

# Risk Management Practices in a Construction Project

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**Abstract:** The purpose of this master thesis is to evaluate how the risk management process is used in the construction industry and how the practitioners are managing risks in everyday situations. The theory of the risk management process will be compared to the actual practice in order to investigate similarities and differences. In other words, the main idea is to see if the construction industry is working with risk management as it is described in the literature regarding the methods and techniques presented.

**Key words:** Risk; Risk management; Risk management process; Risk management methods; Project life cycle.

## Purpose:

In order to achieve the purpose, the following research questions have been formulated to support the investigation:

How are risks and risk management perceived in a construction project?

How is risk management process used in practice?

How do risks change during a project life cycle?

The objectives are to understand the concept of RM and the RMP, investigate how the sector manages risks and facilitate the use of RM focused on the construction industry.

## I. INTRODUCTION

Risk management (RM) is a concept which is used in all industries, from IT related business, automobile or pharmaceutical industry, to the construction sector. Each industry has developed their own RM standards, but the general ideas of the concept usually remain the same regardless of the sector. According to the

Project Management Institute (PMI) , project risk management is one of the nine most critical parts of project commissioning. This indicates a strong relationship between managing risks and a project success. While RM is described as the most difficult area within construction management its application is promoted in all projects in order to avoid negative consequences.

One concept which is widely used within the field of RM is called the risk management process (RMP) and consists of four main steps: identification, assessment, taking action and monitoring the risks. In each of these steps, there are a number of methods and techniques which facilitate handling the risks.

Many industries have become more proactive and aware of using analyses in projects. Likewise, RM has become a timely issue widely discussed across industries. However, with regard to the construction industry, risk management is not commonly used .More construction companies are starting to become aware of the RMP, but are still not using models and techniques aimed for managing risks. This contradicts the fact that the industry is trying to be more cost and time efficient as well as have more control over projects. Risk is associated to any project regardless the industry and thus RM should be of interest to any project manager. Risks differ between projects due to the fact that every project is unique, especially in the construction industry. However there are still many practitioners that have not realized the importance of including risk management in the process of delivering the project .Even though there is an awareness of risks and their consequences, some organizations do not approach them with established RM methods.

The construction industry operates in a very uncertain environment where conditions can change due to the complexity of each project. The aim of each organization is to be successful and RM can facilitate it. However it should be underlined that risk

management is not a tool which ensures success but rather a tool which helps to increase the probability of achieving success. Risk management is therefore a proactive rather than a reactive concept. Many previous studies have been conducted within the field of RM but each presents a different approach to this concept. The research in this master thesis focuses on the construction industry and how the subject is practiced in the everyday operation. The concept of RM is presented in a systematized project life cycle (PLC) approach to show differences between elements of RMP in different project phases. The research for this study was conducted together with a consultancy company working with construction project management, which consults a variety of construction projects. This organization works with risks in a way that they are aware of risks, but do not use any specific structured methods to handle them. However, they believe that a projects performance can be improved by implementing risk management methods. At the time when research was conducted, the company was working on a Hospital project (Aditya Birla, Memorial Hospital) in Thergaon Pune, which is the case study in this thesis. The project was chosen in order to investigate the practices of risk management across project organization.

## II. RESEARCH SIGNIFICANCE AND OBJECTIVES

The development of infrastructure is one of the most important activities that can boost up the business of various industries, thereby increasing the gross domestic product (GDP) of a country. Due to this fact countries stress on infrastructure development and provide finances for the same in their short term and long term financial plans. The vastness of construction projects leaves a lot of scope for various environmental, socio- political and other unforeseen problems during conceptual phase, land expropriation, and execution leading to time and cost overruns in projects and compromise in quality. The cost overruns can be of huge magnitude in a project involving a large amount of money. The loss of services given by the project during the time in which the project overruns can be enormous if put into monetary terms. Hence, to reduce the losses, efficient management of a construction project is required. Application of various project management techniques have to be made from the conception to the completion stage, which include managing various risks associated with the project in its every stage. Risk management becomes an important part of project management. The construction industry,

perhaps more than most of other industries, is overwhelmed by risks. If these risks are not dealt with satisfactorily there is a maximum likelihood of cost overruns, time delays and low quality, resulting in dissatisfaction of clients and public. In India, like other developing countries less importance is given to this aspect of project management. The basic aim of the current research is to identify and assess the current risks and uncertainties in the construction industry around the globe; and to evaluate the current state of risk management practices in India and make a basis for future studies for development of a framework for effective risk management which can be adopted by prospective foreign and local investors, developers and contractors in India.

