

# Requirements Engineering Process

Book Referred: Ian Sommerville 8<sup>th</sup> Edition Chapter 7

# Objectives

- To describe the principal requirements engineering activities and their relationships
- To introduce techniques for requirements elicitation and analysis
- To describe requirements validation and the role of requirements reviews
- To discuss the role of requirements management in support of other requirements engineering processes

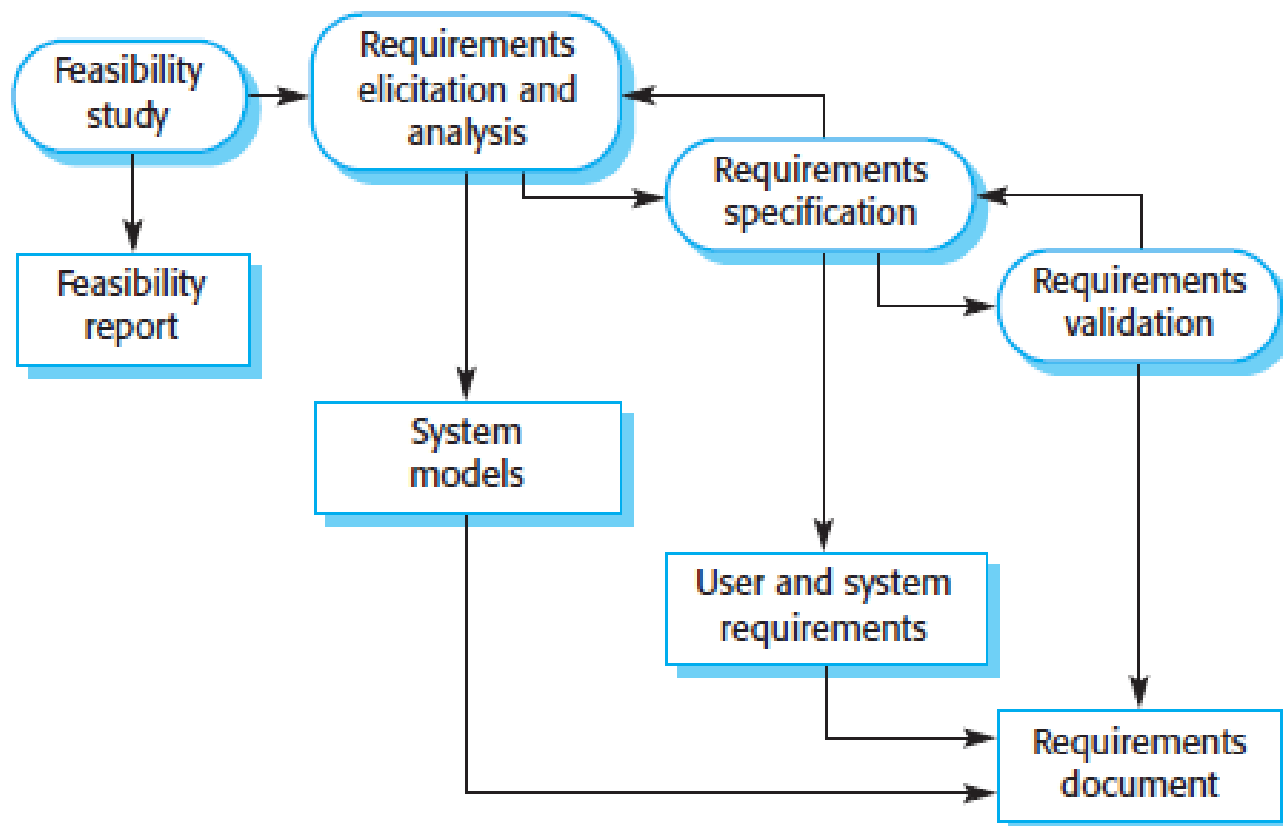
# Topics covered

- Feasibility studies
- Requirements elicitation and analysis
- Requirements validation
- Requirements management

