# Requirements Engineering Processes

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
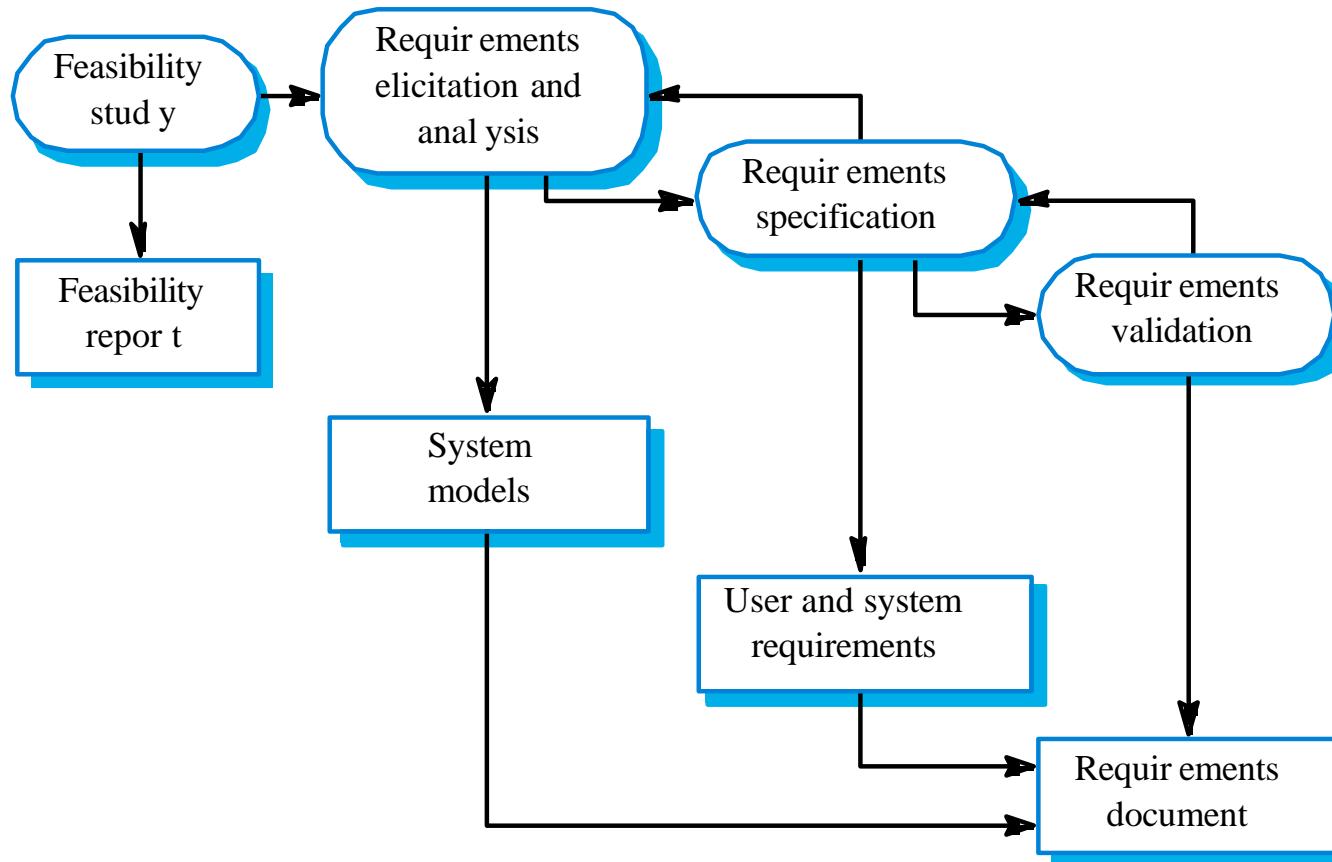
Feasibility studies

- 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 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?

