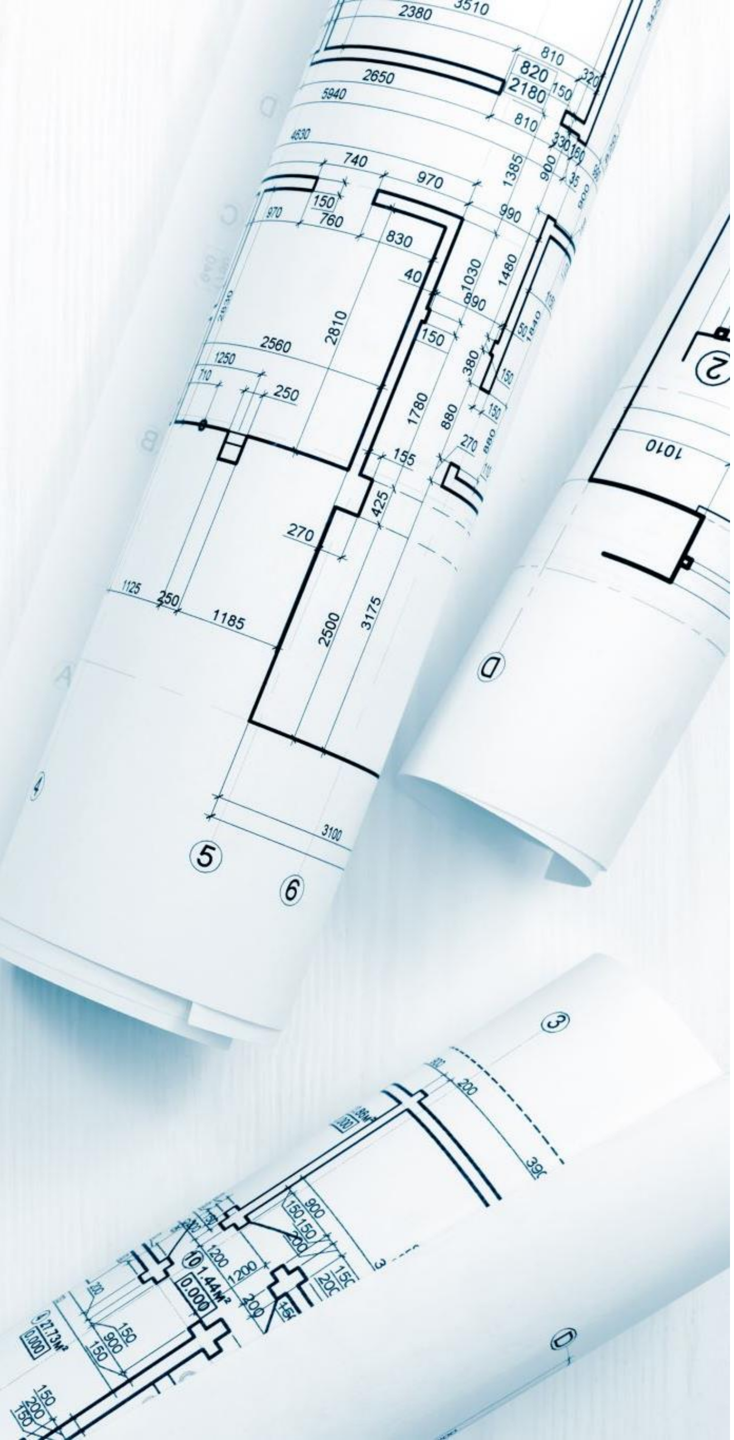
