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The Importance of Requirement Engineering In the Production of High Quality of Software Development

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Abstract

The requirement engineering step of the software development life cycle is critical. The requirement engineering activity is a contract between the client and the developer. The collection of thorough and consistent requirements may motivate the quality of a software product and fulfil the expectations of the user. Requirement engineering is a sophisticated process that considers product requirements from a variety of perspectives, roles, and responsibilities. The systematic implementation of the requirement engineering process can have a positive impact on the quality of the software product. We emphasise the importance of requirement engineering and related activities in the production of high-quality software products in this research article.

Keywords: *Requirement Development, Requirement Classification, Requirement Analysis, Requirement Engineering, Requirement Validation and Requirement Management*

INTRODUCTION

Software engineering is a systematic, disciplined, and quantified technique to building software products in a timely, cost-effective, and high-quality manner. The requirement engineering phase is the most essential part of the software development life cycle. Requirement engineering is a systematic way to gathering needs from many sources and incorporating them into the development process. The most significant and

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complicated socio-technical transdisciplinary process of requirement collection as well as patterns of social interaction is requirement engineering. The statement of requirements is a contract between the users and the developers.

Traditionally, requirement engineering occurs during the initial step of the software development life cycle. The requirements engineering process has a significant influence on the software product. Errors introduced at this level will be carried through to subsequent phases of software development. As a result, in terms of cost and time, repair of faults at an early stage is easier than at a later stage of software development. As a result, requirement engineering is a critical element in reducing mistakes during the early stages of software development.

The requirement engineering process converts the stakeholder's incomplete, imprecise requirements into more full, precise, and formal specifications. Incomplete, inaccurate, and irrelevant requirements collecting may result in low quality software with considerable costs to developers in terms of wasted time, market loss due to malfunctioning and rejected systems, and customer dissatisfaction due to failure to satisfy their objectives.

In reality, however, consistent requirements in big and complicated systems are very hard to achieve across months or years of development. These learning systems rely heavily on process and technology management changes. As a result, requirement engineering is an incremental and iterative process that runs concurrently with the design and coding stages of the software development life cycle.

The purpose of this article is to discuss the function of requirement engineering and its significance in software development. The remainder of the paper is organised as follows. Section 2 summarises the associated work, with an emphasis on previous work on requirement engineering. Section 3 provides an overview spectrum and taxonomy of Requirement Engineering. Section 4 describes the many processes involved in the Requirement Engineering process. Finally, Section 5 concludes with future scope.

OTHER WORK

Over the years, notable thinkers and researchers have focused on the topic of requirement engineering in software engineering. These taxonomies of concepts may be beneficial in extended knowledge discussions in the areas of requirement

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analysis, elicitation, development, and management. The following researchers made significant contributions to the area of requirement engineering.

- According to Healen Sharp et al., the appropriate, timely, and successful collecting of requirements from key stakeholders is more critical than anything else in the requirement engineering process from several perspectives. The author presented a method for identifying the key stakeholders in a given system.

- Martin Gilnz et al wrote a paper on identifying stakeholders and their needs for the production of high-quality software products.

- Azlena Haron et al. outlined the role of actors and their roles, relationships, and interactions in practise while applying the requirement engineering process.

- Dhirendra Pandey and colleagues established an efficient requirement engineering process model for software development and management. The proposed implementation requirement engineering approach may encourage the development of high-quality software.

- Mina Attarha et al. emphasised complete awareness of the function and significance of the requirement engineering process.

- Saima Amber et al published a research article on risk determination in the requirement analysis process using a framework model. On the basis of risk identification approaches, these models are compared.

- Abhijit Chakraborthy et al presented a successful technique for requirement engineering by using a hospital automation system as an example.

- Dhirendra Pandy et al. outlined the basics and dimensions of the requirement engineering process and provided a notion on software requirement definition.

- Dhirendra Pandey and colleagues delivered a paper on requirement engineering and its impact on quality software development. The author presented various requirement engineering categories.

