SOFTWARE REQUIREMENT ENGINEERING

Chapter - 1

What are requirements?

- 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.

Something required, something wanted or needed

- ***Need**- something you have to have*
- ***Want** -something you would like to have*

Product and Process Requirements

- Product parameters are requirements on software to be developed
  - for example, “The software shall verify that a student meets all prerequisites before he or she registers for a course.”.
- A process parameter is essentially a constraint on the development of the software.
  - for example, “The software shall be written in Ada.”.

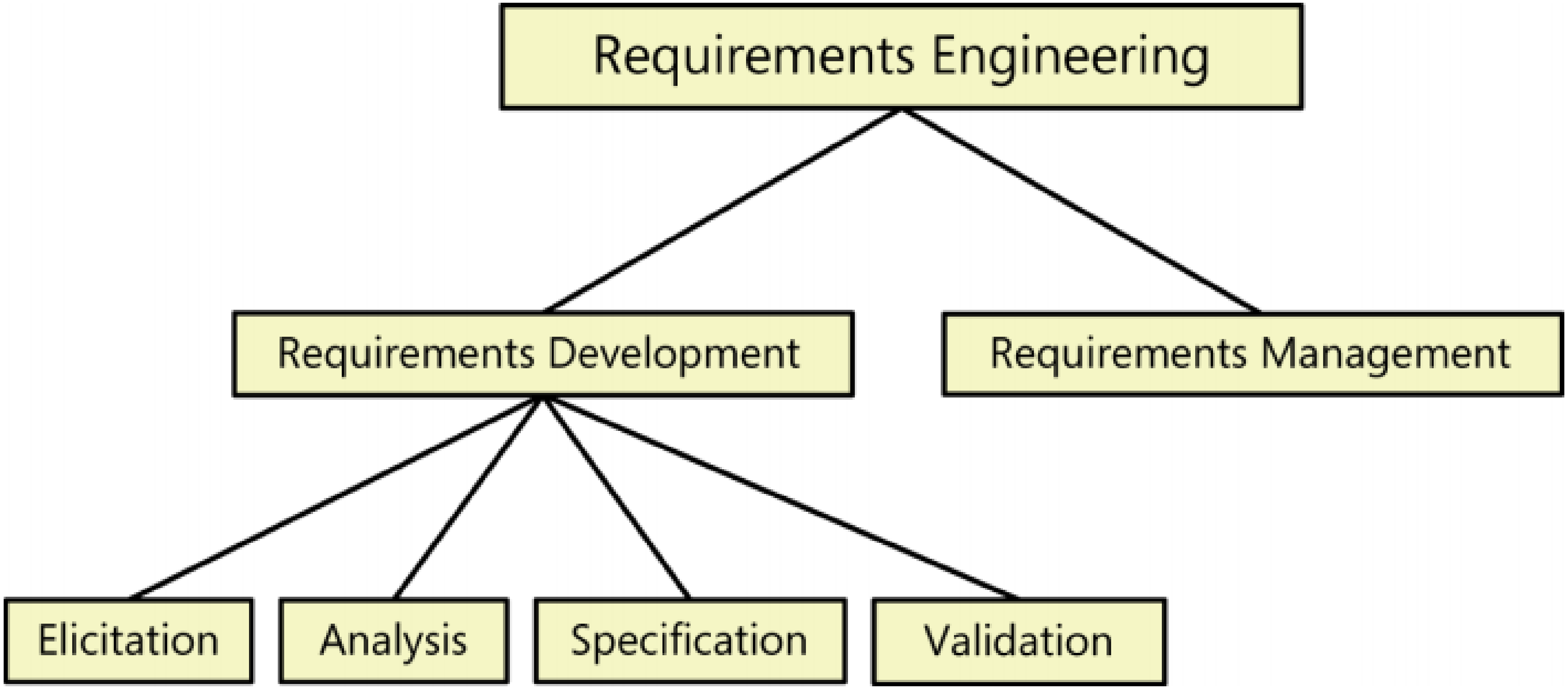
What is requirements engineering?

- 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.

