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Role of Requirement Engineering Processes in Software Development

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ABSTRACT
The rapid development in the field of Computers, Electronics & IT industry has given boost to software development industry also. Use of computers in every field like in governance, banking, commerce, finance, education and recreation etc has been growing at a fast pace, leading to demand for software which is user friendly, yet capable of performing complex tasks. Rapid demand for reliable and cost effective software has forced computer scientists to work in the field of Software engineering to find out better tools, techniques and processes to develop software. On time delivery, quality, reliability and cost of Software development entirely depends upon Requirement Engineering processes, an important part of Software Engineering. Requirement engineering act as a foundation for any software. Requirement engineering comprises of a number of processes to collect requirements as per the needs and demands of users and stakeholders of the software product. There are two broad categories of of RE process: Requirement Gathering (eliciting, analyzing, specifying, and validating requirements of the customers) and Requirement Implementation (executing the requirements of the customers in the software development activities). This paper reviews the important processes used in Requirement engineering and their role in software development. In this study I have done a survey of few Indian companies to check the RE processes in Practice and presented the results. This study helps to evaluate the RE processes practically in use in various companies which leads to better software product.

Keywords – Requirement Engineering, Requirement gathering ,Requirement Implementation, RE Processes, Software Engineering

I. INTRODUCTION

The rapid development in the field of Computers, Electronics & IT industry has given boost to software development industry also. Use of computers in every field like in governance, banking, commerce, finance, education and recreation etc has been growing at a fast pace, leading to demand for software which is user friendly, yet capable of performing complex tasks. There are many commercial and marketable products in which computers are embedded which demand extremely high reliable software to work . Since the early 1960's, the power of computer hardware is increasing speedily. The invention of integrated circuits leads to New and powerful machines which has made scientists, researchers and business professionals to use computers in ways that were previously not even realizable and feasible.

The software industry was considered to be in software crises [1][2] for several reasons:

Cost and schedule of projects were underestimated, the quality of software was not up to the mark or less

than desirable and the demand for good software was outpacing the number of good software designers. Software products were being delivered to customers unreliable and years after the scheduled time. Furthermore, maintenance cost of software which includes cost of fixation of bugs and cost of rework done due to changing it to meet new requirements was now outstripping the initial cost of developing it. In many cases , the cost of the software exceeded the cost of the hardware it ran on. All these trends have made effective software engineering the need of an hour.

1.1 Software Engineering

Software Engineering(SE) is a line of work devoted to the process of designing, implementing and modifying software to produce a software product that is of higher quality, costs less, easy to maintain , user friendly and faster to build. It is a "systematic approach to the analysis, design, assessment, implementation, test, maintenance and reengineering of the software, that is, the application of engineering to software". [3]

Software engineering has open up many avenues for researchers to work to develop new and scientific techniques to develop cost effective, reliable, easy to use software on time. The chances of a product being developed on time and within budget are dependent on thorough and precise analysis of client's current situation and needs. Informally, the client's needs are also called "requirements". A requirement is a specification of what should be implemented by a product. The IEEE standard defines a requirement as "a condition or capability that must be met or processed by a system component to satisfy a contract, standard, specification or other formally imposed document. The set of all requirements forms the basis for subsequent development of the system or system component".

Requirements are primarily of two types: **functional and non-functional**.[4]

Functional requirements relate to actions that the product must carry out in order to satisfy the fundamental reasons of existence. Non-functional requirements are the desirable properties/qualities that the product must have. These are the characteristics that make the product fast, usable, portable, reliable, attractive etc.

Identification of requirement effectively gives rise to another field of software engineering known as Requirement Engineering.

1.2 Requirement Engineering

Requirement Engineering(RE) 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[5]. The use of the term "engineering" implies that the systematic and repeatable techniques are used to ensure that the requirements are complete, consistent and relevant. One early immediate product of RE is the Software Requirements Specification (SRS) [6] document that describes all the externally observable behaviors and characteristics expected of a software system. A quality SRS is one that contributes to successful and cost effective creation of software that solves real-user needs and usually incorporates the viewpoints of all the stakeholders who have an interest in the product.

The cost of discovering a requirement during construction of the product, or, worse when the client starts using the product, is expensive and inefficient and yet a large number of companies typically spend only about 10% of the total time allocated for the project on requirement gathering. By the time the project is typically done, many companies discover that 50-80% of

their total budget is spent on rework. Projects where adequate time is spent on requirement gathering and specifications have more percentage of success rate in terms of cost, delivery time and quality as compared to projects where less time is give to requirement gathering and specification.

2 Processes of Requirement Engineering

Requirement Engineering Process is divided in to two main categories [7]:

a. Requirement Gathering : Requirement gathering is divided in four phases :

1. Requirement Eliciting

2. Analyzing Requirements

3. Specifications of Requirements

4. Validating requirements

b. Requirement Implementation *:* Requirement implementation is actual execution of the requirements in the software development phases.