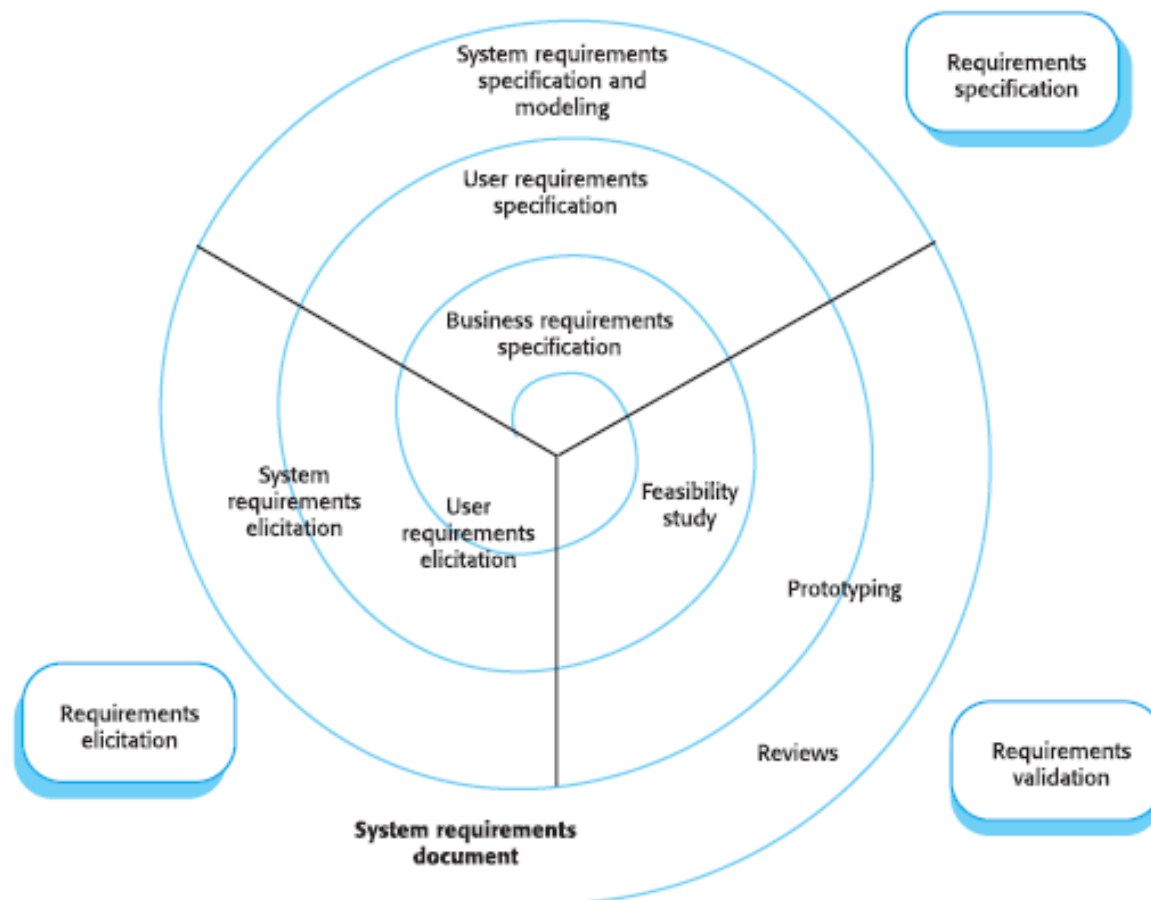
# Requirements Engineering Processes

- 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
  - Feasibility study (assessing whether the system is useful to the business)
  - Requirement elicitation and analysis (discovering requirements)
  - Requirement specification (converting these requirements into some standard form)
  - Requirement validation (checking that the requirements actually define the system that the customer wants)

# The Requirements Engineering Process



# Spiral Model of Requirements Engineering



# 1. Feasibility Study

- 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?