Sub-disciplines of **Software Requirements Engineering**

- ❑ These sub-disciplines encompass all the activities involved with exploring, evaluating, documenting, and confirming the requirements for a product



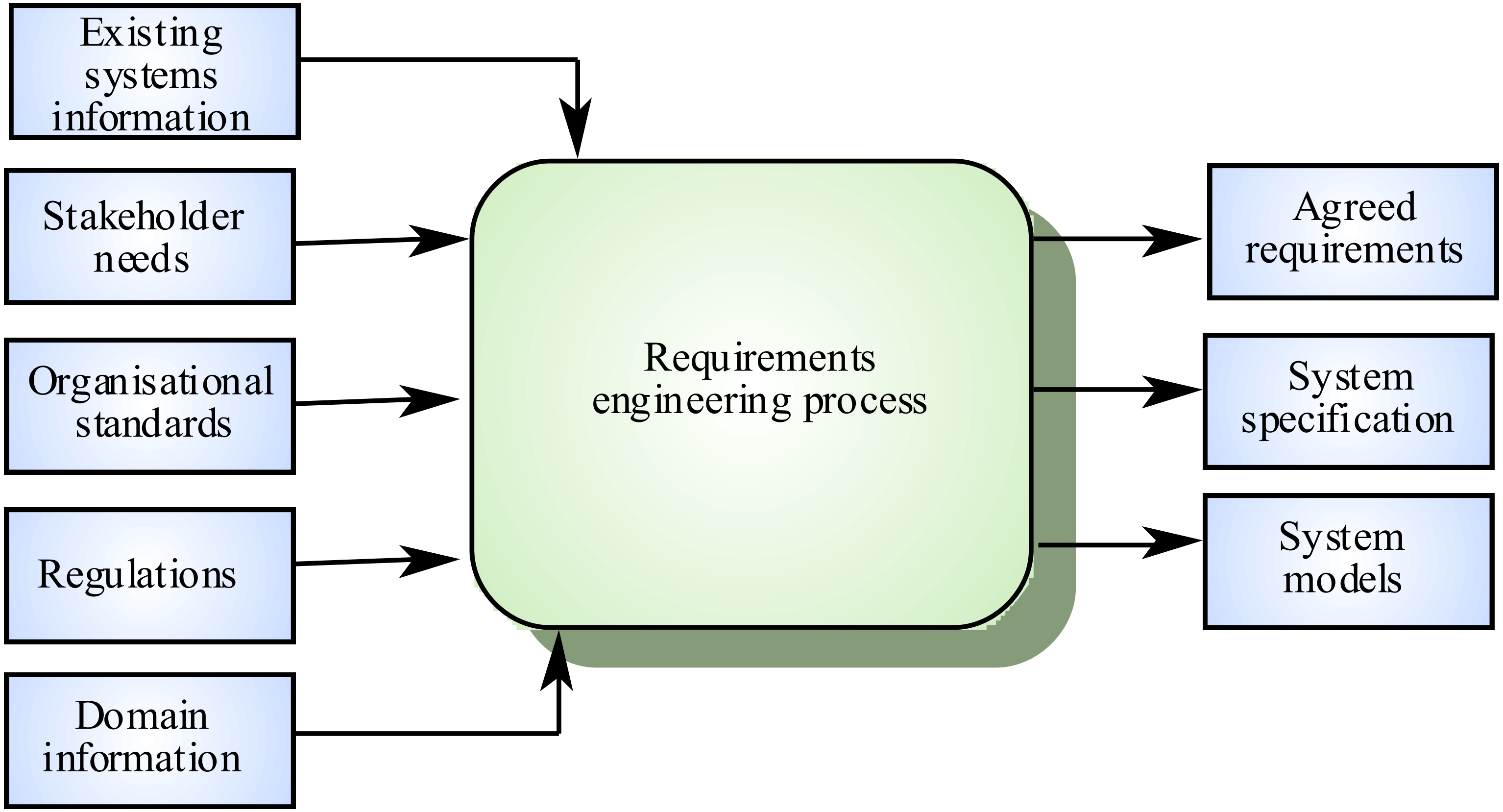
What happens if the requirements are wrong?

- 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?

- 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.

