

Requirements Engineering

Requirements Engineering

- Introduction to Requirements Engineering
- Types of Requirements
- Steps Involved in Requirements Engineering
- Requirement Analysis Modeling

Introduction to Requirements Engineering

- The process of establishing the services that a customer requires from a system and the constraints under which it is developed and operated.
- The system requirements are the descriptions of the system services and constraints that are generated during the requirements engineering process.
- Focuses on Problem Space (‘WHAT’ is required or ‘WHAT’ problem needs to be solved)

Interesting Facts

- Software project life cycle starts with capturing the requirements of the project
- Gathering, analyzing, documenting, disseminating, validating and managing the requirements is key to project success
- More than 90% of the software projects fail due to faulty or incomplete requirements
- The cost of fixing an error in the system increases exponentially with the stage of the project.
- Cost of Change: Assume that a defect identified and fixed at requirement stage costs X. If it is missed at requirements stage but identified post-release, it would cost 10 to 100X.

Requirements Engineering - Definition

The discipline that

- explores the externally imposed conditions on a proposed computer system
- tries to identify the capabilities that will meet those imposed conditions and
- focuses on recording the same in the form of documentation called the requirements document of the system

Question 1

Which of the following is not true in case of requirement engineering?

- A. It involves gathering, analyzing, validating, documenting and managing the requirements
- B. It is key to project success because many projects fail due to faulty or incomplete requirements
- C. It helps understand what is required to be implemented in the proposed software application or product
- D. It is about on how a solution is designed or a problem is solved to develop and test software

Answer: D

What is a Requirement?

- Requirement may range from a high-level abstract statement (of a service or of a system constraint) to a detailed mathematical functional specification.
- Requirements may serve a dual function
 - Basis for a bid for a contract - therefore must be open to interpretation;
 - Basis for the contract itself - therefore must be defined in detail;
 - Both these statements may be called requirements

Example of high-level abstract statement: We need a software application to help customers book tickets in buses operated by the state transport corporation.

User Requirements and System Requirements

- User requirements

- Written in natural language with diagrams of the services the system provides and its operational constraints. Written for customers to understand and validate or confirm requirements.

Example: Bus ticket reservation system shall generate reports to help the station manager, and bus driver/conductor operate their trips smoothly.

- System requirements

- A structured document setting out detailed descriptions of the system's functions, services and operational constraints. Includes what should be implemented.

Example: A report shall be created 1 hour before the departure of the bus per trip. This report is restricted to the station manager and bus driver/conductor. This report will include passenger name, seat number, departure location and destination for all passengers specific to a trip.

Mental Healthcare System

Mentcare - A medical information system used to maintain records of people receiving care for mental health problems (Patient information system for mental healthcare). It maintains information about patients and the treatments they have received.

- Most mental health patients do not require dedicated hospital treatment but need to attend specialist clinics regularly where they can meet a doctor who has detailed knowledge of their problems.
- To make it easier for patients to attend, these clinics are not just run in hospitals. They may also be held in local medical practices or community centres.

