Software Design Processes and Management

Objectives

- To understand how design consists of analysis and resolution activities
- To illustrate and explain generic processes for software product and engineering design
- To explain the five main tasks of project management
- To understand iterative planning and tracking
- To see how to apply project management principles to software design projects

Topics

- Analysis and resolution
- Generic problem-solving and design processes
- Generic software product and engineering design processes
- Project management
- Iterative planning and tracking
- Applying project management to software design projects

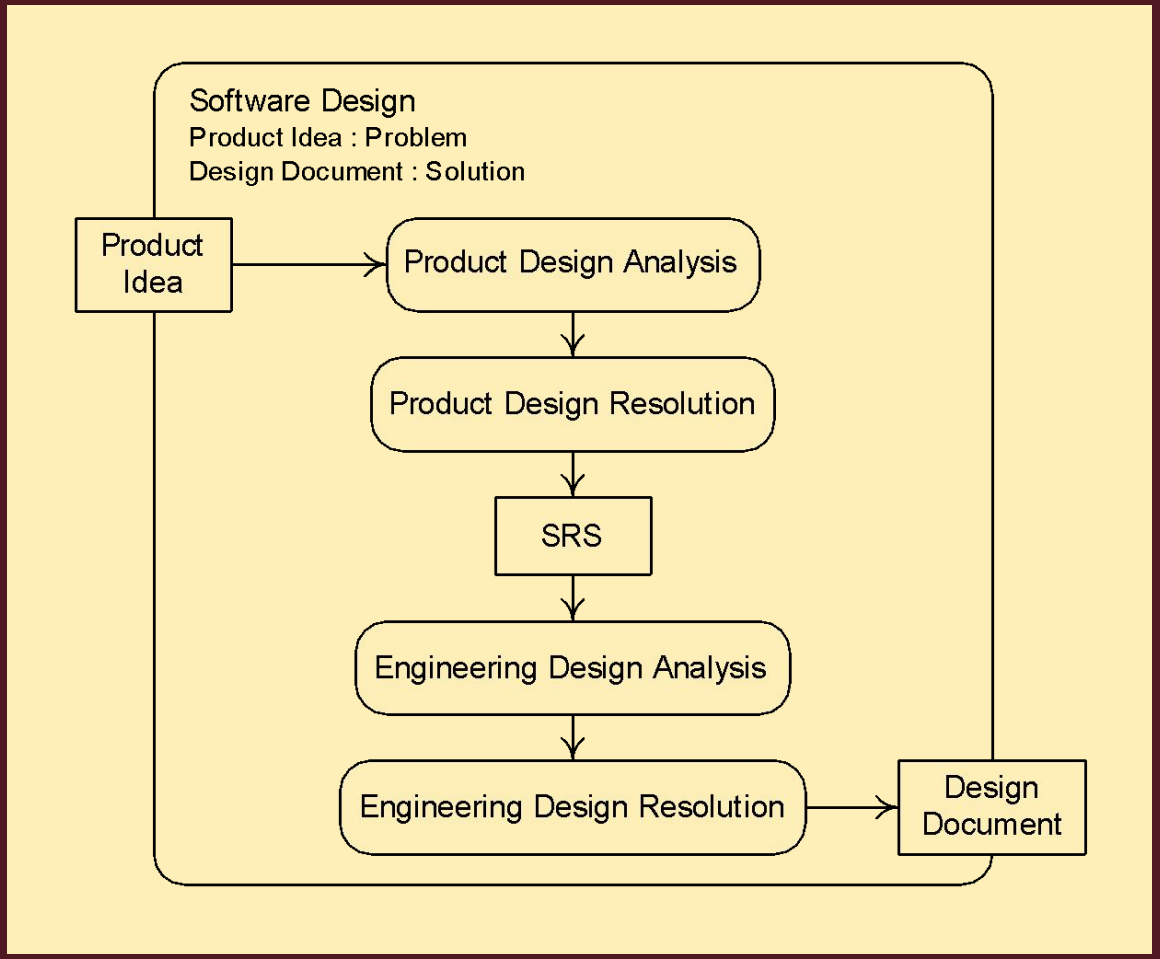
Analysis and Resolution

- Confusion arises around the term *design*.
- This confusion is removed by adopting the following terminology.

Analysis is breaking down a design problem to understand it.

Resolution is solving a design problem.