## 2. Requirement 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*.

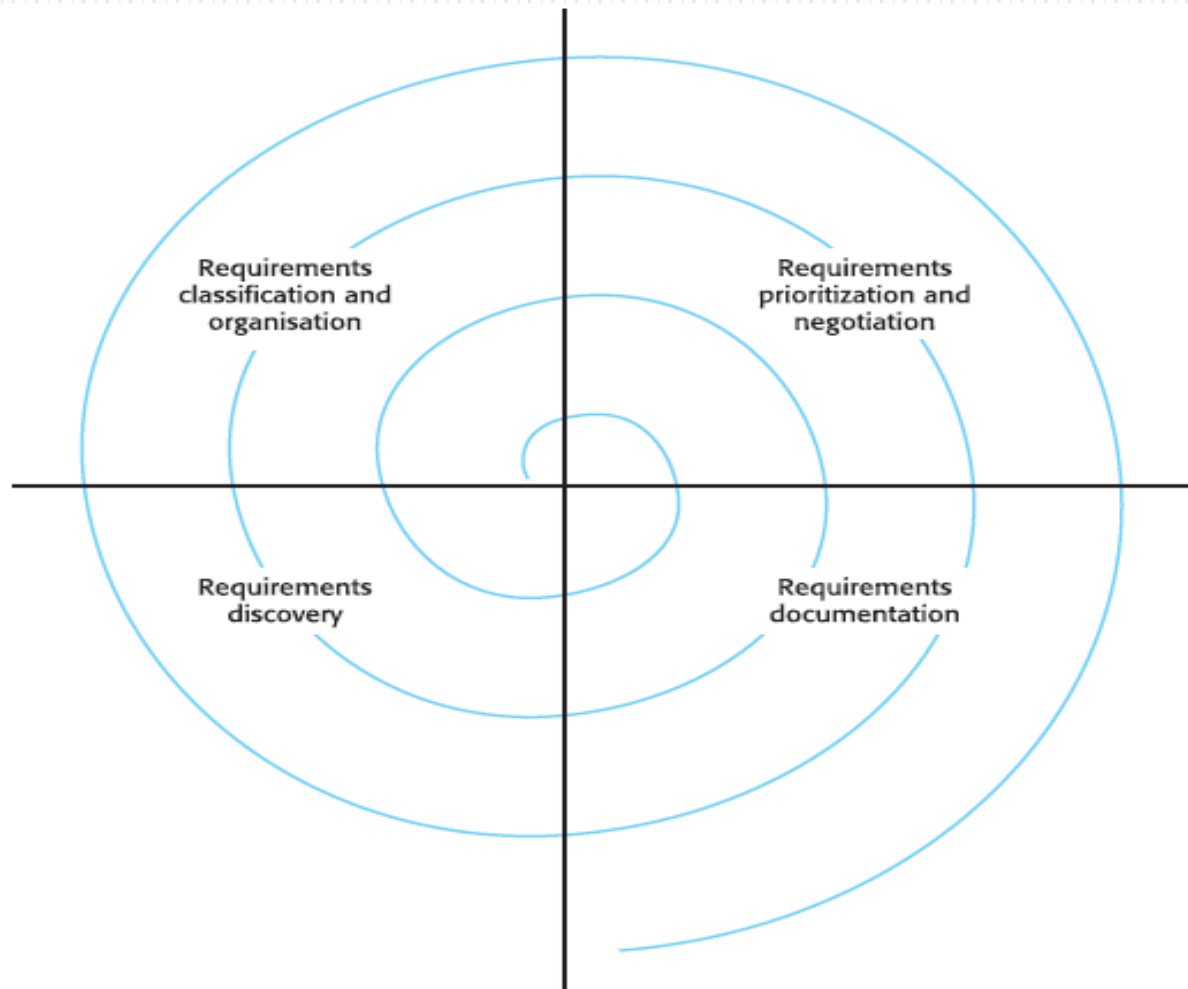
# Problems of Requirements Analysis

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

# Requirement Elicitation and Analysis Process

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

# The requirements Elicitation and Analysis Process



## 2.1 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

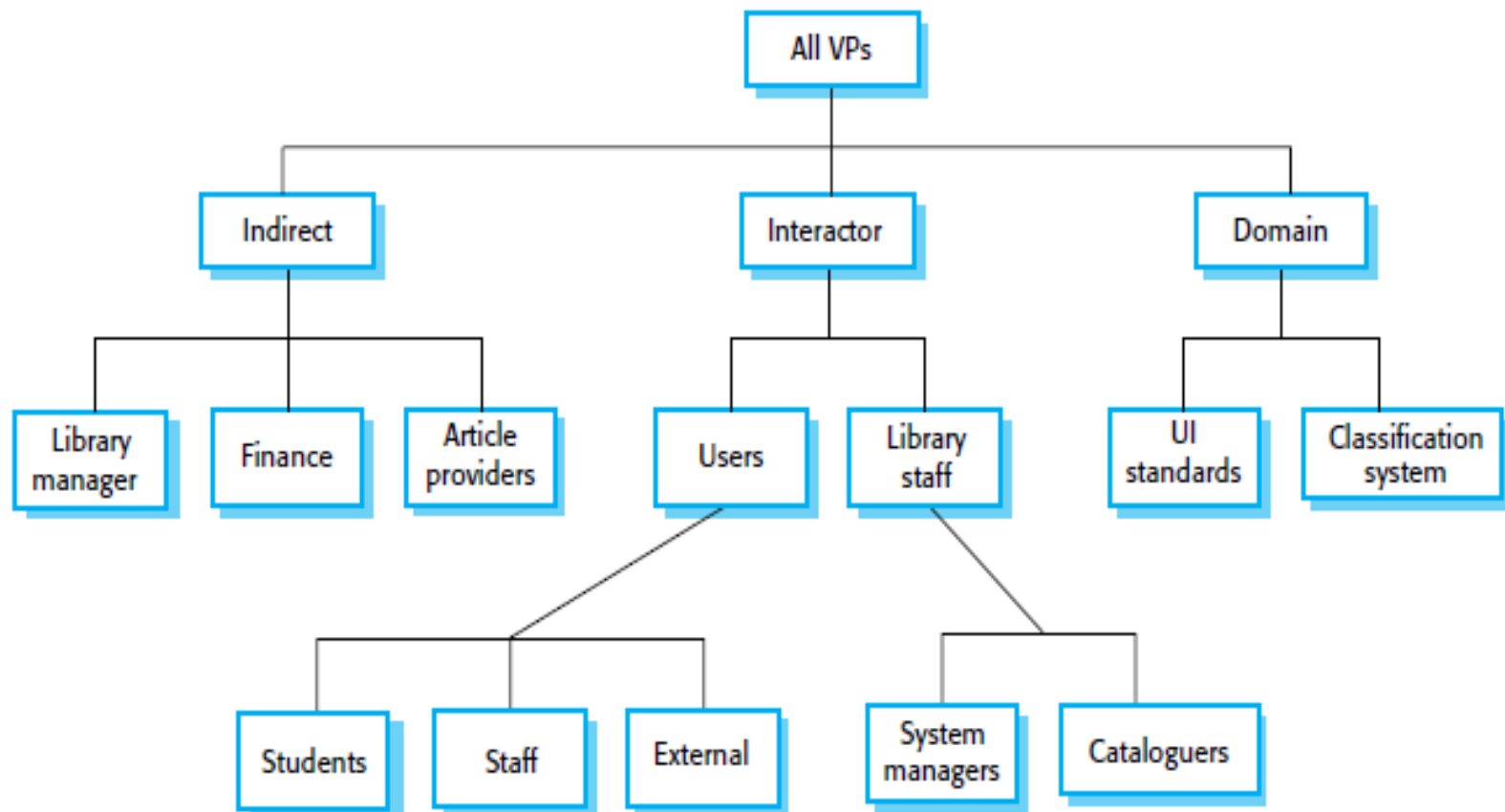
- **Interactor viewpoints**
  - People or other systems that interact directly with the system. In an ATM, the customer is an interactor VP.
- **Indirect viewpoints**
  - Stakeholders who do not use the system themselves but who influence the requirements. In an ATM, management and security staff are 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.

