Software Engineering: A Practitioner's Approach, 6/e

Chapter 7
Requirements Engineering

Requirements Engineering

- Stages:
  - Inception
  - Elicitation
  - Elaboration
  - Negotiation
  - Specification
  - Validation
  - Management

Requirements Engineering

- 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
  - address problems of scope
  - address problems of understanding
    - customers not sure about what is needed, skip “obvious” issues, have difficulty communicating with the software engineer, have poor grasp of problem domain
  - address problems of volatility

Requirements Engineering

- Elaboration—create an analysis model that identifies data, function, features, constraints and behavioral requirements

- Negotiation—agree on a deliverable system that is realistic for developers and customers
  - rank requirements by priority (conflicts arise here …)
  - identify and analyze risks assoc. with each requirement
  - "guestimate" efforts needed to implement each requirement
  - eliminate, combine and / or modify requirements to make project realistic

Requirements Engineering

- Specification—can be any one (or more) of the following:
  - A written document
  - A set of models
  - A formal mathematical model
  - 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 Engineering

- Requirements management involves managing change:
  - **Feature traceability:** how requirements relate to observable system/product features
  - **Source traceability:** identifies source of each requirement
  - **Dependency traceability:** how requirements are related to each other
  - **Subsystem traceability:** categorizes requirements by the subsystem(s) they govern
  - **Interface traceability:** how requirements relate to both external and internal system interfaces

Inception

- Identify stakeholders
  - “whom 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?

Inception

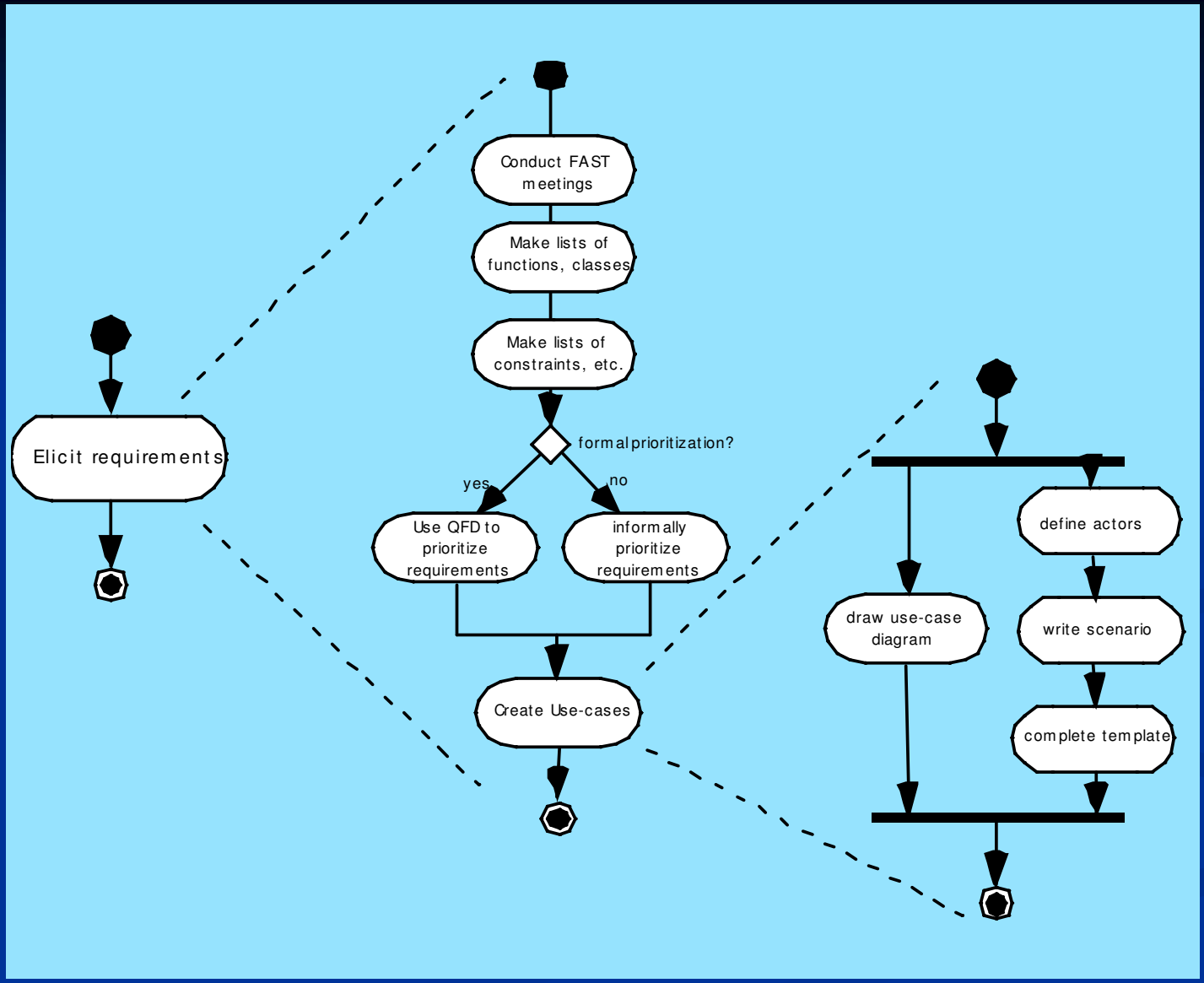
- The subsequent questions:
  - What constitutes a “good” output from the system?
  - What problem(s) does this solution address?
  - What is the intended business environment for this solution?
  - What performance issues or constraints should affecting my approach to the solution

Inception

- The final questions:
  - Are your answers official?
  - Are my questions relevant?
  - Am I asking too many questions?
  - Can anyone else provide additional info?
  - Should I be asking anything else?

