# Chapter 7
# Requirements Engineering

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# Requirements Engineering-I

- Inception—ask a set of questions that establish …
  - basic understanding of the problem (what)
  - the people who want a solution (who)
  - 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 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 (ambiguity)
  - Missing information (incomplete requirement)
  - Inconsistencies
    - a major problem when large products or systems are engineered)
  - 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?

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# Eliciting Requirements

- meetings are conducted and attended by both software engineers and customers
- 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

# *Conducting a Requirements Gathering Meeting (pg188)*

- **The scene:**
  - A meeting room. The first requirements gathering meeting is in progress.
- **The players:**
  - Jamie Lazar, software team member;
  - Vinod Raman, software team member;
  - Ed Robbins, software team member;
  - Doug Miller, software engineering manager;
  - three members of marketing;
  - a product engineering representative;
  - a facilitator.

- **The conversation:**
- Facilitator **(pointing at white board):** So that's the current list of objects and services for the home security function.
- **Marketing person:** That about covers it from our point of view.
- **Vinod:** Didn't someone mention that they wanted all *SafeHome* functionality to be accessible via the Internet? That would include the home security function, no?
- **Marketing person:** Yes, that's right ... we'll have to add that functionality and the appropriate objects.

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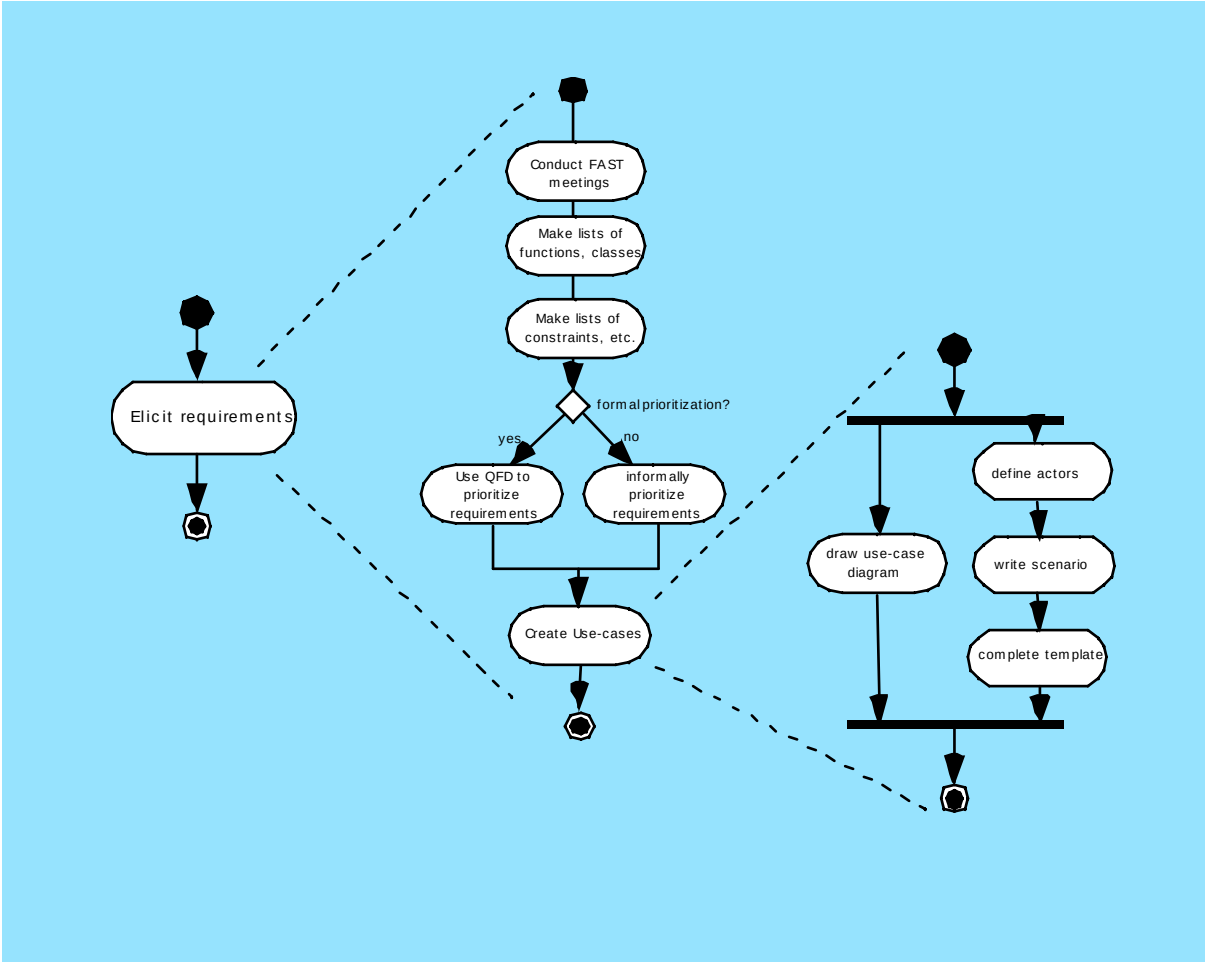
- Facilitator: Does that also add some constraints?
- Jamie: It does, both technical and legal.
- **Production rep:** Meaning?
- Jamie: We better make sure an outsider can't hack into the system, disarm it, and rob the place or worse. Heavy liability on our part.
- Doug: Very true.
- **Marketing:** But we still need Internet connectivity . just be sure to stop an outsider from getting in.
- **Ed:** That's easier said than done and....
- Facilitator **(interrupting):** I don't want to debate this issue now. Let's note it as an action item and proceed. (Doug, serving as the recorder for the meeting, makes an appropriate note.)
- Facilitator: I have a feeling there's still more to consider here.
- (The group spends the next 45 minutes refining and ex-panding the details of the home security function.)