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- Dr. Rajinder Singh analysed critical procedures utilised in the requirement engineering role in software development using a realistic survey of Indian enterprises and assessed the outcomes for a better software product.

- Haron et al discussed the importance of people, processes, and technology in software project requirements. He did a study on the Malaysian IT industry and discovered that 79.7 percent of IT Managers are involved in the requirement engineering process as project leads and project managers.

- Swarnalatha. K.S. et al. emphasised and suggested the dynamic framework model for the requirement engineering process. Effective requirement engineering processes have a positive influence on the production of high-quality software products that can be quantifiably measured.

- The study was done on nine distinct software development organisations by Dr. Rajinder Singh. He demonstrated how the reengineering process is connected to the quality of software products.

- Deanna M. Needell's formal name is Deanna M. Needell. Jeff A. et al. presented a research report on software requirement formulation using an academic domain University Class Scheduler.

- Huma Hayat Khan et al explored the element creating risk throughout the requirement engineering process in the global software development paradigm. The task is beneficial to those with little experience working in global software development.

THE REQUIREMENT ENGINEERING OVERVIEW SPECTRUM AND TAXONOMY

In this part, we will first look at the overview spectrum and taxonomy of requirement engineering for quality product development.

Requirement engineering is a technique for learning what the client wants, assessing its needs, determining its feasibility, negotiating a viable solution, and transforming it into an operational system. It is the process of establishing the services and limitations (that is, the functional and non-functional needs) of the systems that must be created for the client.

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The nature of the new system's difficulties is very difficult to comprehend. The software developer must comprehend the issue, which is often quite complicated. Once the software contract is finalised, the developer should produce a more detailed system specification for the client/user.

The influence of definition will be felt by all system stakeholders. "In an organisation, a stakeholder is any person or group who may be influenced by system specification." End-users, managers and others participating in organisational processes, system engineers for system development, customers, suppliers of the organisation, external stakeholders such as regulators, domain experts, and volunteer groups, and so on are examples of stakeholder types.

The developer collects needs from the system's numerous points of view. Some of the issues that develop throughout the requirement engineering process are the consequence of a failure to clearly separate these multiple levels of description.

The developer transforms the high-level abstraction of requirements into more precise descriptions that are easier to grasp. The thorough description connects the requirements engineering and design phases of the software development life cycle. Figure 1 depicts the transformation of user needs into system requirements and its categorization.

Specifications for users

The needs that are directly given by the client are referred to as "user requirements" at a higher level of abstraction. The user requirements are statements articulated in normal language, together with diagrams, that describe what services the system is expected to offer and under what limitations they must work. These criteria define the system's exterior behaviour. The implementation model should not be expressed in the user requirements.

The functional and nonfunctional needs are described in the user requirements. As a result, system users who lack comprehensive technical understanding may grasp them. The following are some of the issues encountered while gathering user needs.

a. **Lack of Clarity:** The customer lacks comprehensive technical expertise and is unable to explain the problem with simple and straightforward language. The text is lengthy and difficult to read.

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b. **Requirement Confusion:** The system objectives and design information may not be properly differentiated between functional and nonfunctional requirements.

c. **Requirement amalgamation:** Different kinds of requirements might be combined into a single mixed requirement.

In the requirement document, it is best practise to turn the user needs into more precise system requirements.

System prerequisites

The system requirements define the specific system services and restrictions. The system requirements document specifies these needs. It might function as a contract between the system buyer and the software developer.

