REQUIREMENT MANAGEMENT A KEY TO SUCCESSFUL PROJECT MANAGEMENT FOR SOFTWARE SYSTEMS

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Voice of Research
Volume 5, Issue 1
June 2016
ISSN 2277-7733

Abstract

Requirements are basic building block for any project clear requirements definitions are very important for any project. Without clearly spelt out requirements it is very difficult to develop a stable system. Worldwide percentage of successfully completed projects is very low, and most of the failures are attributed to unclear, ambiguous or undefined requirements. In Case of software projects, management of requirements is very critical for successful Project Management.This paper attempts to highlight what are the common causes for failure of requirement management process in software projects. Thispaper also highlights continuous usage of different metrics so that whenever the requirement management process performance goes off track, corrective action can be takeninstead of acting only after completion of the phase.

***Keywords**: - Requirement Management, metrics, Stakeholders, Project Management*

For a project to be successful it should meet all its objectives within fixed delivery schedule using pre allocated fixed budget. Each of the executed projects is unique in nature and is supposed to give unique output. Each project has multiple stakeholders and expectation of each stakeholder from the project differs and can even be contradicting from each other. These expectations normally keeps changing as the environment in which the project is executed is dynamic and changing very rapidly. As a result of these changing expectations the stakeholders keep changing their requirements. The developers face the problem of these changing requirements as whatever he had developed till now becomes not useful and he has to start the process of designing the system again for new requirements. This cycle causes lot of rework and lot of cost and effort is wasted in re doing things.Another problem in managing requirements in software projects is that a software based system is essentially a complex system and it is difficult for a person providing requirements for such a system to be able to provide all requirements in sufficient detail at the very beginning of the project as a person's mind cannot visualizing a complex system in detail at a given time. Requirement management is an process that is performed right from the start of the project till the end of the project. At the very beginning of the project, requirement management process is intended to collect high level project requirements and performing an feasibility study to take a decision whether to continue with the project or not. Once a project is found to be feasible then the aim of this process is to capture detailed requirements, analyse the collected requirements, and document the requirements. During project execution requirement management process deals with finding more detailed requirements as more clarity about the project evolves and an important activity of requirement management process is to ensure that all the requirements collected for the project and only requirements collected for the project are implemented for that project. It means that requirements identified but not implemented will cause a rework later and implementation of unidentified requirements is overkill and the resource (both time and effort) spent for such activities are wasted and could have been utilized for some other activity actually required for the project. During the latter part of the project the purpose of requirement management process is to validate and ensure that all requirements are implemented in the project so that if any requirement is not implemented, then a corrective action can be taken to close the gap before this goes in the hands of the customer or end user.

Definitions

Requirements:-Requirements are what stakeholder's desire or needs from a project. Requirement may be functional, non-functional, technical, reliability related, statutory, performance related, external interface requirements, environmental requirements, resource requirements, design requirements, quality related requirements.

Requirement management:-Requirement management can be defined as a systematic approach to eliciting, organizing and documenting the requirements of the system, and establishing and maintaining agreement between the customer and the project team on the changing of requirements of the system. Requirements management consists of following major steps:- Requirements Eliciting; Requirements Documenting; Requirements Analyzing; Managing changing Requirements

Literature Review

Review of literature with respect to importance and issues faced in Requirement Management process reveals that the problem of changing requirements and difficulty in managing constantly changing requirements has been identified globally. The researchers have proposed various methods, models and metrics to overcome the problem of managing requirements for successful project management. Most of the research work found in this domain has been from outside India. Even though India is a major hub for software development but this problem of requirement management is still relatively less explored in Indian context.

H. Saiedian and R. Dale in the year of 1999 emphasized the importance of 'Effective communication' and 'information-gathering skills' along with 'graphical representations of the user environment' and gave importance to 'Customer participatory techniques' specifically 'Prototyping'. Their research primarily focused on techniques for improvement of requirement elicitation part of requirement management.