1.2.1 Elicitation of requirements can be done using five different techniques [8]

i) ***Traditional techniques****:* **Traditional methods comprise of technique of gathering data using** questionnaires, surveys, interviews, task analysis, domain analysis and Introspection.

ii) **Cognitive techniques** *:* In this technique requirement engineer collect and prioritize requirements. Some of the cognitive techniques are Repertory grids, card sorting, laddering and protocol analysis.

iii) **Group elicitation techniques** *:* This technique involves eliciting requirement through the involvement of team or groups of software engineers. Group works, brainstorming, JAD requirement workshops and protocol analysis relate to group elicitation techniques.

iv) **Prototyping** is the technique which is used for elicitation purpose when requirements are not clear or when urgent stakeholders' feedback is required to proceed further.

v) **Contextual techniques** involves ethnography, conversation analysis and observations/social analysis that serve as an alternative to the traditional cognitive techniques.

1.2.2 Requirement Implementation/development:

The input/output of RE process, devised by Kotonia and Sommervile, intake the following five inputs:

a) Existing system information

b) stakeholder needs

c) organizational standards

d) regulations

e) domain information

It also generates three outputs, namely agreed requirements, system specification and systems models. This process is general and flexible as for all the organizations only the requirements can differ, but these inputs and outputs always remain fixed [7,10].

Linear Requirements Engineering Process Model, envisaged by Linda Macaulay, is a simple model , primarily used for administering small projects. This model is composed of five tasks in sequences :

1. Conceptualization
2. Problem analysis,
3. Feasibility study,
4. Analysis and Modeling,
5. Requirement documentation [7].

Linear Iterative Requirements Engineering Process Model, conceived by Kotonya and Sommervile, emphasizes on accurate

specifications for the system and validation of RE multiple times from the stakeholders. The model is iterative that lasts until the final requirements are attained and stakeholders get satisfied.

Iterative RE Process Model, formulated by Loucopoulos and Karakostas, is performs requirement engineering in several iterations and is suitable for those software development projects which are released version after version. The model consists of three simple phases elicitation, specification and validations.

Spiral Model of RE Process, suggested by Kotonya and Sommerville, performs RE process in spirals (or coil), where each spiral twists represent complete version of the requirements on the basis of which the system is expected to be developed. Each spiral is further divided into four quadrants namely, specification elicitation, requirements analysis and negotiation, requirements documentations and requirements validations. The model is capable to handle risks can increase project cost and compromise quality, such as specification delay, requirements change, low ROI etc.

II. RESEARCH METHODS USED :

RE processes studied theoretically in various literature needs an evaluation. So to check what RE processes are in practice in various companies a survey was conducted in some of Indian companies To prepare the evidence to check the Requirement engineering tools used in Indian Companies, a detailed Questionnaire is prepared and is filled by the authorized employees of the companies such as Infosys, Cognizant Technology (Pune),Market RX(Gurgaon) and One World Technology(Ambala) .After collecting the data from these companies , analysis of the data is done using SPSS Statistical Tools and graphs are plotted using Excel (Spreadsheet Package).

The sample size used in this study involved 22 software development projects from four companies of Pune, Gurgaon and Ambala. Due to this reduced sample size, the use of qualitative research methods was preferred.

We received completed questionnaires from number of respondents, reporting on 22 distinct projects. As noted earlier, the majority of our respondents were developers or project managers from pune, Gurgaon and Ambala based companies(pharmaceutical companies, software development companies, etc.). The responses to set of 22 questionnaires described 22 projects.

Questions were asked about the Software paradigms used , System life Cycle model used , Development tools used , Requirement Document standard used and Requirement document type used.

III. RESULTS

Function Driven System Development paradigm is used by most of the companies 16 projects used Function Driven Paradigm and 13 times the project was delivered on time and no rework was done. Success rate is 81% as far as delivery time is concerned. Object Driven Paradigm has the success rate as 25% and Data Driven has success rate as 50%. Nobody selected Evolutionary.

Water Fall Life Cycle Model is selected 17 times out of 22 projects and 13 times project was delivered on time. Success rate is 76.4% .Evolutionary , Iterative method has success rate as 40%. Spiral and other was not selected by any project.

Projects developed with Requirement management tools has 100% success rate . Projects developed with Case tools has 66.6% success rate as far as delivery time is concerned. Configuaration tool is selected by one project and that was not delivered on time.

Projects developed with requirement document has a success rate as 72.2%and projects developed with task list has success rate as 66.6 % as far as delivery time is concerned.

Projects with flexible document structure has success rate as 70.58% and if standard structure is used on time delivery rate is 60% and no body selected simple and concise document .

Projects developed with Requirement document as hypertext has success rate of 66.6 % , Text Document has 64% Visio ms project and other has 100% Success rate but these options were selected only once.

IV. CONCLUSION

From the above discussion it is clear that projects which used one or the other Requirement engineering technique had greater success rate than projects which have not used. Projects , which used Analogical and case based reasoning method has 92% success rate.

We discovered that:

1) Complete and clear requirement document leads to better results.

2) It is not scope creep, but rather that scope is well defined when it creeps;

3) Function driven methodology followed by Water Fall technique and Testing team positively effects software development.

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