

# Requirements Engineering

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## An Overview

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# Introduction

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Frequently asked questions about  
requirements engineering

## What are requirements?

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- Requirements are defined during the early stages of a system development as a **specification** of what should be implemented or as a constraint of some kind on the system.
- They may be:
  - a user-level facility description,
  - a detailed specification of expected system behaviour,
  - a general system property,
  - a specific constraint on the system,
  - information on how to carry out some computation,
  - a constraint on the development of the system.

## What is requirements engineering?

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- **Requirements engineering** covers all of the activities involved in discovering, documenting, and maintaining a set of requirements for a computer-based system.
- The use of the term '**engineering**' implies that systematic and repeatable techniques should be used to ensure that system requirements are complete, consistent, relevant, etc.

## Are requirements important?

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- European Software Process Improvement Training Initiative (1996)  
“The principal problem areas in software development and production are the requirements specification and the management of customer requirements”
- In a study of errors in embedded systems, it was found that:  
“... difficulties with requirements are the key root-cause of the safety-related software errors that have persisted until integration and system testing”

## What happens if the requirements are wrong?

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- The system may be delivered late and cost more than originally expected.
- The customer and end-users are not satisfied with the system. They may not use its facilities or may even decide to scrap it altogether.
- The system may be unreliable in use with regular system errors and crashes disrupting normal operation.
- If the system continues in use, the costs of maintaining and evolving the system are very high.

## Why is requirements engineering difficult?

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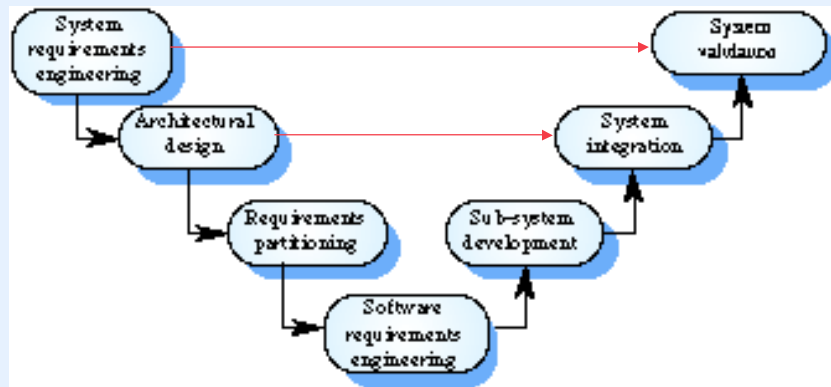
- Businesses operate in a rapidly changing environment so their requirements for system support are constantly changing.
- Multiple stakeholders with different goals and priorities are involved in the requirements engineering process.
- System stakeholders do not have clear ideas about the system support that they need.
- Requirements are often influenced by political and organisational factors that stakeholders will not admit to publicly.

## Requirements engineering processes

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Different views of the processes involved in requirements engineering

