Revisiting Requirement Engineering Techniques: Managerial Perspective

Shreta Sharma, Santosh K. Pandey

***Abstract*: *In Requirement Engineering, Requirements Management (RM) is one of the significant phases that can control the success of a software project. It manages deal between dependencies and requirements, modifications to the approved requirements and connection between other documents as well as the requirements document formed during the process of requirement engineering. In the world of software development, it is estimated that changes to requirements and poor requirement management are one of the major causes for project overrun and quality issues in software development. The practice of requirements management methodologies, with the support of traceability and quantification, is renowned as a substantial ability in the software maintenance and development process, and as an essential aspect for the quality of the final software product. The present study is accompanied by an acute assessment of the current methods for managing and resolving software requirements. It also highlights the management concerns that arise in the said process* . Result analysis rveal that there are still numerous issues, which require immediate attention of research community in order to develop a quality software.**

Keywords*: *Software Engineering, Requirements Engineering (RE), Requirements Management (RM), Requirements Management Techniques, Challenges in Requirements Management.

I. INTRODUCTION

Software products have significantly reformed the aspects of our daily life and work. Software development has now developed one of the leading industries in the world [1] [2]. Software engineering as a discipline appeared in the late 1960s and became gradually essential during the previous 40 years. The main aim of software engineering is to fetch complete engineering disciplines to the development of software products to improve their quality. Software engineering is the procedure of engineering that applies a disciplined, systematic, quantifiable approach to produce, develop, operate and maintain consistently correct, cost-effective, high-quality solutions to software complications." It is expected that 56 percent of revealed errors in software projects are mostly arising from poor management and lack of clear understanding of the customers' requirements of the project [1]. The discipline of RE emphases on these types of errors and various activities related to requirements, from the beginning of the SDLC [2].

Requirements engineering (RE) is a process with objective to gather, document, validate and maintain a complete requirement [2] [3]. The procedure of the engineering denotes that repeatable and organised methods should be used to certify that the requirements are reliable, significant and complete [4][5].Requirements Engineering (RE) is associated with the process of eliciting requirements and merging them into a complete, approved requirements documented and stated in such a way that can aid as the source for all other development activities [6].

Requirements Management is a novel term, which has improved in status in later years, and the area's comparatively enormous form of literature has made it gradually easy to collect significant information [7]. It is performed throughout RE process and includes all activities such as version control, changes control and requirements tracing [8]. The essential task of requirements management is assuring the traceability of the requirements both onwards and backwards and from the initial requirements gathering activities through to system development and maintenance. Requirements management is consequently no longer just a "nice thing to have" for development projects, but somewhat a complete necessity [9] [10].

This paper is intended to revisit and restructure techniques and process of requirements management by emphasizing their key aspects along with the associated challenges. The major aim of this paper is to focus on the challenges of the management phase. This paper is structured in four sections. This section, being an introduction, offers a brief outline of requirements management and the stages of the RM process have been reviewed in section II; Section III – various management techniques used for requirements phase and their challenges. Result analysis and discussion has been presented in section IV and finally, conclusions and future research are given in section V.

REQUIREMENTS MANAGEMENT PROCESS

The key role of the requirements management process is to supervise the development procedure to confirm the quality of product delivered to the customer in a timely and cost effective manner. Entire process can be divided into six phases, which are shown in Fig. 1. and the details are given as follows:

- Assembling requirements: This activity includes hierarchy of user' requirements, dividing requirements, prioritizing requirements, assigning requirements attributes and develop/update the software development plan (cost, schedule [11].

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- Establishing requirement baselines: Major role of this activity is to specify the requirements documented in previous activities, discussion with stakeholders and then forming the standard of the primary requirements of a project [12].
- Supporting project planning: This activity covers human resource management, acquisition and scope management, quality management, risk management, communication management, cost and time management etc [13].
- Monitoring and supervising requirements: This phase supports to monitor the requirements status in a different point of view, control changing requirements due to various reasons, tracing requirements, etc [14].
- Assuring quality of requirements: This helps in quality assessment concerning the requirements management, from inception to current state and complete requirements specification to explain these requirements [15].
- Concluding the requirement management procedure: After recording the implementation result of a requirement management process, procedure of implementation of requirement management will be close. This activity must be performed with the deliberation of situations and surroundings for organizations [16].