# Eliciting Requirements



# Quality Function Deployment

- Function deployment determines 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 during each of the three deployments
  - Value should be one that are perceived by the customer

# Elicitation Work Products

- 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.
- 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.

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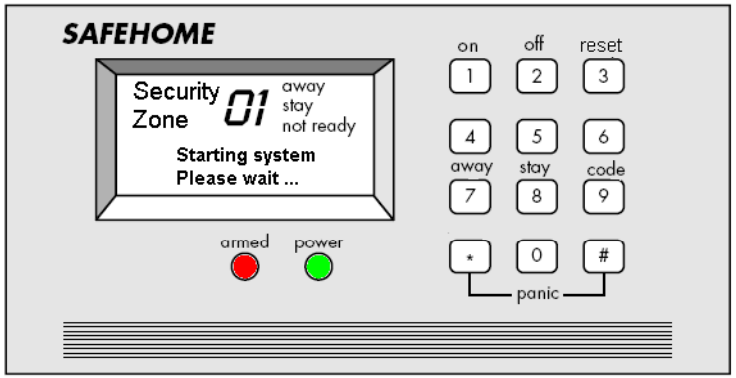
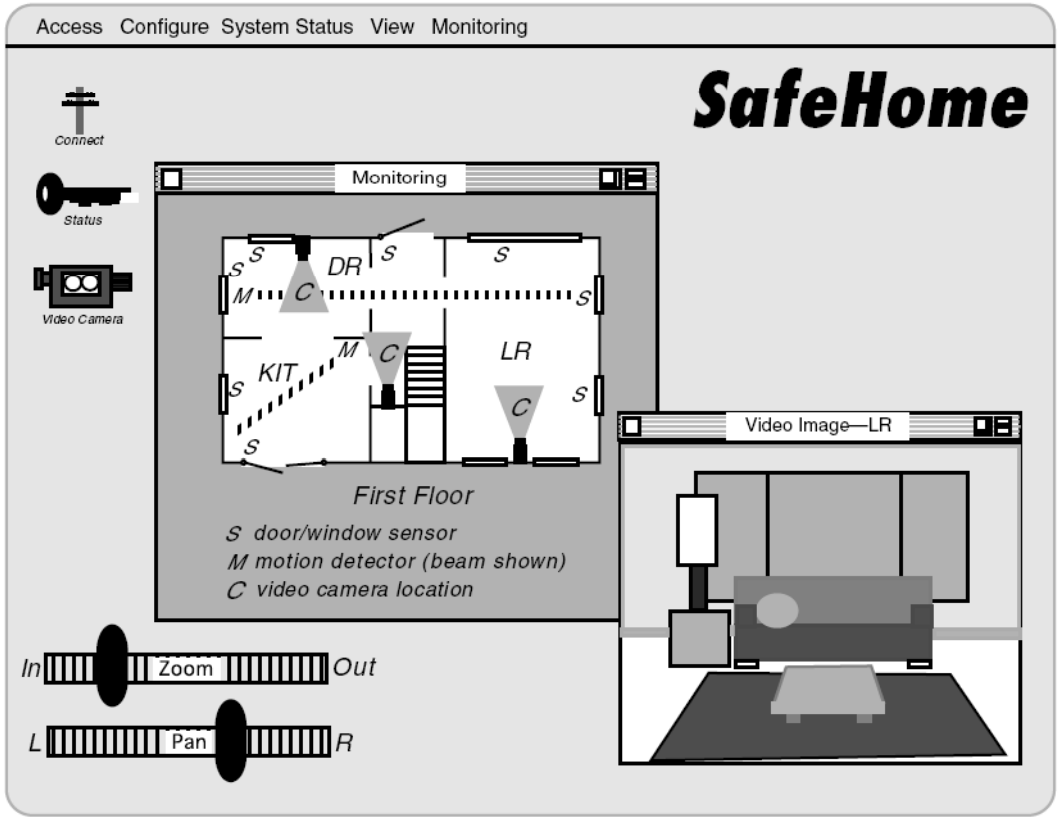
# Use-Cases