Mental Care System

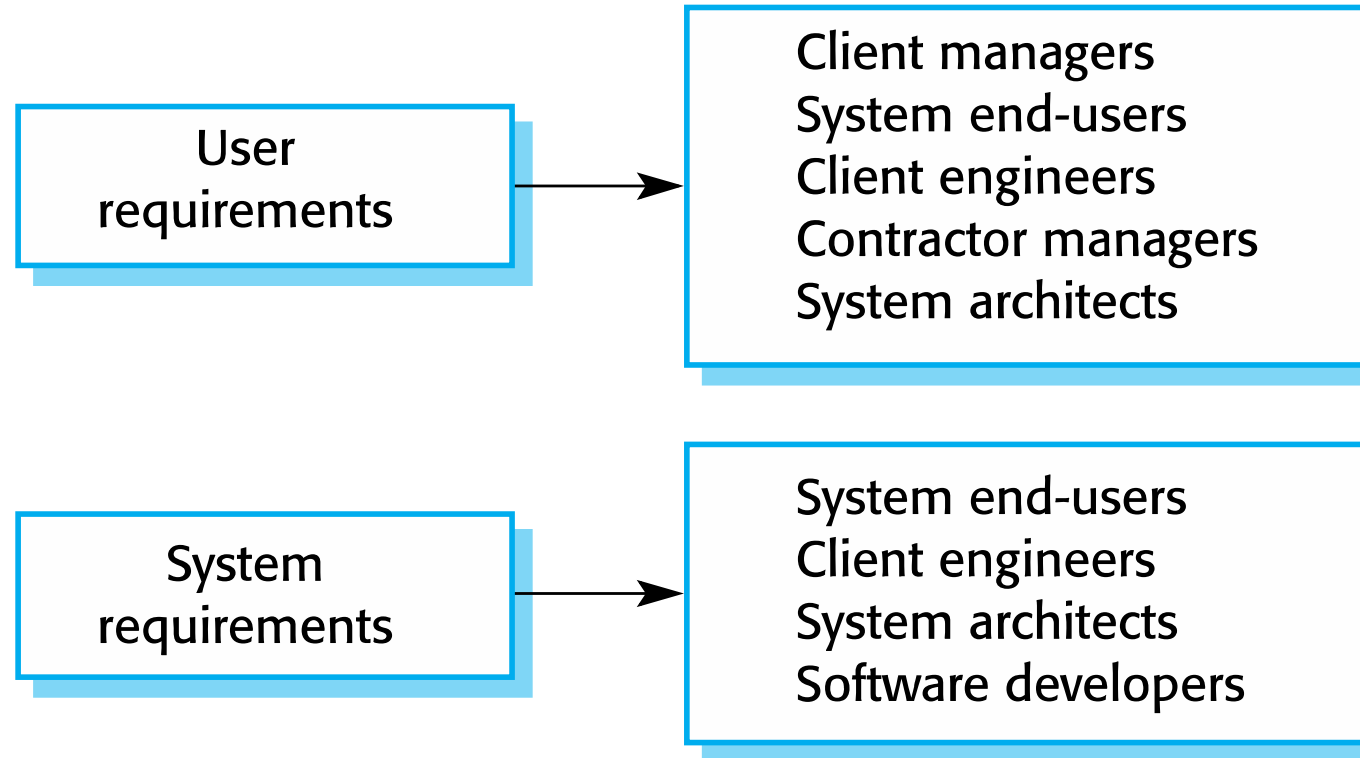
User requirements definition

- 1.** The Mentcare system shall generate monthly management reports showing the cost of drugs prescribed by each clinic during that month.

System requirements specification

- 1.1** On the last working day of each month, a summary of the drugs prescribed, their cost and the prescribing clinics shall be generated.
- 1.2** The system shall generate the report for printing after 17.30 on the last working day of the month.
- 1.3** A report shall be created for each clinic and shall list the individual drug names, the total number of prescriptions, the number of doses prescribed and the total cost of the prescribed drugs.
- 1.4** If drugs are available in different dose units (e.g. 10mg, 20mg, etc) separate reports shall be created for each dose unit.
- 1.5** Access to drug cost reports shall be restricted to authorized users as listed on a management access control list.

Target Audience



Stakeholders

- Any person or organization who is affected by the system in some way and so who has a legitimate interest
- Stakeholder types
 - End users
 - System managers
 - System owners
 - External stakeholders

Stakeholders in Mentcare System

- **Patients** whose information is recorded in the system.
- **Doctors** who are responsible for assessing and treating patients.
- **Nurses** who coordinate the consultations with doctors and administer some treatments.
- **Medical receptionists** who manage patients' appointments.
- **IT staff** who are responsible for installing and maintaining the system.
- **A medical ethics manager** who must ensure that the system meets current ethical guidelines for patient care.
- **Health care managers** who obtain management information from the system.
- **Medical records staff** who are responsible for ensuring that system information can be maintained and preserved, and that record keeping procedures have been properly implemented.

Question 2

Identify the stakeholders in case of a bus reservation system of a state transport corporation?

- A. Passengers who have booked their tickets, drivers, conductors, station managers
- B. Customers, drivers, conductors, station managers, IT/System managers/operators, Insurance Firms, Police Department, RTO Staff
- C. Customers, Employees of state transport corporation, Computer hardware supplier
- D. Customers, Employees, and all government departments

Answer: B

Types of Requirements

- Functional Requirements – Cover all the functional aspects or set of features that deliver such functions. Determine how the software will behave to meet users' needs.
- Non-Functional Requirements – Cover requirements related to non-functional aspects such as *reliability, availability, security, usability, performance, scalability, interoperability, and compatibility*.
- Interface Requirements – Cover how the system would interact with other dependent systems for activities such as *send/receive data, store data, and run a process and get results*. Define how the system will interact with other external systems.