The paper is aimed at senior technical professionals and project management, and it will be utilised by both client and contractor personnel. The system requirements are categorised as follows, as seen in figure.1.

a. Functional Prerequisites b. Requirements that aren't functional d. Domain Prerequisites

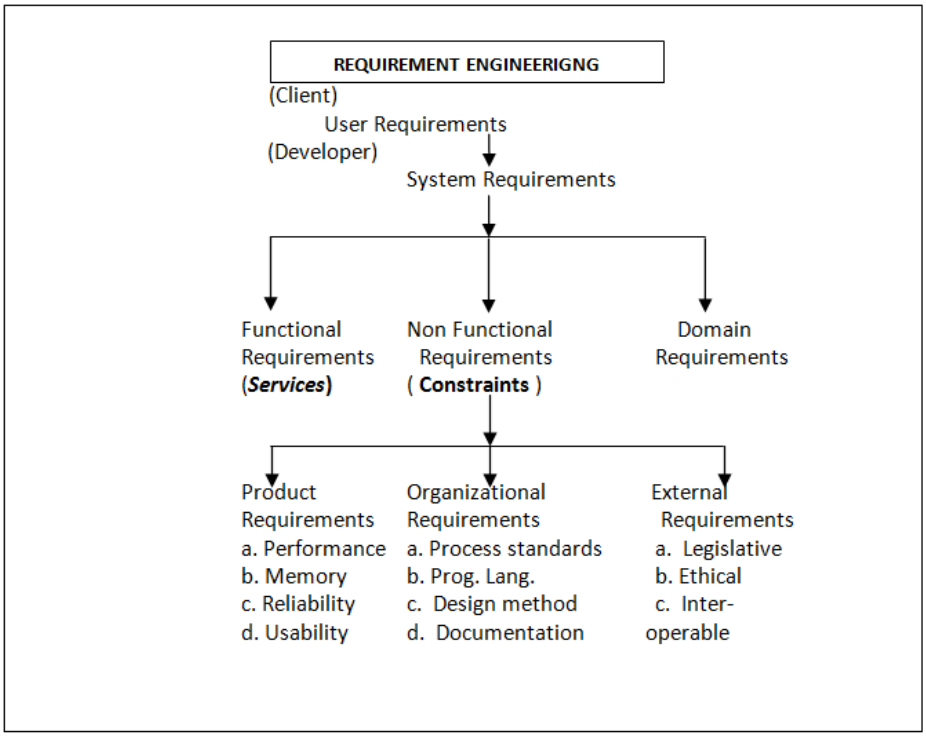


Fig. 1 Representation of Requirement Engineering

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Functional Requirements

The functional requirements are declarations of the functions or services that the system should deliver, as well as how the system should respond to certain inputs and behave in certain scenarios. The functional requirements may also specify precisely what the system should not accomplish.

- These specifications adequately represented input, output, and exceptions.
- Provide information on the system's specialised facilities.
- These are clearly shown in the system requirements paper
- Insertion of new requirements may delay the system delivery and increases the cost.
- The functional requirements should be both complete and consistent.
- Achieving requirements with completeness and consistency in large and complex systems practically impossible.
- Failure to meet the functional requirements may degrade the system

Non-functional Requirements

Non-functional requirements are limitations placed on the system's services or functionalities. The non-functional criteria are related to the system as whole as well as particular system characteristics.

- These are limitations, although they are unrelated to non-functional needs.
- The system provides certain functionalities
- These non-functional needs, such as temporal limitations, are emergent system features.
- Constraints in the development process, standards, and storage occupancy For instance, consider reaction time.
- Efficiency, dependability, transportability, interoperability, adoptability, and so on
- These criteria may determine the capability of I/O storage devices on the system.
- And user interface data representations
- Failure to fulfil the non-functional r criteria may render the whole system inoperable.

Non-functional requirements are divided into three categories: a. product requirements, b. organisational requirements, and c. external requirements.

Product Specifications

Product requirements describe product characteristics such as memory,

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performance, dependability, portability, and usability.

Organizational Prerequisites

These requirements are obtained from company rules, procedures, and standards such as process standards, programming language implementation, design methodology, product documentation, and delivery.

External Requirements

Interoperability, statutory requirements, and ethical standards are examples of external elements that impact the system and its development process.

Domain Prerequisites

These are the system's application domain requirements, which represent the behaviour of that domain. They might be both functional and non-functional needs. If the domain criteria are not met, it may be difficult to operate the system properly.

