Unit-2
Software Requirement

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Outline

- Requirement Engineering
- Functional requirements
- Non-functional requirement
- User requirements
- System requirements
- Software Requirements Document

Requirement Engineering

- Tasks and techniques that lead to an understanding of requirements is called requirements engineering.
- Requirements engineering is a major software engineering action that begins during the communication activity and continues into the modeling activity.
- It builds a bridge to design and construction.
- It provides the appropriate mechanism for understanding what the customer wants, analyzing need, assessing feasibility, negotiating a reasonable solution, specifying the solution unambiguously, validating the specification, and managing the requirements as they are transformed into an operational system

Seven distinct tasks of requirement engineering

- Inception, elicitation, elaboration, negotiation, specification, validation, and management.

Requirement Engineering(contd..)

Inception

- Identify the business needs, or potential market, or discover service.
- Stakeholders (e.g., business managers, marketing people, product managers) define idea, try to identify the market need, do feasibility analysis, and identify the projects scope.
- Understand the problem, desired solution, and communicate and collaborate between the other stakeholders and the software team.
- Query : How does a software project get started? Does the need evolve over time?
- Major outcomes :problem, solution, resources, timing

Inception - example

Table: Inception summary report

Problem	Solution	Resources
SQL injection attack	Parameterized statements	owner-X
Secure update	CPU utilization	ownerY
Test data gen	PSO optimization	ownerZ

Elicitation

- Question the customer, the users, and others about the objectives for the system or product ?
- How the system or product fits into the needs of the business?
- How the system or product used on a day-to-day basis?
- Number of problems that are encountered in elicitation are : (1) Problems of scope (2) Problems of understanding (3) Problems of volatility.

Requirement Engineering(contd..)

Elicitation objective: To mitigate the risk of attack in SQL operations.

Table : Elicitation approach-Questionnaire

Who can access what data?
How big is the project?
Who will use this feature?
What needs to be tracked?
What is most important for success of this software?
What applications and technologies will the project need?
How are all the different sets of data related to each other?

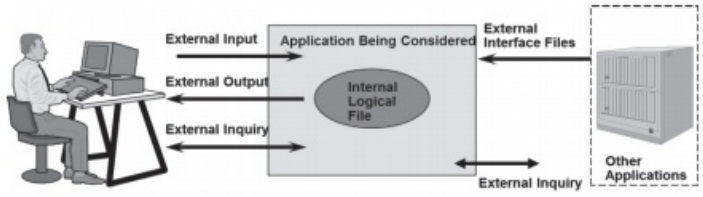
Table : Elicitation approach-Checklist

Does it meet the business need ?
Is the user accessiblity unambiguous ?
Is the data privileges specified ?
Are the key stakeholders and users clear?
Is the specific bottlenecks information collected ?
Do we have levels of expertise to solve this problem ?

Elaboration

- Inception and elicitation information are expanded and refined.
- Focuses on software function, behavior, and information.
- User scenario method identifies actors, classes, services for each class, relationship between classes.

Figure : Function & Behaviour



Requirement Engineering(contd..)

Negotiation

- Prioritize requirements
- Assesses the requirement cost and risk
- Modify or eliminate and combine the conflicting requirements

Example : Negotiation approach

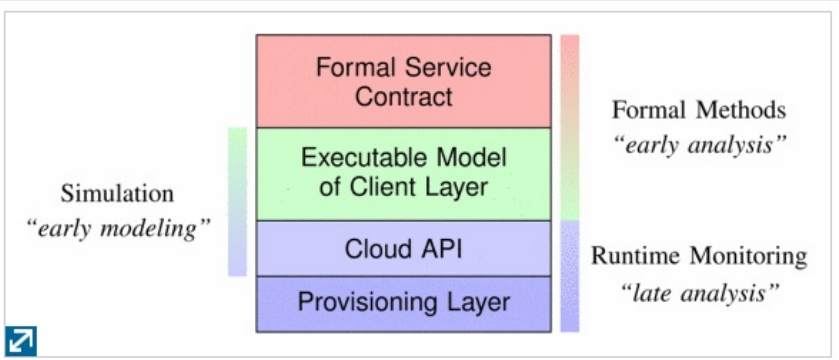
- Software vendor price for a software : $20,000 but can go down to $15,000.
- Software company needs the software for project implementation has a budget of only $17,000, and anything beyond $17,000 would make the product not worth the price for the project.
- $15,000 to $17,000 is the common ground among the parties involved in the negotiation, and a win-win negotiation

Specification

- A specification can be a written document, a set of graphical models, a formal mathematical model, a collection of usage scenarios, a prototype, or any combination of these.

