Requirements Engineering （要求工学）

- ◆ Establishing what the customer requires from a software system

Requirements engineering

- ◆ The process of establishing the services that the customer requires from a system and the constraints under which it operates and is developed
- ◆ Requirements may be functional or non-functional
  - Functional requirements describe system services or functions
  - Non-functional requirements is a constraint on the system or on the development process

What is a requirement?

- It may range from a high-level abstract statement of a service or of a system constraint to a detailed mathematical functional specification
- This is inevitable as requirements may serve a dual function
  - May be the basis for a bid for a contract - therefore must be open to interpretation（入札用）
  - May be the basis for the contract itself - therefore must be defined in detail（開発用）
  - Both these statements may be called requirements

Requirements definition/specification

- Requirements definition（要求定義）
  - A statement in natural language plus diagrams of the services the system provides and its operational constraints. Written for customers
- Requirements specification（要求仕様）
  - A structured document setting out detailed descriptions of the system services. Written as a contract between client and contractor
- Software specification（ソフトウェア仕様／設計仕様）
  - A detailed software description which can serve as a basis for a design or implementation. Written for developers

Definitions and specifications

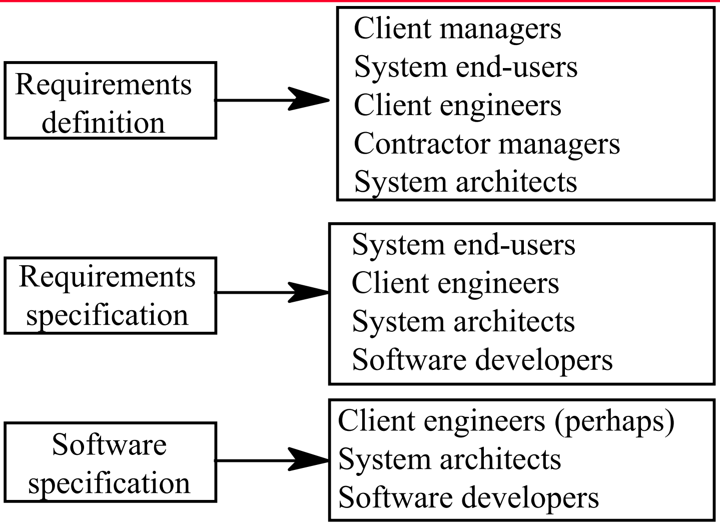
Requirements definition

1. The software must provide a means of representing and accessing external files created by other tools.

Requirements specification

1. The user should be provided with facilities to define file type of external files.
2. Each external file type may have an associated tool which may be applied to the file.
3. Each external file type may be represented as a specific icon on the user's display.
4. Facilities should be provided for the icon representing an external file type to be defined by the user.
5. When a user selects an icon representing an external file, the effect of that selection is to apply the tool associated with the type of the external file to be file represented by the selected icon.

Requirements readers



Wicked problems

- Most large software systems address wicked problems
- Problems which are so complex that they can never be fully understood and where understanding develops during the system development
- Therefore, requirements are normally both incomplete and inconsistent

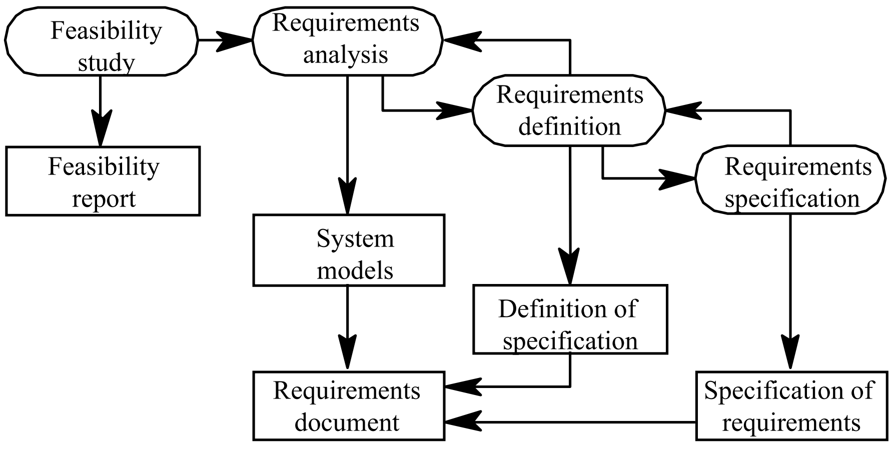
Reasons for inconsistency

- Large software systems must improve the current situation. It is hard to anticipate the effects that the new system will have on the organisation
- Different users have different requirements and priorities. There is a constantly shifting compromise in the requirements
- System end-users and organisations who pay for the system have different requirements
- Prototyping is often required to clarify requirements

