KAIST

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CS30500:
Introduction to Software Engineering

Ch 7. Understanding Requirements

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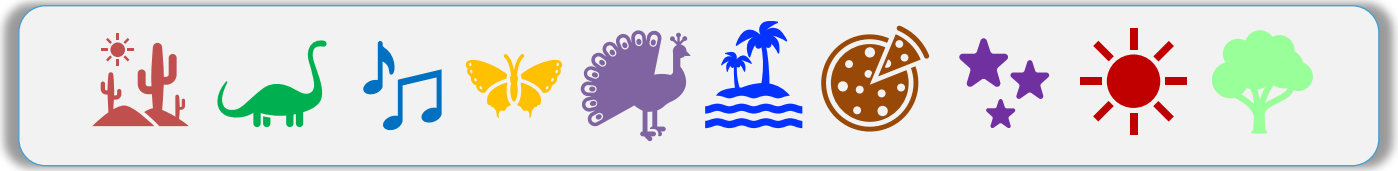
As a Software Engineer…

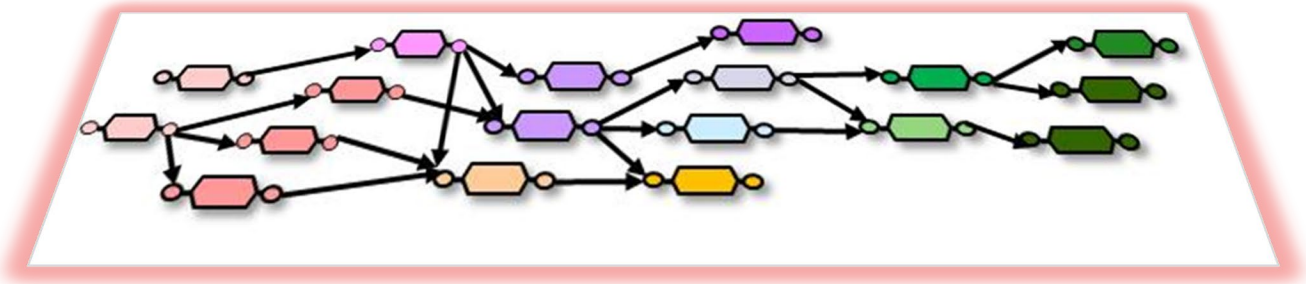
- “A smart home system where a butler robot understands the user's needs and seamlessly controls and coordinates home appliances.”
- Is this description sufficient to begin development? What additional information do you need?

- *A detailed list of necessary features?*
- *Quality-related requirements? – response time, accuracy, ...*
- *Any environmental and technical constraints?*
- *Where can you get such information?*

