Object-Oriented Software Engineering
Using UML, Patterns, and Java

Chapter 3
Requirements Elicitation
(Book Chapter 4)

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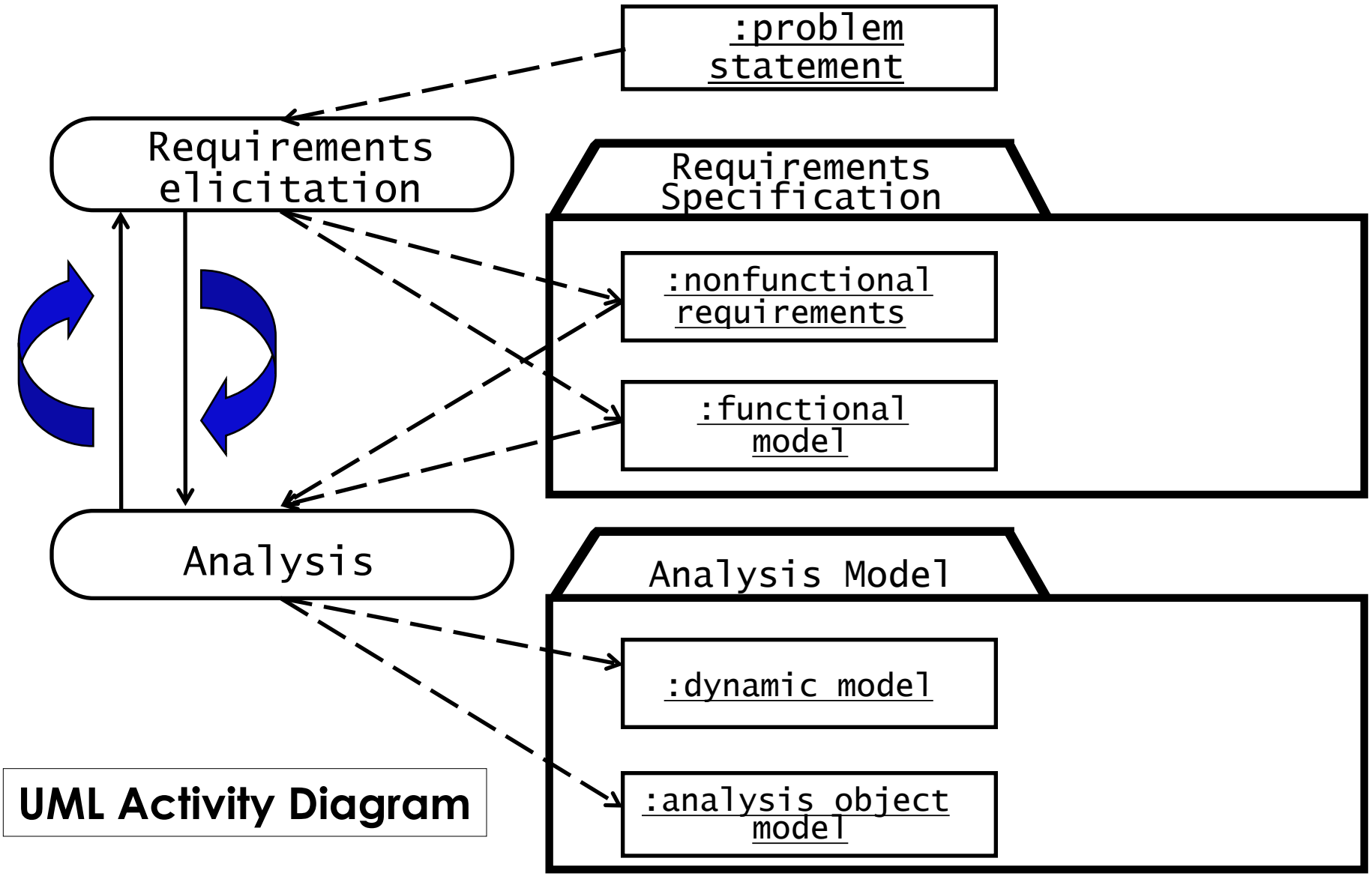
Requirements Process



UML Activity Diagram

Requirements Specification vs Analysis Model

Both focus on the requirements from the user's view of the system

- The requirements specification uses natural language (derived from the problem statement)
- The analysis model uses a formal or semi-formal notation
  - We use UML.

Types of Requirements

- Functional requirements
  - Describe the interactions between the system and its environment independent from the implementation

    "An operator must be able to define a new game. "
- Nonfunctional requirements
  - Aspects not directly related to functional behavior.

    "The response time must be less than 1 second"
- Constraints
  - Imposed by the client or the environment
    - "The implementation language must be Java "
  - Called "Pseudo requirements" in the text book.

Functional vs. Nonfunctional Requirements

Functional Requirements

- Describe user tasks that the system needs to support
- Phrased as actions
  - "Notify an interest group"
  - "Schedule tournament"

Nonfunctional Requirements

- Describe properties of the system or the domain
- Phrased as constraints or negative assertions
  - "All user inputs should be acknowledged within 1 second"
  - "A system crash should not result in data loss".