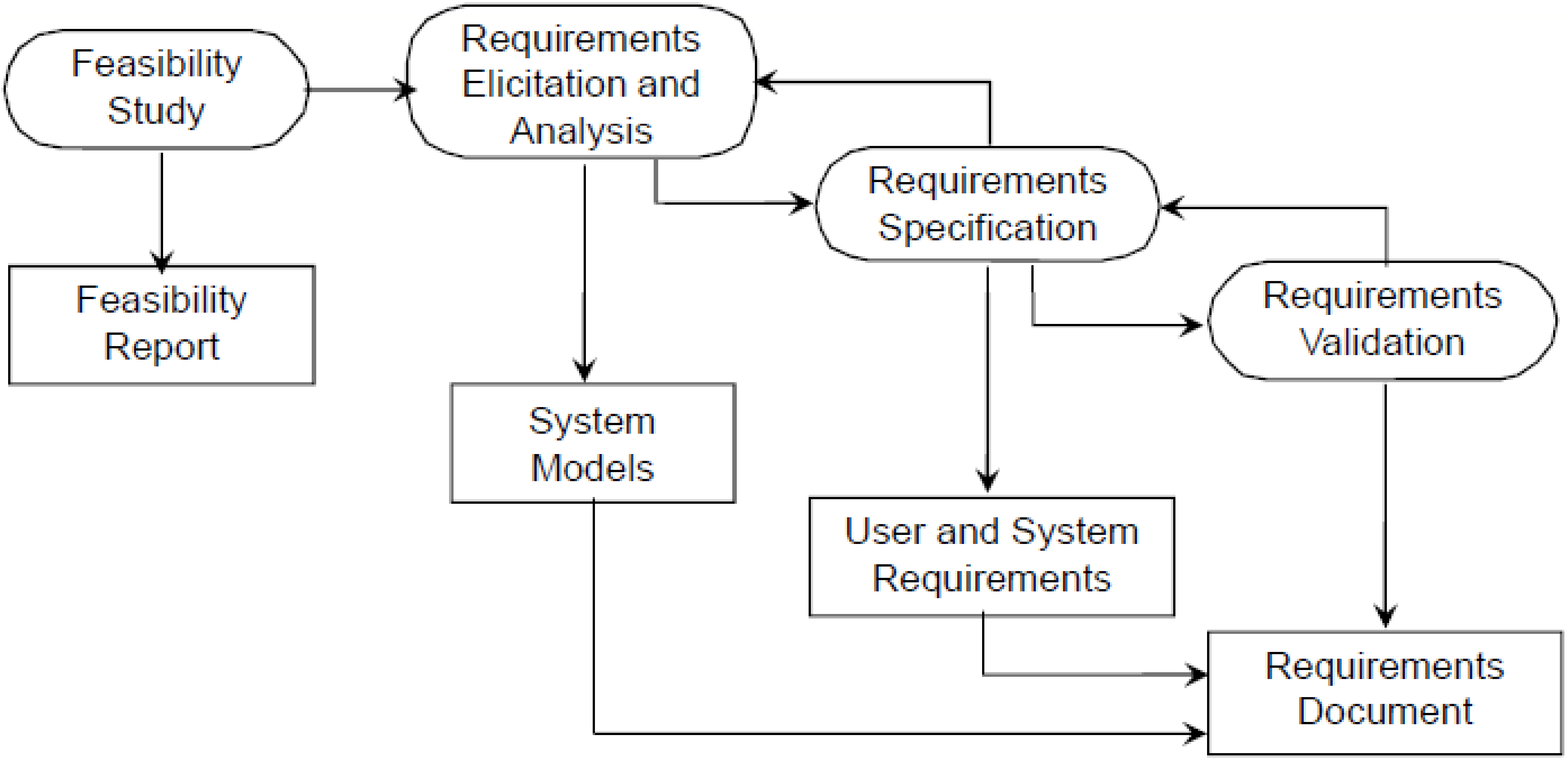
RE process inputs and outputs



Requirements engineering processes

- The goal of RE Process is to create & maintain a system requirements documents.
- Includes 4 High level RE Sub-processes:
  - Feasibility study : usefulness to the business ;
  - Elicitation and analysis : discovering and analyzing requirements;
  - Specification: conversion of requirement into some standard form;
  - Validation : check the requirements which defines the system that the customer wants;

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 organizational objectives;
  - If the system can be implemented using current technology, within given cost and schedule constraints;
  - If the system can be integrated with other systems that are already in place.