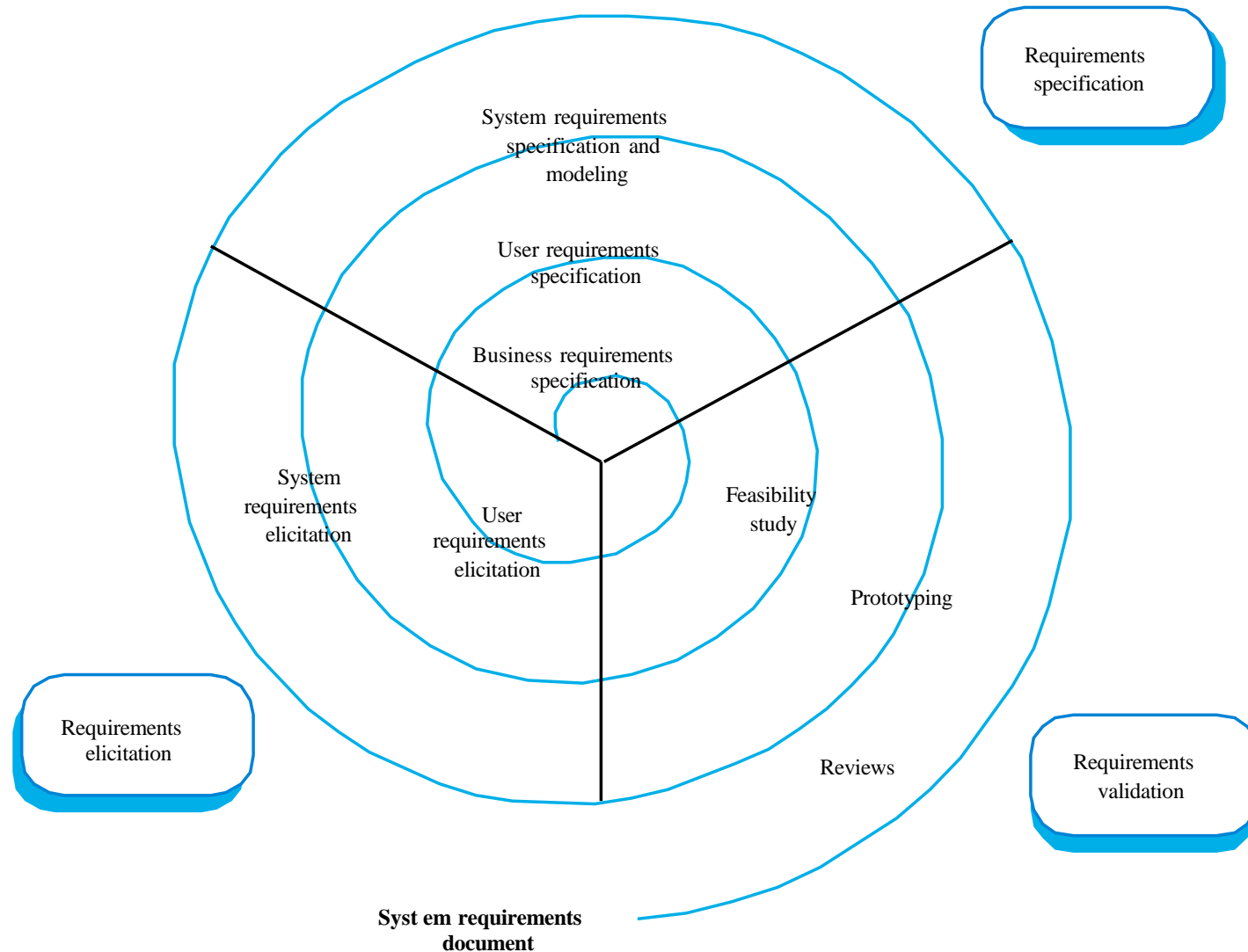 – What facilities must be supported by the proposed system?

