Chapter 5

- Understanding Requirements

*Slide Set to accompany*

*Software Engineering: A Practitioner’s Approach, 7/e*

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Requirements Engineering-I

- **Inception**—ask a set of questions that establish …
  - basic understanding of the problem
  - the people who want a solution
  - the nature of the solution that is desired, and
  - the effectiveness of preliminary communication and collaboration between the customer and the developer
- **Elicitation**—elicit requirements from all stakeholders
- **Elaboration**—create an analysis model that identifies data, function and behavioral requirements
- **Negotiation**—agree on a deliverable system that is realistic for developers and customers
Requirements Engineering-II

- **Specification**—can be any one (or more) of the following:
  - A written document
  - A set of models
  - A formal mathematical
  - A collection of user scenarios (use-cases)
  - A prototype

- **Validation**—a review mechanism that looks for
  - errors in content or interpretation
  - areas where clarification may be required
  - missing information
  - inconsistencies (a major problem when large products or systems are engineered)
  - conflicting or unrealistic (unachievable) requirements.

- **Requirements management**
Inception

- Identify stakeholders
  - “who else do you think I should talk to?”
- Recognize multiple points of view
- Work toward collaboration
- The first questions
  - Who is behind the request for this work?
  - Who will use the solution?
  - What will be the economic benefit of a successful solution?
  - Is there another source for the solution that you need?
Eliciting Requirements

- meetings are conducted and attended by both software engineers and customers
- rules for preparation and participation are established
- an agenda is suggested
- a "facilitator" (can be a customer, a developer, or an outsider) controls the meeting
- a "definition mechanism" (can be work sheets, flip charts, or wall stickers or an electronic bulletin board, chat room or virtual forum) is used
- the goal is
  - to identify the problem
  - propose elements of the solution
  - negotiate different approaches, and
  - specify a preliminary set of solution requirements
Eliciting Requirements

- Conduct FAST meetings
- Make lists of functions, classes
- Make lists of constraints, etc.
- Use QFD to prioritize requirements
- Informally prioritize requirements
- Formal prioritization?
- Yes
  - Use QFD to prioritize requirements
  - Informally prioritize requirements
  - Create Use-cases
- No
  - Conduct FAST meetings
  - Make lists of functions, classes
  - Make lists of constraints, etc.
  - Use QFD to prioritize requirements
  - Informally prioritize requirements
  - Create Use-cases

- Define actors
- Write scenario
- Complete template
- Draw use-case diagram

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Quality Function Deployment

- **Function deployment** determines the “value” (as perceived by the customer) of each function required of the system.
- **Information deployment** identifies data objects and events.
- **Task deployment** examines the behavior of the system.
- **Value analysis** determines the relative priority of requirements.
**Elicitation Work Products**

- a statement of need and feasibility.
- a bounded statement of scope for the system or product.
- a list of customers, users, and other stakeholders who participated in requirements elicitation.
- a description of the system’s technical environment.
- a list of requirements (preferably organized by function) and the domain constraints that apply to each.
- a set of usage scenarios that provide insight into the use of the system or product under different operating conditions.
- any prototypes developed to better define requirements.
Building the Analysis Model

- **Elements of the analysis model**
  - **Scenario-based elements**
    - Functional—processing narratives for software functions
    - Use-case—descriptions of the interaction between an “actor” and the system
  - **Class-based elements**
    - Implied by scenarios
  - **Behavioral elements**
    - State diagram
  - **Flow-oriented elements**
    - Data flow diagram
Use-Cases

- A collection of user scenarios that describe the thread of usage of a system
- Each scenario is described from the point-of-view of an “actor”—a person or device that interacts with the software in some way
- Each scenario answers the following questions:
  - Who is the primary actor, the secondary actor (s)?
  - What are the actor’s goals?
  - What preconditions should exist before the story begins?
  - What main tasks or functions are performed by the actor?
  - What extensions might be considered as the story is described?
  - What variations in the actor’s interaction are possible?
  - What system information will the actor acquire, produce, or change?
  - Will the actor have to inform the system about changes in the external environment?
  - What information does the actor desire from the system?
  - Does the actor wish to be informed about unexpected changes?
Use-Case Diagram

homeowner

Arms/disarms system
Accesses system via Internet
Responds to alarm event
Encounters an error condition
Reconfigures sensors and related system features

system administrator

sensors
### Class Diagram

**From the SafeHome system ...**

<table>
<thead>
<tr>
<th>Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>name/id</td>
</tr>
<tr>
<td>type</td>
</tr>
<tr>
<td>location</td>
</tr>
<tr>
<td>area</td>
</tr>
<tr>
<td>characteristics</td>
</tr>
<tr>
<td>identify()</td>
</tr>
<tr>
<td>enable()</td>
</tr>
<tr>
<td>disable()</td>
</tr>
<tr>
<td>reconfigure()</td>
</tr>
</tbody>
</table>
State Diagram

Reading Commands

- System status = “ready”
- Display msg = “enter cmd”
- Display status = steady

- Entry/subsystems ready
- Do: poll user input panel
- Do: read user input
- Do: interpret user input

State name

State variables

State activities
Analysis Patterns

Pattern name: A descriptor that captures the essence of the pattern.
Intent: Describes what the pattern accomplishes or represents
Motivation: A scenario that illustrates how the pattern can be used to address the problem.
Forces and context: A description of external issues (forces) that can affect how the pattern is used and also the external issues that will be resolved when the pattern is applied.
Solution: A description of how the pattern is applied to solve the problem with an emphasis on structural and behavioral issues.
Consequences: Addresses what happens when the pattern is applied and what trade-offs exist during its application.
Design: Discusses how the analysis pattern can be achieved through the use of known design patterns.
Known uses: Examples of uses within actual systems.
Related patterns: One or more analysis patterns that are related to the named pattern because (1) it is commonly used with the named pattern; (2) it is structurally similar to the named pattern; (3) it is a variation of the named pattern.
Negotiating Requirements

- Identify the key stakeholders
  - These are the people who will be involved in the negotiation

- Determine each of the stakeholders “win conditions”
  - Win conditions are not always obvious

- Negotiate
  - Work toward a set of requirements that lead to “win-win”
Validating Requirements - I

- Is each requirement consistent with the overall objective for the system/product?
- Have all requirements been specified at the proper level of abstraction? That is, do some requirements provide a level of technical detail that is inappropriate at this stage?
- Is the requirement really necessary or does it represent an add-on feature that may not be essential to the objective of the system?
- Is each requirement bounded and unambiguous?
- Does each requirement have attribution? That is, is a source (generally, a specific individual) noted for each requirement?
- Do any requirements conflict with other requirements?
Validating Requirements - II

- Is each requirement achievable in the technical environment that will house the system or product?
- Is each requirement testable, once implemented?
- Does the requirements model properly reflect the information, function and behavior of the system to be built.
- Has the requirements model been “partitioned” in a way that exposes progressively more detailed information about the system.
- Have requirements patterns been used to simplify the requirements model. Have all patterns been properly validated? Are all patterns consistent with customer requirements?