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.**

- **It is the process of discovering, analyzing, documenting and validating the requirements of the system**

Functional and Non-functional requirements

Functional requirements

•Statements of **services** the system should provide, how the system should react to particular inputs and how the system should behave in particular situations.
•May state what the system **should not do**.

•Non-functional requirements

•**Constraints** on the services or functions offered by the system such as timing constraints, constraints on the development process, standards, etc.
•Often apply to the **system as a whole** rather than individual features or services.
•Domain requirements
•Constraints on the system from the domain of operation

Types of Requirements

- **User requirements :**
- Statements in natural language plus diagrams of the services the system provides and its operational constraints.
- **System requirements :**
  - A **structured** document setting out **detailed descriptions** of the system's **functions**, **services** and **operational constraints**.
  - Defines what should be implemented so may be part of a contract between client and contractor.

*U**ser requirement:*** As a user who found a new job announcement, I want to add a new position to the website so s/he can start working on doing the initial research and apply to it

System requirement: A registered user on the academic jobs website should be able to add a new position listing with the name of the school and academic unit, date of posting, date of expiry, application deadline, and contact and application details. The interaction fails if: the position is already listed, the application deadline is in the past, position announcement is expired, or the contact information is missing. If fails, point mistakes to user and ask the user to fix and resubmit.

user requirements problem

- Lack of clarity - ambiguous language
- Requirements confusion - functional, non-functional requirements, design information are not distinguished
- Requirements amalgamation – several requirements are defined as a single one
- Incompleteness – requirements may be missing
- Inconsistency – requirements may contradict themselves

Functional Requirements

- Describe functionality or system services.
- Depend on the type of software, expected users and the type of system where the software is used.
- Functional user requirements may be high-level statements of what the system should do.
- Functional system requirements should describe the system services in detail.

Essentially, these are the ‘whats’ of the system that we often refer to. These are not ‘all that there is,’ but these should describe the overall functionality of the system

Non-functional Requirements

- These define system properties and constraints e.g. reliability, response time, maintainability, scalability, portability, and storage requirements.
- Constraints are I/O device capability, system representations, etc.
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- Process requirements may also be specified mandating a particular IDE, programming language or development method.
- (Often internal to an organization or required for fit / compatibility with other comparable systems.)
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- Non-functional requirements **may be more critical** than functional requirements. If these are not met, the system may be useless.