## III. METHODOLOGY

In this paper, at the outset, general focus has been made on the general concepts of project risk management. A Questionnaire was developed by going through literature on construction risk management. A discussion was made with personnel working for the construction industry in India to identify and assess, the risk factors relating to construction industry in India.

## IV. CONCEPTS OF RISK ANALYSIS AND MANAGEMENT

The concept of risk is multi-dimensional. In the context of construction industry, the probability that a definite factor detrimental to the overall project occurs is always present. A lack of predictability related to the consequences of a planning situation and the associated uncertainty of estimated outcomes leads to the consequence that results can either be better than expected or can be worse. In addition to the different definitions of risks, risks can be categorized for different purposes as well. The broad categories of construction risks are external risks and internal risks; while some other categories curtail risks as political, social and safety risk etc.

*1) Project Risk:* Risk management in a project encompasses the identification of influencing factors which could negatively impact the cost schedule or quality objectives of the project, quantification of the associated impact of the potential risk and implementation of measures to mitigate the potential impact of the risk. The riskier the activity is, the costlier will be the consequences in case a wrong decision is made. Proper evaluation and analysis of risks will help decide justification of costly measures to reduce the level of risk. It can also help to decide if sharing the risk with an insurance company is

justified. Some risks such as natural disasters are virtually unavoidable and affect many people. In fact, all choices in life involve risks. Risks cannot be totally avoided but with proper management these can be minimized.

**2) Determination of Risk:** There are two methods to determine risks in a project, namely the qualitative and quantitative approach. The quantitative analysis relies on statistics to calculate the probability of occurrence of risk and the impact of the risk on the project. The most common way of employing quantitative analysis is to use decision tree analysis, which involves the application of probabilities to two or more outcomes. Another method is Monte Carlo simulation, which generates value from a probability distribution and other factors. The qualitative approach relies on judgments and it uses criteria to determine outcome. A common qualitative approach is the precedence diagramming method, which uses ordinal numbers to determine priorities and outcomes. Another way of employing qualitative approach is to make a list of the processes of a project in descending order, calculate the risks associated with each process and list the controls that may exist for each risk.

**3) Factors affecting Risk:** Several factors expose projects to normal than higher risk.

*a) History:* Newer projects pose more risk because the process has not been refined with the passage of time. If a project of similar nature has been done many times before, then the likelihood of success with the current project is also enhanced.

*b) Management Stability:* Management stability means that the whole management team shares the same vision and direction, thereby leading successful achievement of goals. If the management is unstable then it can lead to unrealistic and impractical schedules for the project and inefficient use of resources.

*c) Staff expertise and experience:* In the event that the members of a project team lack the direct working knowledge and experience of the area, there is a likelihood of time delays, estimated cost upsets and poor quality.

*d) Team Size:* In case of large teams, the probability of problem occurrence increases due to the team size. One of the reasons can be the difficulty of communication due to the large team size.

*e) Resource Availability:* If the availability of resources is easy, the probability of responding to

problems in real time also increases. For example, easy availability of money makes securing human, material and equipment resources easy on as needed basis. However, an abundance of resources does not provide guarantee against risks, all it does is to equip the project team with the tactics to respond to risks.

*f) Time Compression:* In case of highly compressed time schedule, the risks are magnified in the project. When more time is available, more flexibility is present in the project and there is an opportunity to mitigate and reduce the impact of occurring risks.

*g) Complexity:* In case of a highly complex or sophisticated project, the opportunity of a mistake or a problem is also enhanced.