Ann M. Hickey and Alan M. Davis in the year 2002 proposed a mathematical model of the requirements elicitation process that clearly shows the critical role of knowledge in its performance.

SamuliHeinonen in the year 2006 studied the use of Software based tools for requirement management in collaborating environment and primarily compared the features of the following three tools-
1.BorlandCaliberRM, 2.IBM Rational RequisitePro and 3. Telelogic DOORS.
In the year 2008 Bill Davey and Chris Cope conducted research on topic of "Requirements Elicitation – What's Missing?".Their research revealed that interviews (conversations between clients and consultants) are the most effective way of eliciting requirements.
Krzysztof Wnuk from Department of Computer Science Lund University in the year 2010 conducted research on the topic of Understanding and Supporting Large-Scale Requirements Management.The research concluded with identification of following problems existing in Requirements Management process-
1. Large number of variation points with an unmanageable granularity; 2. Unclear responsibilities and unstable process for the product configuration; 3. No clear traceability between configuration parameters and initial requirements; 4. No complete product specification available; 5. Products are configured in an inefficient and iterative process without using the initial requirements.
In the year of 2008 S. Arun Kumar and T.Arun Kumar from VIT University, Vellore conducted a study of the impact of requirements management characteristics in global software development projects. They proposed a framework for the successful and efficient requirements management framework for Global Software Development Projects along with proposing few metrics to be collected for requirement management process.

Objective

1. This paper brings out major road blockers for inefficient requirement management process in software projects
2. To propose set of metrics that can be used to manage requirement management process.

Factors Affecting Requirement Management in Software projects

1. Human limitation in Requirement Elicitation process: In a project ultimately it is humans that are involved in requirement management and humans have limitations when it comes to visualizing a complex system in its totality. So a requirement provider though wishes to bring out all requirements of the system at the beginning itself but he fails to bring out many requirements as he cannot visualize all requirements. This happens mainly due to the fact of single frame of vision problem associated with human beings which limits their visualization beyond a certain limit. Also each person interacting with the system does so for a specific purpose so he can bring out only those aspects of the system and rest of the aspects goes unnoticed.
Another major problem in collecting requirements mainly in our country is often the person sent for requirements elicitation to the client side is not the right person for the job. But he is sent to client side as a reward for his performance in his previous assignments. So he lack the skills needed for requirement elicitation. Requirement elicitation is essentially a specialist job and needs a altogether different skillsets and expertise, but organizations often compromise in that front.
2. Lack of Usage of Tools for managing requirements: Once requirements are collected it needs to be managed during different phases of the software development phases. During the development of the project different team members use and update the requirements collected. If these requirements are not managed using any tools then there is always a case that different team members are referring to different set of requirements.Hence it is important for the organizations to understand the usage of proper requirement management tools so that requirement integrity is maintained. Using such a tools ensures that it can be easily tracked which developer is working on which requirement, for which all requirements design is completed, what requirement are tested, any change in requirement by a person notifies all others individuals through mail or message.
3. Lack of emphasis on Stakeholder management: Project stakeholder is individuals, groups or organizations who may effect or be effected by outcome of any project. It is critical for the project success to identify all the stakeholders and collect their requirement early in the project. Most of the organization doesn't give enough emphasis on stakeholdermanagement early in the project and this causes significant delays. Stakeholder management not only involves identifying and collecting requirements from stakeholders but also include prioritizing stakeholders based on their influence to the success of the project. Prioritizing stakeholders is needed since often different stakeholders have contradicting needs from the project, prioritizing the stakeholders helps the project managers to work on a policy how requirements can be managedthroughout the life cycle of the project.
4. Unable to keep pace with Rapidly growing technology: The technological advancement in the field of software development is very rapid, this causes requirements collected at the beginning of the project to be obsolete by the time project comes to an end. It is imperative for the organizations to keep a track on change in technology regularly to ensure that the requirements collected are relevant or not with the changes happening in the technology.

