QUALITATIVE RISK ANALYSIS IN PRODUCT DEVELOPMENT

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Abstract— Risk management is surrounded by a dark cloak of technology, definitions and methodologies contribute a little for understanding the approach. Risk refers to the set of exceptional effects for a given event which can be assigned probabilities. Traditional projects have always faced problems due to lack of risk management. We present the importance of considering project risk and at same time analyze it to maximize project turnover. Here, we elucidate importance of risk management by illustrating study of risks in new product development in manufacturing industry. This work focuses on Risk management system, Risk Breakdown Structure, Risk Response Strategy.

Index Terms -- Risk management process, Quantitative techniques, Qualitative techniques, Risk Response Strategy, Risk control.

I. INTRODUCTION

The terms risk and uncertainty can be used in different ways. Risk is being defined in many ways and assessment of fatalities and injuries, is done in the form of probability of reliability. It is also assessed in terms of a sample of a population or in terms of the possible effects on a project. Risk management is about avoiding, mitigating, transferring, and accepting the threats and exploiting, accepting, sharing the opportunities. Managing risk has two major objectives that are to avoid the threats and to exploit opportunities as risk can be grouped as threats and opportunities. The risk avoidance strategy helps you to protect your project objectives, which for many organizations is a massive step ahead and may be an only biggest opportunity. However, the major progress in project cost and time reduction are results of innovative thinking with focus on exploring new prospects by challenging the risks.

Risk management is about understanding your project scope and taking better decisions to manage your project; it is not about predicting the future Sometimes that decision may be to stop the project; if that is the only decision which saves many parties from wasting time, money and skilled human resources, then the need for a balanced, repeatable, justifiable risk methodology and risk interpretation is appropriate. It is being always difficult to have boundaries between decision making and problem solving.

Risk management process is successful only if project has commitment from Project Manager, the PMO and the contractor of the project. Program team has to come together and work to overcome all the obstacles in project management. Root cause of each risk has to be assessed and risk mitigation strategy should be in place to manage the risks in each phase of the program effectively. It is project manager's responsibility to have a risk management strategy to be in place so that risks can be avoided before its occurrence or at least team can

work to reduce impact of risk occurrence or provision to face the risk has to be derived so as to reduce the impact of risk occurrence. The risk management strategies help us to secure our project objectives, which is a giant step ahead for many organizations and may be the only prime break for an organization's growth.

II. LITRATURE REVIEW

Risk management is a tool for supervising projects effectively throughout project lifecycles. Turner suggested that "risk management is the process by which the probability of risk occurring or its impact on the project is reduced". He added that the risk analysis captures the crux of project risk as threat, chance of hostile consequence or loss, and exposure to misfortune. Kezsbom and Edward stated that risk management is an significant and integral part of project management, (Kezsbom DS and Edward K, 2001). Risk management is defined as the process of identifying and assessing risk, and to apply methods to reduce it to tolerable level, (Hamid Tohidi , 2011).

It is unfortunate that many projects do not follow a strict risk management methodology. Because of their failure to act for unexpected, many organizations find themselves in state of perpetual crisis characterized by an inability to make effective and timely decision. Many people call this approach risk management or firefighting because the project stakeholders take a responsive approach or only address the project risk after they have become a problem (Jones,1994).

The extensive study has indicated that most organizations perform the basic elements of risk management; the top performers do more, (Burnet, 2013).

In small projects, management of risk may be an informal process and the Project Manager may simply record the risks and propose actions as part of the Project Initiation Document. In medium size projects a basic Risk register is established to aid the recording, management, tracking and communication of risks and mitigating actions. Whereas in large projects it is usually sensible to conduct a risk workshop involving key stakeholders during initiation of the project. As a result such a workshop a full Risk Log will be established that should be maintained throughout the life of the project, (Bussiness Innovations & Skills, November, 2012).

A recent research results have shown that companies that hire construction services on a recurring basis do not systematically apply risk management practices in projects, which has affected the performance of projects (Wolbers; Howard and Serpell, 2012). Hall and Hulett suggested that large and complex projects, like mass transit projects, usually call for multiple stakeholders like contracts, contractors, suppliers, and outside agencies. Complex coordination among the subprojects is a potential risk, because delay in one area can cause a ripple effect in other areas. Complex construction projects are high-risk ventures involving multiple parties with different interests, thus producing a high potential for conflict.