- 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?

# SafeHome Product




See SEPA 193,231pg for more details




See 376 pg for more details

# Example of Use Case for SafeHome

- Use-case: InitiateMonitoring
- Primary actor: Homeowner
- Goal in context: To set the system to monitor sensors when the homeowner leaves the house or remains inside
- Preconditions: System has been programmed for a password and to recognize various sensors
- Trigger: The homeowner decides to “set” the system, i.e., to turn on the alarm functions
- Scenario:
  1. Homeowner: observes control panel
  2. Homeowner:enters password
  3. Homeowner: selects “stay” or “away”
  4. Homeowner: observes red alarm light to indicate that SafeHome has been armed
- Exceptions:
  - 1a. Control panel is not ready: homeowner checks all sensors to determine which are open; closes them
  - 2a. Password is incorrect
- Priority: Essential, must be implemented
- When available: first increment
- Frequency of use: Many times per day
- Channel to actor: Via control panel interface
- Secondary actors: Support technician
- Channels to secondary actors: support technician: phone line
- Open issues:
  - Do we enforce time limit for password entering?

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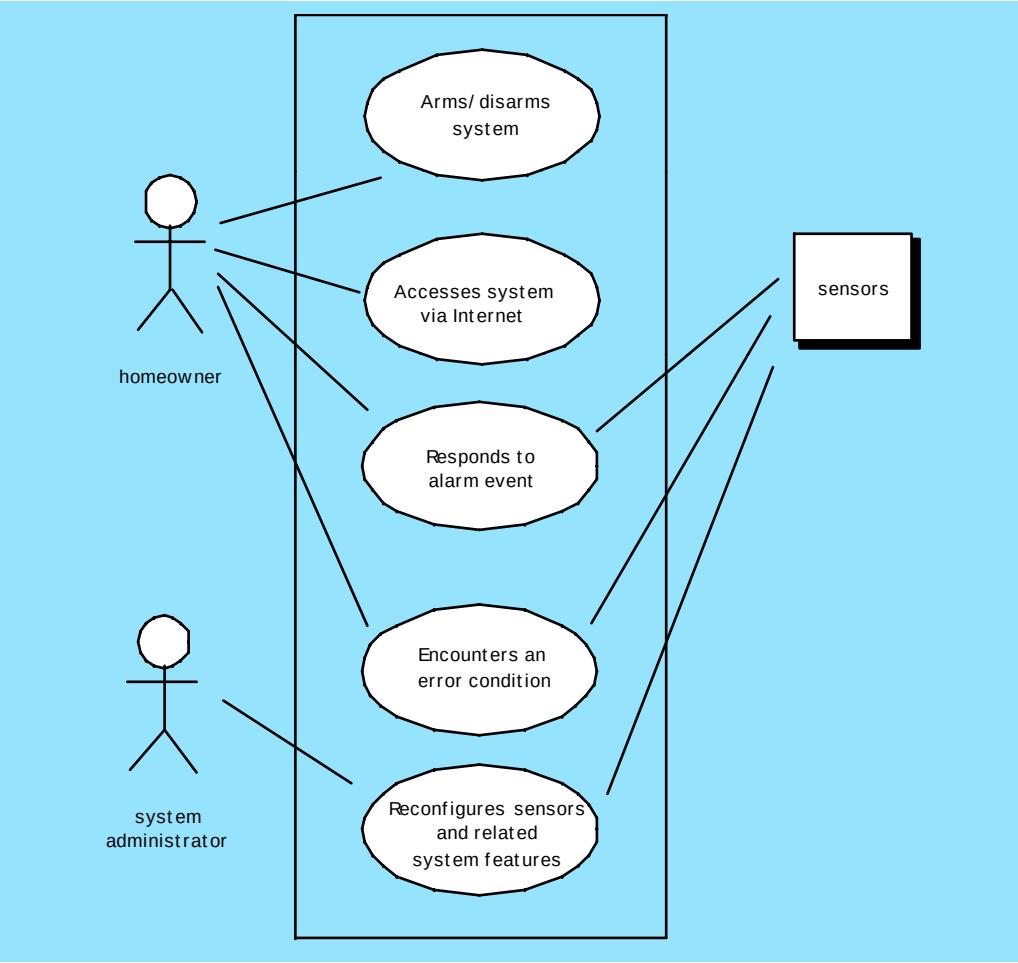
# Use-Case Diagram



# 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

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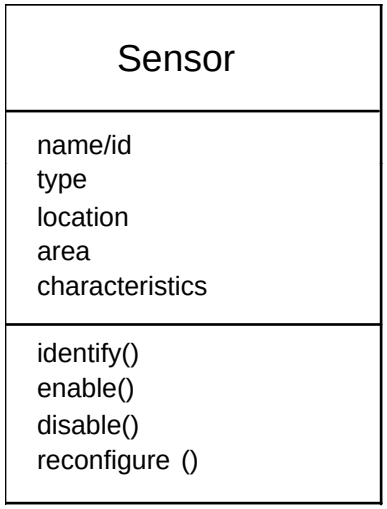
# Class Diagram