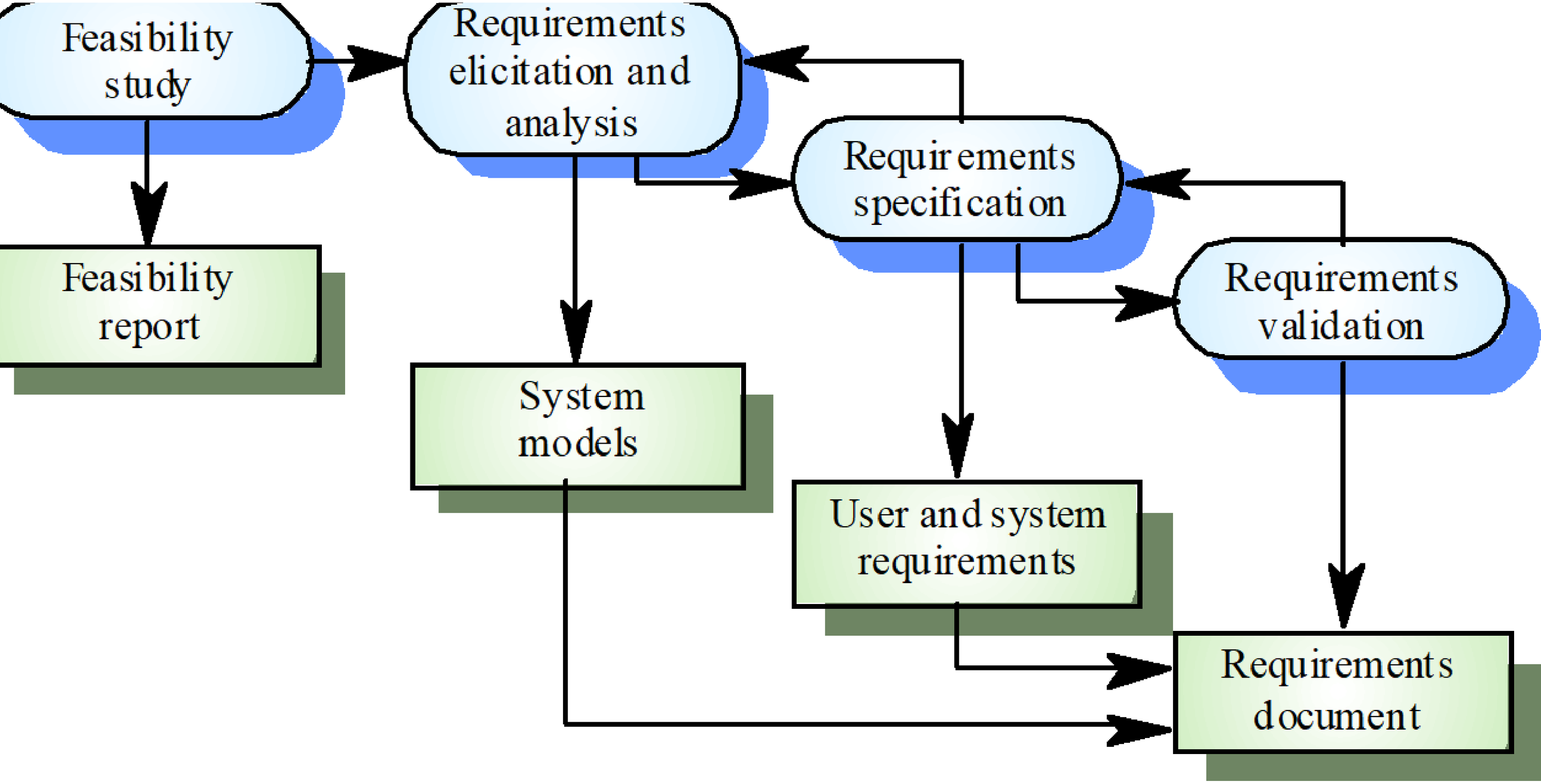
Metrics for specifying nonfunctional requirements

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 (MTTF)** Probability of unavailability Rate of failure occurrence Availability
Robustness	Time to restart after failure **(MTTR)** Percentage of events causing failure Probability of data corruption on failure
Portability	Percentage of target dependent statements

Requirement engineering

5 important activities:

- Feasibility study
- Requirements elicitation
- Analysis
- Requirements documentation
- Requirements validation
- Requirements management


Feasibility study
Requirements elicitation and analysis
Requirements specification
Requirements validation
Feasibility report
System models
User and system requirements
Requirements document

Feasibility study

- It is done at first to decide whether or not the project is worthwhile
- **Look at different perspectives:**

Market analysis, financial, schedule, technical, resource, legal...

- Should make you aware of the risks

Feasibility

Doing the study

- Consult information sources: managers, software engineers, end users…
- Based on information collection (interviews, surveys, questionnaires…)
- Should be short (2-3 weeks)

Requirements Elicitation

- Gathering requirements

- Discovering the requirements for a system by communication with customers, system users and others who have a stake in the system development.

Specific Elicitation Techniques

- Interviews
- Questionnaires
- Requirements elicitation workshops
- Scenarios
- Written materials
- Observations and social analysis
- Requirements reuse
- Prototyping
  - Focus group

Types of Interviews

Structured:

- The Structured interviews allows for interview with multiple interviewees.
- The data collected is more closed to the population – oriented and is easier to analyze.
- **The interviewer has more control over interview by asking the questions in a specific order**

Unstructured interviews

• Informal and with no restriction about the scope and context of the topics called.
• There are no predefined questions prior to interview. • Unstructured interviews make the interview more conversational in style.
• Limited control over the interview.

Surveys

- RE over a large population of interest.
- covers the whole geographical region to get the large set of requirements.