VARIOUS ACTIVITIES IN THE REQUIREMENT ENGINEERING PROCESS

The goal of requirement engineering is to uncover and collect quality needs from clients so that they may be built and implemented in operational systems. The requirement engineering process consists of many actions to produce and manage the system requirement document, as indicated in the picture 2 below

- Feasibility Analysis
- Gathering and Analyzing Requirements
- Documentation & Requirement Specification
- Validation and verification of requirements

Feasibility Analysis

The feasibility study is the first step in the requirement engineering process. An brief description of the system and how it is utilised in the company is provided as input to the feasibility study. The feasibility study focused on many components of the development system of the following, such as behavioural, technological, economic, and legal factors.

- The system may be developed utilising current technologies and within budget and schedule constraints.
- Can the new system achieve the organization's overall goals or is it exacerbating the problems of the previous one
- Is it possible to integrate the new system with existing systems that are currently in place?

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- Is the system to be designed in accordance with legal, ethical, and legislative standards and procedures?

The feasibility study's findings reveal whether or not the system being developed is worthwhile. Finally, the requirement engineering team may confirm "what the system must support and what it must not support." The requirement engineering team will proceed with the development process based on the feasibility analysis.

Elicitation and Analysis of Requirements

The requirement engineer primarily examines and collects desirable system requirements and goals from various stakeholder perspectives. The following process activities are carried out in the elicitation and analysis in an iterative way with continuous feedback activity.

a. Domain comprehension: Understand the issue and its definition.
b. Requirement Gathering: Gathering requirements from possible stakeholders sources.
c. Classification: Requirements of similar kinds are grouped into cohesive groups.
d. Prioritization: The requirement engineer prioritises requirements based on their importance.
e. Requirement Checking: Collect complete requirements in a more consistent manner.

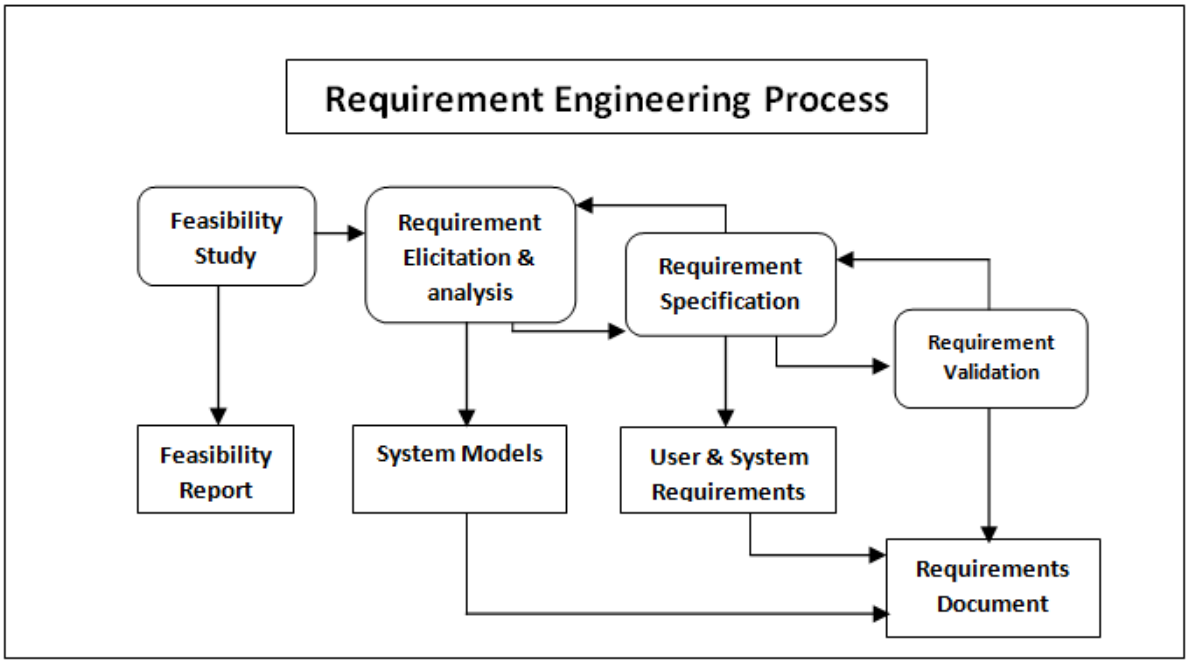


Fig.2. Requirement Engineering Process Activities

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The approaches listed below may be used to elicit requirements.