Example : Specification approach

Fig. Formal methods - Behavior of cloud deployed services



Requirement Engineering(contd..)

Validation

- Work products are assessed for quality
- Specification are examined for completeness, consistencies, unambiguous, conflicting requirement, unrealistic requirements.
- Sample validation checklist :Does the requirement violate any system domain constraints? Are requirements stated clearly? Can they be misinterpreted?

Requirements management

- A set of activities that help the project team to identify, control, and track requirements and changes to requirements at any time as the project proceeds.
- Requirements engineering tools assist in requirements gathering, requirements modeling, requirements management, and requirements validation.
- RE tools : IBM Rational RequisitePro, EasyRM, CaliberRM, etc.

Functional Requirement

- Introduction to FR and NFR

FR

- Statements of services the system should provide.
- How the system should react to particular inputs?
- How the system should behave in particular situations?
- It may also explicitly state what the system should not do.

NFR

- Constraints on the services or functions offered by the system.
- Timing constraints, constraints on the development process, and constraints imposed by standards.
- Applied to the system as a whole, rather than individual system features or services.

Functional Requirement(Contd..)

FR depends on :

- Type of software being developed
- Expected users of the software
- Organization approach in collecting requirement
- User requirements are described in an abstract way for system users
- System requirements describe the system functions, its inputs and outputs, exceptions, etc., in detail.

Sample FR : Mental health problem

- 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 eight-digit employee number.

Complete and consistent FR

- Completeness means that all services required by the user should be defined.
- Consistency means that requirements should not have contradictory definitions.

Functional Requirement(Contd..)

Imprecision (Incomplete, inconsistencies and ambiguous) FR may lead to:

- Many software engineering problems.
- Requirement can be interpreted in a different way
- May delay system delivery
- Increases costs.

Sample ambiguous FR

- A user shall be able to search the appointments lists for all clinics.
  Consequences : Mental health problems are sometimes confused. They may have an appointment at one clinic but actually go to a different clinic.

Large and complex FR

- Easy to make mistakes and omissions when writing specifications for complex systems.
- Due to many stakeholders in a large system, inconsistent requirement are included.

Non-Functional Requirement

What are NFRs ?

- Requirements that are not directly concerned with the specific services delivered to its users.
- Relate to properties such as reliability, safety, confidentiality, response time, performance, security, availability and store occupancy.
- May define constraints on the system implementation.
  Example : Capabilities of I/O devices, data representations used in interfaces with other systems.
- Often more critical than individual functional requirements.

Importance of NFR

- May affect the overall architecture of a system rather than the individual components
- Failing to meet a non-functional requirement can mean that the whole system is unusable.
- **Example 1:** if an aircraft system does not meet its reliability requirements, it will not be certified as safe for operation;
- **Example 2:** if an embedded control system fails to meet its performance requirements, the control functions will not operate correctly.

Non-Functional Requirement(contd..)

How NFR arise ?

- User needs
- Budget constraints
- Organizational policies
- Interoperability with other software or hardware systems
- Safety regulations or privacy legislation.

Usability requirements:

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

Testability requirements:

- Medical staff shall be able to use all the system functions after four hours of training.

How to specify NFR in requirement docuemnt?

- Non-functional requirements often conflict and interact with other functional or non-functional requirements.
- To aviod conflict, functional and non-functional requirements are stated separately
- But explicitly highlight requirements that are clearly related, such as performance or reliability.

Table : NFR Metrics

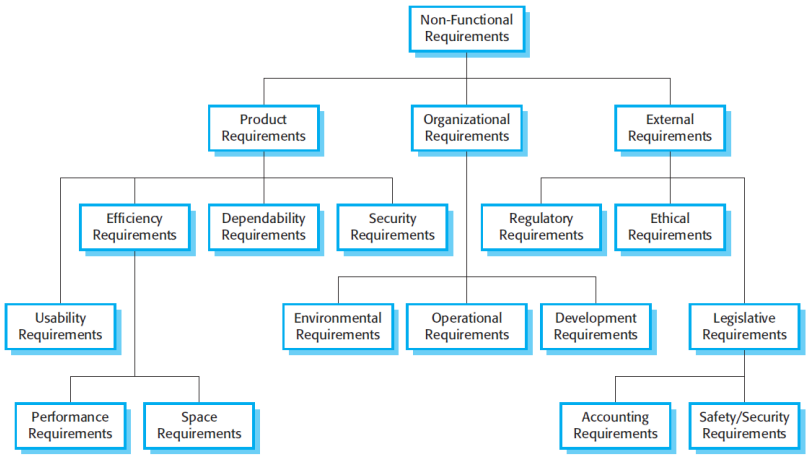
Property	Measure
Speed	Processed transactions/second User/event response time Screen refresh time
Size	Mbytes Number of ROM chips
Ease of use	Training time Number of help frames
Reliability	Mean time to failure Probability of unavailability Rate of failure occurrence Availability
Robustness	Time to restart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

Non-Functional Requirement(contd..)