Requirements engineering

Requirements specification

System requirements specification and modeling

User requirements specification

Business requirements specification

System requirements elicitation

User requirements elicitation

Feasibility study

Prototyping

Reviews

Requirements elicitation

Requirements validation

Syst em requirements document

1. 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.*
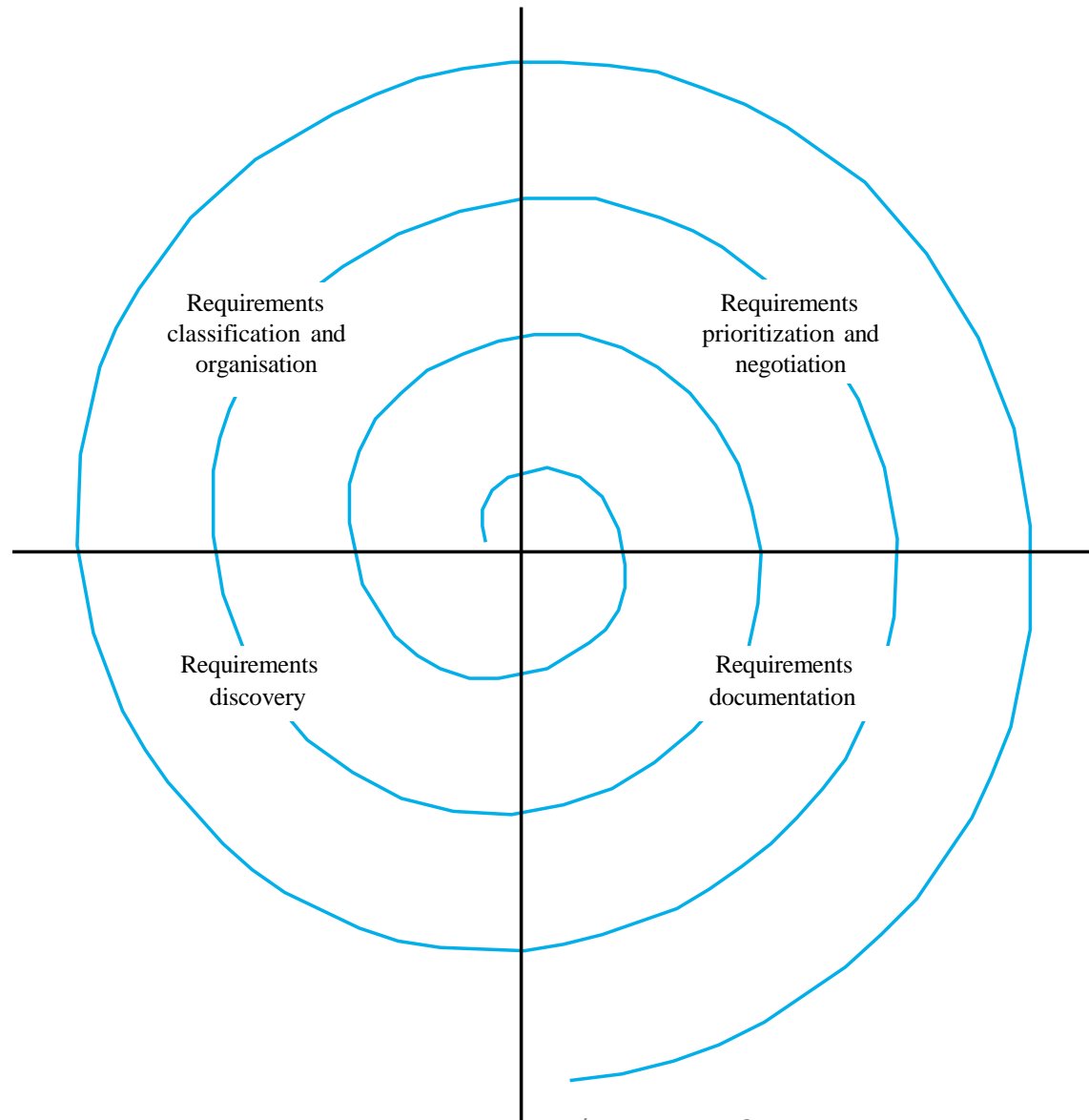
Problems of requirements analysis

- 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 spiral

Requirements
classification and
organisation

Requirements
prioritization and
negotiation

Requirements
discovery

Requirements
documentation

Elicitation Process activities

- **Requirements discovery**

  – Interacting with stakeholders to discover their requirements.

  – Domain requirements are also discovered at this stage.

- **Requirements classification and organisation**

  – Group related requirements and organises them into coherent clusters.

- **Prioritisation and negotiation**

  – Prioritising requirements and resolving requirements conflicts.

- **Requirements documentation**

  – Requirements are documented and input into the next round of the spiral.

Requirements discovery

- The process of gathering information about the proposed and existing systems and distilling the user and system requirements from this information.

- Sources of information include documentation, system stakeholders and the specifications of similar systems.

ATM stakeholders

- Bank customers
- Representatives of other banks
- Bank managers
- Counter staff
- Database administrators
- Security managers
- Marketing department
- Hardware and software maintenance engineers
- Banking regulators

Viewpoints

- Viewpoints are a way of structuring the requirements to represent the perspectives of different stakeholders. Stakeholders may be classified under different viewpoints.

- This multi-perspective analysis is important as there is no single correct way to analyse system requirements.