# LIBSYS scenario (1)

**Initial assumption:** The user has logged on to the LIBSYS system and has located the journal containing the copy of the article.

**Normal:** The user selects the article to be copied. The system prompts the user to provide subscriber information for the journal or to indicate a method of payment for the article. Payment can be made by credit card or by quoting an organisational account number.

The user is then asked to fill in a copyright form that maintains details of the transaction and submit it to the LIBSYS system.

The copyright form is checked and, if it is approved, the PDF version of the article is downloaded to the LIBSYS working area on the user's computer and the user is informed that it is available. The user is asked to select a printer and a copy of the article is printed. If the article has been flagged as 'print-only' it is deleted from the user's system once the user has confirmed that printing is complete.

## LIBSYS scenario (2)

**What can go wrong:** The user may fail to fill in the copyright form correctly. In this case, the form should be re-presented to the user for correction. If the resubmitted form is still incorrect, then the user's request for the article is rejected.

The payment may be rejected by the system, in which case the user's request for the article is rejected.

The article download may fail, causing the system to retry until successful or the user terminates the session.

It may not be possible to print the article. If the article is not flagged as 'print-only' it is held in the LIBSYS workspace. Otherwise, the article is deleted and the user's account credited with the cost of the article.

**Other activities:** Simultaneous downloads of other articles.

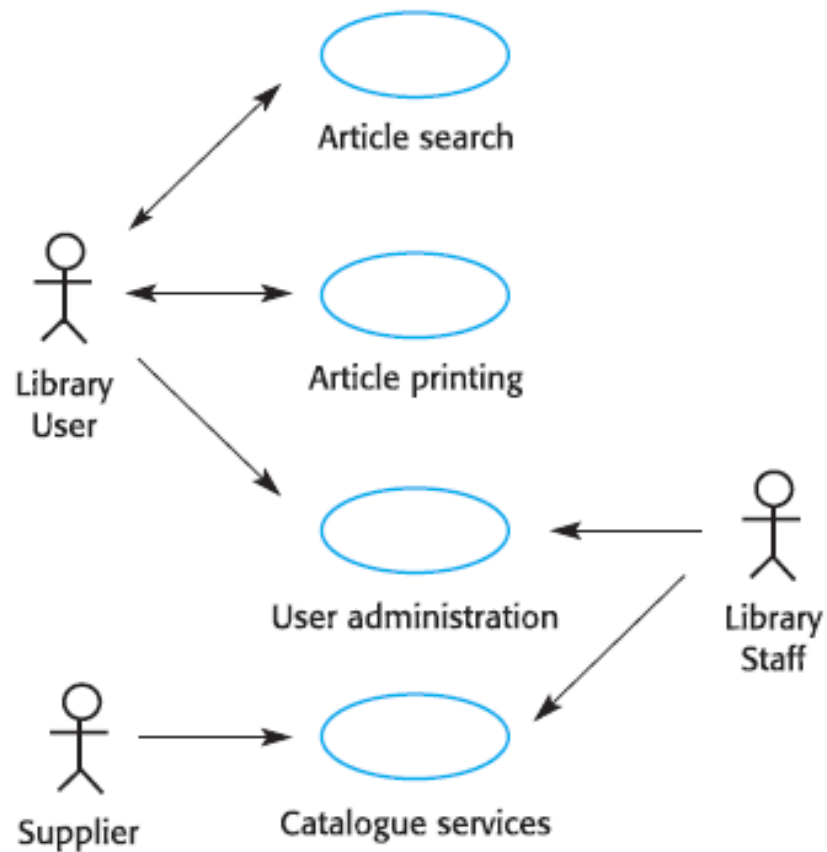
**System state on completion:** User is logged on. The downloaded article has been deleted from LIBSYS workspace if it has been flagged as print-only.