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Mentcare System – Functional Requirements

- A user shall be able to search the appointments lists for all clinics.
- The system shall generate each day, for each clinic, a list of patients who are expected to attend appointments that day.
- Each staff member using the system shall be uniquely identified by his or her 8-digit employee number.

Requirements Need to be Precise

- Ambiguous or imprecise requirements may be interpreted in different ways by developers and users.
- Consider the term 'search' in requirement "A user shall be able to search the appointments lists for all clinics".
 - User intention – search for a patient name across all appointments in all clinics;
 - Developer interpretation – search for a patient name in an individual clinic. User chooses clinic then search.

Completeness and Consistency

- In principle, requirements should be both complete and consistent.
- Complete
 - They should include descriptions of all facilities required.
- Consistent
 - There should be no conflicts or contradictions in the descriptions of the system facilities.
- In practice, because of system and environmental complexity, it is very challenging to produce a complete and consistent requirements document.

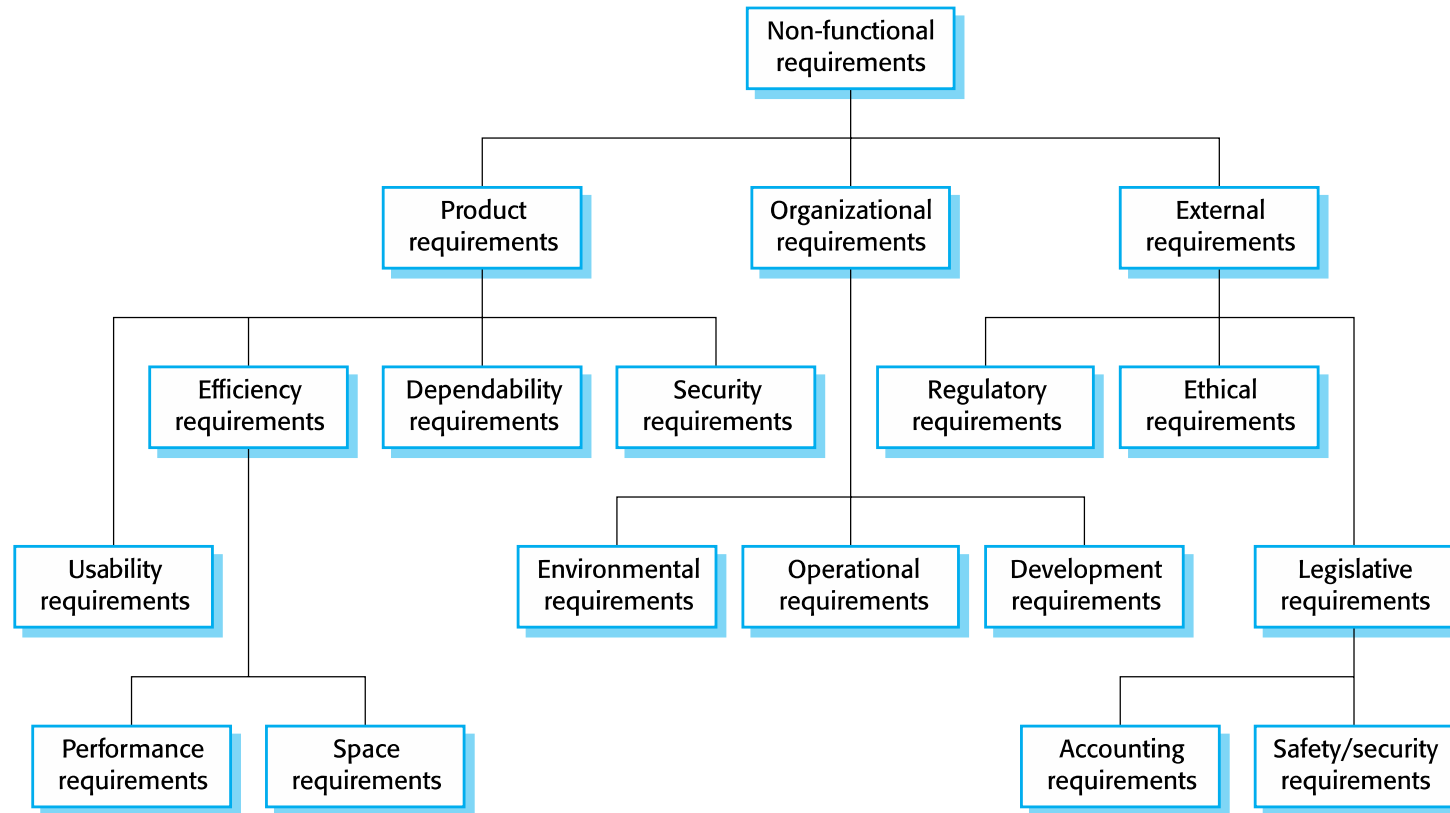
Question 3

Which of the following is not a functional requirement?