Types of viewpoint

- **Interactor viewpoints**

  - People or other systems that interact directly with the system. In an ATM, the customer's and the account database are interactor VPs.

- **Indirect viewpoints**

  - Stakeholders who do not use the system themselves but who influence the requirements. In an ATM, management and security staff are indirect viewpoints.

- **Domain viewpoints**

  - Domain characteristics and constraints that influence the requirements. In an ATM, an example would be standards for inter-bank communications.

Viewpoint identification

- Identify viewpoints using
  - Providers and receivers of system services;
  - Systems that interact directly with the system being specified;
  - Regulations and standards;
  - Sources of business and non-functional requirements.
  - Engineers who have to develop and maintain the system;
  - Marketing and other business viewpoints.

LIBSYS viewpoint hierarchy
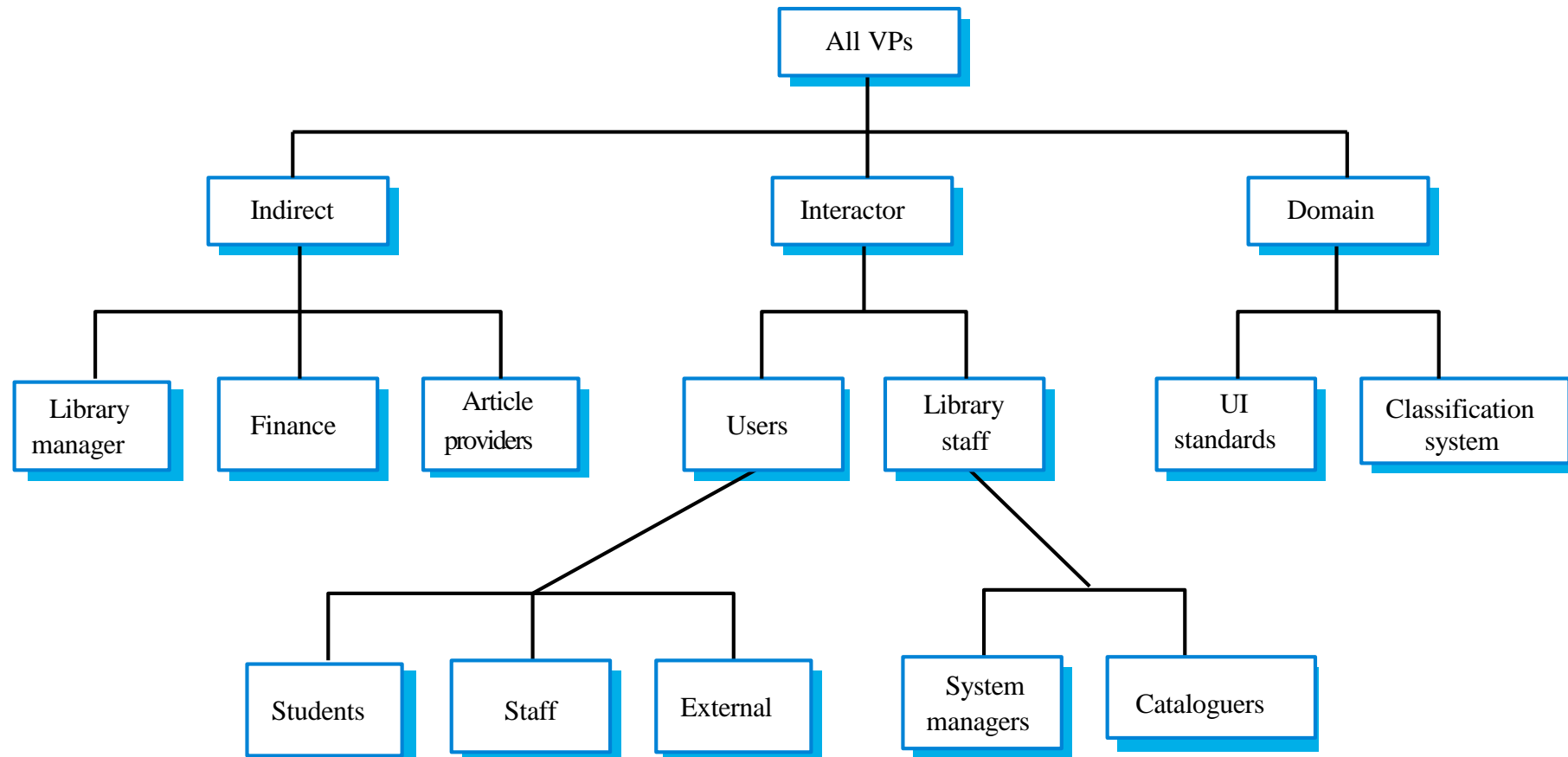
Interviewing

- In formal or informal interviewing, the RE team puts questions to stakeholders about the system that they use and the system to be developed.