**4) Types of risks:** Risks can be associated to technical, operational or business aspects of projects. A technical risk is the inability to build a product that complies with the customer's requirement. An operational risk arises when the project team members are unable to work cohesively with the customer. Risks can be either acceptable or unacceptable. An unacceptable risk is one which has a negative impact on the critical path of a project. Risks can either have short term or long term duration. In case of a short term risk, the impact is visible immediately, such as a requirement change in a deliverable. The impact of a long term risk is visible in the distant future, such as a product released without adequate testing. Risks can also be viewed as manageable and unmanageable. A manageable risk can be accommodated, example being a small change in project requirements. An unmanageable risk, on the other hand, cannot be accommodated, such as turnover of critical team members. Finally, the risks can be characterized as internal or external. An internal risk is unique to a project and is caused by sources inherent in the project; example can be the inability of a product to function properly. Whereas, an external risk has origin in sources external to the project scope, such as cost cuts by senior management. Risks associated with the construction industry can be broadly categorized into:

*a) Technical risks:*

\*Inadequate site investigation

\*Incomplete design

\*Appropriateness of specifications

\*Uncertainty over the source and availability of materials.

*b) Logistical risks:*

\*Availability of sufficient transportation facilities

\*Availability of resources-particularly construction equipment spare parts, fuel and labor.

*c) Management related risks:*

- \*Uncertain productivity of resources
- \*Industrial relations problems

*d) Environmental risks:*

- \*Weather and seasonal implications
- \*Natural disasters

*e) Financial risks:*

- \*Availability and fluctuation in foreign exchange
- \*Delays in Payment
- \*Inflation
- \*Local taxes
- \*Repatriation of funds

*f) Socio-political risks:*

- \*Constraints on the availability and employment of expatriate staff
- \*Customs and import restrictions and procedures
- \*Difficulties in disposing of plant and equipment
- \*Insistence on use of local firms and agents

**5) Common sources of risk in construction projects:**

The common sources of risks in construction industry are listed below:

- \*Changes in project scope and requirements
- \*Design errors and omissions
- \*Inadequately defined roles and responsibilities
- \*Insufficiently skilled staff
- \*Subcontractors
- \*Inadequate contractor experience
- \*Uncertainty about the fundamental relationships between project participants
- \*New technology
- \*Unfamiliarity with local conditions
- \*Force majeure

**6) Major processes of project risk management:**

Risk management involves four processes namely:

*a) Risk Identification:* Determination of most likely risks affecting the project and documentation of characteristics of each risk.

*b) Risk quantification:* Assessment of risks and the possible interactions of risks with project activities to evaluate the possible outcomes of the project.

*c) Risk response development:* Definition of response steps for opportunities and threats associated with risks

*d) Risk response control:* Response to the changes implemented to remove risks throughout the project duration

**7) Response to risk:**

There are five categories of classic risk response strategies: accepting, avoiding, monitoring, transferring and mitigating the risk.

*a) Accepting the risk:* This category implies to understand the risk, its consequences and probability of occurrence, and not doing anything about it. The project team will react to the risk in case of occurrence. This strategy is commonly used in cases when the probability of a problem occurrence is minimal. This strategy makes sense for cases when consequences are cheaper than the cure.

*b) Risk quantification:* Risk can be avoided by not doing part of the project which contains risk. Scope of the project is changed in this manner, which might change the business case as well, since a scaled down product could lead to lesser revenue or cost saving opportunities. More risk is involved with high return on an investment. Avoiding risks on projects can have same effect on low risk, low return projects.

*c) Monitor the risk and prepare contingency plans:*

Risk can be monitored by employing a predictive indicator to watch the project as it approaches a risky point. The risk strategy is to monitor the risk by being part of the test team. Contingency plans are the alternative courses of action prepared before the risk event occurs. The most common contingency plan is to set aside extra money, a contingency fund, to draw on in the event of unforeseen cost overruns. Contingency plans can be looked on as a kind of insurance and, like insurance policies, they can be expensive.

*d) Transfer the risk:* In order to transfer the risk in a project, many large scale projects purchase insurance for risks ranging from theft to fire. By doing so, the risk is effectively transferred to the insurance company in such a way that if a disaster occurs, the insurance company would be liable to pay the costs associated with the disaster.