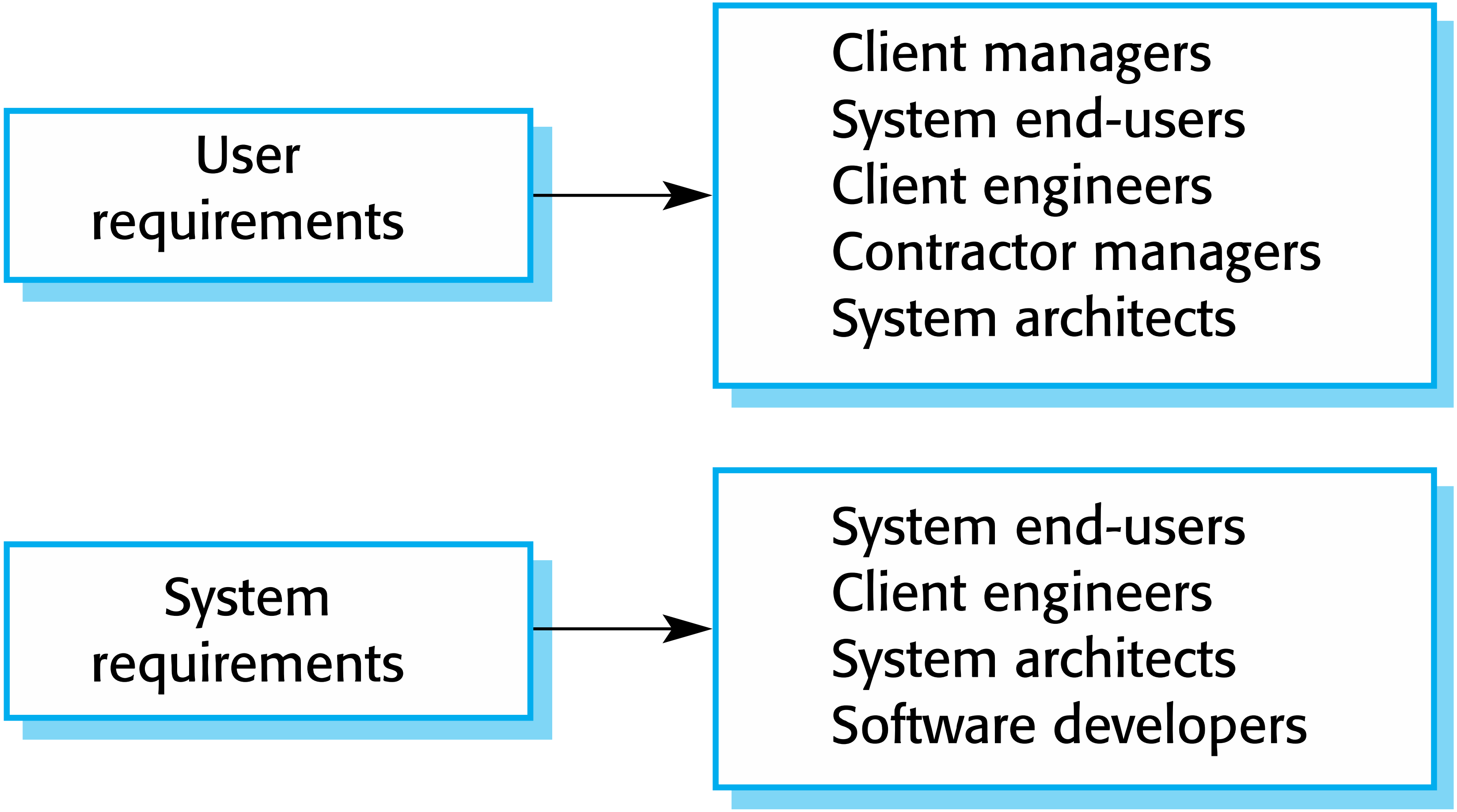