- There are two types of interview

  – Closed interviews where a pre-defined set of questions are answered.

  – Open interviews where there is no pre-defined agenda and a range of issues are explored with stakeholders.

Interviews in practice

- Normally a mix of closed and open-ended interviewing.

- Interviews are good for getting an overall understanding of what stakeholders do and how they might interact with the system.

- Interviews are not good for understanding domain requirements

  – Requirements engineers cannot understand specific domain terminology;

  – Some domain knowledge is so familiar that people find it hard to articulate or think that it isn't worth articulating.

Effective interviewers

- Interviewers should be open-minded, willing to listen to stakeholders and should not have pre-conceived ideas about the requirements.

- They should prompt the interviewee with a question or a proposal and should not simply expect them to respond to a question such as 'what do you want'.

Scenarios

- Scenarios are real-life examples of how a system can be used.

- They should include
  - A description of the starting situation;
  - A description of the normal flow of events;
  - A description of what can go wrong;
  - Information about other concurrent activities;
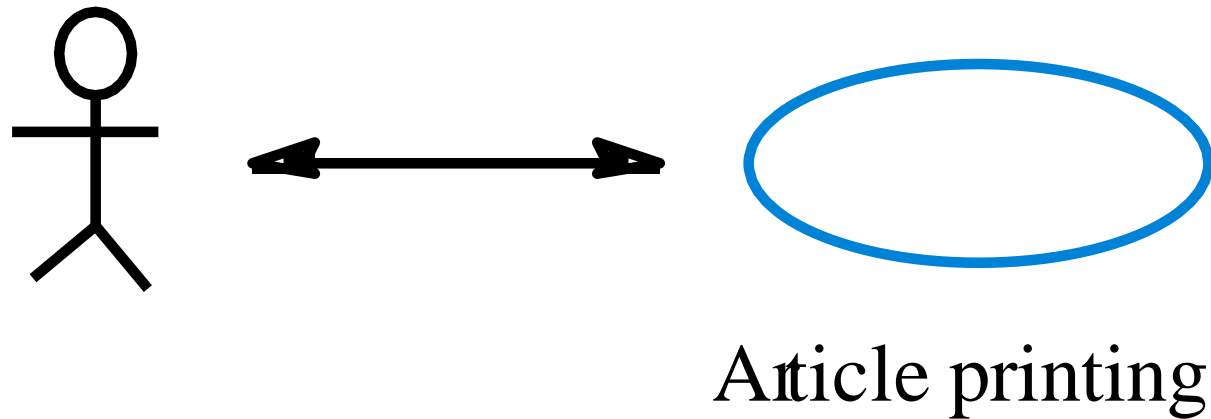 - A description of the state when the scenario finishes.

Use cases

- Use-cases are a scenario based technique in the UML which identify the actors in an interaction and which describe the interaction itself.

- A set of use cases should describe all possible interactions with the system.