Feasibility study implementation

- Feasibility study involves information assessment (what is required), information collection and report writing.
- Questions for people in the organization for information assessment and collection:
  - *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?*
  - *Feasibility study report should make a recommendation about the development to continue or not.*

Requirements elicitation and analysis

Requirement Elicitation

- Elicitation encompasses all of the activities involved with *discovering requirements*.
- The key actions are:
  - Identifying the product’s expected user classes and other stakeholders.
  - Understanding user tasks and goals and the business objectives with which those tasks align.
  - Learning about the environment in which the new product will be used.
  - Working with individuals who represent each user class to understand their functionality needs and their quality expectations.
- Requirements elicitation typically takes either a usage-centric (understanding and exploring user goals) or a product-centric approach (focuses on defining features)

Requirements elicitation and analysis..

- Eliciting & understanding stakeholder requirement is difficult due to the following reasons:
  - Stakeholders don’t know what they really want except in most general.
  - Stakeholders express requirements in their own terms.
  - Different stakeholders may have deferent requirements.
  - Organizational & political factors may influence the system requirements.
  - The requirements change during the analysis process.
  - New stakeholders may emerge and the business environment change.

Requirements elicitation and analysis..

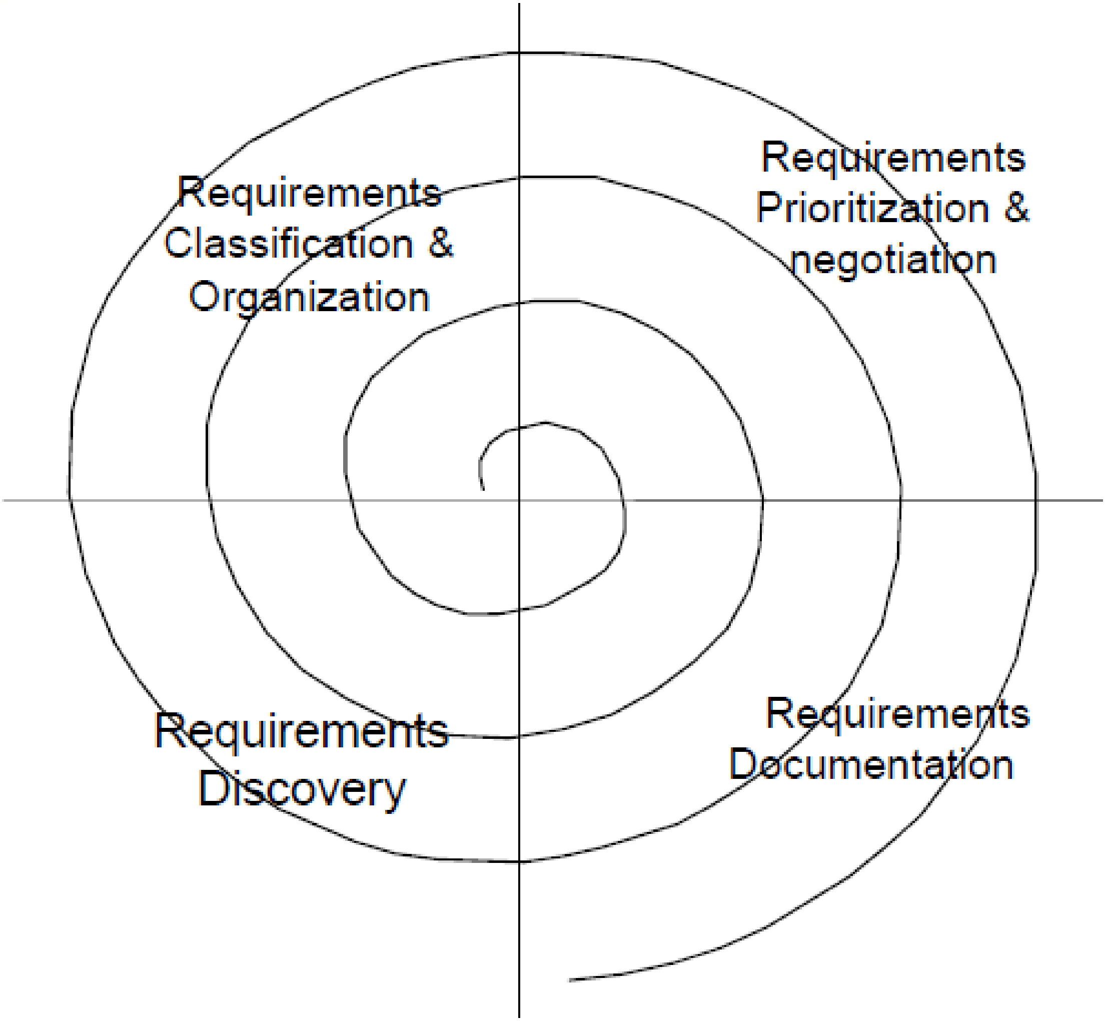
Requirement Analysis

- understanding of each requirement & representing sets of requirements in multiple ways.
- Following are the principal activities:
  - Analysing the information received from users to distinguish their task goals from functional requirements, quality expectations, business rules, suggested solutions, and other information
  - Decomposing high-level requirements into an appropriate level of detail
  - Deriving functional requirements from other requirements information
  - Understanding the relative importance of quality attributes
  - Allocating requirements to software components defined in the system architecture
  - Negotiating implementation priorities
  - Identifying gaps in requirements or unnecessary requirements as they relate to the defined scope

E&A Process activities…

- Requirements discovery
  - Interacting with stakeholders to discover their requirements. Domain requirements are also discovered at this stage.
- Requirements classification and organization
  - Group related requirements and organizes them into coherent clusters.
- Prioritization and negotiation
  - Prioritizing requirements & finding and resolving requirements conflicts.
- Requirements documentation
  - Requirements are documented and input into the next round of the spiral.

Requirements elicitation & analysis Process…


Requirements Classification & Organization
Requirements Prioritization & negotiation
Requirements Discovery
Requirements Documentation

Requirements elicitation & analysis Process…

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.
- Approaches & Techniques of requirements discovery are:
  - Questioner
  - Interviewing
  - Document analysis
  - Use-cases

Requirements Specification