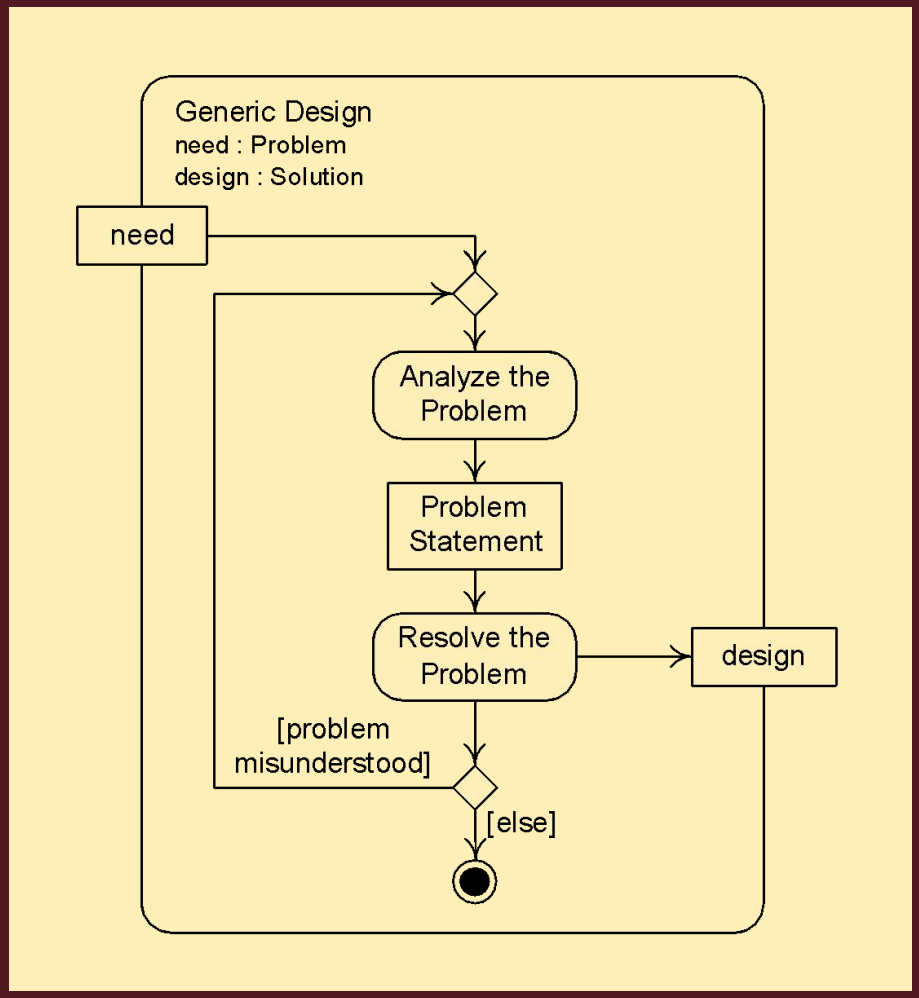
Analysis and Resolution in Software Design



