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Association between Requirement Engineering Processes and Risk Management

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Abstract: The software industry has shown ballooning growth rate in last few years but still it is over burdened with failed and delayed projects. Most of these failed projects overrun their original budget. As per a report presented by The Standish Group, 72 percent of software projects are failed as those are completed after scheduled time and are over budget. More than 23 percent of software projects are cancelled before they ever get completed, and 49 percent of projects cost 145 percent of their original estimates. (Standish, 1995). In retrospection, many of these companies reported that their problems could have been avoided or drastically reduced if high-risk elements of the project could have been identified in advance. Although there are many risks involved in software development life cycle but the major risks are related to software cost, quality and scheduling which can be controlled and avoided if proper strategies are adopted in the initial stages. Risk management helps us to identify, analyze and control various risks associated with software development cycle. Theories say, all of these risks creep in due to poor requirement engineering processes followed by software development team. Lack of understanding of client's requirements, frequent changes in requirements, lack of user involvement. Lack of standards for requirement elicitation methods are some of the factors which leads to delayed, over budget and low quality software projects. If requirement engineering processes are followed by companies, risks can be managed properly. So requirement engineering processes and risk management are co-related and go side by side. The aim of this study is to check how much RE processes affects risk management by conducting a survey in nine different software development companies and taking evidence from the software developers who are actually using these practices practically in their jobs.

Keywords: Requirement Engineering, RE Processes, Risk Management, Software Engineering

I. Introduction

The software industry has shown ballooning growth rate in last few years but still it is over burdened with failed and delayed projects. Most of these failed projects overrun their original budget. As per a report presented by The Standish Group, 72 percent of software projects are failed as those are completed after scheduled time and are over budget. More than 23 percent of software projects are cancelled before they ever get completed, and 49 percent of projects cost 145 percent of their original estimates (Standish, 1995). In retrospection, many of these companies reported that their problems could have been avoided or drastically reduced if high-risk elements of the project could have been identified in advance.

Although there are many risks involved in software development life cycle but the major risks are related to software cost, quality and scheduling which can be controlled and avoided if proper strategies are adopted in the initial stages. Risk management helps us to identify, analyze and control various risks associated with software development cycle.

Theories say, all of these risks creep in due to poor requirement engineering processes followed by software development team. Lack of understanding of client's requirements, frequent changes in requirements, lack of user involvement. Lack of standards for requirement elicitation methods are some of the factors which leads to delayed, over budget and low quality software projects. If requirement engineering processes are followed by companies, risks can be managed properly. So requirement engineering processes and risk management are co-related and go side by side.

The aim of this study is to check how much RE processes affects risk management by conducting a survey in nine different software development companies and taking evidence from the software developers who are actually using these practices practically in their jobs.

For this study, I have asked the questions to 23 respondents from 9 software development companies of Ambala, Gurgaon, Pune, and Chandigarh. All these respondents are engaged in software development as developer or manager.

This paper is divided in five sections. Section I gives introduction, Section II describes Requirement Engineering, Section III gives introduction of Risk Management, Section IV states the objective of study, and Section V gives details of Questions, results and their analysis followed by conclusion.

II. Requirement Engineering:

RE can be simply defined as identifying a problem's context, locating the customer's requirements within that context and delivering a specification that meets customer needs within that context. There are many

requirements methodologies that purport to do this, for example, soft systems methodology [1], scenario analysis [2], and UML [3]. Sometimes they work, sometimes they do not. The implication of such requirements methodologies, if we can label at least aspects of them as such, is that the application of 'x' method will produce the right requirements irrespective of the problem's characteristics.

This is conventional wisdom and unsurprisingly, the creators and vendors of requirements methodologies claim, with one exception [4] that their approach is a hammer and all problems are nails. While there are many factors other than just application of a requirements methodology that influence the success or failure of software projects in practice, in this paper I focus only on requirements engineering.