Insurance certainly is the most direct method of transferring risk; however, there are other methods as well. For example, a fixed price contract with a contractor states that work will be done for a pre-specified amount. Fixed schedule can also be added to such a contract, and penalties are imposed in case of overruns. Thus these measures effectively transfer cost and schedule risks from the project to the subcontracting firm and any overruns will be the responsibility of the sub-contractor. The only drawback in this case is that the sub-contractor knowingly makes a higher bid to make up for the risk he is assuming. Risk can also be transferred by hiring

an expert. Transferring risk to another party has advantages, but it also introduces new risks.

e) *Mitigate the risk*: Mitigation is process of response to the risk after it has affected the project. Mitigation covers all actions the project team can take to overcome risks from the project environment.

8) **Advantages of risk management**: Following are advantages of risk management:

- a) Achievement of objectives
- b) Shareholders reliability
- c) Reduction of capital cost
- d) Less uncertainty
- e) Creation of value

9) **Limitations of risk management**: In the event of improper assessment of risks, important time can be wasted in dealing with risk losses which are unlikely to occur. If too much time is spent on the assessment and management of unlikely risks, then important resources can be diverted which otherwise could have been very profitable. Unlikely events can occur, but if the likelihood of the risk occurrence is too low, then it is better to retain the risk and deal with the result if the risk in fact occurs.

## V. LITERATURE SURVEY

A lot of researches have been undertaken in the field of risk management in construction industry in the past. Conclusive remarks of the few are narrated as follows:

1) According to Akintoye and Macleod, risk analysis and management in construction industry is dependent on three factors; experience, judgement and intuition of team members. Unfortunately, formal activities to analyze and manage risk are rarely used in construction industry. The main reason for this is the ignorance of project teams towards such techniques and the associated myths that these techniques are unsuitable to be used in the construction industry.

2) Uher and Toakely studied cases from Australian construction industry where risk management was used in the conceptual phase of project development. They found that although a majority of respondents had familiarity with risk management processes and techniques; but despite their willingness to adapt these techniques, they were rarely employed in the conceptual phase of projects.

3) In a survey on international construction joint ventures by Lei Bing three main groups were made to identify risk factors; external, internal and project specific. The study examined some cases where risk

mitigation measures were used effectively, for risk management, by construction professionals in East Asia. An international survey of contractors revealed that the most critical risk factors existed in the financial aspects of joint ventures, government policies, economic conditions, and project relationships. When a local company enters a foreign construction market by forming a joint venture with a foreign company, risks could be reduced by a careful selection of the partner and by a careful drafting of the contract agreement. The right staff and sub-contractors must be chosen, good relationships must be established and fair construction contracts be secured with the clients.

4) Hastak and Shaked conducted a study in which they made three broad categories of construction risks; project, market and country level risks. Country risks are associated with macroeconomic stability of the country and are linked with the monetary and fiscal policy of the country and the resistance of the country against economic variability. Market level risks arise from foreign risks, include technical advantage of the firm over local competitors, availability of construction related resources and government support at both local and foreign level towards construction industry. Project level risks are specific to the project activities, and they include improper project design, safety measures for construction site, constraints of logistics, improper control of quality and environmental protection etc.

5) The study by Wand and Dulami identified twenty eight risks related to construction projects in developing countries. They categorized the risks into three levels; country, market and projects. Twenty two risks were deemed as critical or very critical based on a seven degree rating scale. The top eleven critical risks are (in no particular order); termination of joint venture, influence of government on disputes, policies of government, interest and inflation rates, corruption, cost overruns, political instability of the country, credit worthiness of local partner, enforcement of justice, changes in law and permit approval. The three types of risks have precedence in terms of criticality over one another; county risks being most critical, project risk being least critical of the three and market risks lying somewhere in the middle. For identified risks, practical measures of risk mitigation were found to be effective by the respondents, using a seven point rating scale. The respondents suggested that in order to effectively mitigate a task, the measures leading to higher effectiveness should be prioritized in implementation. Since the risks at higher hierarchy level are more critical, risk mitigation measures should also make

use of this prioritization and risks at higher level (i.e. country and market level) must be mitigated before moving on to risks at lower level i.e. project risks.

