of building a software system is deciding what to build. No part of the work so cripples the resulting system if done wrong. No other part is more difficult to rectify later”

Fred Brooks
Denver International Airport
DIA: Automated Baggage System
Glass’ Law

Requirement deficiencies are the prime source of project failures.
Why Requirement Analysis?

- We need to systematically address the problem of getting the right set of requirements
- So, who should I ask first?
Stakeholders

• Persons or organizations who...
  • have a valid interest in the system
  • are affected by the system
Stakeholders

• anyone who *operates* the system
  (normal and maintenance operators)

• anyone who *benefits* from the system
  (functional, political, financial and social beneficiaries)

• anyone involved in *purchasing* or procuring
  the system
Stakeholders

• organizations which *regulate* aspects of the system
  (financial, safety, and other regulators)

• organizations responsible for systems which *interface* with the system under design

• people or organizations *opposed* to the system
  (*negative* stakeholders)
Identify stakeholders
Understand each stakeholder
Help stakeholders to understand themselves
Help stakeholders to understand each other
Reach a consensus among stakeholders
"Requirements Analysis"
Standard Glossary of Software Engineering Terminology

• The process of studying user needs to arrive at a definition of system, hardware, or software requirements.

• The process of studying and refining system, hardware, or software requirements.
I) Inception

• Identify stakeholders
• Recognize multiple viewpoints
• Ask first Q&A
2) Elicitation

- Collaborate with stakeholders
- Address problems (scope/understanding/volatility)
- Method: Collaborative Requirements Gatherings
Problems of scope

- What is the boundary of the system?
- What details are actually required?
Problems of understanding

• Users don’t know what they want
• ...don’t know what is needed
• ...have a poor understanding of their computing environment
• ...don’t have full understanding of their domain
Problems of volatility

- Requirements change over time
3) Elaboration

- Expand & refine information
- Document requirements taken during elicitation
- Use cases
- Contract style
- UML diagrams
4) Negotiation

- Reconcile conflicts
- Ranking of requirements
- Risk estimation (very rough)
5) Specification

- Written document
- Natural Language +
- Graphical models
6) Validation

• Search for
  • Inconsistencies
  • Omissions
  • Errors
• Technical Review
  • Review Team
7) Requirements Management

- Control Requirements change
- Trace requirements to:
  - Features
  - Code
  - Subsystems
- How Requirements are related to each other
Collaborative Requirement Gathering
Collaborative Requirement Gathering

- Meetings attended by both customers and software engineers (±other stakeholders)
- Rules for preparation and participation are established
- Agenda is suggested
- A facilitator controls the meeting
- A “definition mechanism” is used
Collaborative Requirement Gathering

• Goal:
  • Identify problem
  • Propose elements of solution
  • Negotiate approaches
  • Specify preliminary set of requirements
Documenting Requirements

- Contract-style requirements
- Use cases (user stories)
- UML-diagrams
- Paper prototyping
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Contract Style

Classify product features as

- **Must-have** features
  “The product must conform to accessibility guidelines”

- **May-have** features
  “The product may eventually be voice-controlled”

- **Must-not-have** features
  “The product supports only one language”

Be explicit about *must-not-have* features!
Contract Style

• Provide a *contract* between sponsors and developers

• Can run to *hundreds of pages*

• Abstract all requirements, with little context
Contract Style

love it

hate it
Use Case

• An actor is something that can act – a person, a system, or an organization

• A scenario is a specific sequence of actions and interactions between actors (where at least one actor is a system)

• A use case is a collection of related scenarios – successful and failing ones

• Useful for clients as well as for developers
Actors and Goals

• What are the *boundaries* of the system? Is it the software, hardware and software, also the user, or a whole organization?

• Who are the *primary actors* – i.e., the stakeholders?

• What are the *goals* of these actors?

• Describe how the system fulfills these goals (including all exceptions)
Example: SafeHome
Initial Scenario

Use case: display camera views
Actor: homeowner

If I’m at a remote location, I can use any PC with appropriate browser software to log on to the SafeHome Web site. I enter my user ID and two levels of passwords and, once I’m validated, I have access to all the functionality. To access a specific camera view, I select “surveillance” and then “select a camera”. Alternatively, I can look at thumbnail snapshots from all cameras by selecting “all cameras”. Once I choose a camera, I select “view”…

Thursday, October 17, 13
Refined Scenario

Use case: display camera views
Actor: homeowner

1. The homeowner logs on to the Web Site
2. The homeowner enters his/her user ID
3. The homeowner enters two passwords
4. The system displays all major function buttons
5. The homeowner selects “surveillance” button
6. The homeowner selects “Pick a camera”…
Alternative Interactions

• Can the actor take some other action at this point?
• Is it possible that the actor encounters some error condition? If so, which one?
• Is it possible that some other behavior is encountered? If so, which one?

Exploring alternatives is the key to successful requirements analysis!
Use-Case Template for Surveillance

Use-case: Access camera surveillance—display camera views (ACS-DCV).

Primary actor: Homeowner.

Goal in context: To view output of camera placed throughout the house from any remote location via the Internet.

Preconditions: System must be fully configured; appropriate user ID and passwords must be obtained.

Trigger: The homeowner decides to take a look inside the house while away.

Scenario:

1. The homeowner logs onto the SafeHome Products Web site.
2. The homeowner enters his or her user ID.
3. The homeowner enters two passwords (each at least eight characters in length).
4. The system displays all major function buttons.
5. The homeowner selects “surveillance” from the major function buttons.
6. The homeowner selects “pick a camera.”
7. The system displays the floor plan of the house.
8. The homeowner selects a camera icon from the floor plan.
9. The homeowner selects the “view” button.
10. The system displays a viewing window that is identified by the camera ID.
11. The system displays video output within the viewing window at one frame per second.

Exceptions:

1. ID or passwords are incorrect or not recognized—see use-case: “validate ID and passwords.”
2. Surveillance function not configured for this system—system displays appropriate error message; see use-case: “configure surveillance function.”
3. Homeowner selects “view thumbnail snapshots for all cameras”—see use-case: “view thumbnail snapshots for all cameras.”
4. A floor plan is not available or has not been configured—display appropriate error message and see use-case: “configure floor plan.”
5. An alarm condition is encountered—see use-case: “alarm condition encountered.”

Priority: Moderate priority, to be implemented after basic functions.

When available: Third increment.

Frequency of use: Infrequent.
SafeHome

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UML Diagrams

• UML: Unified Modeling Language

• Graphical models useful for communicating ideas (both stakeholders and engineers)

• UML class diagram: static snapshot of system’s relationships (classes, attributes, operations)

• UML sequence diagram: how processes interact
UML sequence diagram
Paper prototyping
Paper prototyping
Summary
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