III. Risk Management:

A risk is a *potential future harm that may arise from some present action* (Wikipedia, 2004), such as, a schedule slip or a cost overrun. The loss may be in terms of direct financial loss or indirect loss in terms of goodwill, fame, future business, or loss of property or life.

Risk management is a series of steps whose objectives are to identify, address, and eliminate software risk items before they become either threats to successful software operation or a major source of expensive rework. (Boehm, 1989)

In the software development cycle, risks can be software requirement risks, software cost risks, software scheduling risks and software quality risks. Due to these risks projects fail. Many projects fail either because simple problems were reported too late or because the wrong problem was addressed (Bruegge and Dutoit, 2000). Software development Teams can be reactive or proactive about these problems. Reactive teams are which take rapid action after the problem has occurred and find out the solution. On the other hand, Proactive teams anticipate the risks and take preventive measures to avoid those risks to happen. They plan in advance to avoid those risks to happen.

A. Risk Management Process (Risk Management ,Laurie Williams 2004):

A.1 Risk Identification

The very first step in the risk management process is risk identification. In this step, the team identifies as many project risks as possible to make them explicit before they become problems. Risks can be of three types:

- i) **Project Risks**
The risks which affect the project schedule or the personnel or budgets dedicated to the project are known as Project risks.
- ii) **Product risks**
The risks which affect the quality or performance of the software being developed are known as Product risks.
- iii) **Business risks:**
The risks which threaten the viability of the software are known as business risks , such as building an excellent product no one wants or building a product that no longer fits into the overall business strategy of the company.

A.2 Analyze

After the identification of risks, the next step is the analysis of risks. In the analysis phase, the identified risks are transformed into decision-making information. The probability and the seriousness of each identified risk is assessed. For each risk, the team must do the following:

- Assess the probability of a loss occurring. Set numerical probability for each qualitative value (e.g. very improbable= 5 percent, improbable = 10 percent).
- Assess the impact of the loss if the loss were to occur. Delineate the consequences of the risk, and estimate the impact of the risk on the project and the product. Similar to the probability discussion above, the team can choose to assign numerical monetary values to the magnitude of loss, such as Rs100,000 for a week delay in schedule.

A.3 Prioritize

The third step in risk management process is prioritizing the risks by ranking them. It is not feasible to take action on every identified risk as too much of cost is involved. Some of them have a very low impact or a very low probability of occurring – or both. By prioritization process, the team decides which risks it will take action on. The team sorts the list so that the high probability, high impact risks percolate to the top of the table and the low-probability, low impact risks drop to the bottom.

A.4 Plan

Risk management plans should be developed for each of the “above the line” prioritized risks so that proactive action can take place.

A.5 Mitigate

Related to risk planning, through risk mitigation, the team develops strategies to reduce the possibility or the loss impact of a risk. Risk mitigation produces a situation in which the risk items are eliminated or otherwise resolved.

A.6 Monitor

After risks are identified, analyzed, and prioritized, and actions are established, it is essential that the team regularly monitor the progress of the product and the resolution of the risk items, taking corrective action when necessary. This monitoring can be done as part of the team project management activities or via explicit risk management

A.7 Communicate

On-going and effective communication between management, the development team, marketing, and customer representatives about project risks is essential for effective risk management.

IV. Objective of Study:

Theories say that RE practices helps managing the risk which in turn leads to the success of any software project. The objective of this study is to explore the impact of requirement engineering practices on risk management. Software industry is devoting large amount of funds towards the development of software thus increasing the cost of final project. Cost incurred due to risks of rework or delayed projects or over budget projects can be eliminated if can be identified at the initial stage of project development cycle and RE processes if followed can reduce these risks drastically. Knowing the common underlying problems that cause risks and identification of RE practices that reduces scope of risks will help software development teams avoid making those same mistakes over and over and making use of those practices that have more success rate. Aim of this study is to take the evidence from the IT professionals about the impact of RE processes on Risk management.