6) Ling and Hoi investigated the risks faced by Singapore based architecture, engineering and construction (AEC) firms in India. They also investigated the techniques used for risk response by these firms. Their in-depth interviews with Singaporean experts working on AEC projects in India revealed that the main risks faced by AEC firms were; huge differences of culture between the expatriates and Indians, exchange rate of currency and its fluctuations, high financing cost, political and social risks. The techniques used for responding to risks were to obtain effective insurances and carefully plan and manage all risk response activities.

## VI. QUESTIONNAIRE STRUCTURE

Risk factors for this study are classified into eight categories namely:

- 1) *Financial risks*
- 2) *Legal risks*
- 3) *Management risks*
- 4) *Market risks*
- 5) *Policy and political risks*
- 6) *Technical risks*
- 7) *Environmental risks*
- 8) *Social risks*

## VII. ANALYSIS OF SURVEY RESULTS AND DISCUSSION

**1) Evaluation of risk analysis techniques:** The findings from the survey indicate that a major portion of construction companies in India deal with project risks on basis of their experience, judgment and intuition. The reasons provided by the companies for not using risk analysis techniques are listed below:

- a) The majority of risks is subjective and is related to contracts or construction processes. These risks are better dealt on the basis of previous experience.
- b) Risk management techniques require valid data to be available, which is difficult to implement.
- c) The clients seldom require risk analysis of construction projects. They expect the project management function to manage and mitigate risks.
- d) Doubts are present related to the applicability of risk response techniques to construction industry.
- e) The companies are unfamiliar with techniques of risk management.
- f) The degree of sophistication involved in the techniques is unwarranted if compared with project size.

**2) Evaluation of risk response practices:** The results of this research reveal that the two most utilized measures by Pune based contractors are risk elimination and risk transfer. The study also revealed that in case of the companies trying to eliminate risks, they either do not bid for a job or they bid at a very high price. Majority of contractors transfer the risk by subletting the contract. The general contractors use both risk transfer and risk elimination in their projects, but their preferred choice, in the event that expected loss of a risk is high, is to transfer the risk to a specialty sub-contractor. Although, the practise of risk transfer is accepted in the case when the other party has better capability of dealing with it, but the situations where all risks are transferred point towards lack of creativity and innovativeness. Some of the respondents interviewed for the study revealed that this lack of innovation leads to delays in projects, unacceptable quality and low productivity. Public sector organizations concerned with construction industry accept and reduce minor risks by contingency plans.

## VIII. CONCLUSION

Formal risk analysis and management techniques are rarely employed by Indian construction industry owing to the lack of experience and knowledge in the area. The industry also holds disbelief that these techniques are suitable to be employed in construction projects, much in the same manner as employed in other industries. The perception of risk by contractors and consultants is mostly based on their intuition and experience. The most utilized risk response measures are risk elimination and risk transfer. However, the respondents have revealed that these practices cause the problems of delays, low quality and low productivity in projects.

## IX. RECOMMENDATIONS

Majority of contractors and construction managers in Indian construction industry is unaware of formal risk management techniques. In light of this finding, it is imperative to educate these professionals about risk management, and thus a formal and informal system of risk management training needs to be developed. Graduate level education in construction project management should be used to provide formal education on the topic. Informal education could be provided by career development programs and trainings, like risk management awareness programs. Such trainings can be organized by academic

institutions or professional organizations such as Indian Engineering Council and Institute of Engineers India, public sector organizations and engineering universities. Providing such education will yield long term benefits and will be considered as a step in the right direction. Further researches in this area are welcome and can be done to develop a generic risk management model for construction industry at both global and national level. Such model can help contractors in the correct identification and classification of risk as either controllable or uncontrollable. It can also help them in the correct measurement of impacts of risks and probabilities of risk occurrence. In addition to this, the model could also help the contractors in deciding under different circumstances when to avoid risks, retain them, try to reduce them by taking preventive steps or transfer them to a third party which could handle them in a better manner. Such a model will definitely lead to an increase in profitability and help the companies, employing it, in maintaining a competitive advantage.

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