Role of Requirement Engineering in Enhancing Software Quality and Reliability

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ABSTRACT

Requirement Engineering is the crucial phase of software development life cycle. The activity of requirement engineering is contract between the client and developer. The gathering of complete and consistent requirements can motive the quality of software product and can satisfy the user's needs. The requirement engineering is a complex exercise that consider the product requirement demands from the number of viewpoints , roles and responsibilities. The successful systematic implementation of requirement engineering process can have good impact on the quality of software product.. In this research paper, we highlights the role of requirement engineering and its activities in the development of quality software product.

KEYWORDS: Requirement Engineering, Requirement Classification, Requirement Analysis, Requirement Elicitation, Requirement Development, Requirement Management.

INTRODUCTION

The software engineering is systematic, disciplined and quantifiable approach for developing the software products within the stipulated time, affordable cost and with more quality. The Requirement engineering is the most important phase of software development life cycle of the software engineering. The requirement engineering is a systematic approach which collects the requirements from the different sources and implements into the development process. The requirement engineering is most critical and complex socio-technical multidisciplinary process of requirement gathering as well as patterns of social interaction. The requirement specifications are a contract between the users and the developers.

Traditionally, The requirement engineering is performed in the first phase of the software development life cycle[1]. The requirement engineering have dominant impact on the software product. The errors incorporated at this stage will be continued to later stages of software development. So that, rectification of errors at early stage more easy than the later stages of software development in terms of cost and time. Therefore requirement engineering crucial phase and reduce the errors at the early stage of the software development

The requirement engineering transforms the incomplete, imprecise needs wise of the stakeholder into more complete, precise and formal specifications. The incomplete, imprecise, irrelevant requirements gathering can develop the poor quality software with significant costs to developers in terms of wastage of efforts, lose of market place with faulty and rejected systems and unsatisfaction from the customers which fails to meet their goals.

However, in the large and complex systems consistent requirements practically impossible throughout the months or years of development in practice. These type of learning systems mostly depends on change of process and technology management. Therefore, the activity of requirement engineering is an incremental and iterative process held in parallel with other design, coding phases of software development life cycle.

This paper presents the role of Requirement engineering and its importance in the software development. The organization of the rest of the paper is as follows. The Section 2 describes the related work focusing on prior work on requirement engineering The section 3 states the overview spectrum & taxonomy of Requirement Engineering. The section 4 presents various activities of Requirement Engineering process. Finally conclude with future scope in the Section 5.

RELATED WORK

Over the years eminent theorists and researchers have worked on software engineering on the domain of requirement engineering. These concept taxonomy can be useful in extensive knowledge discussion in the area of requirement analysis, elicitation, development and management. The good number of researchers provided key research contributions in the field requirement engineering is as follows.

- Healen Sharp, et l [2], discussed in his research publication that, the adequate, timely and effective collection of requirements from relevant stakeholders is more important than any thing else in the requirement engineering process from different viewpoints. The author proposed an approach for identifying the relevant stakeholders for a particular system.

- Martin Gilnz, et al [3], published on identification of stakeholders and their requirements for the development of quality software product.

- Azlena Haron, et al, described the role of actors and their roles, relationship in practice while implementing the requirement engineering process[4].

- Dhirendra Pandey, et al [5], proposed the effective requirement engineering process model for software development and management. The propose implementation requirement engineering process can motivate the quality software.

- Mina Attarha. et al [6], highlighted comprehensive knowledge on role and importance of the requirement engineering process.

- Saima Amber, et al [7], presented reaserch paper on determination of risks in the requirement analysis process with framework model. These models are compared on the basis of risk identification methodologies.

- Abhijit Chakraborthy et al [8], demonstrated an effective method on requirement engineering taking different viewpoints with example of hospital automation system.

- Dhirendra Pandy, et al, described the basic fundamentals and dimensions of requirement engineering process and provide the idea on software requirement specification [9].