- Sequence diagrams may be used to add detail to use-cases by showing the sequence of event processing in the system.
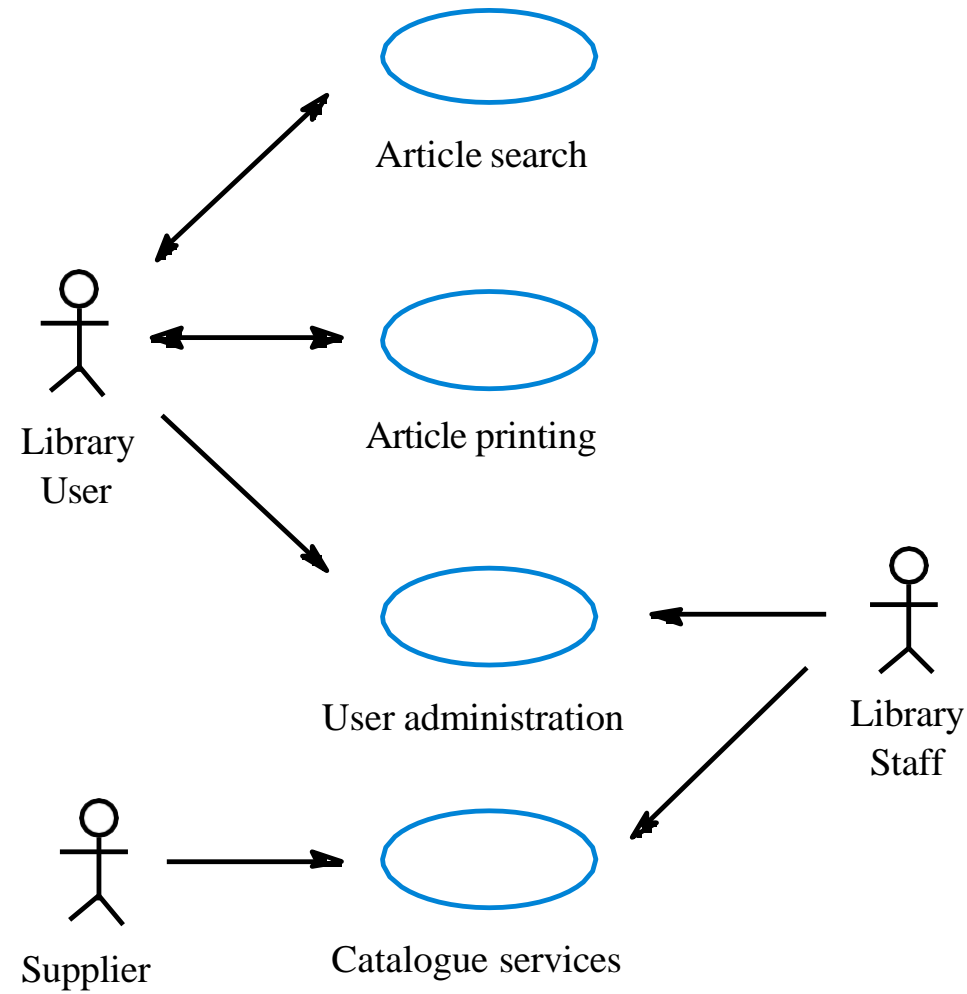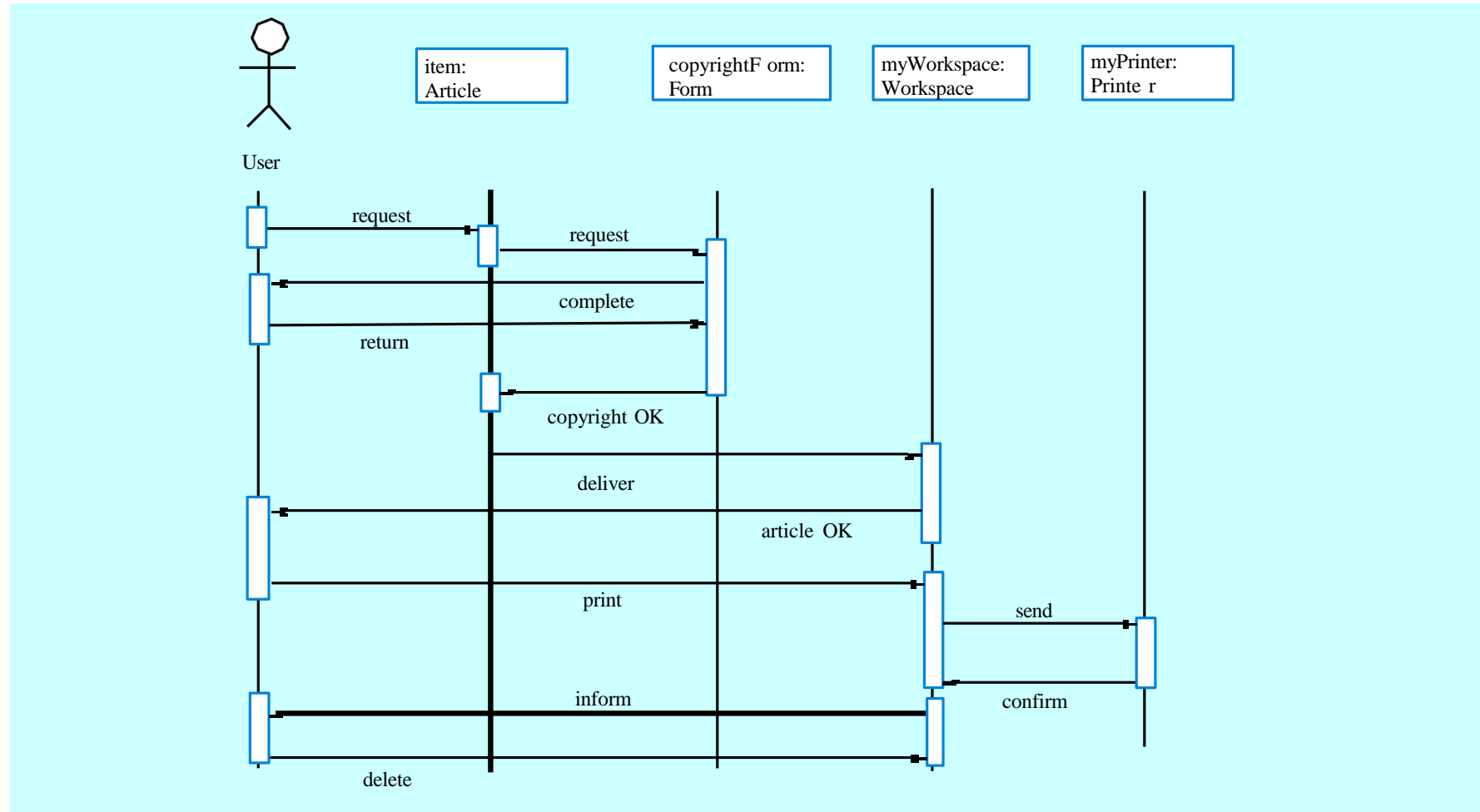
Article printing use-case