Requirement Engineering Processes

Requirement engineering is the process of establishing the services that the customer requires from a system and the constrains under which it operates and is developed.

Type of Requirements



User requirements

Client managers
System end-users
Client engineers
Contractor managers
System architects

System requirements

System end-users
Client engineers
System architects
Software developers

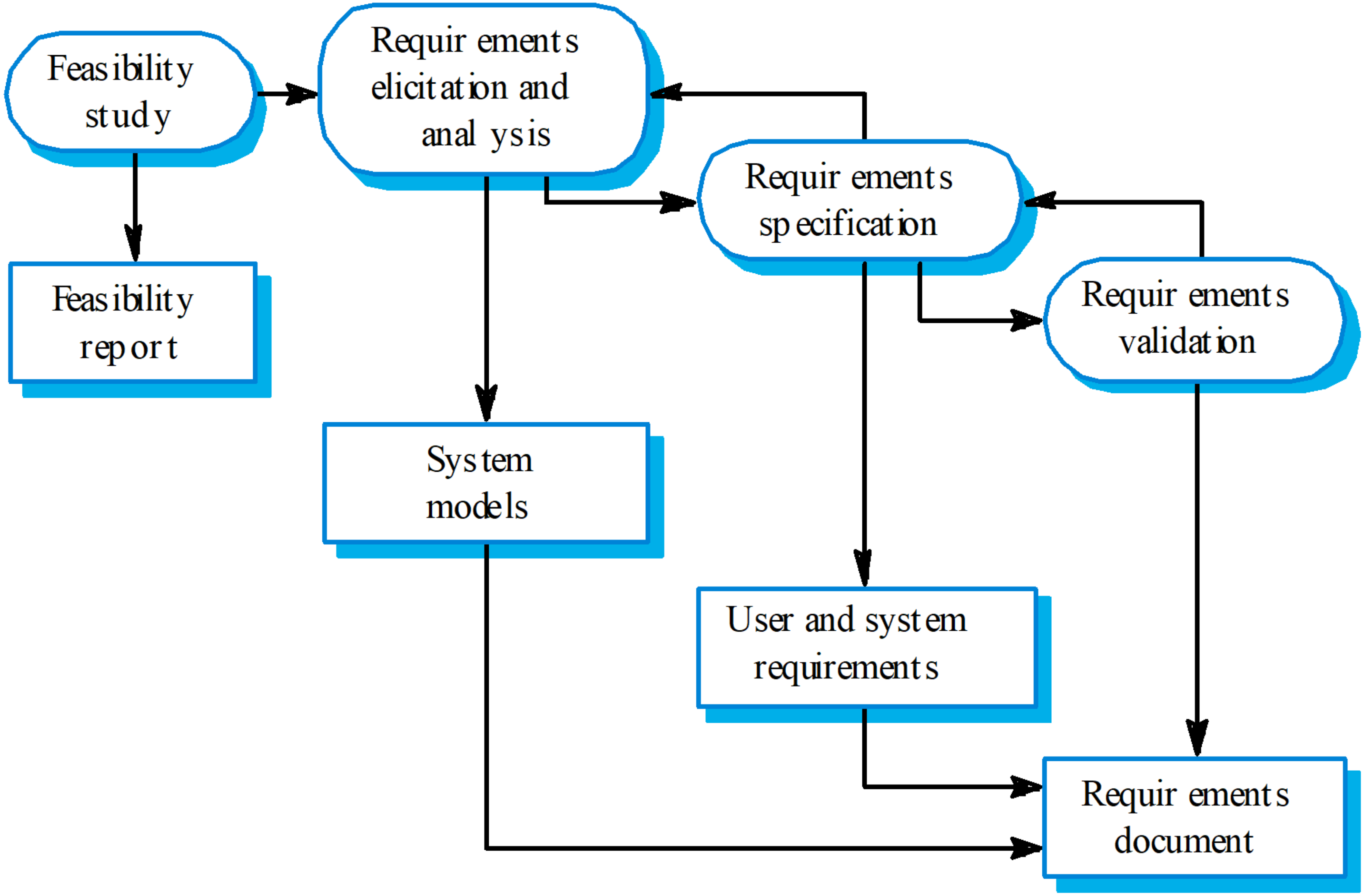
Requirements engineering processes

- The processes used for RE vary widely depending on the application domain, the people involved and the organisation developing the requirements.

- However, there are a number of generic activities common to all processes

  - Requirements elicitation;
  - Requirements analysis;
  - Requirements validation;
  - Requirements management.

The requirements engineering process



Feasibility study

Requirements elicitation and analysis

Requirements specification

Requirements validation

Feasibility report

System models

User and system requirements

Requirements document

Feasibility studies

- A feasibility study decides whether or not the proposed system is worthwhile.
- A short focused study that checks
  - If the system contributes to organisational objectives;
  - If the system can be engineered using current technology and within budget;
  - If the system can be integrated with other systems that are already used.

Feasibility study implementation

- Based on information assessment (what is required), information collection and report writing.