- Dhirendra Pandey, et al [10], presented the paper on requirement engineering and its influence on quality software development. The author proposed the several classifications for requirement engineering.

- Dr. Rajinder Singh [11] reviewed crucial processes used in requirement engineering role is the software development with practical survey conducted on Indian companies and evaluated results for better software product.

- A. Haron, et al [12] described the role of people, process and technology during software project requirement . He conducted survey on IT Industry of Malaysia and find out 79.7% of IT Managers are in the requirement engineering process performing the roles of Project leaders and project managers.

- Swarnalatha. K.S, et al [13] highlighted and proposed the dynamic framework model for requirement engineering process. The effective requirement engineering process have good impact on the development of quality software product which can be quantitatively measurable.

- Dr. Rajinder Singh [14]. conducted the survey on nine different software development companies. He analyzed with evidence how the reengineering process co-related with quality of software product

- Deanna M. Needell Jeff A. et al, presented the research paper on software requirement specification with a University Class Scheduler of academic domain.

- Huma Hayat Khan, et al [15], discussed the factor generating the risk in the mean time of requirement engineering process in paradigm of Global software development. The work is useful for the people with less experience working in the global software development.

THE OVERVIEW SPECTRUM AND TAXONOMY OF REQUIREMENT ENGINEERING

In this section, we would first look the overview spectrum and taxonomy of requirement engineering for development of quality products.

Requirement engineering is mechanism for understanding the customer wants, analyzing its need, accessing the its feasibility, negotiating of suitable solution and transformed into operational system. It is the process of determining the services and constraints (i.e. the functional and non-functional requirements) of the systems that need to be designed for the client [16].

The nature of the problems of the new system is very difficult to understand. The software engineer has to understand the problem is often immensely complex. Once the software contract has completed, the developer should write the system definition for the client/user in more detail.. The impact of definition will be on the every stakeholder of the system. " A stakeholder in an organization is any individual or group who can affect by system definition". The stakeholder categories include, end-users, manger and involved with organizational process, system engineers for system development, customers, vendors of organization, external stakeholders such as regulators, domain experts and voluntary organizations etc.

The developer gathers the requirements from the various viewpoints of the system. Some of the problems that, arise during the requirement engineering process are a result of failing to make a clear separation between these different level of description. The developer converts the high level abstraction of requirements into detailed description which are more understandable The detailed description is a bridge between requirement engineering and design phase of the software development life cycle. The conversation of user requirements into system requirements and its classification described in the Figure1.

User requirements

The requirements are directly delivered by client are in higher level abstraction called as "user requirements". The user requirements are the statements which expressed in a natural language plus diagrams, what the services of the system is expected to provide under which constraints that must operate. These requirements specify the external behavior of the system. The user requirements should not express the implementation model.

The user requirements describe the functional and nonfunctional requirements. So, that are understandable by the system users who don't have detailed technical knowledge. There are various problems in getting the user requirements is as follows.

a. Lack of Clarity : The client doesn't have detailed technical knowledge, unable to articulate the problem with more clarity in concise and unambiguous. The document is verbose and difficult to read.

b. Requirement Confusion: The functional and Non functional requirements system goals and design information may not clearly distinguished.

c. Requirement amalgamation : The different types of requirements may be expressed into single requirement as mixed.

The good practice is to convert the user requirements into more detailed system in the requirement document.

System requirements

The system requirements are detailed system services and constraints. These requirements are specified in the system requirements document. It may serve as a contract between the system buyer and software developer. The document targeted as senior technical staff and project management, again it will be used by staff from the client and the contractor. The system requirements are classified as following and shown in figure .1.