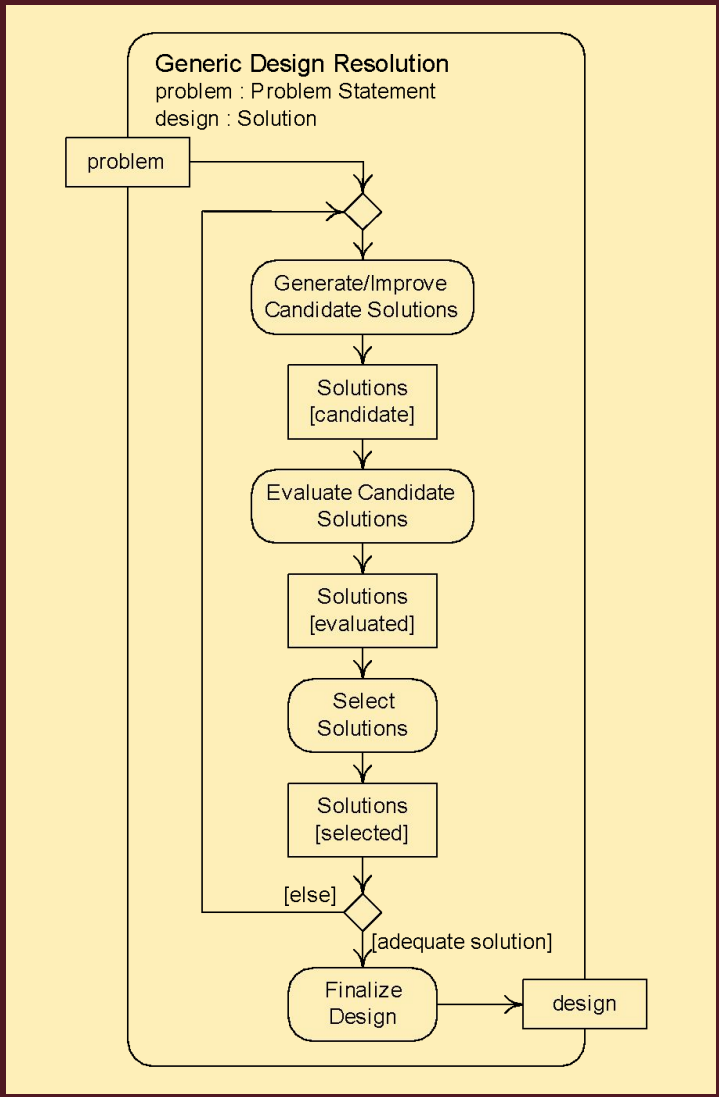
A Problem-Solving Process

1. Understand the problem
2. Generate candidate solutions
3. Evaluate candidate solutions
4. Select the best solution(s)
5. Iterate if no solution is adequate
6. Ensure the solution is complete and well-documented, and deliver it