The requirements engineering process

- Feasibility study
  - Find out if the current user needs be satisfied given the available technology and budget?
- Requirements analysis
  - Find out what system stakeholders require from the system
- Requirements definition
  - Define the requirements in a form understandable to the customer
- Requirements specification
  - Define the requirements in detail

The RE process

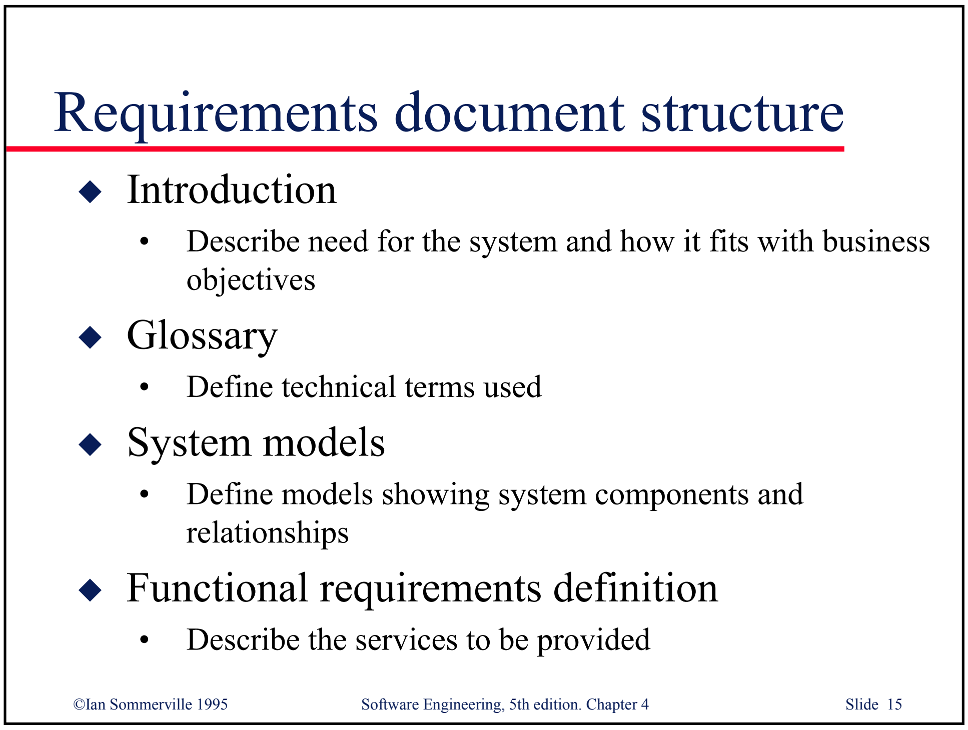


The requirements document

- The requirements document is the official statement of what is required of the system developers
- Should include both a definition and a specification of requirements
- It is NOT a design document. As far as possible, it should set of WHAT the system should do rather than HOW it should do it