a. Functional Requirements b. Non-functional Requirements c. Domain Requirements

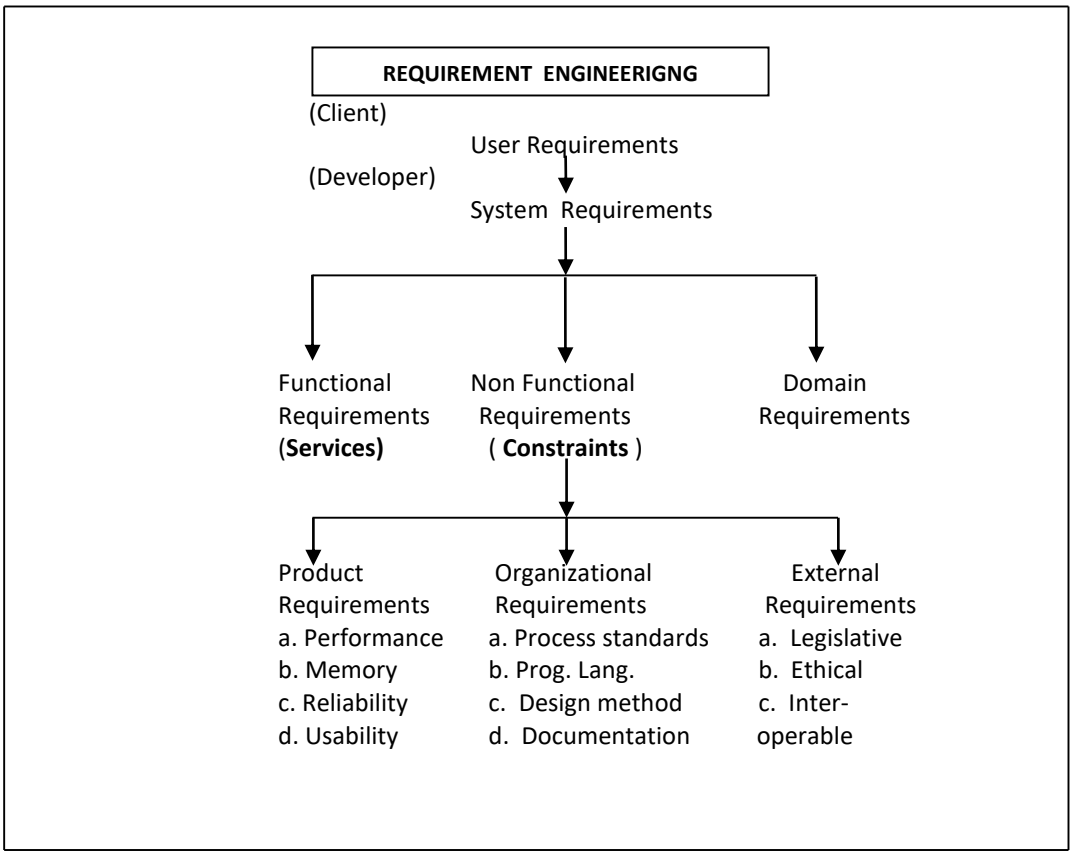

Fig. 1. Representation of Requirement Engineering.

Functional Requirements

The functional requirements are the statements of functions or services the system should provide, how the system should react with particulars into inputs and behave with certain situations. Sometimes the functional requirements may also explicitly express what the system should not do.

- These requirements fairly expressed input, output and exceptions.
- Provide the information about specific facilities of the system
- These are illustrated unambiguously in system requirement document.
- 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

The non-functional requirements are constraints defined on the services or functions of system. The non-functional requirements relate to the system as whole and individual features of the system.

- These are constraints, but non-functional requirements are not directly concerned with specific functions delivered by the system.
- These non-functional requirements are emergent system properties such as timing constraints, development process constraints , standards and storage occupancy. Example : response time,

efficiency, reliability, transportability, interoperability, adoptability and efficiency, etc

- These requirements may define on the system such as the capabilities of I/O storage devices and data representations of the user interface.

- Failure to meet the non-functional r requirements may make the entire system is useless

The non functional requirements are categorized into a. product requirement b. Organizational requirements c. External requirements.

Product Requirements
The product requirements represents the product behavior such as memory, performance , reliability , portability and usability.