- Questions for people in the organisation
  - What if the system wasn’t implemented?
  - What are current process problems?
  - How will the proposed system help?
  - What will be the integration problems?
  - Is new technology needed? What skills?
  - What facilities must be supported by the proposed system?

Requirements elicitation and analysis

- Sometimes called requirements elicitation or requirements discovery.
- Involves technical staff working with customers to find out about the application domain, the services that the system should provide and the system’s operational constraints.
- May involve end-users, managers, engineers involved in maintenance, domain experts, trade unions, etc. These are called stakeholders.

Requirement's elicitation

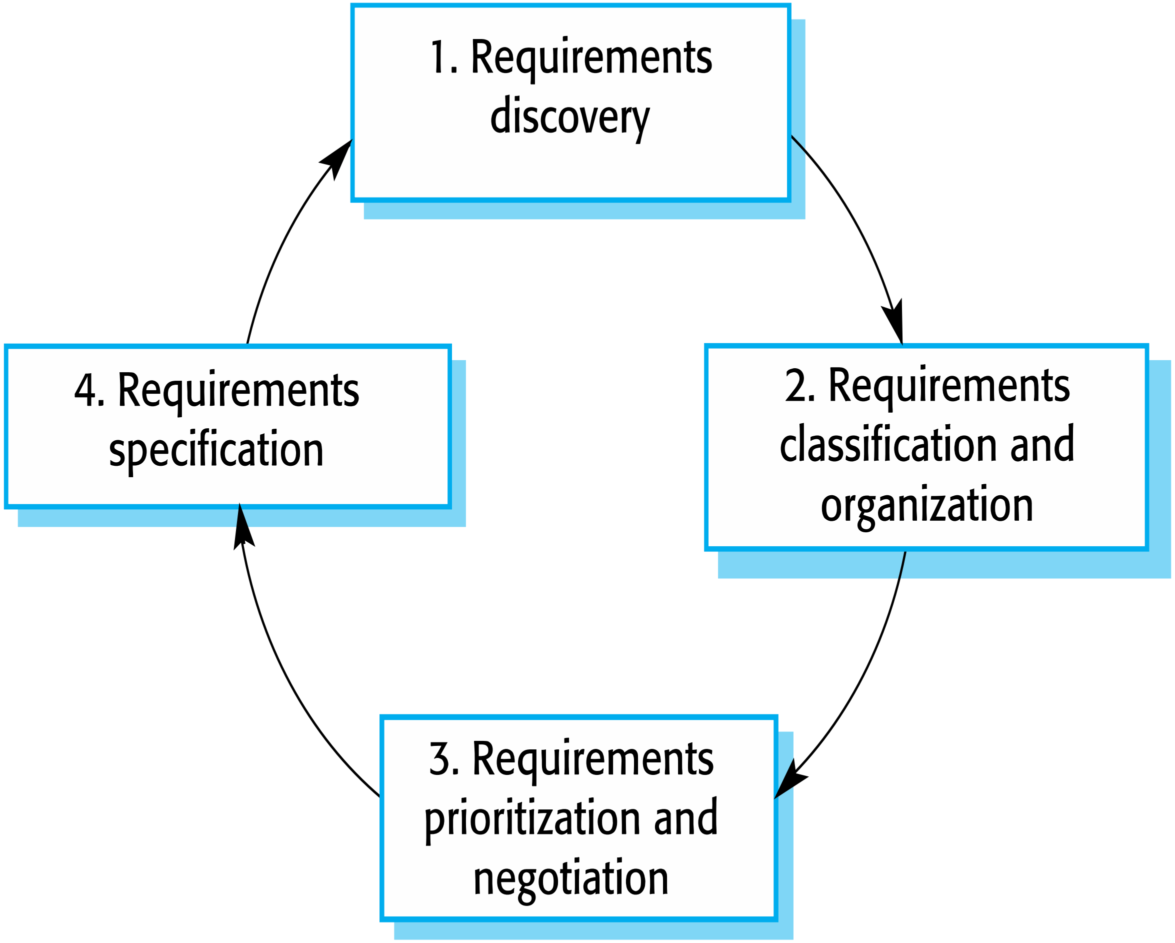
- Software engineers work with a range of system stakeholders to find out about the application domain, the services that the system should provide, the required system performance, hardware constraints, other systems, etc.