A. Research Methodologies

The aim of this paper is to check whether the RE practices lead to effective risk management or not. If such practices are thoroughly studied, they could be used for enabling reduction of risks associated with project development.

For this paper, I have conducted survey on some of Indian Companies and tried to find out the relation between RE practices and Risk management.

To prepare the evidence to check the impact of Requirement engineering tools on risk management, a Questionnaire is prepared and is filled by the authorized employees of the companies such as Infosys, Cognizant Technology(Pune), Market RX (Gurgaon), One World Technology (Ambala), Ameotech Informatics (Chandigarh), GENPACT, GTech Informatics, Automatic Data Processing India Pvt. Ltd, Silex Softwares Pvt. Ltd. (Ambala).

After collecting the data from these companies, analysis of the data is done using frequency tables and graphs tools of SPSS Software. The sample size used in this study involved 23 software development projects from nine companies of Pune, Gurgaon, Chandigarh and Ambala. Due to this reduced sample size, the use of qualitative research methods was preferred. Furthermore, the main aim of this study is to formulate a hypothesis about the relationship between RE process and the risk management.

V. Questionnaire Results & Analysis:

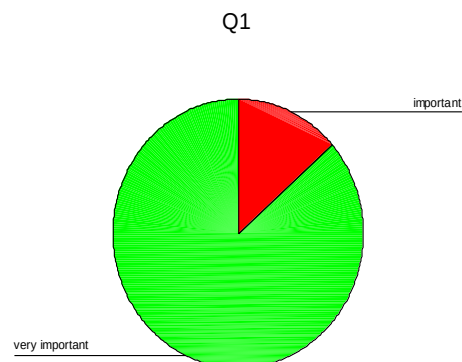
I received completed questionnaires from number of respondents, reporting on 23 distinct projects. As noted earlier, the majority of our respondents were developers or project managers from Pune, Gurgaon, Chandigarh and Ambala based companies. The Survey questionnaire had mixed type of questions.

A. Questions & Responses:

Q1 How important is the use of RE Processes in improving risk management?

- Very Important
- Important
- Unsure
- Not really Important
- Not Important at All

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	important	3	13.6	13.6	13.6
	very important	19	86.4	86.4	100.0
	Total	22	100.0	100.0	



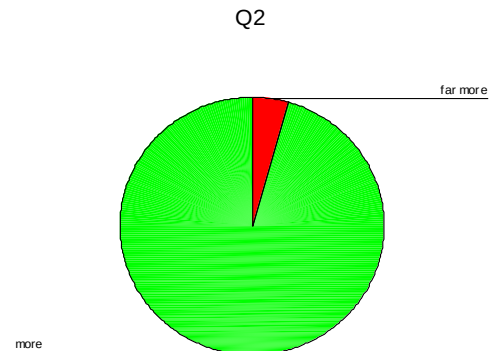
Analysis:

13.6 % respondents believe that RE processes are very important in improving risk management and 86.4% believes it plays important role in improving risk management. No one selected unsure, not really important or no important at all.

Q2 How the RE process affected risk assessment of the project?

- Far More
- More
- Same
- Less
- Far Less

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	far more	1	4.5	4.5	4.5
	more	21	95.5	95.5	100.0
	Total	22	100.0	100.0	



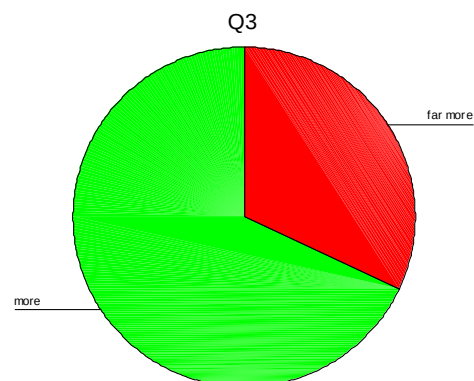
Analysis:

95.5% respondents have selected more option. 4.5% respondents selected far more option. That means 100% respondents believe that RE process affected risk assessment of the project

Q3 How do you believe the communication inspired by the requirements Analysis sessions improved or deteriorated Risk management

- Far More
- More
- Same
- Less
- Far Less

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	far more	7	31.8	31.8	31.8
	more	15	68.2	68.2	100.0
	Total	22	100.0	100.0	



Analysis:

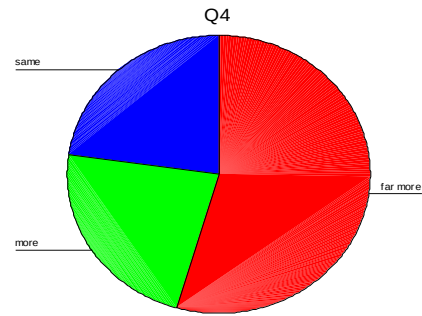
68.2% respondents have selected more option. 31.8% respondents selected far more option. That means 100% respondents believe that communication inspired by the requirements Analysis sessions improved or deteriorated Risk management.

Q4 To what extent did the requirements engineering process enable your organization to manage requirements:

- Far More
- More
- Same

- Less
- Far Less

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	far more	12	54.5	54.5	54.5
	more	5	22.7	22.7	77.3
	same	5	22.7	22.7	100.0
	Total	22	100.0	100.0	



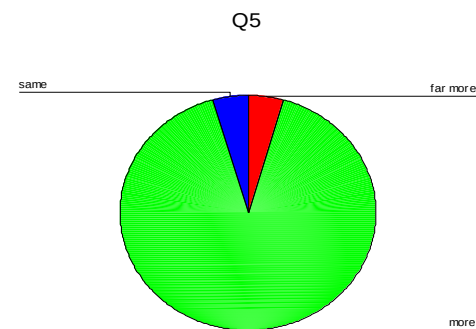
Analysis:

54.5% respondents have selected far more option. **22.7%** respondents have selected more option and **22.7%** respondents have selected same option. That means requirements can be managed effectively if RE processes are followed.

Q5 To what extend did the requirements engineering process enable your organization to assess impact of changing requirements?

- Far More
- More
- Same
- Less
- Far Less

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	far more	1	4.5	4.5	4.5
	more	20	90.9	90.9	95.5
	same	1	4.5	4.5	100.0
	Total	22	100.0	100.0	



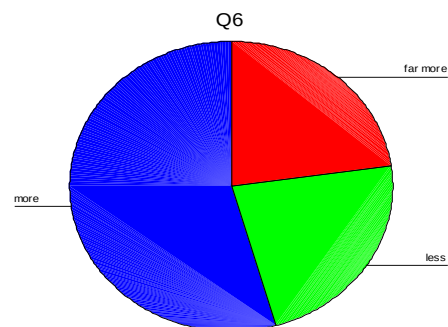
Analysis:

90.9% respondents have selected more option. **4.5%** respondents have selected far more option and **4.5%** respondents have selected same option. That means approx 95% respondents believe that requirements engineering process enable organization to assess impact of changing requirements.

Q6 To what extend did the requirements engineering process enable your organization to analyze risk

- Far More
- More
- Same
- Less
- Far Less

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	far more	5	22.7	22.7	22.7
	less	5	22.7	22.7	45.5
	more	12	54.5	54.5	100.0
	Total	22	100.0	100.0	



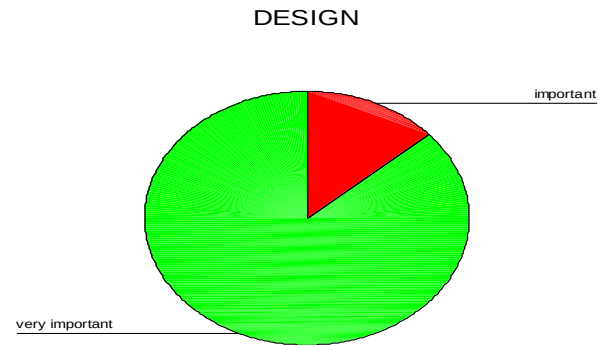
Analysis:

54.5% respondents have selected more option. 22.7% respondents have selected far more option and 22.7% respondents have selected less option. That means 77.2% respondents believe that requirements engineering process enable organization to analyze risk.