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



Quality Function Deployment

- A technique of translating customer needs into technical system requirements:
- **Normal requirements:** reflect stated customer goals and objectives
- **Expected requirements:** implicit to the product or system; their absence will cause significant customer dissatisfaction
- **Exciting requirements:** featured going beyond customer expectations, causing customer euphoria (;-)

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

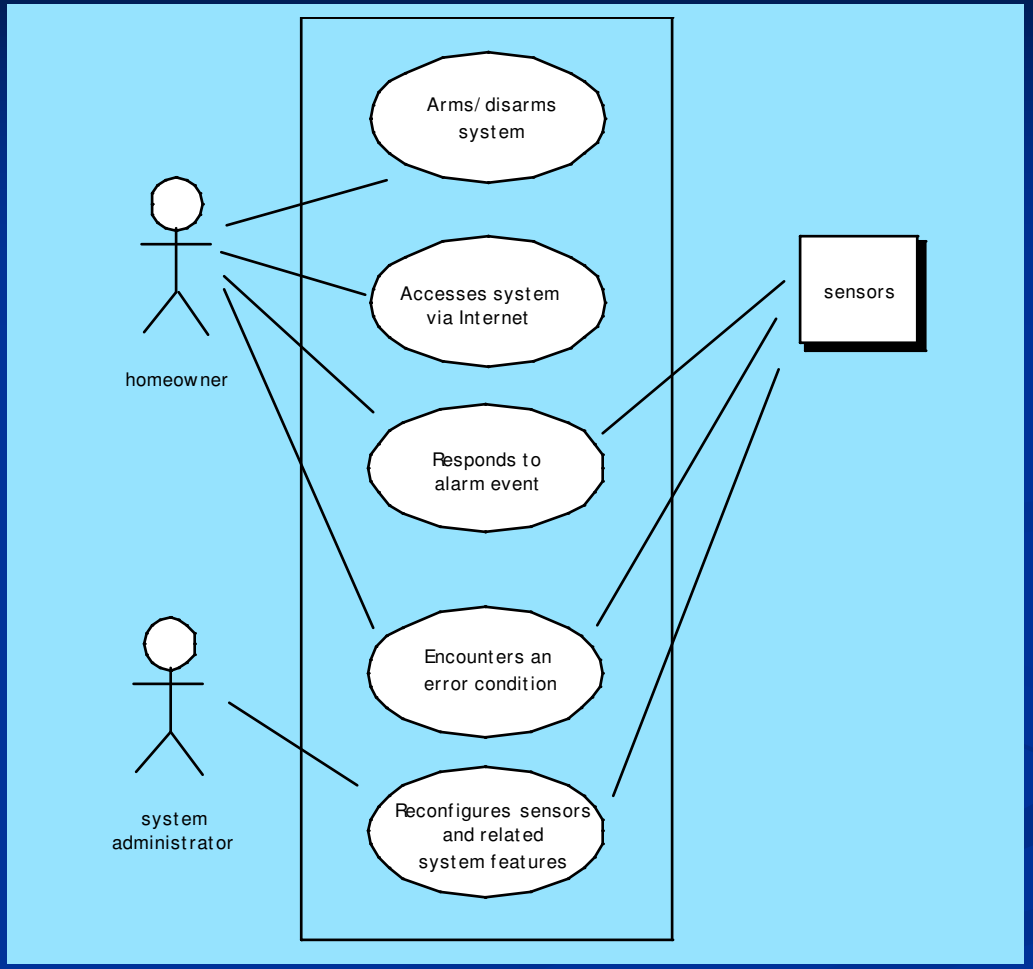
Elicitation Work Products

- 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.