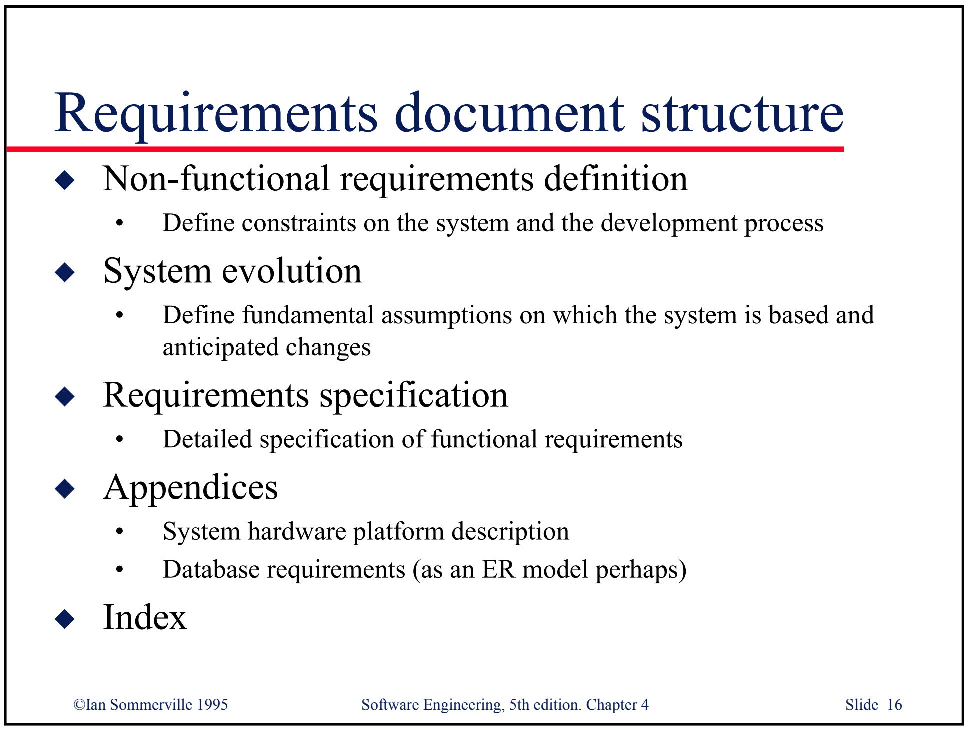
Requirements document requirements

- Specify external system behaviour
- Specify implementation constraints
- Easy to change
- Serve as reference tool for maintenance
- Record forethought about the life cycle of the system i.e. predict changes
- Characterise responses to unexpected events



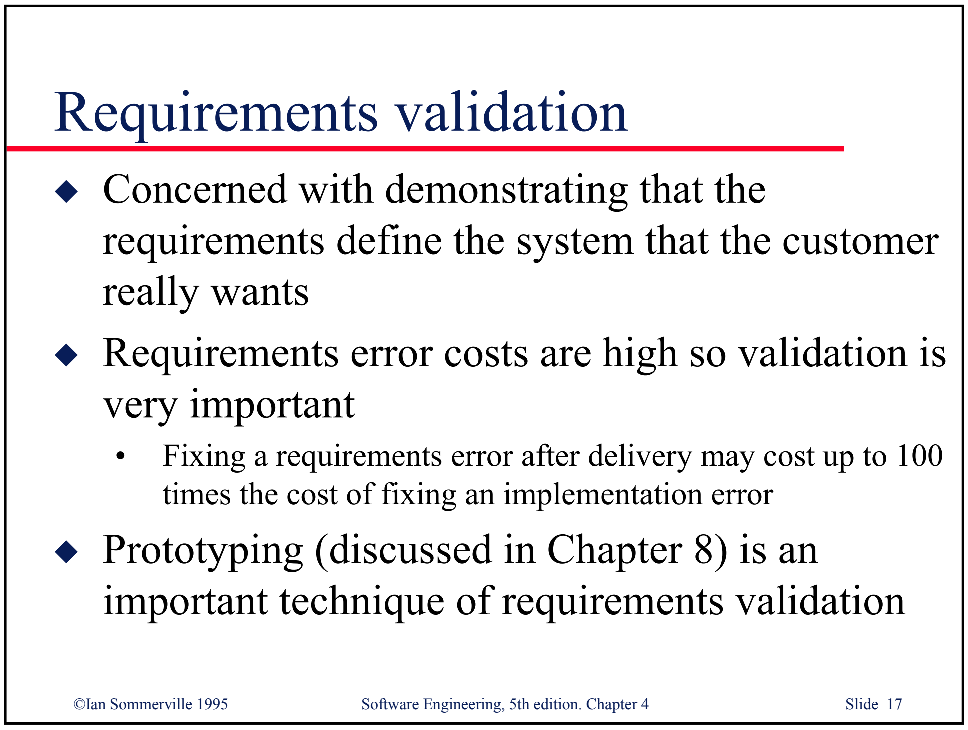
Requirements document structure

- Introduction
  - Describe need for the system and how it fits with business objectives
- Glossary
  - Define technical terms used
- System models
  - Define models showing system components and relationships
- Functional requirements definition
  - Describe the services to be provided