Q7 In your design, coding, testing or documentation activities, how important is it to understand the effect of RE processes on risk management.

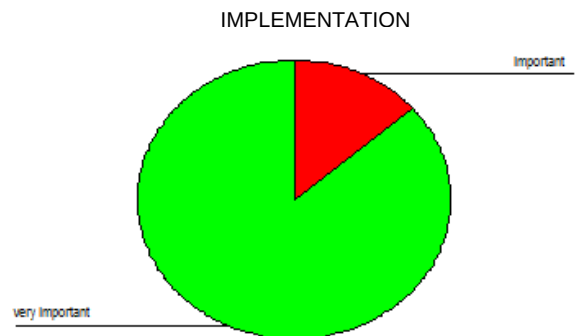
DESIGN

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	important	3	13.6	13.6	13.6
	very important	19	86.4	86.4	100.0
	Total	22	100.0	100.0	



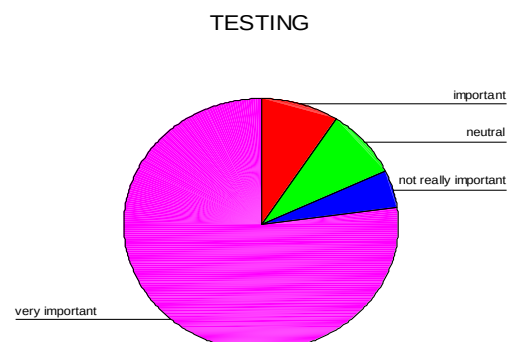
IMPLEMENTATION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	important	3	13.6	13.6	13.6
	very important	19	86.4	86.4	100.0
	Total	22	100.0	100.0	



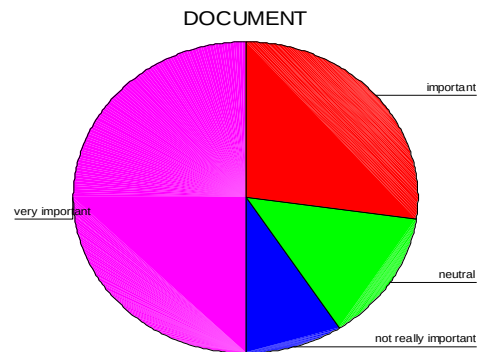
TESTING

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	important	2	9.1	9.1	9.1
	neutral	2	9.1	9.1	18.2
	not really important	1	4.5	4.5	22.7
	very important	17	77.3	77.3	100.0
	Total	22	100.0	100.0	



DOCUMENT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	important	6	27.3	27.3	27.3
	neutral	3	13.6	13.6	40.9
	not really important	2	9.1	9.1	50.0
	very important	11	50.0	50.0	100.0
	Total	22	100.0	100.0	



Analysis:

In Design phase, 100% respondents considered RE processes Important and very important for risk management
In Implementation phase, 100% respondents considered RE processes Important and very important for risk management.

In Testing phase, 77.3% respondents considered RE processes very important, 9.1 % considered important, 9.1% were neutral and 4.5 % considered not important.

In Documentation phase, 50% respondents considered RE processes very important, 27.3 % considered important, 13.6% were neutral and 9.1 % considered not really important.

Conclusion:

From above study, it is concluded that practically also most of the Software developers believe that if RE processes followed properly help manage the risk effectively thereby reducing the risk of cost, schedule, quality and requirements. There is a direct relationship between RE processes and Risk management.

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