Organizational Requirements
These requirements represents derived from organizational policies, procedures and standards such as process standards, implementation of programming language, design methodologies, product documentation and delivery.

External Requirements
These requirements are external factors which influence the system and its development process such as interoperability, legislative requirements and ethical requirements.

Domain Requirements
These are the requirements of the application domain of the system which reflects the behavior of that domain. They may be functional or non-functional requirements. The domain requirements are not satisfied, it may be practically impossible to use the system satisfactorily

THE VARIOUS ACTIVITIES OF REQUIREMENT ENGINEERING PROCESS

The objective of the requirement engineering is to discover and gather the quality requirements from the client that can be designed and implemented in operational system. The requirement engineering process consists of various activities to create and maintain the system requirement document as the following and shown in figure.2.

- Feasibility Study
- Requirement Elicitation & Analysis
- Requirement Specification & Documentation
- Requirement Validation and Verification

Feasibility Study
The requirement engineering starts with feasibility study. The input to the Feasibility study is an outline description of the system and how it is used in the organization. The feasibility study focused on various areas like behavioral, technical, economical and legal aspects of the development system of the following.

- It is possible to develop the system using existing technology and within the cost and time Constraints.
- Does the new system can fulfill overall objectives of the organization or elevating the problems of old one.
- Can the new system be integrated with other systems which are already in the place.
- Is the system to be developed with legal, ethical, legislative standards and procedures.

The outcome of the feasibility study indicates whether or not it is worthy system which is going to develop. Finally the requirement engineering team can verify " What must be supported bye the system and what need not be supported". Based on the feasibility study, the requirement engineering team will go for the further development process

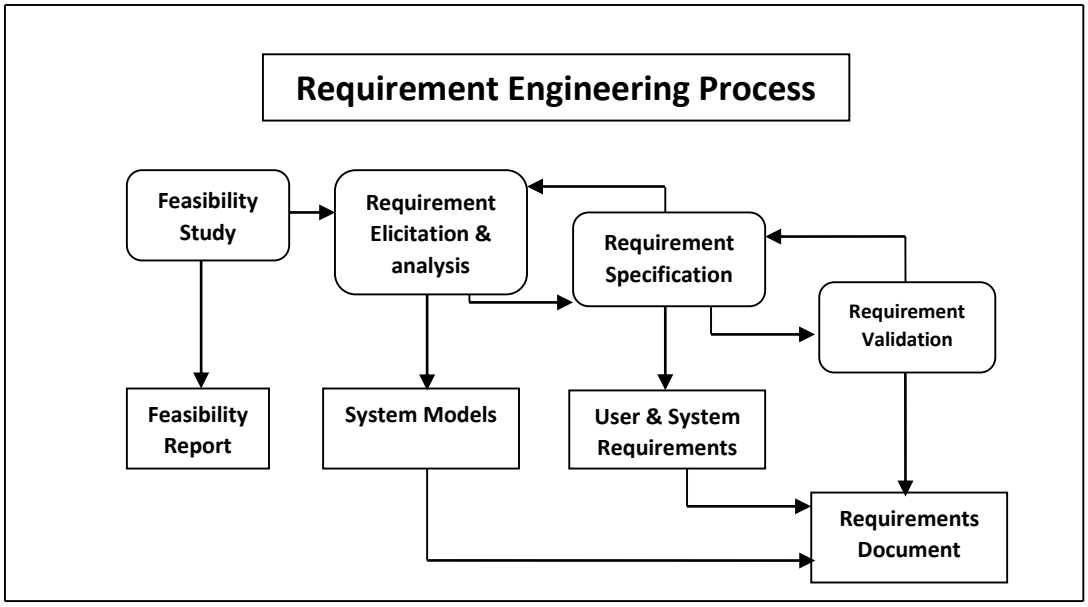

Fig.2. Requirement Engineering Process Activities

Requirement Elicitation & Analysis

The requirement engineer mainly focuses on examining, gathering desired requirements and objectives for the system from different stakeholder viewpoints. The various following process activities performed in the elicitation & analysis in iterative manner with continual feed back activity.

a. Domain understanding: Understanding problem and its definition.
b Requirement Collection: Collection of stakeholders requirements from potential sources.
c. Classification : Similar types of requirements are group into coherent clusters.
d. Prioritization : The requirement engineer prioritize requirements based on necessity.
e. Requirement Checking : Collect the complete requirements more consistent.