Additionally, one of the research work claims and contract disputes in a number of construction projects had shown occurrence of number of unidentified risks which were not identified by parties, customers or contractors, and that were one of the main causes of some of those claims and disputes, (Palma, 2007). In the last four decades the risk management research has grown considerably in the construction industry given that construction projects are exposed to risk at the time of their coming into existence and are perceived to have more inherent risk due to the involvement of many contracting parties such as owners, contractors and designers, among others. Despite this, communication of construction project risk is poor, incomplete, and inconsistent throughout the construction supply chain, (El-Sayegh, 2008). Wenbin Tang stated that the urban rail transit systems are exposed to larger risks due to long construction period, large investment and wide complex technology. The major risks involved in this project are Political risks (Permission risks, Policy risks and Nationalization risks), Financial and Economic risks, (Wenbin Tang, 2011).

In banking also, the rapid varying financial environment exposes the banks to numerous risks. The concept of risk and management are fundamental of financial enterprise. The banking sector in India is going through series of changes. Increasing global competition, rising deregulation, introduction of innovative products and distribution networks have pushed risk management to the forefront of today's financial landscape. Ability to gauge the risks and take appropriate position will be the key to success, (Dr. Krishn A. Goyal, (December 2010)).

The banking crisis across globe along with recession in United States has highlighted need for concept of risk management to be incorporated into banking sector. Also the great advancements in terms of technology and quality are being made in Indian banks which bring them under context of risk. This is so because bank has to maintain parity between risk and return, (Dr. Krishn A. Goyal, (December 2010)).

As risk and risk management continue to generate attention at the board or board committee level, risk management leaders face challenges in meeting expectations while delivering sustainable risk management practices and processes that "fit" the organization's culture and risk profile. In addition, regulatory focus on risk management capability combined with growing understanding of "near miss" events suggests that risk mistake will continue to increase, (Beier, 2013).

The main purpose of project's risk management is to identify, evaluate, and control the risk for project success, (Lee, 2009). Overall, risk management process includes the following main steps: (1) Risk planning; (2) Risk identification; (3) Risk assessment (qualitative and quantitative); (4) Risk analysis; (5) Risk response; (6) Risk monitoring, and (7) Recording the risk management process. In projects, risk could severely constrain the primary objectives: time, cost, scope, and quality; it could mean additional cost and hence a lower return on investment to the client; and a loss of revenue for the contractor, among others, (Visser, Joubert, 2008).

Survey from manufacturing company explains that risk of sole suppliers contributes to fifty percentage of the risk for the product as revenue to manufacturing company is directly proportional to number of units sold per month which can affect due to delay or miss of one of the rare components supply from sole supplier. This risk is not identified at initial phase of the project and new supplier gets involved when the risk hits the project resulting increase of product cost, miss on OTD (on time delivery) and poor quality. Most common failures in a new products and processes development are related to focus on the individual project to ensure fastness, manufacture execution, provision of sufficient initial information to plan ahead, and articulate individual projects with the company competitive strategy.

We conclude from the above review that effective and successful project risk management includes commitment by all stakeholders, stakeholder responsibility, and different risk for different types of projects. And also its unfair to judge any risk without analyzing as even smsll risk has a potential to cause great damage to project in future if not taken care at initial stages.

III. MAJOR RISKS: NEW PRODUCT DEVELOPMENT PROJECTS

New product development is crucial for organizations growth as their revenue plan is dependent on product launch. New product development refers to any product launch in automobile industry, mechanical equipment industry or manufacturing industry. New product launch is based on golden rule of marketing i.e. correct product with correct quality and at correct time. Hence, new product launch plan comes with a specific product requirement i.e. scope is pre-defined for new product. Cost analysis is done comparing competitor's product and costs id identified for the new product. Launch period is also defined based on marketing strategy. Company may face major risk if any of above defined categories is not met in new product development.

Here we study major risks in new product development projects which are being faced by many of the manufacturing companies.

#	Risk	Condition	Consequence

	Type		
1	Schedule	New Facility/ Building for New Product line not ready at pre-production phase	Delay for production due to long Lead time to setup new line.
2	Cost	Low Volume Order	Material Cost/pc. Increases
3	Cost	Higher quotes received from Best known capable supplier	Product Cost increase
4	Schedule	Delay in supply of one of the Bill Of Materials component	Delay in Assembly of production lot
5	Process	Supplier Machined components dimensions are not meeting requirements	Product Functional Abnormalities
6	Schedule	Delay in Field trials/ Testing	Delayed Project Timelines
7	Schedule	Delayed procurement of imported parts (bought out items)	Delayed Production schedule
8	Process	Deign Failure	Failure during field testing
9	Schedule	Project Delay Due to time consumption in meeting all the regulatory requirements	Project Delay Resulting Competitor enters new product Market
10	Commercial	New Requirement Coming in during Value Creation Kaizen after design release	Extra effort i.e. cost and time increase

Table 1: Identified Risks

IV. PROPOSED MODEL OF RISK MANAGEMENT

The risk management for this project was followed as per risk management Processes. As explained in the risk management process, there are standard 6 steps of risk management.