- A. A registered user shall view the availability of seats in a bus travelling from city A to B (Mumbai to Pune for example)
- B. A registered user shall be able to book a seat and print the ticket
- C. A registered user will be able to login to the system through 2-factor authentication (1) username/password and 2) OTP on registered mobile number)
- D. The refund amount will be 100% in case of cancellations initiated before 24 hours of scheduled departure.

Answer: C

Types of Non-Functional Requirements



Implementing Non-Functional Requirements

- Non-functional requirements may affect the overall architecture of a system rather than the individual components.
 - For example, to ensure that performance requirements are met, you may have to organize the system to minimize communications between components.
- A single non-functional requirement, such as a security requirement, may generate a number of related functional requirements that define system services that are required.
 - It may also generate requirements that restrict existing requirements.

MentCare System – Examples of NFRs

Product Requirement

- The Mentcare system shall be available to all clinics during normal working hours (Mon–Fri, 0830–17.30). Downtime within normal working hours shall not exceed five seconds in any one day. **(Availability)**

Organizational Requirement

- Users of the Mentcare system shall authenticate themselves using their health authority identity card. **(Security)**

External Requirement

- The system shall implement patient privacy provisions as per government standards. **(Compliance)**

NFRs Have to be Measurable

Property	Measure
Speed	Processed transactions/second User/event response time Screen refresh time
Size	Mbytes Number of ROM chips
Ease of use	Training time Number of help frames
Reliability	Mean time to failure Probability of unavailability Rate of failure occurrence Availability
Robustness	Time to restart after failure Percentage of events causing failure Probability of data corruption on failure
Portability	Percentage of target dependent statements Number of target systems

Question 4

Identify the statement that need not correspond to a non-functional requirement.


- A. The bus driver or conductor or station manager shall print the trip sheet (report with details of passengers) 60 minutes before departure.
- B. The system shall respond to reservation requests with in 20 milliseconds.
- C. The system will be available 99.99% of the time every year.
- D. A registered user will be asked to change the password once in two months.

Answer: A

Interface Requirements - Examples

- National Identity Authentication (Aadhar card for example)
- Credit rating check for loan processing in a bank (through a central agency)

Steps Involved in Requirements Engineering

- Feasibility Study (Deliverable: Feasibility Report)
 - Requirements Elicitation
 - Requirement Analysis
 - Specifying and Validating Requirements (Deliverable: System Requirements Specification(SRS) document)
 - Requirement Management (Updates to SRS)
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Feasibility Study

Helps decide if the system

- is worth pursuing
- contributes to organizational objectives
- can be developed using the available technology within the specified time and budget
- can easily be integrated with other systems as required

THREE TYPES

1. Operational Feasibility – Related to Usability, User Adoption
2. Technical Feasibility – Related to availability of technology
3. Economic Feasibility – Related to investment vs. returns (cost vs. benefits)

Requirement Elicitation

- Starts with identification of stakeholders and involving them
- Software engineers work with a range of system stakeholders to find out about the application domain, the services that the system should provide, the required system performance, hardware constraints, other systems, etc.
- Stages include,
 - Discovery
 - Classification and organization
 - Prioritization and negotiation
 - Specification

Challenges of Requirement Elicitation

- **Awareness:** Stakeholders don't know what they really want.
- **Communication Gap:** Stakeholders express requirements in their own terms.
- **Conflicting Requirements:** Different stakeholders may have conflicting requirements.
- **Volatile Requirements:** The requirements change during the analysis process. New stakeholders may emerge and the business environment may change.
- **Other Influencing Factors:** Organisational and political factors may influence the system requirements.

Requirement Elicitation Techniques

- Interviewing
- Focus Groups
- Facilitated Workshops
- Prototyping
- Questionnaires
- Brainstorming
- Direct Observation
- Apprenticing (Performing hands-on tasks on the existing system)

Question 5

Which elicitation technique is similar to interviewing but involves a group of 6 to 10 people?