# 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.

# LIBSYS use cases



# 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.
- Ethnography is an observational technique that can be used to understand social and organisation requirements.
- Ethnographic studies have shown that work is usually richer and more complex than suggested by simple system models.

## 4. 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?



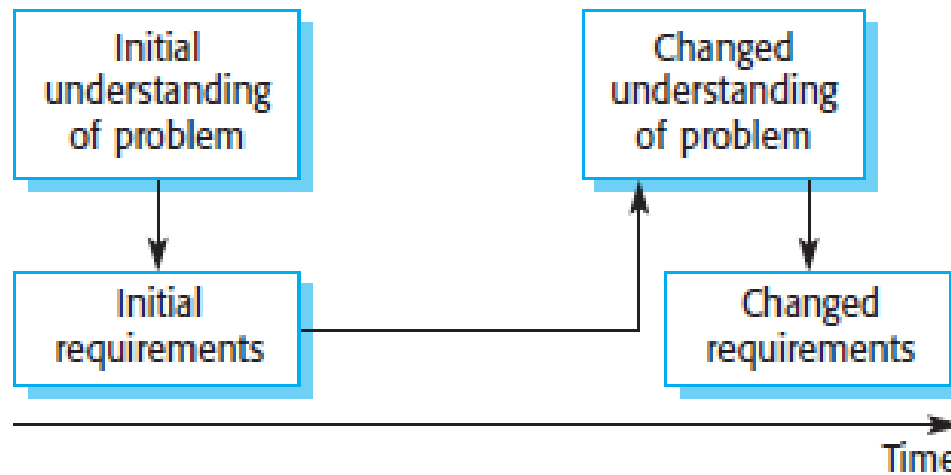
# Requirements Management

- 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



# 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;

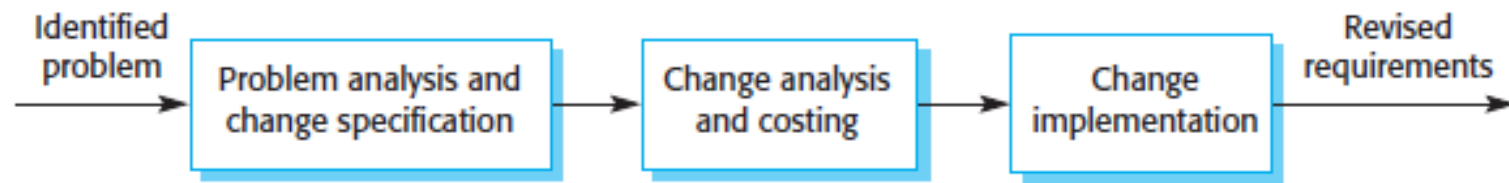
# Traceability

- 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;

# 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			R		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



# SUMMARY

- The requirements engineering process includes a feasibility study, requirements elicitation and analysis, requirements specification and requirements management.
- Requirements elicitation and analysis is iterative involving domain understanding, requirements collection, classification, structuring, prioritisation and validation.
- Systems have multiple stakeholders with different requirements.
- Social and organisation factors influence system requirements.
- Requirements validation is concerned with checks for validity, consistency, completeness, realism and verifiability.
- Business changes inevitably lead to changing requirements.
- Requirements management includes planning and change management.



Thank you!!!

Any Questions???