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Assessing and managing potential risk in industrial construction

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ABSTRACT

Risk is defined as the problem or issue which is expressed in the form of probability with its chance of occurrence and the severity of the impact it can cause. Risk is used in many different ways and with many different words, such as hazard or uncertainty. Every activity has a degree, characterized by the presence of risk. Risk management is an important step in project success. It is the process of identifying, classifying, analyzing and assessing of inherent risks in a project. The literature survey revealed that the various risks in construction projects have varied impact on the success of the project.

The purpose of the paper is to identify and assess the likelihood of occurrence and degree of impact of the risk factors in Industrial construction and then control the risks by allocation, contribution and mitigation. Risks have a significant impact on a construction project's performance in terms of cost, time, quality and safety. The main objective of this thesis is to gain understanding of the risk factors that could be governing factors in industrial projects and to identify and analyze the various Potential Risks that are associated with the industrial construction. These factors can have either direct or indirect effects which can be found out using Quantitative and Qualitative Methods. Further Statistical Analysis and Software Analysis are carried out. The present thesis aims in identifying risk factors that effects the smooth completion of the project. A total of 180 risk factors were identified and listed under six subgroups. The research also implements Super Decisions Software using the Analytic Network Process (ANP). ANP is the most Comprehensive framework for analysis, which has been used for decision making. Software analysis together with the statistical analysis gives top three risk groups which governs successful completion of project.

Keywords: Risk management, risk factors, risk assessment

INTRODUCTION

Construction is a risky zone in worldwide Risks in construction projects has been recognized as a very important management process in order to achieve the project objectives in terms of time, cost, quality and safety. Project risk management is an integral part of the process which aims at identifying the potential risks associated with a project and responding to those risks. It includes activities which aim to maximize the consequences associated with positive events and to minimize the impact of negative events. It is believed generally that risk in an environment is a choice rather than fate, and the inherent uncertainty in the plans can affect the desired outcome of achieving project and business Goals. Construction risks can be related to technical, management, logistical, or socio-political aspects or can be related to natural disasters. In the domain of project management, some of the critical effects of risks are failure to achieve operational requirements and the required quality, non-completion of the project within stipulated time and estimated cost.

OBJECTIVES & STUDY

The main objective of the thesis is to identify and analysis the various Risk factors that are associated with the construction of industrial

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building which has its effects directly or indirectly by using Quantitative and Qualitative Methods and analyzing it. And also identifying the most suitable model to validate for Industrial Construction.

An attempt is made in this study to identify risk factors which effect the smooth completion of the project. On the basis of literature review and inputs from various project experts and site observation in field condition have been identified and grouped under various categories.

LITERATURE REVIEW

Risk management is a process which consists of identification of risks, assessment with qualitatively and quantitatively, response with a suitable method for handling risks, and then control the risks by monitoring.(Patel Ankit Mahendra, Jayeshkumar R. Pitroda, J. J. Bhavsar, 2013)

The life cycle of a construction project can generally be divided into five stages: feasibility, design, tendering, construction and handling and maintenance.

Different types of risk arise at different stages in construction. Because of the low level of certainty, higher levels of risks would normally occur at the outset of a project, yet the amount of money at stake at the initial stage is also comparatively higher than at other stages. As the project progresses, the level of risk reduces with the increasing level of certainty.

PMBOK describes risk through the notion of uncertainty; however, these two phenomena are not synonymous (Perminova, Gustafsson, & Wikstrom, 2008). According to the Olsson (2007) and Hillson (2004) attempts to link risk with uncertainty based on the distinction between lavatory and epistemic uncertainty in the following couplet:

- Risk is measurable uncertainty.
- Uncertainty is immeasurable risk.

This implies that, when measurable, an uncertainty is to be considered a risk.

METHODOLOGY

In this paper, focus has been made on the general concepts of risk management. Risk identification has been done with the study of literature. The data's are collected from the Site observation. A risk assessment can be done with the aid of qualitative and quantitative analysis. Risk Contribution and Risk Allocation could be planned on the basis of the outcome of the study. Risk Mitigation is the last step in the process of risk management.

RISK MANAGEMENT PROCESS

- **Risk Identification**- It comprises determination of various risk involved, and the events or actions that would adversely the cost, performance, schedule or viability of project. Al-Bahar and Crandal (1990) has defined "Risk Identification as the process of systematically and continuously identifying, categorizing and assessing the initial significance of risks associated with a construction project".
- **Risk Assessment**-The identified risks are evaluated in terms of the probability of occurrence and impact. Risk can be assessed either using quantitative or qualitative analysis.
- **Risk Allocation-**After Identifying and assessment of project risks, the risk are allocated to right place at right time. Flanagan and Norman (1993) have given certain fundamental considerations, which govern the allocation of risk wherein the project manager has to consider how the risk can be effectively controlled and to what extent the risk should be taken care of.
- **Risk Contribution-**In this step, the risk contributes the time cost Quality and Safety in the project. Monitoring and Controlling of risks is necessary for the success of project, improving the reputation of organization.
- **Risk Mitigation**- Risk Mitigation aims at providing efficient response to the identified and analyzed risks. Al-bahar and Crandall (1990) describe risk mitigation strategies as risk prevention, risk reduce, risk transfer and risk Acceptance.