- Stages include:
  - Requirement's discovery,
  - Requirement's classification and organization,
  - Requirement's prioritization and negotiation,
  - Requirement's specification.

Problems of requirements analysis

- Stakeholders don’t know what they really want.
- Stakeholders express requirements in their own terms.
- Different stakeholders may have conflicting requirements.
- Organisational and political factors may influence the system requirements.
- The requirements change during the analysis process. New stakeholders may emerge and the business environment change.

The requirements elicitation and analysis process



1. Requirements discovery

2. Requirements classification and organization

3. Requirements prioritization and negotiation

4. Requirements specification

Process Activity

- Requirements discovery
  - Interacting with stakeholders to discover their requirements. Domain requirements are also discovered at this stage.
- Requirements classification and organisation
  - Groups related requirements and organises them into coherent clusters.
- Prioritisation and negotiation
  - Prioritising requirements and resolving requirements conflicts.
- Requirements specification
  - Requirements are documented and input into the next round of the spiral.

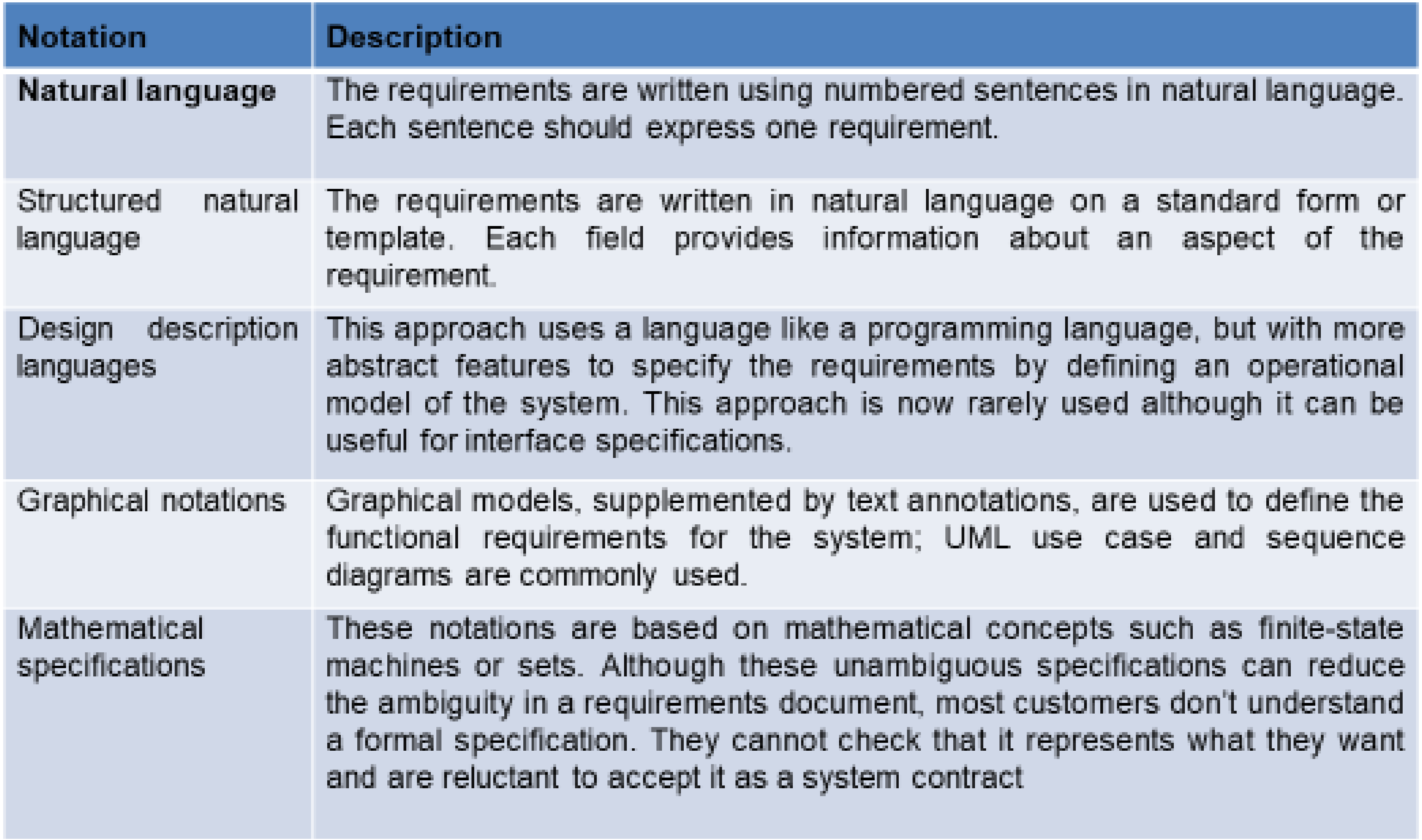
Requirement Validation Checks

- Validity checks – A system is needed to perform certain functions
- Consistency checks – Requirements should not be contradictory or of the same system function
- Completeness checks – requirements document should include all functions and constraints
- Realism checks – Requirements should be checked to ensure that they could actually be implemented
- Verifiability – Requirements should always be written so that they are verifiable

Requirement's specification

- The process of writing down the user and system requirements in a requirements document.
- User requirements must be understandable by end-users and customers who do not have a technical background.
- System requirements are more detailed requirements and may include more technical information.
- The requirements may be part of a contract for the system development
  - It is therefore important that these are as complete as possible.

Ways of writing a system requirements specification



Notation	Description
Natural language	The requirements are written using numbered sentences in natural language. Each sentence should express one requirement.