## The systems engineering process

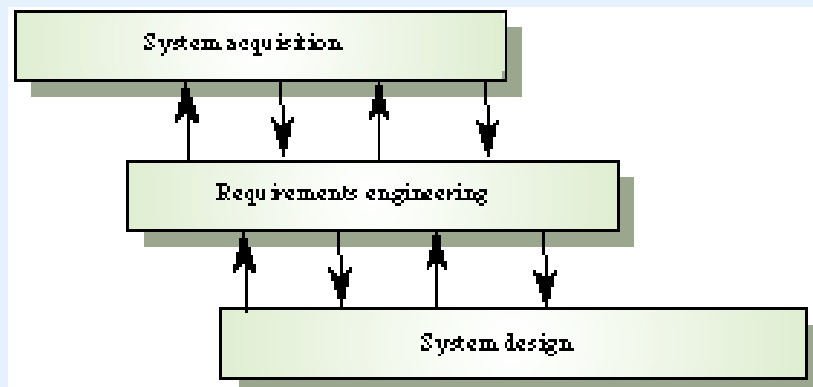


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## RE process context

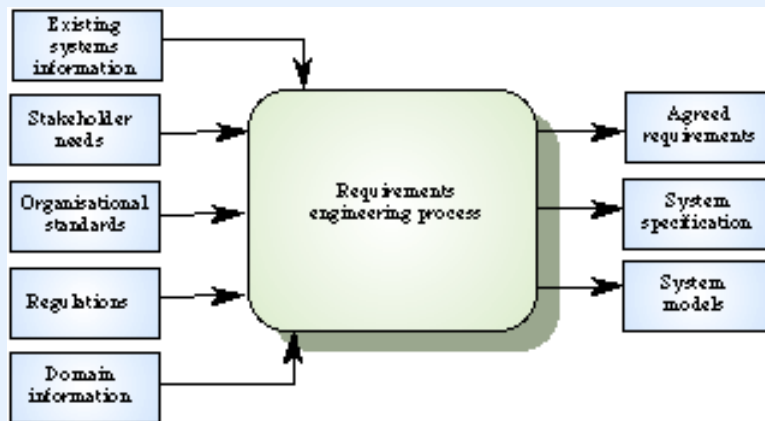


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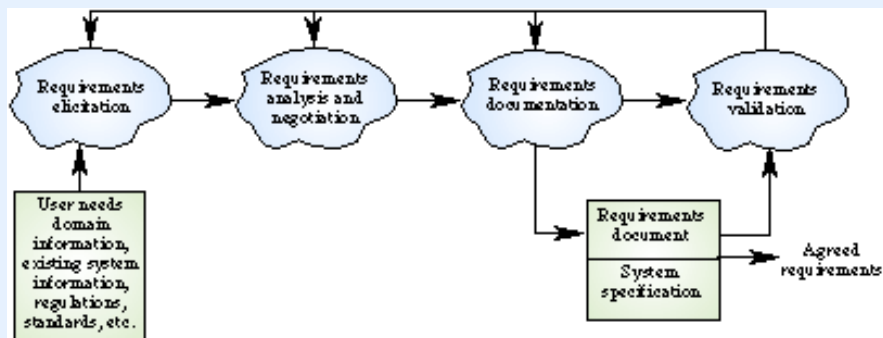
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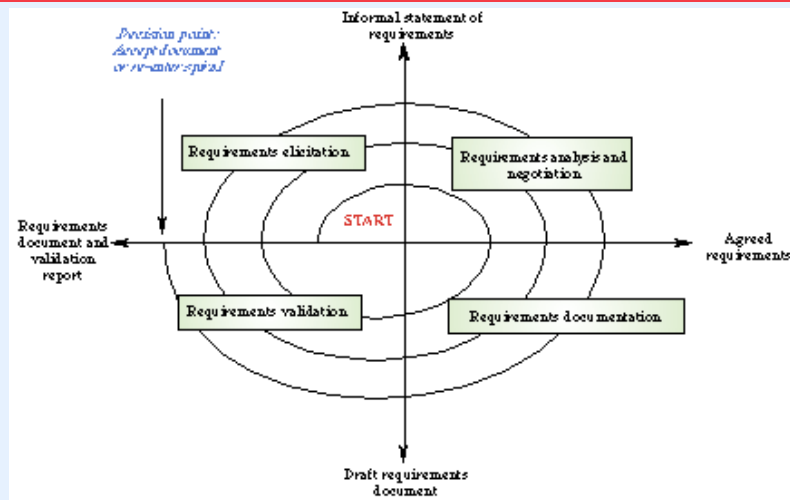
## RE process inputs and outputs



## RE process activities



## RE process iteration



## Requirements engineering problems

Fundamental issues that mean that establishing requirements for complex systems will always be a difficult technical and organisational problem

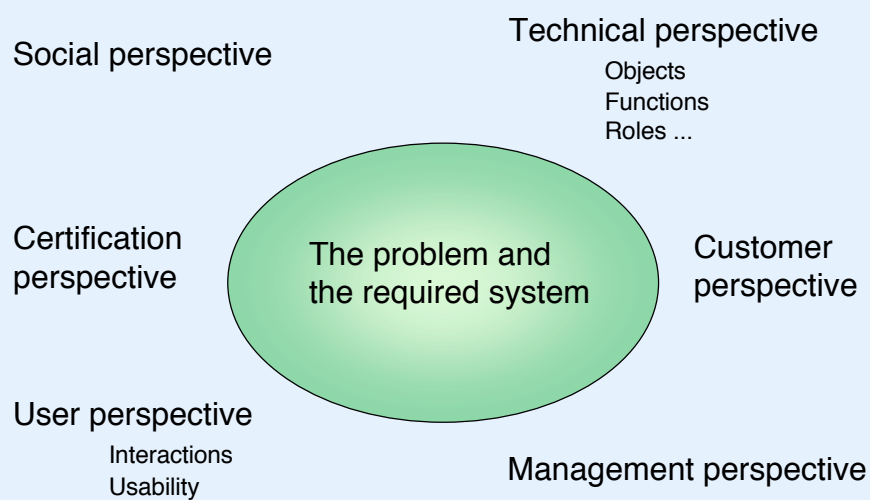
## Requirements change

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- System requirements reflect the world outside of the system. As this is constantly changing then the requirements will inevitably also change
  - Technology changes
  - Organisational changes
  - Market changes
  - Economic changes
  - Political and legal changes
- It is often difficult to understand the implications of changes for the requirements as a whole

## Stakeholder perspectives

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## Stakeholder uncertainty

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- Key stakeholders have other jobs to do!
  - Developing detailed requirements for future systems often cannot be given a high priority by the senior people who will be affected by these requirements.
  - They therefore are unable to express their requirements except as vague, high-level descriptions
- There are no objective ways to compare alternative sets of requirements
  - The impact of a system on a business is very hard to understand so therefore we cannot tell which might be the 'best' system for any particular business

## Process variability

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- The level of detail required in a requirements specification differs greatly depending on the type of product that is being developed
  - A railway signalling system is a very detailed specification that can be validated by authorities outside of the organisation procuring the software
  - A computer game specification is a storyboard with pictures and examples
- They use completely different processes involving different types of people to derive these specifications
- Scope for process standardisation and support is therefore limited