Questionnaires

- **used when we want to gather requirements from peoples who are far away and large in number**
- **Can quickly collect info from large numbers of people •**
- **Administer the questionnaire using simple rules:**
- **Scoring Scheme : e.g a range from 1 to 5**
- **Group Interrelated questions :**
- **E.g Q 1 3 4 represent customer satisfaction with current systems**
- **Q 2 5 6 represent customer willingness to try a new one.**

Brainstorming

- both idea generation and idea reduction

• Generate as many ideas as possible, combine ideas, reduce ideas and prioritize ideas

• Various voting techniques may be used to prioritize the ideas created

• **Advantages:**

• Brainstorming are mostly used for the innovative sort of projects where each participant provides his or her own ideas after their personal research about the project to be started.

• This technique is often used make the key decisions about the requirements of the project.

• It promotes free thinking and expression of ideas. • Brainstorming provides the innovative ideas about the project to be developed.

• **Disadvantages:**

• Brain storming is seriously affected by exploring the critique ideas.

• Brainstorming is not used to resolve the major issues.

Requirements Workshops

• Requirements workshop is a collection of different types of meeting conducted by the stakeholder to elicit the requirements of the project to be developed.

Advantages

- Requirements are mostly unchanged whenever elicited with this type of method.
- This technique is feasible for the large and complex solution.

Observation

- It is one of the ethnographic techniques in which the requirements engineer visits and observes the environment of the customer where the software has to perform the services.
- This technique is often used with the conjunction of other requirements engineering techniques like interview and task analysis.

Prototyping

A prototype is an initial version of a system which may be used for experimentation

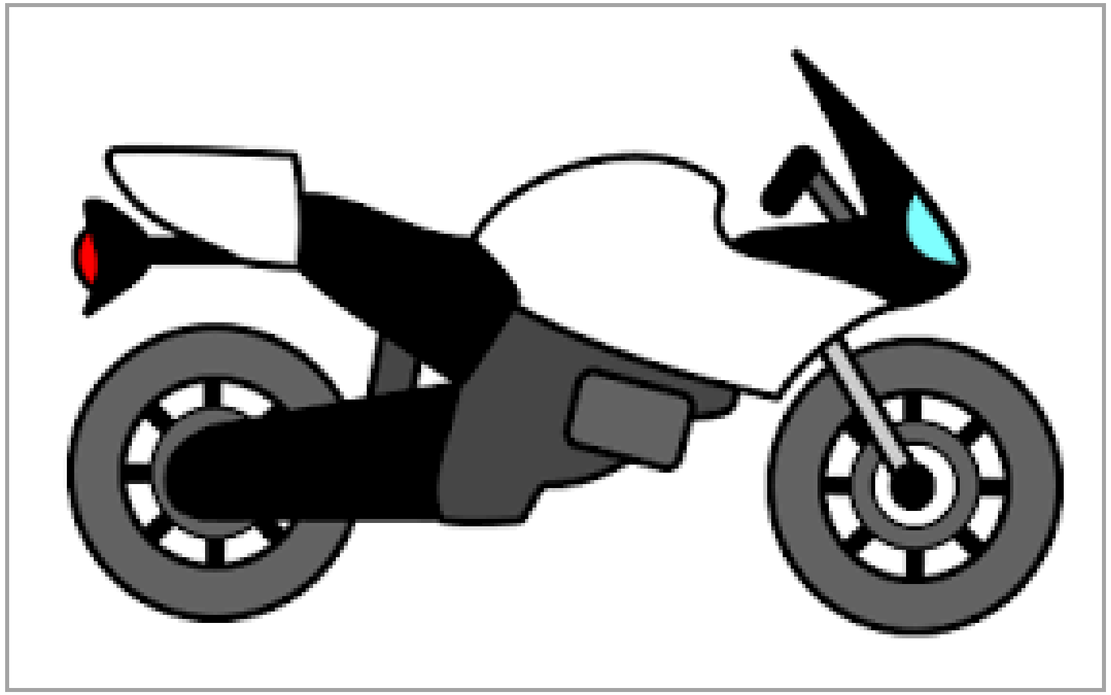
- Prototype may be a quick rough version of the system
- Prototypes are valuable for requirements elicitation because users can experiment with the system and point out its strengths and weaknesses.