Types of NFR

- **Product requirements:** Specify or constrain the behavior of the software. **Examples** : Memory, speed, failure rate, security requirements, and usability requirements.
- **Organizational requirements :** Policies and procedures in the customers and developers organization. **Examples:** operational process requirements, development process requirements, development environment, process standards

Fig. Types of NFR



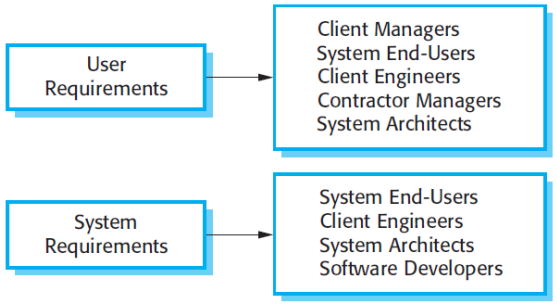
- **External requirements:** Factors external to the system and its development process. **Examples:** regulatory requirements for central bank; legislative requirements for law, and ethical requirements

User and System Requirement

User requirement

- High-level abstract requirements
- What services the system is expected to provide to system users and the constraints under which it must operate.
- For example, Security - Limiting access to authorized users

Diagram



System requirement

- Detailed description what the system should do
- Provide more specific information about the services, functions and operational constraints of the system that is to be implemented
- Example : Security - Need to include user authentication facilities in the system.

Software Requirements Document(SRD) or SRS

What does SRD / SRS contain ?

- Official statement of what the system developers should implement.
- User requirements for a system and a detailed specification of the system requirements.

Disadvantages of SRS?

- Requirements are unstable
- Requirements keep changing and more effort is required to change the document.
- System evolution

Advantages of SRS

- Essential to face legal issues
- Requirements are stable it is best
- Supporting document that defines the business and dependability requirements for the system
- Used by many stakeholders
- Compromise between communicating the requirements to customers
- Defining the requirements in precise detail for developers and testers
- Help system designers avoid restrictive design decisions
- Help system maintenance engineers who have to adapt the system to new requirements.

Software Requirements Document(SRD) or SRS(contd..)

Level of detail

- Depends on the type of system that is being developed and the development process used.
- Critical systems need to have detailed requirements because safety and security have to be analyzed in detail.
- An inhouse, iterative development process is used, the requirements document can be much less detailed and any ambiguities can be resolved during development of the system.

Standard

- IEEE standard for requirements documents (IEEE, 1998)
- A generic standard that can be adapted to specific uses.
- This information helps the maintainers of the system and allows designers to include support for future system features.

Specification

- Define the user requirements and high-level, non-functional system requirements.
- Designers and programmers use their judgment to decide how to meet the outline user requirements for the system.
- Long requirements documents should include table of contents and document index for easily use.

Software Requirement Specification (SRS)template

1. Introduction
   1. Purpose
   2. Document Conventions
   3. Intended Audience and Reading Suggestions
   4. Project Scope
   5. References
2. Overall Description
   1. Product Perspective
   2. Product Features
   3. User Classes and Characteristics
   4. Operating Environment
   5. Design and Implementation Constraints
   6. User Documentation
   7. Assumptions and Dependencies
3. System Features
   1. System Feature 1
   2. System Feature 2 (and so on)
4. External Interface Requirements
   1. 4.1 User Interfaces
   2. 4.2 Hardware Interfaces
   3. 4.3 Software Interfaces
   4. 4.4 Communications Interfaces
5. Other Nonfunctional Requirements
   1. Performance Requirements
   2. Safety Requirements
   3. Security Requirements
   4. Software Quality Attributes
6. Other Requirements
   1. Appendix A: Glossary
   2. Appendix B: Analysis Models
   3. Appendix C: Issues List

Summary

- Seven tasks of requirement engineering
- Difference between User and System requirement
- Differentiate between FR and NFR
- Write a few functional requirements in online exam software.
- Write a few Non-functional requirements in online exam software.
- Prepare a software document for online exam software - Use IEEE SRS template

Assessment

- Name the seven tasks of requirement engineering.
- Difference between FR and NFR.
- Write few functional requirements of IRCTC.
- Write few non-functional requirements of IRCTC.
- Who are the stakeholders responsible to propose FR & NFR ?
- Give an example of requirement conflict.
- Prepare SRS for online examination.
- List out few user and system requirements.

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