A Generic Design Process



A Design Resolution Process

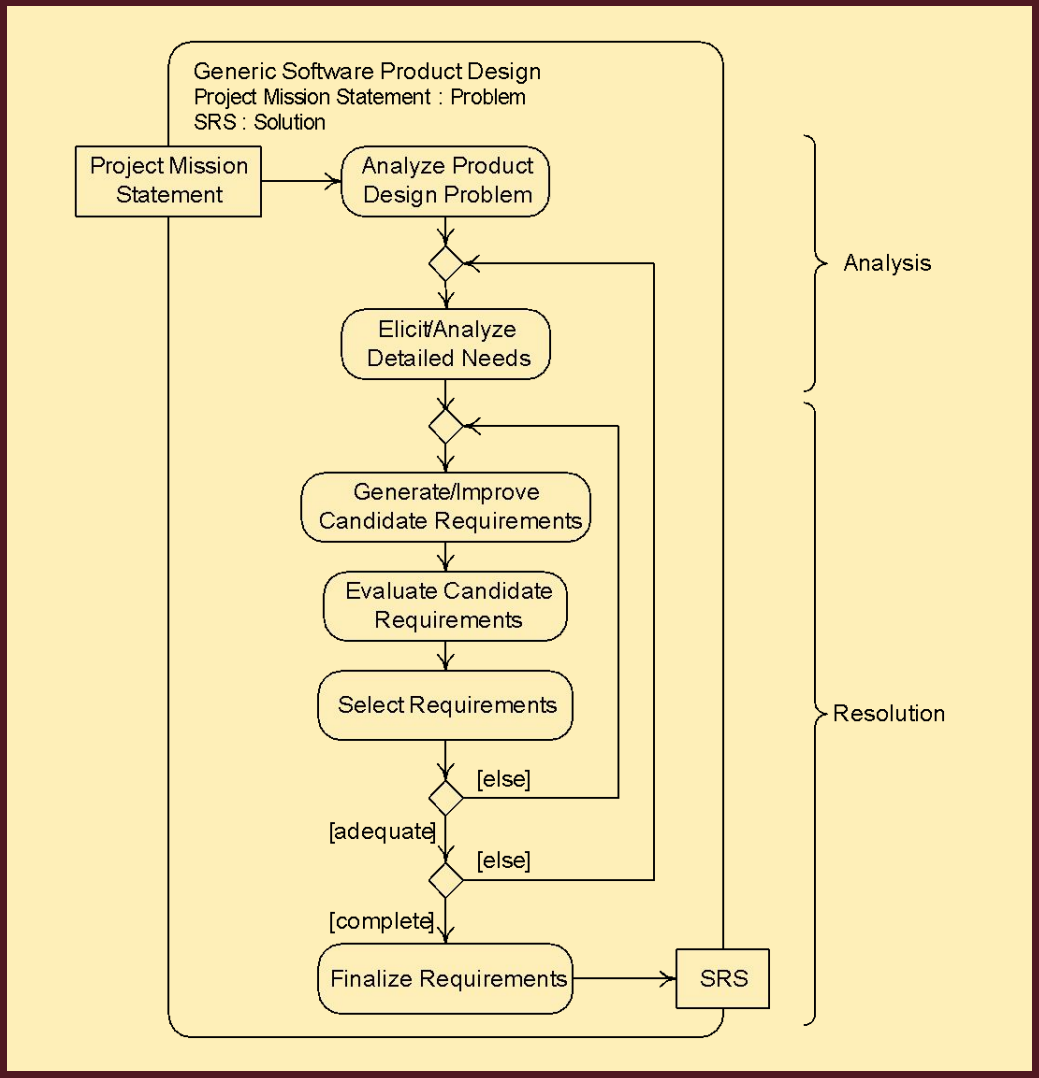


This diagram shows details of the resolution activity from the previous diagram.

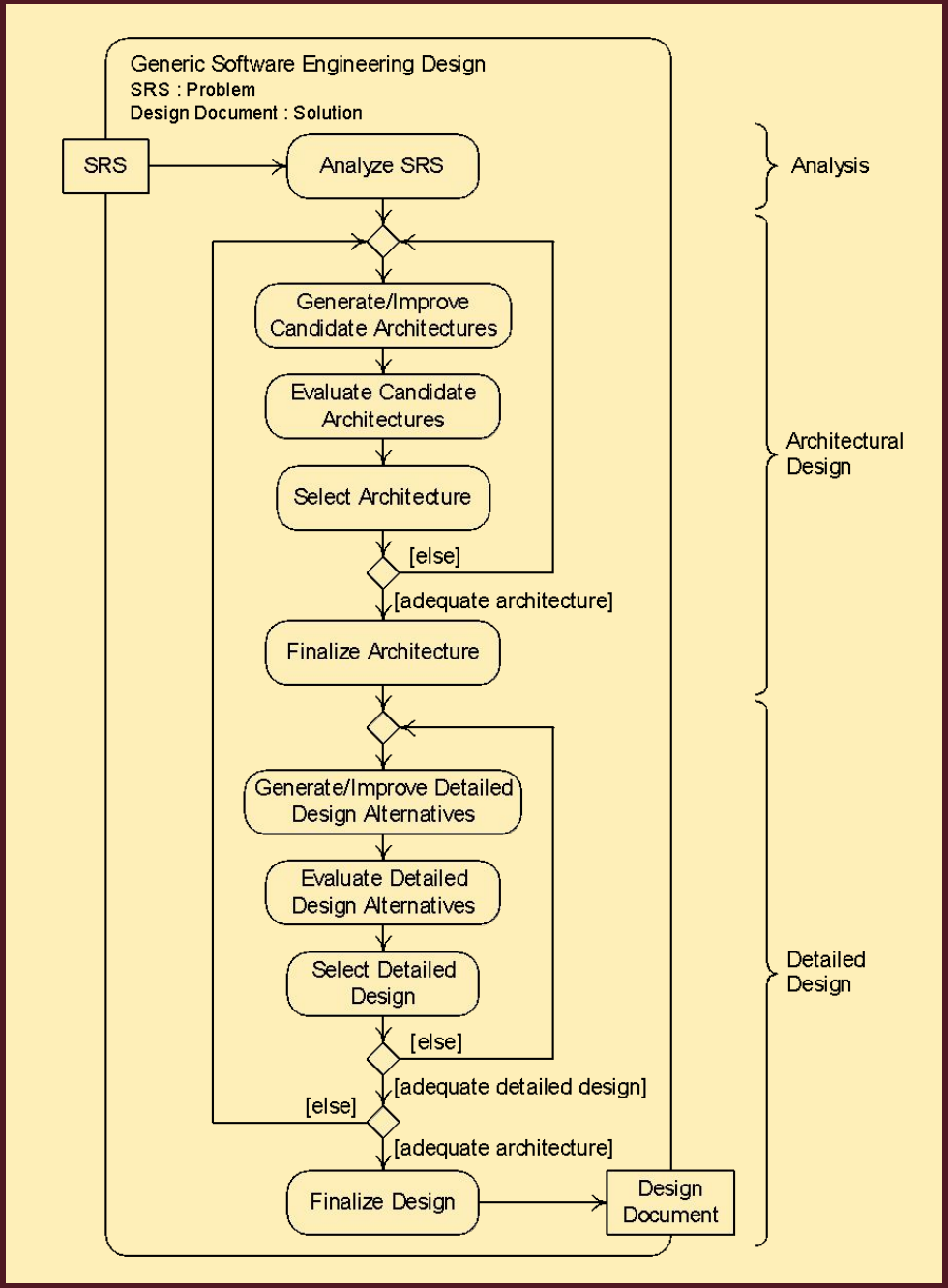
Design Process Characteristics

- The best solutions are rarely the first solutions designers think of.
  - *Designers should generate many candidate solutions*.
- The design process is highly iterative.
  - *Designers must frequently reanalyze the problem and must generate and improve solutions many times*.