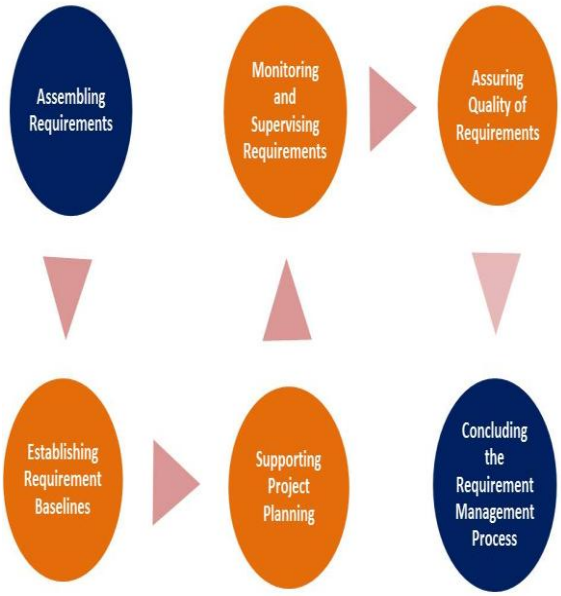

Fig:1.(Requirement Management Process)

II. REQUIREMENTS MANAGEMENT TECHNIQUES AND CHALLENGES

Requirements management entails conversation between the stakeholders and project team members and amendment to requirements changes during the development of the project. However, there are still certain challenges in management phase with reference to its techniques.

A.Requirements Identification Techniques

Basic task of requirements identification techniques is to distinguish every requirement so that they can be simply maintained individually. This distinctiveness can be achieved with the help of requirements attributes and with unique identification number. Dynamic renumbering, database record identification and symbolic identification are the types of this method. Major issues identified by RE practitioners are given as under:

- RiI1: Numbers can be clearly allocated only when the document is complete [17].
- RiI2: Allocating section/chapter numbers is an implied arrangement of the requirement [18].
- RiI3: It is a tedious and time consuming process [19].
- RiI4: The requirement engineer may lack domain knowledge and be inexperienced [20].

B.Requirements Traceability

Traceability states to the facility to define and track the existence of a requirements. Requirements traceability is capable to define the life cycle of a requirement from its roots over its improvement and description to its following distribution and use and through all stages of ongoing improvement and repetition in any of these stages [21]. Major issues in requirement traceability are given as under:

- TI1: One of the major issues is the cost of development faced by the requirement traceability [21].
- TI2: It becomes time consuming and tedious as the scale and complexity of software increases [22].
- TI3: Organizational issues similarly provide a substantial task to the execution of traceability. Various organizations take traceability as a directive from sponsors or a method for normal submission. Generally, these organizations do not have assurance to complete traceability practices [23].
- TI4: Maintaining traceability is also a major issue [23].
- TI5: Lack of training and knowledge of traceability methods is also a key concern [24][25].

C.Requirements Base-lining

Requirement baselines are the foremost notions in the theme of requirements management. These are the groups of requirements agreed upon at the initiation of the project. Baselines are mostly useful during requirements management to check for additions, modification/deletion [26]. Major issues in requirements baseline are given as follows:

- BI1: This process is time- consuming [27].
- BI2: It requires resources in order to fulfil the required steps [28].
- BI3: It may be tough to manage changes because real requirements may exceed [28].

D.Version Control Tool

Version control is a vital method to achieve requirements. It supports developer to finish the changes to the source code. Additionally, it emphasizes on every modification to the code in a distinct database [29].

It provides access to previous versions of the project and allows several people to work on a particular project at the same time. However, it has some issues as well, which are given as follows:

- VCI1: Sometimes, manual involvement is essential to resolve the clashes as version control system cannot impulsively choose ‘which of the two edits to use’ [28].

- VCI2: The service of file locking does not authorize the developers to work on the similar portion of code at the same time [28].
- VCI3: Distributed version control allows copying the repository that could be the reason of source code leakage [28][9].
- VCI4: If the central server goes down, the developers can't save version changes [28].
- VCI5: Several forms of certain documents are being used the multiple teams, making it hard to confirm data consistency. Therefore, it is not likely to have version control on specific requirements [29].

E. Change Management Methodology

Changes are inevitable in any developments. This method is concerned with the developments, principles and procedures, which are used to achieve changes to the system requirements [30]. The method supports pre-arranged and unexpected changes. However, it has some issues as well, which are given as under:

- CMI1: One of the major issues in this method is a well-defined bond between software artefacts and requirement change management [30].
- CMI2: Another issue is lack of communication about the changes [31].
- CMI3: Dependency on human role is one of the critical challenges in modern change management, which does not guarantee the reproducibility of the outcome of a transformation [32].
- CMI4: Reusability has a foremost concern in requirements change management [32].
- CMI5: There is a lack of ability to process incomplete or contradictory information [30].

