

A Comprehensive Study on FMEA: A Tool for Construction Risk Management

Nikita Garg¹, Vijya Saxena²

Assistant Professor^{1,2}

Department of Civil Engineering

R. N. Modi Engineering College, Kota

Corresponding author's email id: nikita.6957@gmail.com

Abstract

The objective of this paper is to provide risk assessment tool for the construction projects by using Failure mode cause and Effective Analysis (FMEA) .A literature study were done to mitigate various potential risk factors affecting construction productivity at each stages of construction progress. The technique used to identify the potential risk factors is Delphi technique. Using Delphi technique the questionnaire survey was conducted. The project risk mapping has been plotted by using Radar chart to show the perceptions of contractors and project managers on Construction Risk management in ongoing construction projects. It was suggested that Identifying risks in planning stages and assessing their cause and effects, project managers and contractors can easily Identify strategies used to reduce risks. Such early identification helps to minimize major escalations on cost and time overrun in construction projects.

Keywords: *FMEA, Delphi techniques, Risk mapping, Escalations*

I. INTRODUCTION

The Important Thing in project success is the ability to manage the risks continuously. The necessity of this study is to investigate the factors contributing to project risk management in construction

projects and to understand the reasons behind it. The use of Delphi method is to identify the potential factors that contribute to major project cost and time escalations. The survey includes a two or more-round questionnaire .many project

managers have experienced a variety of potential risks over a course of time in the project and they try to avoid the most potential one in the future. Risks vary by type of the construction projects and also the risks changes based on the persons involved in it.

For example a roadway or abridge project may experience different risk than a town house project because of change in construction methodology, complexity in executing works and workmanships involved in it. If the owner attempts to save money in the planning and design stages of the project itself by improper design and feasibility studies, the post construction failure tends to be maximum and moreover the ethical background will be violated.

Construction project involves various variables it is difficult to determine their cause and effect, dependence and correlations hence risk play a very important role in decision making process. Even if the contractor or the project managers are more proactive in the preconstruction stages, the risks in the projects are unavoidable because of external factors the risks in the construction projects can only be

controlled so that major cost and time escalations can be able to be minimized.

In this connection, Risk management in construction projects becomes necessary. Risk management process can be summarized can be four categories and they are Risk Identification, Risk Quantification, Risk Response and Risk Control[1-8].

OBJECTIVE

The main objective of this research is to investigate the factors contributing to risks in construction projects and also to explore the potential risk factors causing severity by using failure mode and effective analysis.

LITERATURE SEARCH

This Study mainly discusses the critical risk factors through comparative study of various international construction projects. The potential Risk Factors of construction Projects include Scope and design changes, Technology Implementation ,Site conditions and Unknown Geological Condition ,Inflation, Country Economic Condition and rules and regulation, unavailability of funds, Financial failure Inadequate managerial skills, improper coordination between teams ,Lack of availability of resources, Weather and

climatic Conditions ,Statutory clearance and approvals ,Poor Safety procedures, Construction Delays[1]. the risk of Project management includes risks of procurement, factors of clients, factors related to design team ,factors of contractors, factors of project managers, factors of business environment[2] Risk include Political, economical, social, climate, time, cost, quality, technical ,building ,resources ,project team members ,project location ,documents[3].

The risks on project include Decision making consequences, engineering experience, completeness of project information, external information criticality decision motivation, professional knowledge [4]. the study on risks on were uncertain and it mainly depends on Project team discussions on risk , Revision of price, Time for planning, Disputes between labours ,Safety of workers[5].The risk involved in the construction projects include problems that have the potential of causing harm and loss to people, property, or other interests[6].

The study was carried out particularly to identify construction project risk and outcome is a list of risk factors under the category of design, procurement, technical, construction, legal, environmental, project

management, financial, construction and political risks. Based on above factors identified the study can be carried out to understand criticality of each factor and their probability of occurrence. That kind of study will help the construction industry to work on certain important and most critical factors so that risk can be properly managed.

RESEARCH METHODOLOGY

Failure Mode Methodology

The Risk assessment process for carrying out FMEA can be divided into several steps are Conduct of comprehensive literature study to identify typical risk factors in construction projects. And to list the risk factors and categorize the identified risk factors. then the severity, Probability of occurrence and detectability ranking of risk factors has to be accessed by using Delphi techniques.

Severity ranking is based on the effects of risks occurrence ranking is based on the causes of risks and the detectability ranking is based on the current controls that the current control able to minimize the risks are not. Finally the Risk Priority Number of the Risk Factors are calculated to access the potential key risk factors.