**From the *SafeHome* system …**



# State Diagram

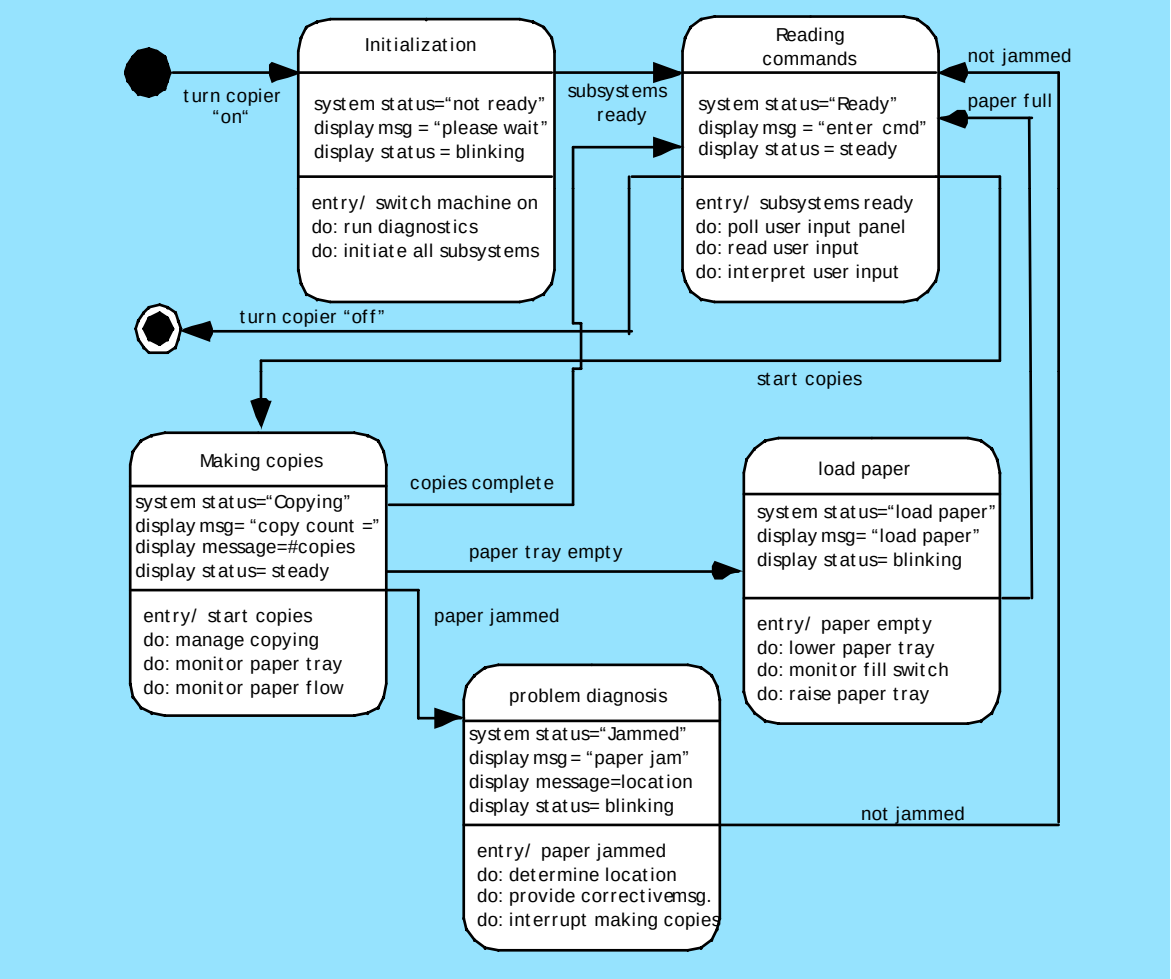



Figure 7.6 Preliminary UML state diagram for a photocopier

# 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?

# Validating Requirements-II

- Do any requirements conflict with other 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.

# Specification Guidelines

- use a layered format that provides increasing detail as the "layers" deepen
- use consistent graphical notation and apply textual terms consistently (stay away from aliases)
- be sure to define all acronyms
- be sure to include a table of contents; ideally, include an index and/or a glossary
- write in a simple, unambiguous style (see "editing suggestions" on the following pages)
- always put yourself in the reader's position, "Would I be able to understand this if I wasn't intimately familiar with the system?"

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# Specification Guidelines

Be on the lookout for persuasive connectors, ask why?
keys: *certainly, therefore, clearly, obviously, it follows that ...*

Watch out for vague terms
keys: *some, sometimes, often, usually,ordinarily, most, mostly ...*

When lists are given, but not completed, be sure all items are understood
keys: *etc., and so forth, and so on, such as*

Be sure stated ranges don't contain unstated assumptions
e.g., *Valid codes range from 10 to 100.* Integer? Real? Hex?

Beware of vague verbs such as *handled, rejected, processed, ...*

Beware "passive voice" statements
e.g., *The parameters are initialized.* By what?

Beware "dangling" pronouns
e.g., *The I/O module communicated with the data validation module and its contol flag is set.* Whose control flag?

# Specification Guidelines

When a term is explicitly defined in one place, try substituting the definition forother occurrences of the term

When a structure is described in words, draw a picture

When a structure is described with a picture, try to redraw the picture to emphasize different elements of the structure

When symbolic equations are used, try expressing their meaning in words

When a calculation is specified, work at least two examples

Look for statements that imply certainty, then ask for proof keys; always, every, all, none, never

Search behind certainty statements뻗e sure restrictions or limitations are realistic