A Generic Software Product Design Process



A Generic Software Engineering Design Process



Architectural and Detailed Design

Architectural design is high-level software engineering design resolution.

Detailed design is low-level software engineering design resolution.

Later discussions will consider architectural and detailed design, the latter being further divided into mid-level and low-level detailed design.

Operations versus Projects

- **Operations** are standardized activities that occur continuously or at regular intervals.
  - Payroll
  - Hiring and performance evaluation
  - Shipping and receiving
- **Projects** are one-time efforts to achieve a particular current goal.
  - Process improvement
  - Business restructuring
  - *New product introduction (including design)*

Project Management Activities

- *Planning*—Formulating a scheme for doing a project.
- *Organizing*—Structuring the organizational entities involved in a project and assigning them authority and responsibilities.
- *Staffing*—Filling the positions in an organizational structure and keeping them filled.
- *Tracking*—Observing the progress of work and adjusting work and plans accordingly.
- *Leading*—Directing and supporting people doing project work.

Project Planning

- **Estimation** is calculation of the approximate cost, effort, time or resources required to achieve some end.
- A **schedule** specifies the start and duration of work tasks.
- Tasks are allocated resources based on the schedule and estimates.
- **Risk analysis** is an orderly process of identifying, understanding, and assessing **risks** (any occurrence with negative consequences).
- Policies, procedures, tools, and techniques are specified to govern work.

Project Organization and Staffing

- Organizational structures
  - Project organization
  - Functional organization
  - Matrix organization
- Team structures
  - Hierarchical teams
  - Democratic teams
- Staffing
  - Often the single most important factor in success is having good people to do the work.

Project Tracking

- Projects may not go as planned for many reasons.
  - Resource consumption is not as expected.
  - Tasks do not take as long as expected.
  - Policies, procedures, tools, or techniques cause problems.
  - Something bad occurs (illness, budget cuts, equipment failures, etc.
- When plans fail they must be adjusted.

Leading a Project

- Direction is needed to follow plans, use resources efficiently, etc.
- Directing people is not enough—people need inspiration, help, a congenial work environment, emotional support, etc.

Iterative Planning and Tracking

- Good planning requires knowledge of tasks and their costs, risks, and other details not known until the project is under way—but this is not known when plans are made.
- **Iterative planning and tracking** is making a rough base or initial project plan and refining it at fixed periods during a project in light of tracking data and completed work products.

Design Project Management

- All five project a management activities are needed to manage a design project.
- Iterative planning and tracking is the best approach to planning and tracking.
- The design project decomposition on the next slide is useful for planning, organization, staffing, and tracking.
- Design constitutes the largest activity in software development, so design can drive an entire development project.

Design Project Decomposition

Work Phase		Typical Work Products
Product Design	Analysis: Design Problem	Statement of interested parties, product concept, project scope, markets, business goals Models (of the problem) Prototypes (exploring the problem)
	Analysis: Detailed Needs	Client surveys, questionnaires, interview transcripts, etc. Problem domain description Lists of needs, stakeholders Models (of the problem) Prototypes (exploring needs)
	Resolution: Product Specification	Requirements specifications Models (of the product) Prototypes (demonstrating the product)
Engineering Design	Analysis	Models (of the engineering problem) Prototypes (exploring the problem)
	Resolution: Architectural Design	Architectural design models Architectural design specifications Architectural prototypes
	Resolution: Detailed Design	Detailed design models Detailed design specifications Detailed design prototypes

Summary

- **Analysis** is breaking a design problem down to understand it; **resolution** is solving a design problem.
- Design processes begin with analysis and have a highly iterative resolution phase.
- Designers should generate many candidate solutions and expect to reanalyze and resolve the problem repeatedly.
- Design management is project management and hence requires planning, organization, staffing, tracking, and leadership.
- Iterative planning and tracking is the best way to make and revise plans during a project.