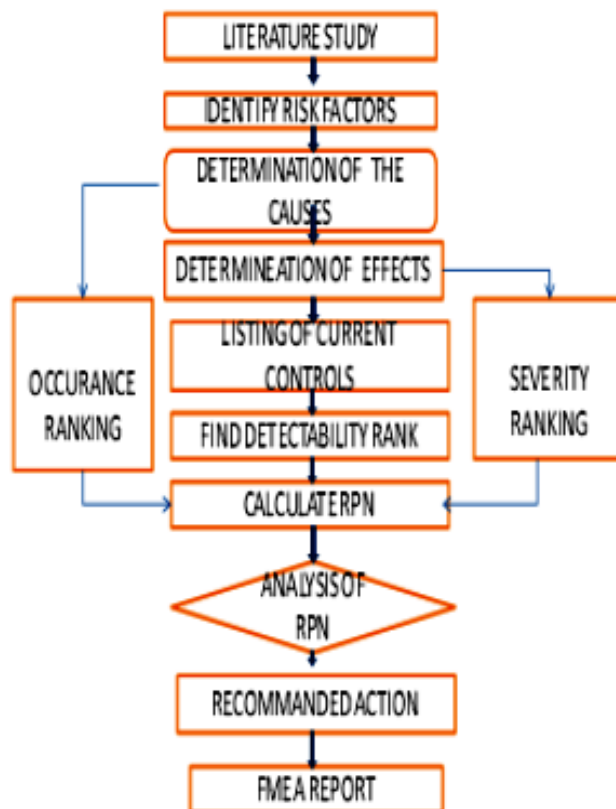


Fig.1. Failure Mode Effective Analysis Methodology

Data Acquisition Process

Delphi is a collective Judgment processes. The persons involved in Delphi studies only give estimations. For the participation experts a Delphi panel has been formed consisting of 5 to 18 members are to be involved who on the basis of their knowledge and experience are able to assess in a competent way. In this study 12members were selected who are project managers and contractors .they were equal in number and At each round the results of the previous round will be updated to the panel experts, During the rounds, they have the opportunity to gather new

information. The FMEA worksheet will be distributed to the construction contractors and project managers and the severity, occurrence and detectability ranking of each risk factor will be collected from them. Also the cause, effect and current controls must be reviewed by project team leaders to enhance the reliability of work done in brainstorming sessions.

RESULT AND DISCUSSIONS

First Phase Survey

In the phase one, the Ten Major Risk factors Containing the questionnaire were distributed to the Delphi panel members.

At first the importance of the study, failure mode and effective procedure were detailed to the Delphi panel members and they were asked to rank. The results of round one were shown below. See Figure: 1

In the second phase survey, The questionnaire were modified by adding the results of previous survey. The experts should answer the questionnaire based on the opinions of other experts who are well professional in the construction domain.