Our Goal

Customer Needs

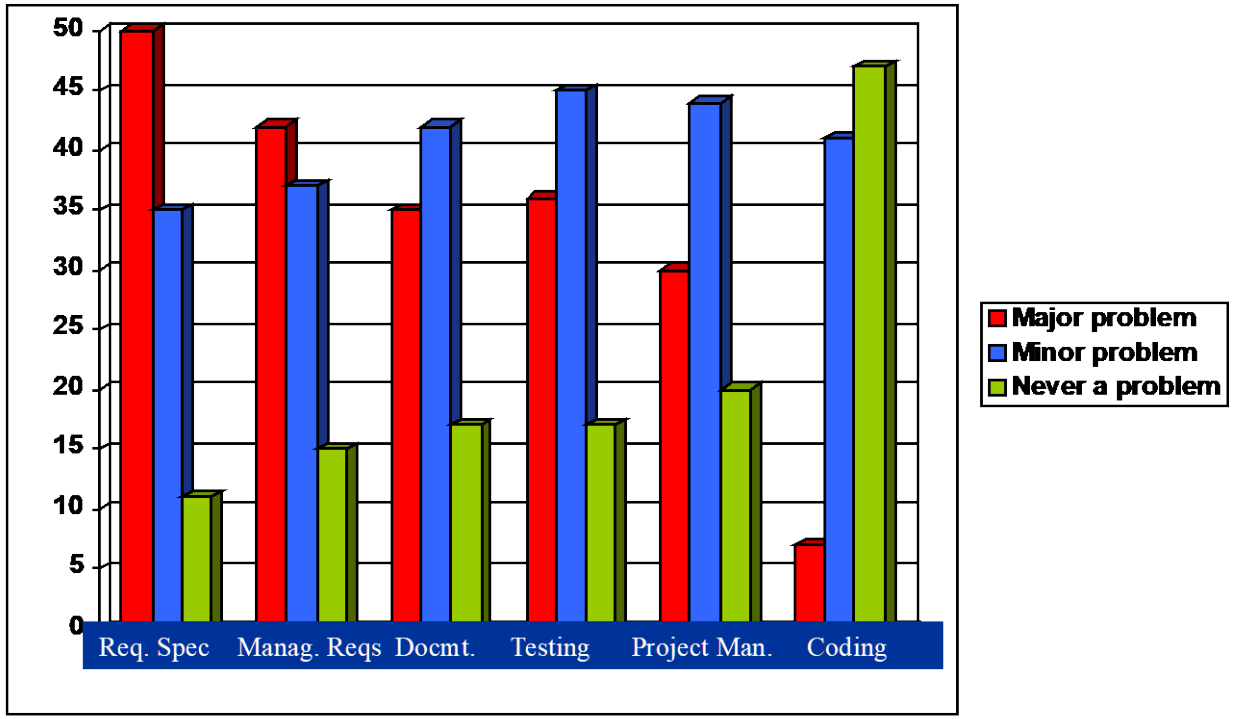




Software Design

Why are requirements important?

- Most commonly cited causes of the challenged projects:
  - Lack of user input (13%)
  - Incomplete requirements (12%)
  - Changing requirements (12%)
  - Lack of technical skill (7%)
  - Lack of resource (6%)
  - Inadequate time (4%)



Largest software development problems by category

ESPITI [1995 in Leffingwell and Widrig., 2000. Managing Software Requirements, p. 6-7]

[Standish Group International, 1994 and 2003 Surveys]

What is a Requirement?

- A property to be met or a service to be provided by a system
- "A condition or capability needed by a user to solve a problem or achieve an objective" [IEEE610.12]
- "A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed documents" [IEEE610.12]
- **Requirements Engineering (RE)** is the process of finding out, analyzing, documenting and checking the required services and constraints of a system [Som11]

User & System Requirements (1/2)

- **User requirements**
  - Statements of what services a system is expected to provide to system users and the constraints under which it must operate
  - Usually represented in a natural language plus diagrams
- **System requirements**
  - More detailed descriptions of a software system's functions, services, and operational constraints
  - Define exactly what is to be implemented (functional specification)
  - Usually a part of the contract between the system buyer and the software developers

[Som11]

User & System Requirements (2/2)

- **User requirement definition**

> 1. The MHC-PMS 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 automatically 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., 10 mg, 20 mg) separate reports shall be created for each dose unit.
>
> **1.5** Access to all cost reports shall be restricted to authorized users listed on a management access control list.

[Som11]

Functional & Non-functional Requirements

- **Functional Requirements (FR)**
  - Statements of activities and services a system must provide
  - Descriptions about how the system react to particular inputs, and how the system behave in particular situations
  - Descriptions about what the system should not do
- **Non-functional Requirements (NFR)**
  - Constraints on the services or functions offered by the system
  - Including timing constraints, constraints on the development process, and constraints imposed by standards
  - Often apply to the system as a whole, rather than individual system features or services

[Som11]

Functional Requirements (FRs)

- FRs define specific facilities to be provided by the system
- FRs should be precise enough not to be ambiguous
- FRs need to be complete and consistent
- New requirements have to be established and the system needs to be changed according to them