Major Causes of Failure in the Requirement Management Process

Following list covers the major causes that results in failure of requirement management process-
Less emphasis on planning requirement management process Delay in capturing requirement causing rework; Development team not on common understanding for collected requirements due to lack of communication; Inflexible system in place causing inability to adapt to changes in requirement; Different interpretations due to ambiguous requirements; No method in place to measure and assess requirements processes performance; No mechanism in place to communicate changes in requirements to relevant stakeholders; Lack of following practice to obtain affirmation from customer for interpretation of captured requirements; Little or No control over requirement changes injected by stakeholders; Stakeholder's not sufficiently involved in requirement elicitation process; Requirements not documented or inaccessible to relevant stakeholders; Multiple teams involved in requirement management with little or no coordination; Focus only on functional requirements as a result of which other types of requirements like non-functional, security are missed.

Defining and collecting data for measuring Requirement management process performance

Data collection and populating the collected data in various metrics helps in monitoring the performance of the requirement management process. It helps in measuring the performance against the initially set targets, projects can significantly improve the quality of their requirement management process which in return will not only help in delivering the software projects in conformity with the schedule and budget, but will also serve as an effective tool for the project managers to better administer the software projects.

Following metrics can be used to measure the effectiveness of requirement management process:

Volatility Metrics: This metric provides the information as to how much requirements are changed over a period of time. Volatility is typically high in the initial phase of software development and reduces as the project progresses so that further development is not affected.

Traceability Metrics: Requirements traceability metrics links the requirements and the work products developed. Traceability provides information which helps in determining whether all relationships and dependencies are addressed.

Specificity Metrics: This metrics indicates ratio of ambiguous requirements to total requirements captured. During the start of the project ambiguous requirement may be higher, however as the project progresses continuous clarification of requirement brings down ambiguous requirements.

Requirements Validation Metrics: This metric indicates the total number of requirements validated to total number of requirements in the project. This metrics helps in ensuring that all the requirements are validated.

Requirement Prioritization Metrics: This metrics indicate the priority of each requirement so that the development team can develop requirements based on their priority value, also this metrics is useful in preparation of test plan so that testing team can focus more on high priority requirements as compared to low priority ones.

Conclusion

Based on the study conducted it can be concluded that 'Requirement Management' is very critical for the success of the project. Badly managed requirement can seriously jeopardize the success of the project. In today's world of technological advancement where competition is very high, any misunderstood or missed requirement can be the difference between success and failure. It is not very practical to think of collecting all requirements initially and then proceed with other phases of software development. Hence change control process needs to strengthen so that changes can be accommodated smoothly and will have minimal negative impact if any at all. Metrics proposed in this study can be used to continuously monitor the performance of the requirement management process. Usage of requirement management related metrics will significantly improve the performance of an organization. There are many tools available for effective requirement management; these tools can be integrated with tools required for other software development management process. Usage of a requirement management tool simplifies management of requirements along with added benefits of configuration control and various metric generations.

Suggestions

Project Teams should follow the Best Practices mentioned in the study for effective requirement management. For Requirement elicitation there are many techniques of requirement elicitation available and the selection of appropriate techniques depends on various factors like project team, customers, environment of project execution. Hence a team should select combination of requirement elicitation techniques after considering all the factors. Hence there is no single techniquesthat is right but the right technique varies from project to project. Organizations should be prepared for changing requirements and should have a process in place to manage changing requirements. Use of Change control Board is suggested for requirement change management. Defining and using requirement management related metrics is advisable. Requirement management related tools needs to be identified and used throughout the life cycle of the project. Requirement management process should be considered as a continuous iterative process rather than one time activity and enough emphasis should be given on requirement management as requirements are a basic building block of any project and hence success or failure of any project hinges on successful Requirement Management.

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