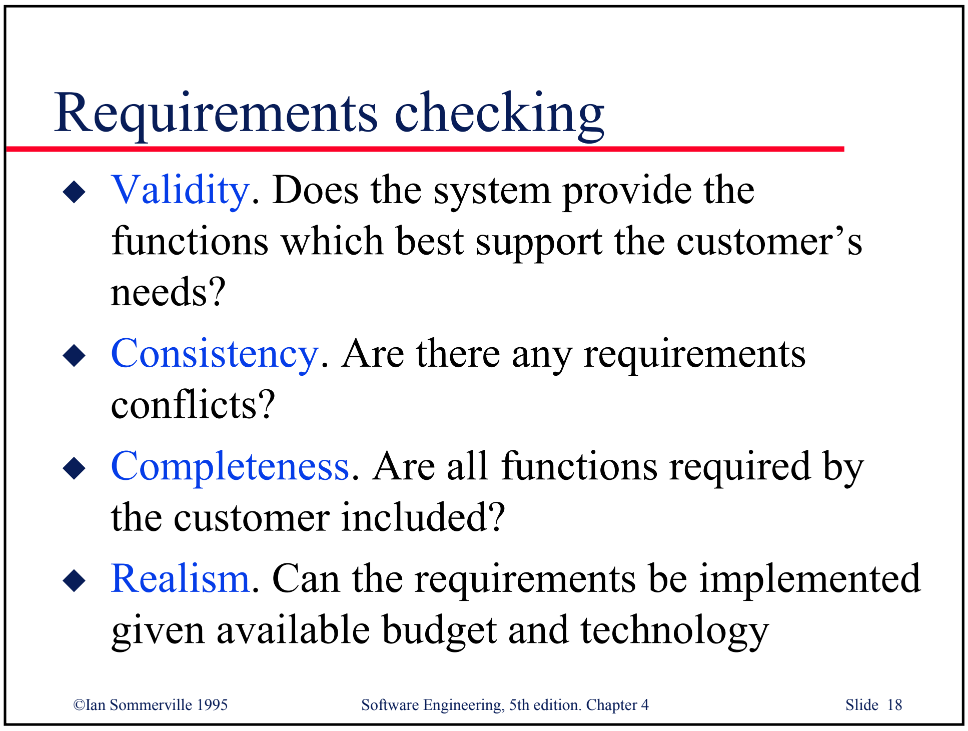
Requirements document structure

- Non-functional requirements definition
  - Define constraints on the system and the development process
- System evolution
  - Define fundamental assumptions on which the system is based and anticipated changes
- Requirements specification
  - Detailed specification of functional requirements
- Appendices
  - System hardware platform description
  - Database requirements (as an ER model perhaps)
- Index



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
- Prototyping (discussed in Chapter 8) is an important technique of requirements validation



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

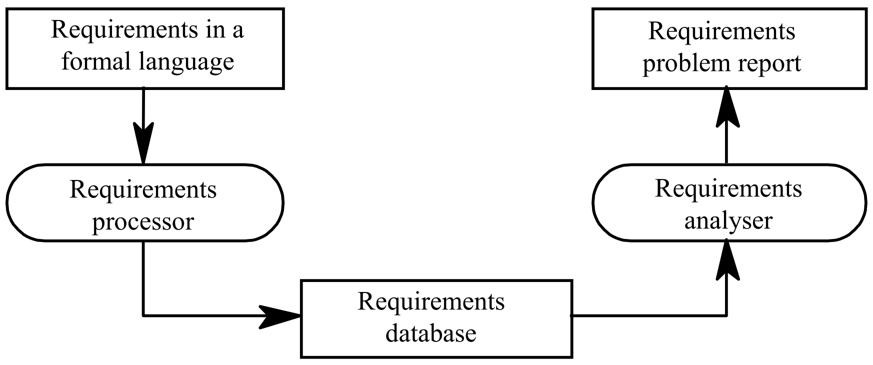
Requirements reviews

- 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?