Structured natural language	The requirements are written in natural language on a standard form or template. Each field provides information about an aspect of the requirement.
Design description languages	This approach uses a language like a programming language, but with more abstract features to specify the requirements by defining an operational model of the system. This approach is now rarely used although it can be useful for interface specifications.
Graphical notations	Graphical models, supplemented by text annotations, are used to define the functional requirements for the system; UML use case and sequence diagrams are commonly used.
Mathematical specifications	These notations are based on mathematical concepts such as finite-state machines or sets. Although these unambiguous specifications can reduce the ambiguity in a requirements document, most customers don't understand a formal specification. They cannot check that it represents what they want and are reluctant to accept it as a system contract

Requirements Validation

- It is concerned with showing that the requirements actually define the system that the customer wants
- It is important because errors in requirements documentation can lead to extensive rework costs when they are discovered during development process
- The cost of fixing a requirements problems is much greater than repairing design or coding errors

Requirements checking

- Validity. Does the system provide the functions which best support the customer’s needs?
- Consistency. Are there any requirements conflicts?
- Completeness. Are all functions required by the customer included?
- Realism. Can the requirements be implemented given available budget and technology
- Verifiability. Can the requirements be checked?

Requirements validation techniques

- Requirements reviews
  - Systematic manual analysis of the requirements.

- Prototyping
- Using an executable model of the system to check requirements.

- Test-case generation
- Developing tests for requirements to check testability.

Requirements Reviews

- Regular reviews should be held while the requirements definition is being formulated.
- Both client and contractor staff should be involved in reviews.
- Reviews may be formal (with completed documents) or informal. Good communications between developers, customers and users can resolve problems at an early stage.