They have something concrete to criticize

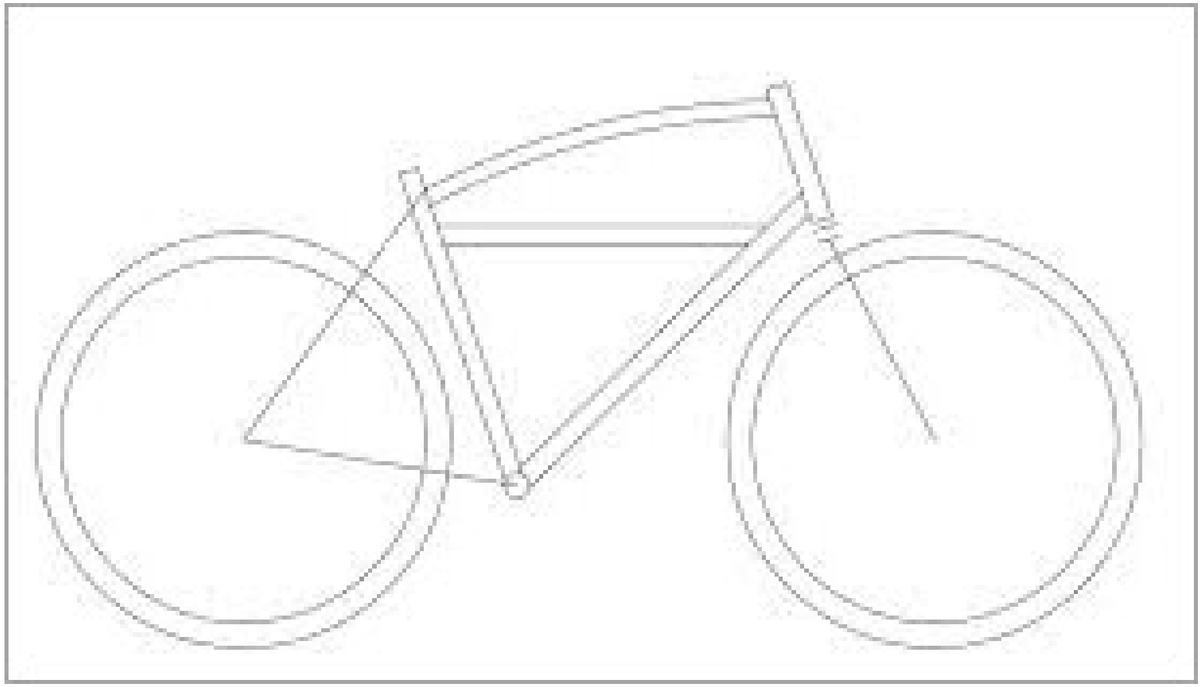
Requirement elicitation challenges

1. **Managing stakeholders:** multiple stakeholders with different goals and priorities, making it difficult to satisfy everyone's requirements.
2. **Identifying and mitigating risks:** security vulnerabilities or scalability issues.
3. **Handling ambiguity:** Requirements may be ambiguous, inconsistent, or incomplete, making it difficult for engineers to understand what the system should do.
4. **Keeping up with changing technology:**
5. **Maintaining traceability**

Requirement Analysis



end user expectation



end user receive

Reasons,

- incorrect implementation of customer requirements,
- a wrong understanding of customer requirements by programmers and quality team, etc.

Analysis is important :

- A business analyst might have understood the requirement from the customer differently than how a programmer would have interpreted it.

- Analyze the requirements gathered and look for the feasibility to implement them
- Atomic
- Uniquely identified
- Complete
- Consistent and unambiguous
- Traceable
- Prioritized
- Testable
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Atomic :

Bad requirement Students will be able to enroll to undergraduate and post graduate courses

Good requirement

- Students will be able to enroll to undergraduate courses
- Students will be able to enroll to post-graduate courses

Complete

Bad one :

A professor user will log into the system by providing his username, password, and **other relevant information**

Good one :

A professor user will log into the system by providing his username, password and department code

Consistent and unambiguous

Bad one : A student will have either undergraduate courses or post-graduate courses but not both. Some courses will be open to both under-graduate and post-graduate

Good one : A student will have either under-graduate or post graduates but not both

Testable

Each page of the system will load in an acceptable time-frame

Better one

Register student and enroll courses pages of the system will load within 5 seconds