Traditional Techniques: Data collection utilising traditional methods such as questionnaires, surveys, and Interviews, surveys, domain analysis, and task analysis are some of the methods used.

Cognitive Methods: The requirement engineer gathers and prioritises needs depending on their importance. Repository grids, sorting, laddering, and protocol analysis are some of the cognitive approaches.

Group elicitation methods: This approach includes gathering requirements from a team or group of individuals via activities like as group work, brain storming, video conferencing, and so on.

When the requirements are unclear, the prototype methodology that is utilised for elicitation proposes getting rapid feedback from the functioning system of the stakeholder.

Contextual methods: Contextual approaches are an alternative to conventional and cognitive methods that include ethnography, observations, social analysis, and conversation analysis.

Elicitation and Analysis Issues:

- Stakeholders are unaware of what they desire from the growing system. They are tough to communicate requirements, and occasionally they demand unreasonable needs that are cost effective.
- Stakeholders may convey their needs in their own natural language, relying on implicit knowledge. The requirements engineer must comprehend the specifications.
- Political forces may impact the system's special needs in order to boost their influence and image.
- Stakeholders may convey their desires in a variety of ways. The requirement engineer will be able to identify probable sources, commonalities, and conflicts.

Documentation & Requirement Specification

After identifying full and consistent requirements, the Software Requirement document is created. The software requirement specification is a thorough description of the behaviour of the programme that will be produced. The software requirement definition shortens the time and effort necessary by developers to accomplish desired results while also lowering development costs. In

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terms of cost and time, fixing flaws in the requirement document is easier than later phases of development. The effective SRS specifies how the application will interact with system hardware, other applications, and users in a broad range of real-world scenarios.

Entity Relationship Diagrams, Data Flow Diagrams, Activity Diagrams, State Transition Diagrams, and Use-Case Diagrams are used in requirement specification to describe needs at varying degrees of complexity. The requirement document describes the system's functional and nonfunctional needs.

Validation and verification of requirements

The validation of requirements increases the quality of the requirement engineering process. When the whole set of requirements is stated in SRS, all stakeholders must agree on its nature. The ability of a requirement engineer to establish the system requirements against the raw requirements is referred to as "Requirement Validation," and the ability to check the validity of System requirement documentation is referred to as "Verification." The process of ensuring that requirements are explicit, full, compatible, and tested for the subsequent development process."

Management of Requirements

Changes in large-scale systems are unavoidable as processes and technology evolve. The practise of managing changes to requirements is known as requirement management.

The procedure is carried out in tandem with other activities in the software development process. Requirement management operations include keeping the development plan updated with new needs and monitoring and tracing the progress of requirements. A change in requirements may have a significant influence on the development process, making it difficult to predict the cost and re-development effort. The software requirement management solutions can handle the stable and unstable requirements changes, as well as the vast number of data gathered throughout this process.

CONCLUSION AND FUTURE RESEARCH

The requirement engineering process has several inherent difficulties. The different aspects that contribute to the requirement engineering process based on requirement

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engineer expertise and stakeholder commitment. Because it is almost impossible to complete a flawless SRS, an SRS is deemed excellent if it includes as many quality attributes as feasible. In software development, the requirement engineering process demands special attention. The degree to which a software system requires the goal for which it was designed defines its quality. Finally, it is found that the vast majority of software developers feel that a thorough requirement engineering process results in high-quality software solutions. The requirement engineering process and software quality have a significant beneficial connection.

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