- Requirements specification involves representing and storing the collected requirements knowledge in a persistent and well-organized fashion.
- The principal activity is:
  - Translating the collected user needs into written requirements and diagrams suitable for comprehension, review, and use by their intended audiences.
- A complete Software Requirement Specifications should be:
  - Clear, Correct, Consistent, Coherent, Comprehensible, Modifiable Verifiable, Prioritized, Unambiguous, Traceable…

Requirements validation…

- Confirms that you have the correct set of requirements information that will enable developers to build a solution that satisfies the business objectives
- 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 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
- Verifiability: Can the requirements be checked?

Requirements validation…

Requirements validation techniques (central activities):

- 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.
  - If test is difficult or impossible to design for the requirement means it is difficult to implement that requirement

Requirements validation…

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 validation…

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 management…

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.

Emergent properties

- Emergent properties are properties of the **system as a whole** rather than properties that can be derived from the properties of components of a system.
- Emergent properties are a consequence of the **relationships between system components**.

Some examples of emergent properties:

- Volume/the total space occupied
- Reliability
- Security
- Reparability
- Usability

Types of Software Requirements

Functional requirement

- A **functional requirement** defines a function of a software system or its component.
- A function is described as a set of inputs, the behaviour, and outputs.
- Functional requirements may be calculations, technical details, data manipulation & processing and other specific functionality that define *what* a system is supposed to accomplish.
- Functional requirements should be complete and consistent
- Customers and developers usually focus all their attention on functional requirements

Types of Software Requirements…

<u>Non-Functional requirement</u>

- □ A requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviours.
- □ Non-functional requirements are often called **qualities** of a system

Types:

- □ ***Product requirements:*** Efficiency (performance & space) , Reliability, Portability requirements
- □ ***Organizational requirements (****organizational policies* and procedures)***:*** Delivery , Implementation , Standards requirements
- □ ***External requirements*** *(factors which are external* to the system)***:*** Interoperability , *legislative (Privacy & safety), Ethical requirements* ..

Software and System Requirements

- A **software requirements specification (SRS)** includes in-depth descriptions of the software that will be developed.
- A **system requirements specification (SyRS)** collects information on the requirements for a system.
  - **System requirements relate to the system as a whole**. They may relate to hardware, software, processes, documentation and so on.
- “Software” and “system” are sometimes used interchangeably as SRS.
  - But, a software requirement specification provides greater detail than a system requirements specification.

Thank You!!

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