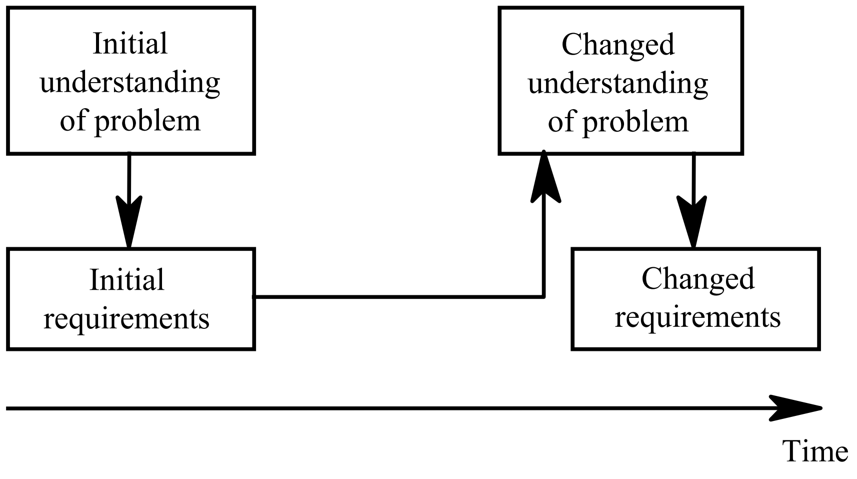
Automated consistency checking



Requirements evolution（発展）

- Requirements always evolve as a better understanding of user needs is developed and as the organisation’s objectives change
- It is essential to plan for change in the requirements as the system is being developed and used

Requirements evolution


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

Requirements classes

- 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

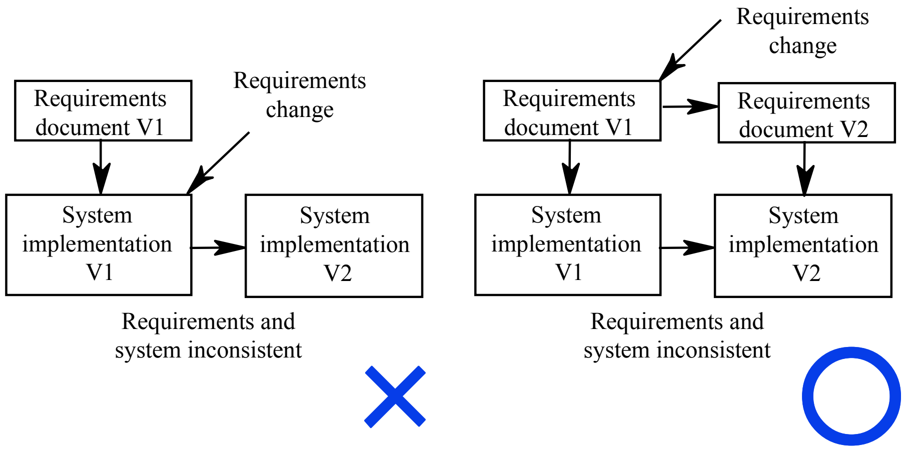
Classification of requirements

- Mutable requirements（変化しやすい）
  - Requirements that change due to the system’s environment
- Emergent requirements（あとからわかる）
  - Requirements that emerge as understanding of the system develops
- Consequential requirements（結果として発生）
  - Requirements that result from the introduction of the computer system
- Compatibility requirements（互換性）
  - Requirements that depend on other systems or organisational processes

Requirements document changes

- The requirements document should be organised so that requirements changes can be made without extensive rewriting
- External references should be minimised and the document sections should be as modular as possible
- Changes are easiest when the document is electronic. Lack of standards for electronic documents make this difficult（…昔は）

Controlled evolution


Requirements document V1
Requirements change
System implementation V1
System implementation V2
Requirements and system inconsistent
Requirements change
Requirements document V1
Requirements document V2
System implementation V1
System implementation V2
Requirements and system inconsistent