- A. Prototyping
- B. Focus Groups
- C. Facilitated Workshops
- D. Direct Observation

Answer: B

Question 6

A project involves developing a new application to replace an existing application based on outdated technology. Which of the following elicitation techniques involves gaining hands-on knowledge and experience on how the existing application operates?

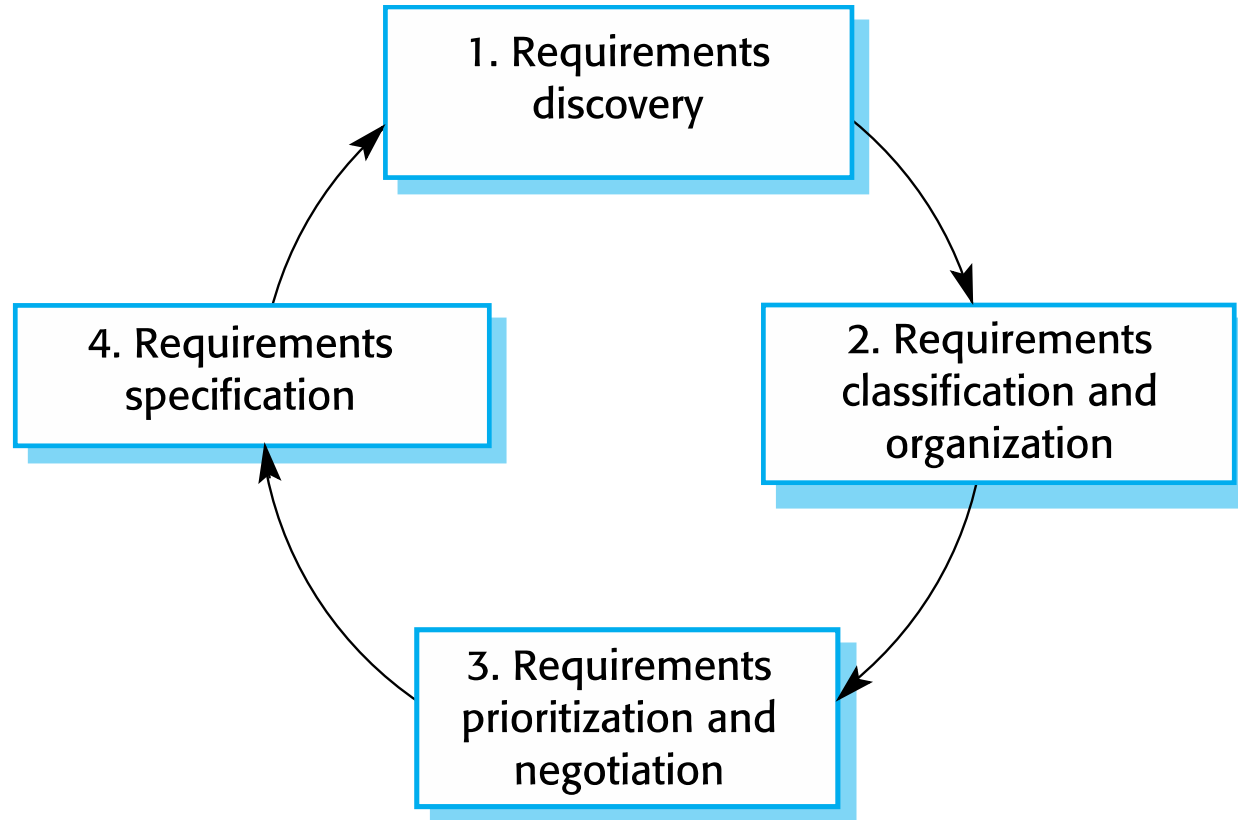
- A. Prototyping
- B. Brainstorming
- C. Apprenticing
- D. Direct Observation