Types of Nonfunctional Requirements

- Usability
- Reliability
  - Robustness
  - Safety
- Performance
  - Response time
  - Scalability
  - Throughput
  - Availability
- Supportability
  - Adaptability
  - Maintainability

Quality requirements

- Implementation
- Interface
- Operation
- Packaging
- Legal
  - Licensing (GPL, LGPL)
  - Certification
  - Regulation

Constraints or
Pseudo requirements

Some Quality Requirements Definitions

- Usability
  - The ease with which actors can use a system to perform a function
  - Usability is one of the most frequently misused terms (“The system is easy to use”)
  - **Usability** must be **measurable**, otherwise it is **marketing**
    - Example: Specification of the number of steps to perform a internet-based purchase with a web browser
- Robustness: The ability of a system to maintain a function
  - even if the user enters a wrong input
  - even if there are changes in the environment
    - Example: The system can tolerate temperatures up to 90 C
- Availability: The ratio of the expected uptime of a system to the aggregate of the expected up and down time
  - Example: The system is down not more than 5 minutes per week.

Nonfunctional Requirements: Examples

- "Spectators must be able to watch a match without prior registration and without prior knowledge of the match."
  - *Usability Requirement*
- "The system must support 10 parallel tournaments"
  - *Performance Requirement*
- "The operator must be able to add new games without modifications to the existing system."
  - *Supportability Requirement*

What should not be in the Requirements?

- System structure, implementation technology
- Development methodology
- Development environment
- Implementation language
- Reusability

- It is desirable that none of these above are constrained by the client.

Requirements Validation

Requirements validation is a quality assurance step, usually performed after requirements elicitation or after analysis

- Correctness:
  - The requirements represent the client's view
- Completeness:
  - All possible scenarios, in which the system can be used, are described
- Consistency:
  - There are no requirements that contradict each other.

Requirements Validation (2)

- Clarity:
  - Requirements can only be interpreted in one way
- Realism:
  - Requirements can be implemented and delivered
- Traceability:
  - Each system behavior can be traced to a set of functional requirements
- Problems with requirements validation:
  - Requirements change quickly during requirements elicitation
  - Inconsistencies are easily added with each change
  - Tool support is needed!

We can specify Requirements for "Requirements Management"

- Functional requirements:
  - Store the requirements in a shared repository
  - Provide multi-user access to the requirements
  - Automatically create a specification document from the requirements
  - Allow change management of the requirements
  - Provide traceability of the requirements throughout the artifacts of the system.

Tools for Requirements Management (2)

DOORS (Telelogic)

- Multi-platform requirements management tool, for teams working in the same geographical location. DOORS XT for distributed teams.

RequisitePro (IBM/Rational)

- Integration with MS Word
- Project-to-project comparisons via XML baselines

RD-Link (http://www.ring-zero.com)

- Provides traceability between RequisitePro & Telelogic DOORS

Unicase (http://unicase.org)

- Research tool for the collaborative development of system models
- Participants can be geographically distributed.

Different Types of Requirements Elicitation

- Greenfield Engineering
  - Development starts from scratch, no prior system exists, requirements come from end users and clients
  - Triggered by user needs
- Re-engineering
  - Re-design and/or re-implementation of an existing system using newer technology
  - Triggered by technology enabler
- Interface Engineering
  - Provision of existing services in a new environment
  - Triggered by technology enabler or new market needs

Prioritizing requirements

- High priority
  - Addressed during analysis, design, and implementation
  - A high-priority feature must be demonstrated
- Medium priority
  - Addressed during analysis and design
  - Usually demonstrated in the second iteration
- Low priority
  - Addressed only during analysis
  - Illustrates how the system is going to be used in the future with not yet available technology

Nonfunctional Requirements (Questions to overcome "Writers block")

User interface and human factors

- What type of user will be using the system?
- Will more than one type of user be using the system?
- What training will be required for each type of user?
- Is it important that the system is easy to learn?
- Should users be protected from making errors?
- What input/output devices are available

Documentation

- What kind of documentation is required?
- What audience is to be addressed by each document?

Nonfunctional Requirements (2)

Hardware considerations

- What hardware is the proposed system to be used on?
- What are the characteristics of the target hardware, including memory size and auxiliary storage space?

Performance characteristics

- Are there speed, throughput, response time constraints on the system?
- Are there size or capacity constraints on the data to be processed by the system?

Error handling and extreme conditions

- How should the system respond to input errors?
- How should the system respond to extreme conditions?

Nonfunctional Requirements (3)

System interfacing

- Is input coming from systems outside the proposed system?
- Is output going to systems outside the proposed system?
- Are there restrictions on the format or medium that must be used for input or output?

Quality issues

- What are the requirements for reliability?
- Must the system trap faults?
- What is the time for restarting the system after a failure?
- Is there an acceptable downtime per 24-hour period?
- Is it important that the system be portable?

Nonfunctional Requirements (4)

System Modifications

- What parts of the system are likely to be modified?
- What sorts of modifications are expected?

Physical Environment

- Where will the target equipment operate?
- Is the target equipment in one or several locations?
- Will the environmental conditions be ordinary?

Security Issues

- Must access to data or the system be controlled?
- Is physical security an issue?

Nonfunctional Requirements (5)

Resources and Management Issues

- How often will the system be backed up?
- Who will be responsible for the back up?
- Who is responsible for system installation?
- Who will be responsible for system maintenance?