Article printing

LIBSYS use cases

Article search

Article printing

Library
User

User administration

Library
Staff

Supplier

Catalogue services

Print article sequence

Social and organisational factors

- Software systems are used in a social and organisational context. This can influence or even dominate the system requirements.

- Social and organisational factors are not a single viewpoint but are influences on all viewpoints.

- Good analysts must be sensitive to these factors but currently no systematic way to tackle their analysis.

Ethnography

- A social scientists spends a considerable time observing and analysing how people actually work.

- People do not have to explain or articulate their work.

- Social and organisational factors of importance may be observed.

- Ethnographic studies have shown that work is usually richer and more complex than suggested by simple system models.

Requirements validation

- Concerned with demonstrating that the requirements define the system that the customer really wants.

- Requirements error costs are high so validation is very important

  – Fixing a requirements error after delivery may cost up to 100 times the cost of fixing an implementation error.

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.

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?

Requirements management

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

- Requirements are inevitably incomplete and inconsistent
  - New requirements emerge during the process as business needs change and a better understanding of the system is developed;
  - Different viewpoints have different requirements and these are often contradictory.
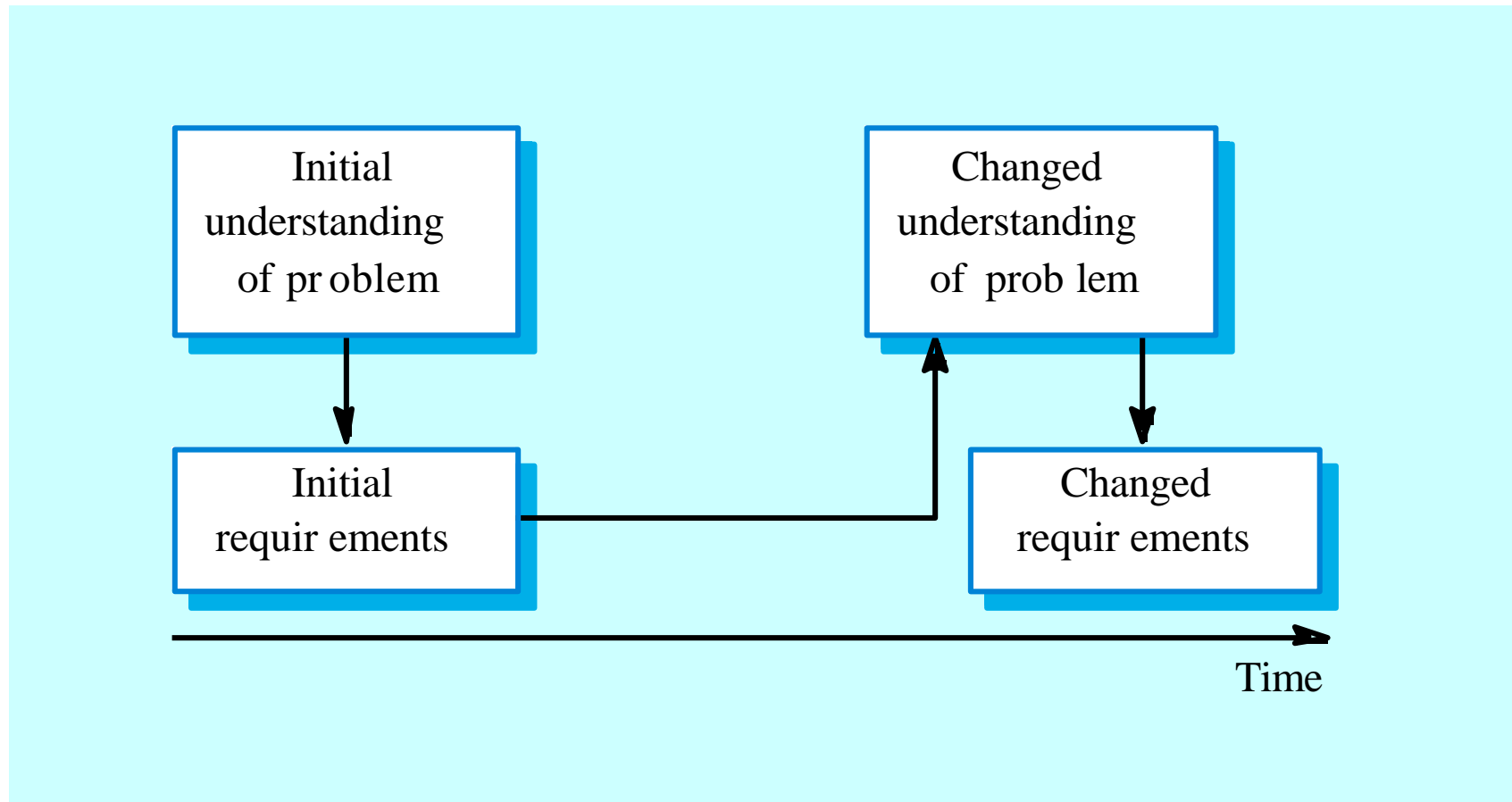
Requirements change

- The priority of requirements from different viewpoints changes during the development process.

- System customers may specify requirements from a business perspective that conflict with end-user requirements.

- The business and technical environment of the system changes during its development.

Requirements evolution

Enduring and volatile requirements

- **Enduring requirements**. Stable requirements derived from the core activity of the customer organisation. E.g. a hospital will always have doctors, nurses, etc. May be derived from domain models

- **Volatile requirements**. Requirements which change during development or when the system is in use. In a hospital, requirements derived from health-care policy

Requirements classification

Requirement Type	Description
Mutable requirements	Requirements that change because of changes to the environment in which the organisation is operating. For example, in hospital systems, the funding of patient care may change and thus require different treatment information to be collected.
Emergent requirements	Requirements that emerge as the customer's understanding of the system develops during the system development. The design process may reveal new emergent requirements.
Consequential requirements	Requirements that result from the introduction of the computer system. Introducing the computer system may change the organisations processes and open up new ways of working which generate new system requirements
Compatibility requirements	Requirements that depend on the particular systems or business processes within an organisation. As these change, the compatibility requirements on the commissioned or delivered system may also have to evolve.

Requirements management planning

- During the requirements engineering process, you have to plan:
  - Requirements identification
    - How requirements are individually identified;
  - A change management process
    - The process followed when analysing a requirements change;
  - Traceability policies
    - The amount of information about requirements relationships that is maintained;
  - CASE tool support
    - The tool support required to help manage requirements change;

Traceability

- Traceability is concerned with the relationships between requirements, their sources and the system design

- Source traceability
  - Links from requirements to stakeholders who proposed these requirements;

- Requirements traceability
  - Links between dependent requirements;

- Design traceability
  - Links from the requirements to the design;

A traceability matrix

Req. id	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2
1.1		D	R					
1.2			D			D		D
1.3	R			R				
2.1			R		D			D
2.2								D
2.3		R		D				
3.1								R
3.2							R	

Change management

Identified problem → Problem analysis and change specification → Change analysis and costing → Change implementation → Revised requirements