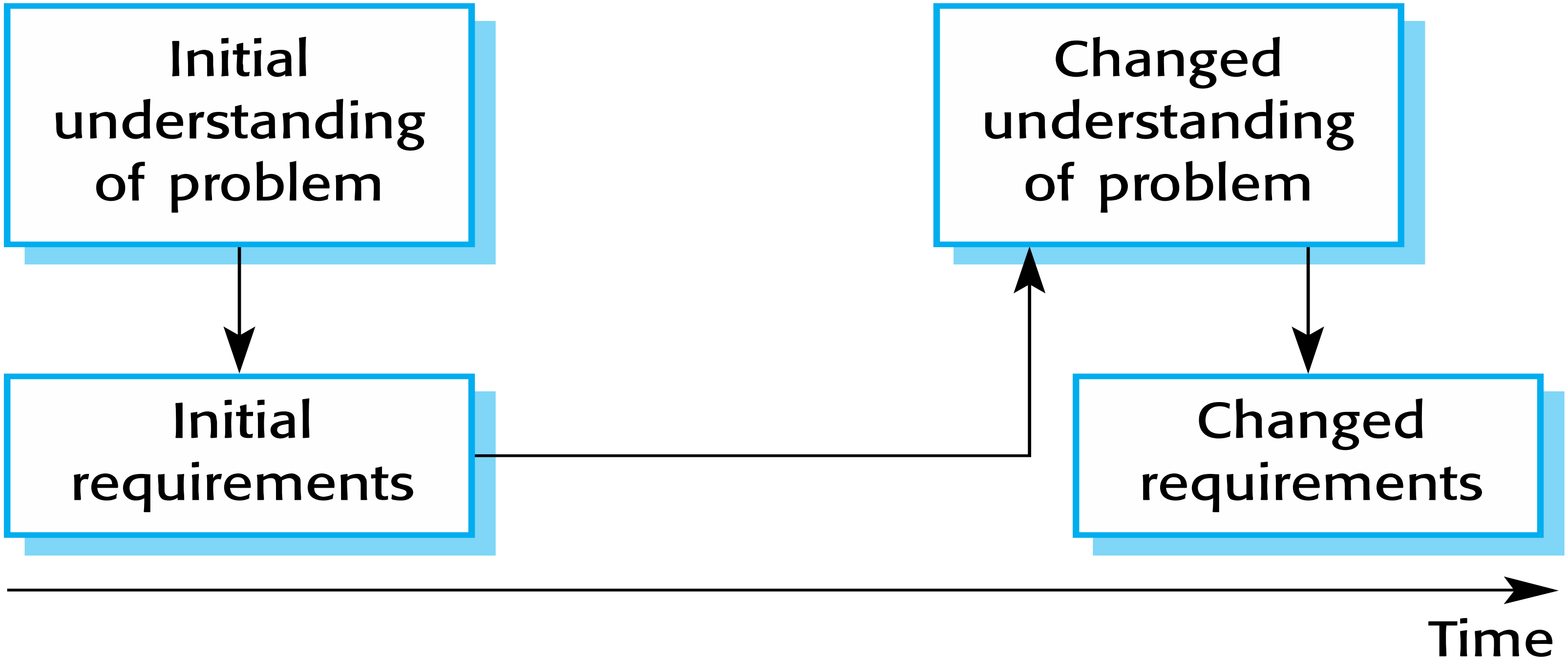
Requirements Reviews

- It is a manual process that involves people from both client and contractor organizations.
- They check the requirements document for anomalies and omissions.
- Requirements reviews can be informal (involves contractors discussing requirements with stake holders) and formal (the development team walks through the system requirements)
- Reviewers may also check for
  - Verifiability
  - Comprehensibility
  - Traceability
  - Adaptability

Review checks

- Verifiability
  - Is the requirement realistically testable?
- Comprehensibility
  - Is the requirement properly understood?
- Traceability
  - Is the origin of the requirement clearly stated?
- Adaptability
  - Can the requirement be changed without a large impact on other requirements?

Requirement's evolution


Initial understanding of problem
Changed understanding of problem
Initial requirements
Changed requirements
Time

Requirements Management

- Requirements management is the process of managing changing requirements during the requirements engineering process and system development.

- New requirements emerge as a system is being developed and after it has gone into use.

- You need to keep track of individual requirements and maintain links between dependent requirements so that you can assess the impact of requirements changes. You need to establish a formal process for making change proposals and linking these to system requirements.

Requirement Management Planning

- Establishes the level of requirements management detail that is required.

- Requirements management decisions:
  - ***Requirement's identification*** Each requirement must be uniquely identified so that it can be cross-referenced with other requirements.

  - ***A change management process*** This is the set of activities that assess the impact and cost of changes.

  - ***Traceability policies*** These policies define the relationships between each requirement and between the requirements and the system design that should be recorded.

  - ***Tool support*** Tools that may be used range from specialist requirements management systems to spreadsheets and simple database systems.