Answer: C

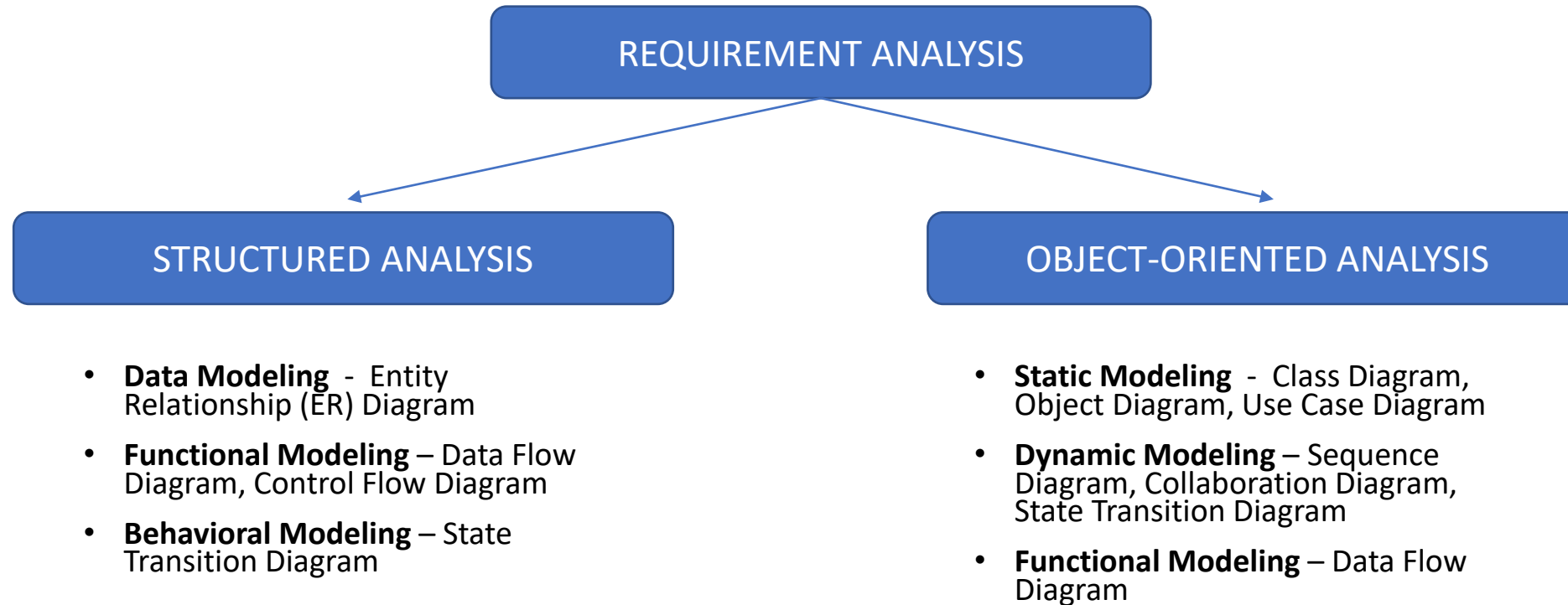
Requirement Analysis

- Requirement analysis is performed to analyze and understand the requirements in detail in terms of
 - Flow and content of information
 - Externally observable data objects
 - Software functionality elaboration
 - Software behaviour based on inputs
 - Interface requirements
 - User Interface and other design constraints
- Comprises of analysis modeling
- It involves negotiation with stakeholders and prioritization

Requirement Elicitation, Analysis and Specification



Modeling Techniques with Examples



In the next session, we will discuss specific examples with details.

Requirement Specification

- The process of documenting the user and system requirements in a requirements document.
- User requirements must be understandable by end-users and customers who do not have a technical background.
- System requirements are more detailed requirements and may include more technical information.
- The requirements may be part of a contract for the system development
 - It is therefore important that these are as complete as possible.

Question 7

Which of the following statements is true?

- A. The three types of feasibility study are a) Technical Feasibility, b) Operational Feasibility and c) Data Security Feasibility
- B. Requirements Elicitation is easy to undertake because end users are well aware of what they want
- C. Requirement Specification is the process of documenting the user and system requirements in a requirements document.
- D. Requirement analysis is done well before requirement elicitation

Answer: C

Question 8

The cost of fixing an error in the system increases exponentially with the stage of the project.

- A. True
- B. False

Answer: A

Question 9

Software engineering is

- A. An engineering discipline that is concerned with all aspects of software production.
- B. Concerned with the practicalities of developing and delivering useful software.
- C. A subject area that includes the fundamental ideas, concepts, process models and best practices that are applicable to all types of software systems
- D. All of the above

Answer: D

Question 10

What are the different types of requirements

- A. Functional Requirements, Non-Functional Requirements, Technical Requirements
- B. Technical Requirements, Non-Functional Requirements, Key Stakeholder Requirements
- C. Functional Requirements, Non-Functional Requirements, Interface Requirements
- D. Functional Requirements, Non-Functional Requirements, Security Interface Requirements

Answer: C

Summary

- ✓ Introduction to Requirements Engineering
- ✓ Types of Requirements
- ✓ Steps Involved in Requirements Engineering
 - Requirement Analysis Modeling (TO DO)