F. Document Analysis and Generation Methodology

The methodology helps to create a requirements document and database. The tool produces internal and official documents. The document generator is capable to comprise meta data like the ownership in the generated document or change history along with the requirements data [34]. Major challenges identified under this technique are given as follows:

- DAI1: Readers may lack abilities to access the requirements database [34].
- DAI2: The connection among the requirements document and the database may not be maintained successfully [35].
- DAI3: Another problem may be duplication of requirements between different documents [35].
- DAI4: The lack of automatic navigation from one requirement to another requirement is another important challenge [35].

III. RESULT ANALYSIS AND DISSCUSSION

Software requirements must be described to develop high quality software. Requirements increase the understanding of the proposed system. Faults in the requirements can impact all the successive phases of software development. The purpose of this research is to identify the possible challenges faced by developers during requirements management process and to represent the same in pictographic approach for clarity. One of the main challenges for scholars remains the development of methods to minimize the changes in requirements. This can only be achieved by managing requirements properly and making the approaches/methodologies more effective. Various requirements management techniques with their associated challenges have been discussed in the previous section. Below some of the potential requirements management challenges, which may be regarded as potential research areas under management techniques have been listed in Table I. These are not completely resolved and deserve appropriate attention in the coming years.

Table-I: Potential research areas under management techniques

	Techniques	Challenges
Requirements Managament	Requirements Identification Techniques	• Explicit allocation • Implied arrangement • Time-consuming • Lack of domain knowledge
	Requirements Traceability	• Cost • Time-consuming • Execution of traceability • Maintaining traceability • Lack of training
	Requirements Baselining	• Time-consuming • Difficult to manage • Resources
	Version Control Tool	• Manual involvement • File locking • Code leakage • Server failure • Disk damage • Data consistency
	Change Management Methodology	• Strong connection • Lack of communication • Reproduction • Reusability • Incomplete Information

	Document Analysis and Generation Analysis	• Lack of skills • Linking • Duplicate requirements • Transparency • Automatic Navigation

After identifying the current challenges in related management techniques, it has become urge to work towards the improvement and formulation of existing techniques. Additionally, critical analysis of the overall study indicates that quality of requirements needs to be improved and existing methodologies require novel /automatic approach, which can minimize the human intervention in management process up to some extent. All the possible future challenges are given in fig.2.

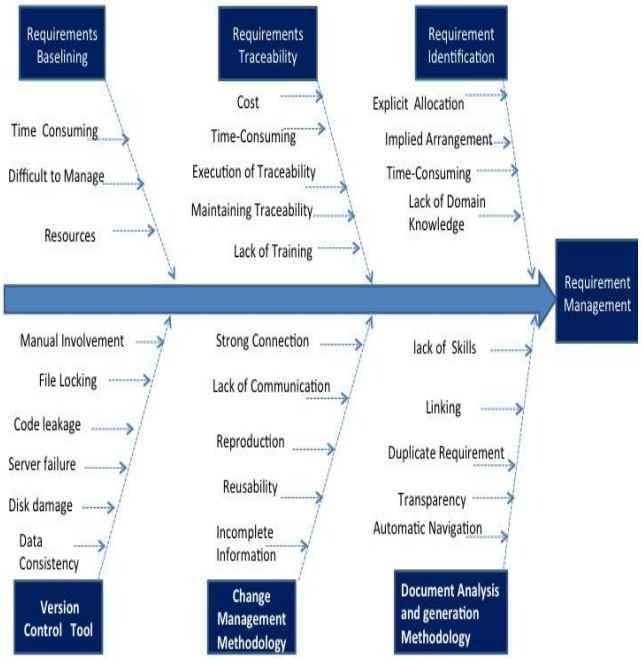

Fig. 2.(Requirement Management Techniques and Challenges)

IV. CONCLUSION AND FUTURE WORK

The paper offered an outline of the requirements management process by encompassing all the foremost activities of the same. Additionally, the study also presented a brief but broad depiction of various management techniques used by RE specialists worldwide. Previous studies reveals several challenges in requirements management, which may be present due to poorly ended portion of systems analysis. These challenges detected in management have been recognized many times be a foremost cause of system failure. This research has tried to represent important challenges into the highlights of numerous types of requirements management techniques.

Upcoming work may propose new approaches to overcome these challenges along with robust validation results. Advance research may be directed for integration of AI techniques in various events of requirements management. This work may offer a substantial supervision to the RE experts in evolving a quality software with less time and cost.

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