## Politics and people

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- Many system requirements are influenced by the politics in an organisation. Decisions on requirements are not made on a rational basis but are made because of the personal goals of stakeholders
- Requirements engineers may not understand the politics and, even when they do, they may not be able to challenge the 'political' requirements
- People providing requirements for a system may not be convinced that the system is necessary or may feel that other systems should have a higher priority. They may actively or passively refuse to cooperate in the requirements engineering process

## Requirements methods and tools

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Techniques and CASE tools that may be used  
in the requirements engineering process

## Scenarios

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- What are scenarios?
  - Scenarios are descriptions of typical ways that a particular end-user task might be carried out. By understanding what is done then requirements for computer support can be developed
- Applicability
  - They are primarily useful during requirements elicitation
- Maturity
  - This approach to requirements elicitation is becoming increasingly widely used. Use-cases in the UML process are closely related to scenarios
- Problems
  - Time consuming to develop scenarios
  - Focused on end-user stakeholders

## Viewpoints

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- What are viewpoints
  - Ways of identifying stakeholders and organising the requirements from different stakeholders
- Applicability
  - Different types of viewpoint have been proposed that are applicable during requirements elicitation and the development of detailed system requirements
- Maturity
  - Methods have existed for many years but have not been extensively used
- Problems
  - Too many viewpoints lead to an unmanageable amount of data
  - Lack of tool support

## Structured analysis methods

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- What are structured analysis methods
  - Methods of deriving detailed models of the problem or of the system to be developed in some well-defined notation
- Applicability
  - Methods of structured analysis, such as object-oriented analysis, are applicable when developing detailed requirements from user requirements
- Maturity
  - These are the most mature techniques for requirements analysis
- Problems
  - End-users often do not relate to the models or have time to be involved in the process of model development

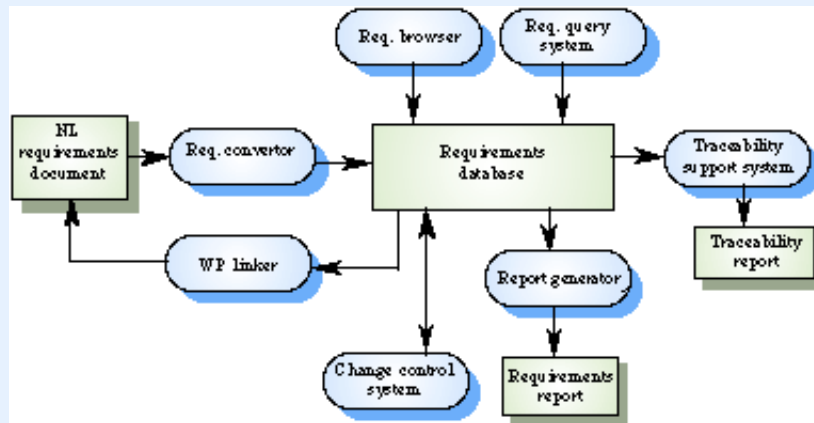
## CASE tools for requirements engineering

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- CASE tool support for requirements engineering is limited to two areas
  - Requirements analysis using structured methods
    - » Developing a set of user requirements into detailed system requirements that are expressed using different system models
    - » Rationale Rose for object-oriented analysis
  - Requirements management
    - » Supporting the process of managing requirements change
    - » DOORS (QSS) for managing text-based requirements
- The critical areas of requirements elicitation, understanding and negotiation are not supported by CASE tools.

## Requirements management tool

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## Requirements challenges

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Some challenges for requirements engineering in the early 21st century

## E-commerce and globalisation

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- E-commerce systems that are designed to serve a global customer base have new types of requirement
  - Aesthetic requirements
    - » What image is the company trying to convey through its software systems?
  - Marketing requirements
    - » How can the system be used to reinforce the brand and the marketing goals of the company?
  - Multicultural requirements
    - » How can the system be designed to take into account different cultural traditions and sensitivities?

## Accelerated system development

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- The need for organisations to be more responsive means that there is increasing pressure for faster delivery of all types of system
- Increasing competition means that the business costs of delivering unsuitable systems are increasing
- Therefore
  - The time to deliver requirements must be reduced
  - The requirements must be a better reflection of the business needs

## Off-the-shelf systems

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- Many business systems and an increasing number of other types of system are being developed by integrating existing off-the-shelf systems
- How can we decide if an existing system meets a business need and what are the costs of using an existing system rather than developing detailed requirements for a custom system?
- How can we decide whether or not the integration of several systems meets a set of requirements especially if these include security, performance and reliability requirements?

## Summary

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- Requirements engineering is a key component of system development processes.
- If we pay attention to requirements, we reduce later problems in system development and operation
- Requirements engineering will always be difficult because the requirements are reflections of a rapidly changing business environment
- ‘Traditional’ requirements engineering processes will have to evolve for new types of software system and business needs