- Plan risk management.
- Identify risk.
- Perform qualitative risk analysis.
- Perform quantitative risk analysis.
- Plan risk responses.
- Monitor and control risks.

We propose detailed risk management process which can be implemented in any scale of project:

Implement Risk Management Plan In Every Project:

A Risk management plan should always be implemented in a project small or big, simple or complex. Its very essential to consider risks from early stages of product life cycle. Risk Management is the process of identifying, assessing, responding to, monitoring and controlling, and reporting risks.

Figure 1: Detailed Risk Management Process

This Risk Management Plan defines how risks associated with the project will be identified, analyzed, and managed. It outlines how risk management activities which will be performed, recorded, and monitored throughout the lifecycle of the project and provides templates and practices for recording and prioritizing risks by

the Risk Manager and/or Risk Management Team.

Identify Risk In Your Project:

After making a risk management plan in initial phases of the project, identifying the risks was a biggest challenge. Brainstorming, Delphi, Root-and cause analysis, marketing expert's judgment etc. tools were used to identify the risks.

As seen in Fig.1 project can be delayed due to different potential causes, such as resources were not sufficient to finish the project on time, project was failing in testing hence it took more time to complete the project. Project was delivered late because it was not on priority of company. All these causes may result to project delay. Hence what all risks may occur which may delay the project were found out. And likewise several risks were found out. Also we interviewed project management experts to find out more risks. Brainstorming session was conducted to find out risks in this project.

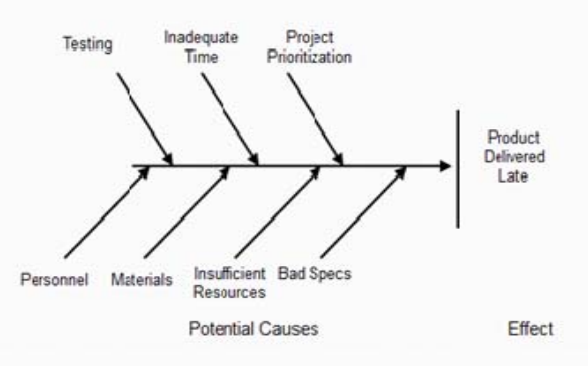

Figure 2: Fishbone Analysis

Communicate Identified Risk:

The team member and other stakeholders of project must commuinicated about the identified risk on timley basis. It should also be discussed In cross functional team.

Consider Threats & Oppourtunities:

Once the risk is communicated it should be classified into threats and opportunity.

Clarify ownership Issue:

The ownership of risk should be clarified. To decide ownershio it should be either transferred, accepted, avoided or mitigated.

- Mitigate – Identify ways to reduce the probability or the impact of the risk.
- Transfer – Shift the consequence of a risk to a third party together with
- Contingency –Define actions to be taken in response to risks
- Accept – Nothing will be done its impact by eliminating the cause
- Avoid – Eliminate the threat or condition or to protect the project objectives from

Prioritize And Analyse Risks:

Risks considered in earlier stages must be prioritized and analysed. To analyse risk we use qualitative and quantitative analysis.

A. Qualitative Risk Analysis:

The probability impact matrix is formulated using risk register, risk management plan and scope statement. We also considered organisational security terms and conditions to find out what will be the probability of occurrence of particular risk and what will be the impact if the risk occurs. From Fig.2 it is understood that risks in red matrix area were severe risks and had to be addressed first.

Risk in green matrix area was less severe and risks in yellow matrix area had medium level of risk.

B. Quantitative Risk Analysis:

Considering the probability and impact matrix and expert's judgment, quantitative analysis was carried out. Each risk was reviewed and scaled from one to three i.e. low, medium and high and product of impact and probability decided the severity of risk. Risk falling in red matrix area is most severe risk and it needs majot attention.

Plan & Implement Risk Response Plan:

Risks were categorised into positive and negative risks. There is different risk response strategies used for different types of risks. Threats, that is negative risks should be avoided, mitigated, transfer or accepted if there is no other

option to handle that risk. A positive risk, that is opportunities should be exploited, enhanced or shared. Each risk was categorised and risk response strategies were finalised.