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



Building the Analysis Model

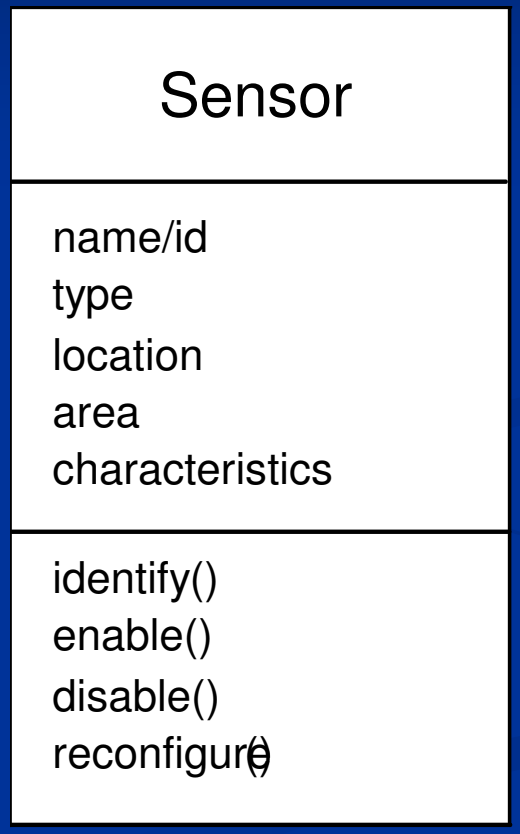
- Intent: to provide a description of the required informational, functional and behavioral domains of the computer-based system
- The model changes dynamically as the system engineers learn more about the system
- Is a series of time-ordered snapshots of requirements

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

Class Diagram

From the *SafeHome* system …



State Diagram

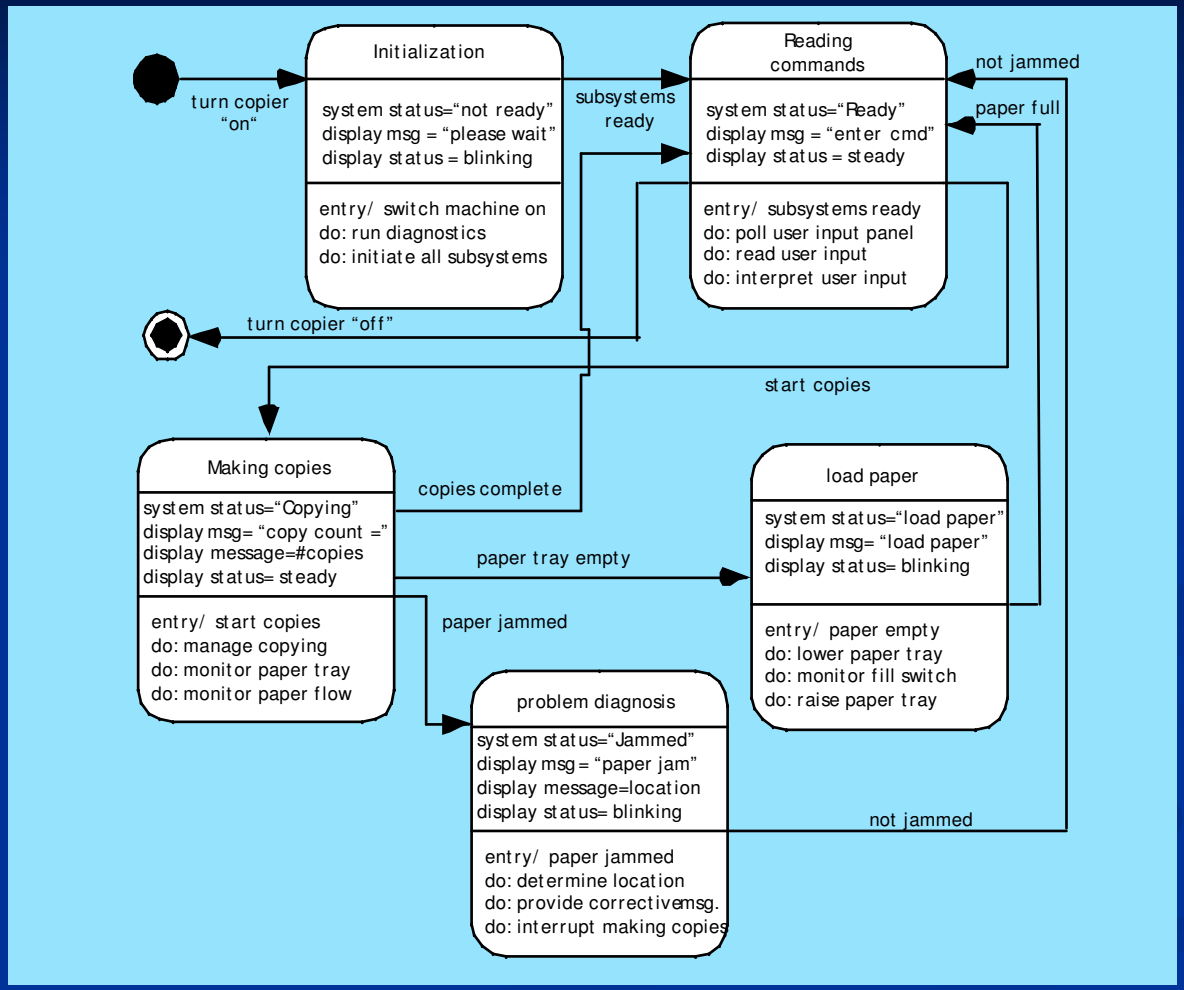


Figure 7.6 Preliminary UML state diagram for a photocopier

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: On e 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

Checking for Consistency, Omissions, Ambiguity

- 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

- 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?