The elicitation of requirements can be done using the following methods.[17].

Traditional Methods : The gathering of data using the traditional methods such as questionnaires, surveys, interviews, surveys, domain analysis and task analysis.
Cognitive Methods : The requirement engineer collects and prioritize requirements based on necessity. The various cognitive methods are Repository grids, sorting, laddering and analysis of protocol.
Group elicitation methods: This method involves requirement collects from the team or group of people like group works, brain storming, video conferencing etc.
Prototyping methods: The prototyping technique which is used for elicitation propose taking the instant feedback from the working system of stakeholder, when the requirements are not clear.
Contextual methods: The contextual methods are alternative to the traditional and cognitive methods which involves with ethnography, observations, social analysis and conversation analysis.

Problems in Elicitation & Analysis :

- Stakeholders don't know that they actually wants from the developing system. They difficult to articulate requirement sometimes they requires unrealistic demands which cost effective.
- Sometimes stakeholders express their requirements in their own natural language with implicit knowledge. The requirement engineer must understand the requirements.
- The political factors can influence the specific requirements of the system to increase their influence and image.

- Different stakeholder can express their demands in different ways. The requirement engineer can identify the potential sources, commonalties and conflicts.

Requirement Specification & Documentation
The Software Requirement document is produced after identification of complete and consistent requirements. The software requirement specification is an effective comprehensive description of behavior of the software to be developed. The software requirement specification reduces the time and effort required by developers to achieve desired goals and also minimizes the development cost. Fixing of errors are more easy in the requirement document compare to later stages of development in terms of cost and time. The effective SRS defines how application will interact with system hardware , other programs and users in a wide variety of real-world situations.

The requirement documentation represents various notations such as Entity Relationship Diagrams, Data Flow Diagrams, Activity diagrams, State Transition Diagrams and Use-Case diagrams are used to express the requirements at different levels in detail. The requirement document represents the functional and nonfunctional requirements of the system.

Requirement Validation & Verification
The requirement validation improves the quality of the requirement engineering process. When the entire requirements are described in SRS, then all the stakeholders have to satisfy on its nature. Requirement engineer can ascertain the systems requirements against the raw requirements are called as "Requirement Validation" and verifying the correctness of System requirement documentation called as "Verification". The process of conformation of requirements in terms of unambiguous, complete, compatible and also testable for the further development process".

Requirement Management
In the large scale systems changes are inevitable with change of process and technology. Requirement management is the process of managing the changes to requirements.
The process is performed in parallel with other activities in the software development. The activities of requirement management keeping the development plan enhanced with new requirements, tracking and tracing the status of requirements. A requirement change can have huge impact on the development process, which is very hard to estimate the cost and re-development work. The software requirement management tools can manage the stable, and unstable requirements change and large volume of data which are also collected during the this process.

CONCLUSIONS AND FUTURE RESEARCH

There many inherent complexities tin the requirement engineering process The various factors that contribute to the requirement engineering process based on the knowledge of requirement engineer and commitment of stakeholder. Practically finalizing perfect SRS is impossible, therefore an SRS is considered as good which contains many quality attribute as possible. The requirement engineering process deserves a strong attention in software development. The quality of the software system is the degree to which it needs the purpose for which it was intended Finally, it is concluded that practically the most of the software developer believe that the proper requirement engineering process produce the quality software products. There is a strong positive relationship between requirement engineering process and software quality.

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