http://1stmuse.com/projects/top_reasons_why_projects_fail/

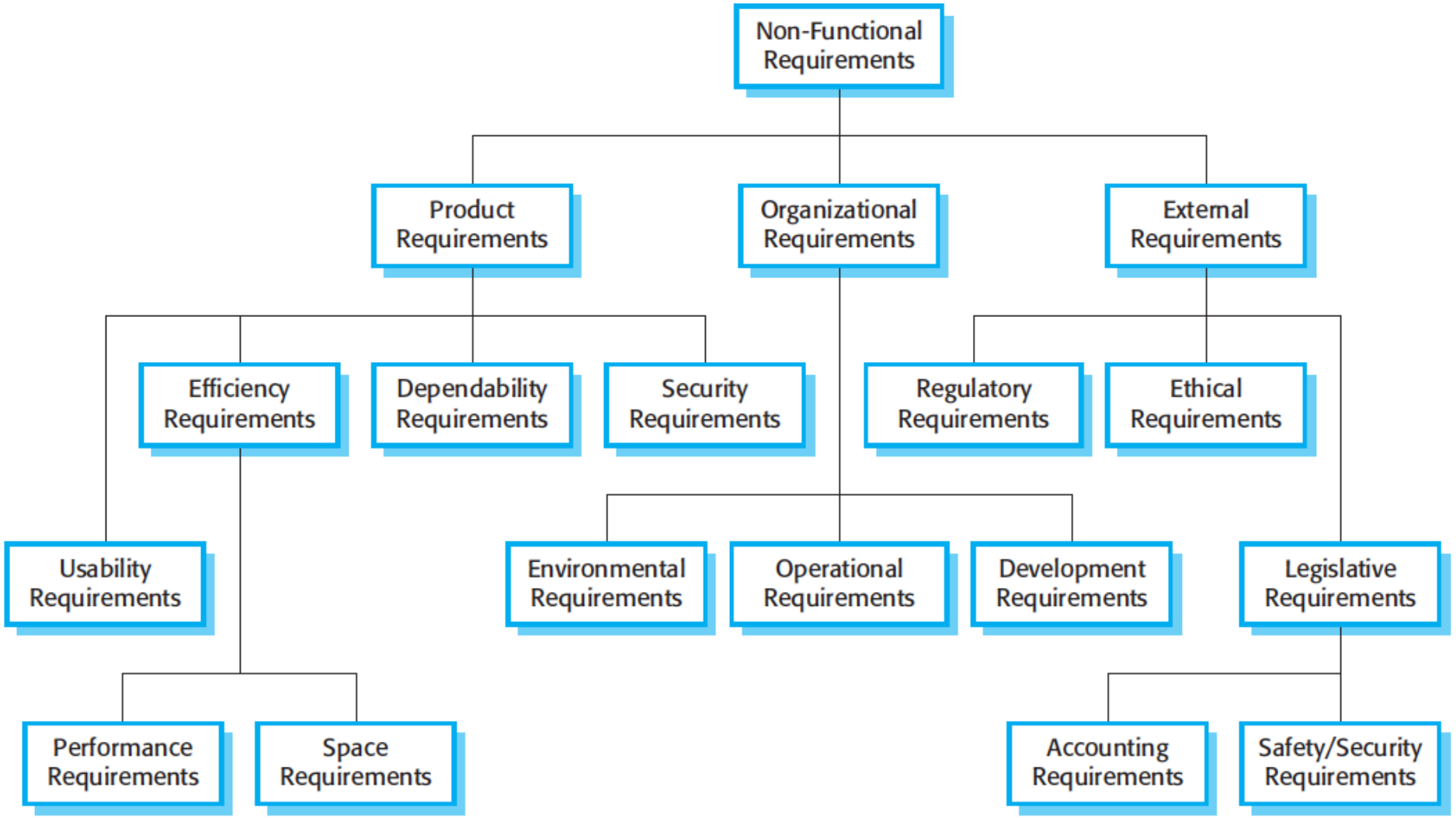
[Som11]

Non-functional Requirements (NFRs) (1/2)

- NFRs are not directly concerned with the specific services delivered by the system to its users
- NFRs include emergent system properties such as reliability, response time, and store occupancy
- NFRs include the constraints on the system implementation such as the capabilities of I/O devices or the data representations used in interfaces with other systems
- NFRs may affect the overall architecture of a system rather than the individual components
- A single NFR, such as a security requirement, may generate a number of related functional requirements that define new system services that are required

[Som11]

Non-functional Requirements (NFRs) (2/2)



[Som11]

Classification of Non-functional Requirements (1/2)

- **Product Requirements**
  - Requirements that specify or constrain the behavior of the software
  - e.g., performance, reliability, security, and usability requirements
- **Organizational Requirements**
  - Broad system requirements derived from policies and procedures in the customer's and developer's organization
  - e.g., operational process, development process, standards, and operating environment
- **External Requirements**
  - Requirements derived from factors external to the system and its development process
  - Requirements that need to be met for the system to be approved for use by a regulator (e.g., a central bank)
  - Legislative requirements that must be followed to ensure that the system operates within the law
  - Ethical requirements that ensure that the system will be acceptable to its users and the general public

[Som11]

Classification of Non-functional Requirements (2/2)

- **Product Requirements**

> The MHC-PMS shall be available to all clinics during normal working hours (Mon–Fri, 08.30–17.30). Downtime within normal working hours shall not exceed five seconds in any one day.

- **Organizational Requirements**

> Users of the MHC-PMS system shall authenticate themselves using their health authority identity card.

- **External Requirements**

> The system shall implement patient privacy provisions as set out in HStan-03-2006-priv.

[Som11]

Measurable Non-functional Requirements

- Non-functional requirements need to be expressed as ‘testable’ or ‘measurable’ ones
  - e.g.,

> *The system should be easy to use by medical staff and should be organized in such a way that user errors are minimized.*

> *Medical staff shall be able to use all the system functions after four hours of training. After this training, the average number of errors made by experienced users shall not exceed two per hour of system use.*

- The cost of objectively verifying measurable, non-functional requirements can be very high
- Non-functional requirements often conflict and interact with other functional or non-functional requirements
  - Need to specify the related requirements explicitly and clearly

[Som11]

Metrics for Specifying NFR

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

[Som11]