CONCEPTS OF RISK ANALYSIS

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. The list of risk factors identified in the present research is based on literature review and it was further revised on the basis of interaction with the help different project members.

The broad categories of construction risks are technical Risk, Financial Risk, Construction Risk, Socio political Risk, Organizational Risk, Socio political Risk, Environmental Health and Safety (EHS) Risk [1-9].

Quantitative method of analysis

The Quantitative analysis relies on statistics to calculate the probability of occurrence of risk and 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.

Qualitative method of analysis

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 risk associated with each process and the list that controls that may exist for each risk [10-12].

FACTORS AFFECTING RISK

Technical Risk

- Incomplete Design
- Inadequate specification
- Inadequate Site investigation
- Change in scope
- Construction Procedures
- Insufficient Resources Availability
- Human Resources Management Challenges.

Construction Risk

- Labour Productivity
- Labour Disputes
- Site Condition
- Design Changes/inaccurate BOQ
- Too high Quality Standard
- Incomplete Pre plan
- Delay in Procurement

Organizational Risk

- Contractual Relations
- Contractual Experience
- Attitudes of Participants
- Inexperienced Work force
- Communication
- Budget
- Schedule impact

Financial Risk

- Increased material cost
- Low Market Demand
- Exchange Rate Fluctuation
- Payment Delays
- Operational Risk
- Time Risk
- Profitability Risk

Socio Political Risk

- Changes in Laws and Regulations.
- Pollution and Safety Rules
- Bribery/ Corruption
- Law and Order
- Requirement for Permits and Approval
- Difficulties in disposing plant and equipment.

Environmental Health and Safety Risk

- Natural Disasters
- Weather Implications
- Sudden Unforeseen Events
- Environmental Analysis incomplete (EAI)
- Improper Safe Work Method Statement
- Site Unsafe Condition
- Poor Monitoring

STATISTICAL METHOD

Methods of collecting, summarizing, analyzing and interpreting Quantitative data to discover its patterns, relationships, and trends.

Ranking method

From site observation, various potential risk factors affecting the progress of the project and the frequency of occurrence of those risk factors are identified. Based on their frequency of occurrence, the various potential risks are ranked.

From the result of Ranking Method

Table 1

S.No	Stage	Risk	Risk factor	%
1	Planning Stage	EHS Risk	EAI	37.19%
2	Execution Stage	EHS Risk	Improper safety training	27.51%

Mean Median Mode Method

Mean can be calculated by using the relation consisting of terms median and mode. From the results of mean the risk factors are ranked with higher value of mean as major risk

$$\text{Mean} = \frac{3Median - Mode}{2} \quad Median = L + \left(\frac{\frac{N}{2} - F}{f}\right) \text{XC}$$

$$Mode = L + \left(\frac{f_1}{(f_1 + f_2)}\right) * \text{C}$$

From the Result of Relation between Mean Median Mode analysis

Table 2

S.No	Stage	Risk	Mean
1	Planning Stage	Socio Political Risk	37.5
2	Execution Stage	Socio Political Risk	52.5

Spearman Ranking Correlation

$$\rho = 1 - \frac{6\sum di^2}{n(n^2 - 1)}$$

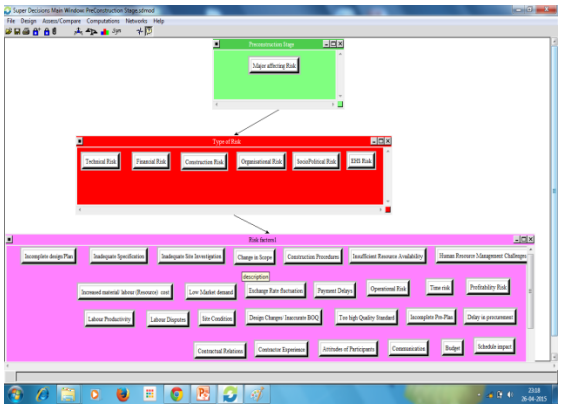
From the ranking analysis, risk groups are shorted out and correlation existing between groups are found out and correlated with each other. And based on evaluation results are arrived and plotted which causes and provide major effect over the project

Table 3

S.No	Stage	Risk
1	Planning Stage	ConstructionRisk
2	Execution Stage	Construction Risk

Super Decisions Software

The Super Decisions Software implements the Analytic Network Process. This Program was working for the Creative Decisions Foundation. The first step involves the creation of clusters within which nodes are created. The label of each node indicates the risk parameters involved in the particular process. The order of hierarchy is maintained which is similar to that of a network diagram. Once the nodes are created inside the clusters to form the network, the next step is to compare the various nodal values. These comparisons would be taken up for each pair of the nodes starting from the top to the bottom clusters.



The Result gives the most influential parameter based on the validation results of the input data are given below

S.No	Stage	Risk group	Validation Result
1	Planning Stage	Construction Risk	0.819
2	Execution Stage	Socio Political Risk	0.190

CONCLUSION

This research attempted to identify key risks associated with the achievement of all project objectives in terms of cost, time, quality, environment and safety. The key risks were highlighted on a comprehensive assessment of their likelihood of occurrence and level of impacts on project objectives. From the analysis done, the highly sensitive risk group can be identified. And also the risk factor which affects the most from that group is determined. The most influencing risk group is **Socio political Risk/Construction risk** and it majorly affects the industrial construction to a larger extent than other risk factor groups.

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