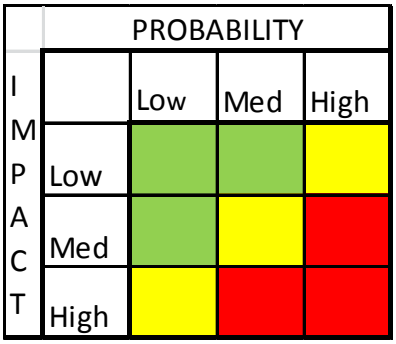

Figure 3: Probability Impact Matrix

Risk Monitor and Control:

Responsible entities were assigned to each risk so that if it occurs, responsible person will handle that risk. Also, time interval for checking the risk occurrence was decided for each risk.

timely. Research and experience are both equal value factors which can move organizations from risk-averse to risk-ready risk management.

Each risk was monitored timely and hence all risks were managed successfully

V. Results and Discussions

All Projects have thousands of risks involved in it right from initiation phase to closure of the project. Project manager needs to identify these risks and work continuously towards risk management. Risk is the important aspect of product development after People, Process, and Evolving technology. Entrenching risk as the fourth aspect of business has the potential to vitally change how organizations link risk to return. Companies succeeding in transforming risk into return can always create a competitive advantage. It is the high time where companies should invest on the project risk management under developing product department. Risks can be analyzed with cross functional team discussions and having full-proof risk management plan which has to be reviewed and updated

Detailed risk management process was applied here as explained above to manage new product development project risks which have to be monitored on timely basis.

#	Risk Type	Condition	Consequence	Probability	Impact	Exposure	Mitigation	Assignee
1	Schedule	New Facility/ Building for New Product line not ready at pre-production phase	Delay for production due to long Lead time to setup new line.	High	High	High	Planning team to find out assembly line layout at initial stage and track development of new facility location	Operations and Project Manager
2	Cost	Low Volume Order	Material Cost/pc. Increases	Low	High	High	Documented Forecast analysis. Pre-orders if possible	Marketing
3	Cost	Higher quotes received from Best known capable supplier	Product Cost increase	High	Medium	High	Identify Other new supplier with lower costs parallel and third party involvement to identify new suppliers	Procurement Manager
4	Schedule	Delay in supply of one of the Bill Of Materials	Delay in Assembly of production lot	Medium	Medium	Medium	Parallel ordering for Critical items	Procurement Manager

		component						
5	Process	Supplier Machined components dimensions are not meeting requirements	Product Functional Abnormalities	Low	High	Mediu m	Process Feasibility Report to be completed before proceeding to supplier approvals	Supplie r Quality Manag er
6	Schedule	Delay in Field trials/ Testing	Delayed Project Timelines	Medium	Mediu m	Mediu m	communicate with Regions from start of the project	Project Manag er
7	Schedule	Delayed procurement of imported parts (bought out items)	Delayed Production schedule	Medium	Mediu m	Mediu m	Start looking for local suppliers	Procure ment Manag er
8	Process	Deign Failure	Failure during field testing	Low	High	Mediu m	Mandatory Detailed Failure Mode Effect Analysis documentations	Design Engine er
9	Schedule	Project Delay Due to time consumption in meeting all the regulatory requirements	Project Delay Resulting Competitor enters new product Market	High	High	Low	Breakup the Regulatory Requirements for particular regions and deliver phase wise	Marketi ng
1 0	Commerci al	New Requirement Coming in during Value Creation Kaizen after design release	Extra effort i.e. cost and time increase	Low	High	Low	Value Creation Kaizen to be done well before finalizing PRS and	Marketi ng

Table 2: Risk Management Plan

VI.CONCLUSION AND FUTURE SCOPE

Though we have focused on risks in new product development, the principles and strategies developed in this paper are relevant for managing other project risks. It can be concluded by saying that implementation of risk management has to be done from early stages of the project, especially from project concept and initiation phase. There are plenty of large, medium and small scale organizations which still do not follow Risk Management practices in their projects resulting project failures in terms of overspending, long delays, missing large amount of revenues planned.

Currently described methods of risk management are clear and rational in concept but there are many real-world issues that raise demands about how they can be applied in practice, particularly in the areas of complex technologically challenging projects. The absence of an empirical literature is felt here in trying to sort out which of these risks are really challenging. Prioritizing risks and consequence of risk arrival can be empirically expressed to show an impact of risk occurrence more explicitly.

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