Second Phase Survey

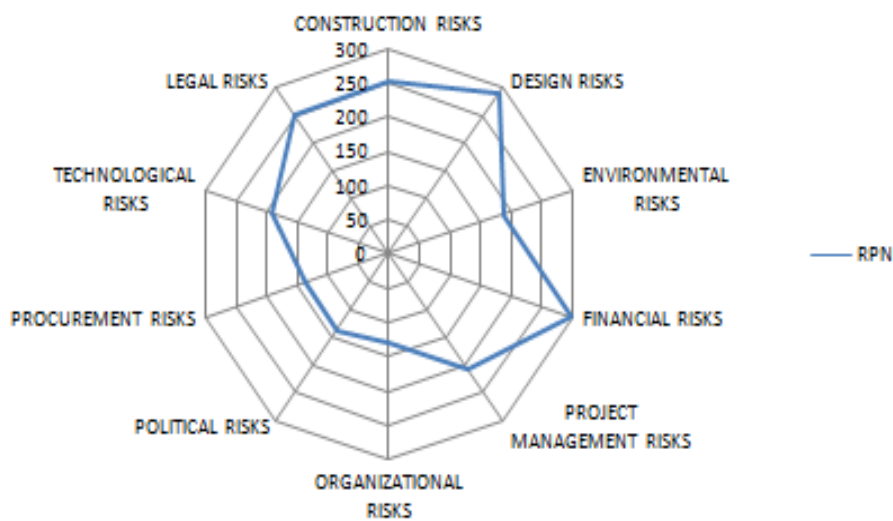


Fig. 2 Risk mapping of first phase survey

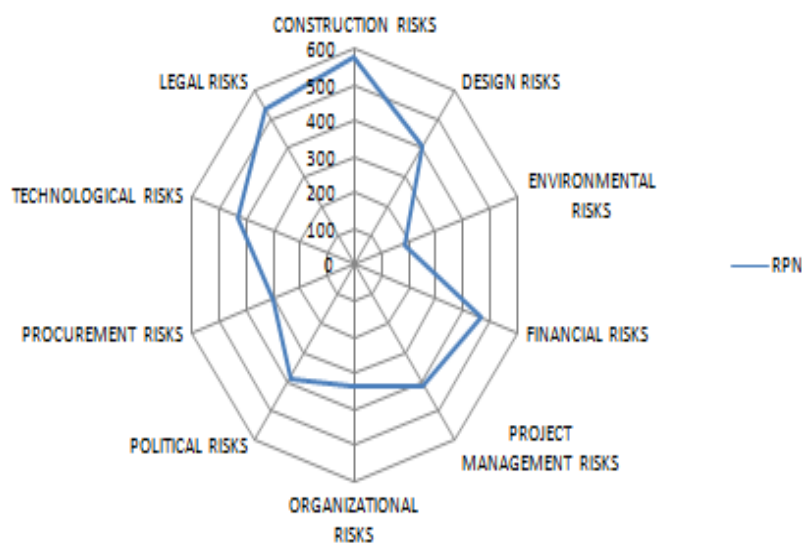


Fig. 3 Risk mapping of second phase survey

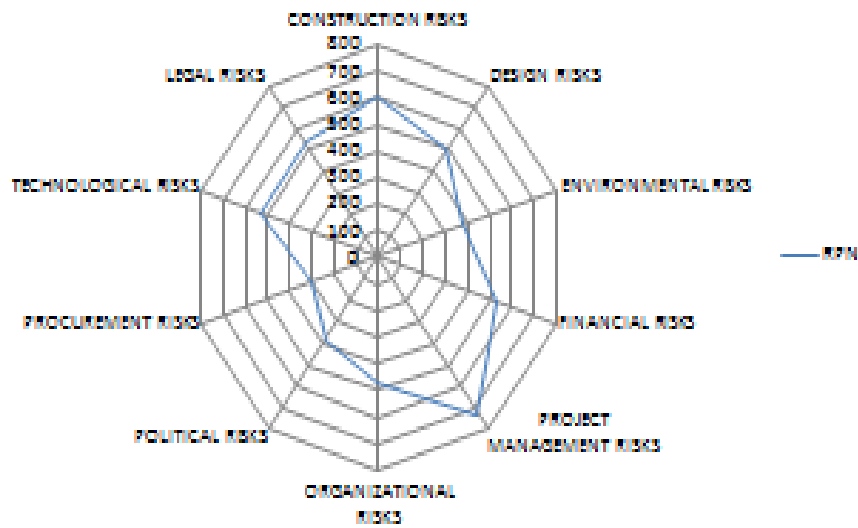


Fig. 4. Risk mapping of third phase survey

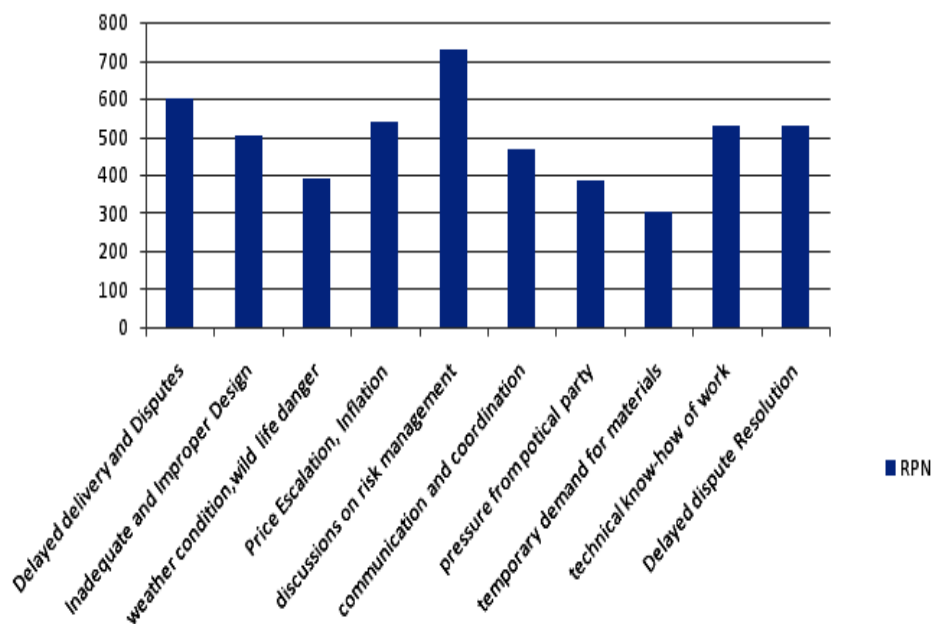


Figure: 5

Third Party Survey

In the third phase survey, the results were analysed, It was noted that project management risks gain the maximum risk priority number. It has been identified that risks faced in construction stages are more complex because it could reflect the faults

which carried over in preconstruction stages and design stages.

ANALYSIS AND RESULTS

The Potential Risk Factors that was Identified are analysed and the sub risk factors that were contributing to major

project risks are also identified by using Brainstorming sessions and Delphi technique are Delayed delivery and disruptions, inadequate and improper design, weather condition and danger to wildlife, Price Escalations and inflation, decisions on risk management, communication and coordination among project team members, temporary demand for Raw materials, technical know-how and delayed dispute Resolutions. The ranking for the sub risk factors are shown above

CONCLUSION

Construction Risks are more probable in the construction phase and post construction phase without proper planning in the pre-construction and also in design stages of the project. The study was used to identify the potential risk factors that contribute to major risks or loss of resources involved in construction projects. The severity of risks were also involved in the project based on the personnel who mitigate it in early stages and provide proper barrier to control it and avoid the progress of risks in next stages. Risks in the project can be controlled and can be avoided based on the approach of the manager to risks who handle the project effectively and efficiently. The perceptions of the manager

and the contractor to risks is very much important hence it could reflect in success of the project and in gaining profits.

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