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# Application of Risk Management Theory in Construction Project

Mr. Pushkaraj P. Pawar, Prof. Rahul D. Shinde

## DEPARTMENT OF CIVIL ENGINEERING

RMD SINHGAD SCHOOL OF ENGINEERING, WARJE, PUNE-58

# ABSTRACT

Application of risk management has become very essential in business life cycle. Various industries & companies develop their own way of analysis & standard procedure for creating a full proof zero risk model for business. Indian construction industry has been constantly evolving with respect to techniques & tools for becoming efficient day by day & tools for becoming efficient day by day. Projects in construction industry are widely complex having considerable amount invested and project. Risk identification & reduction should be priority of a project manager. This master thesis presents implementation of the early stage of project life cycle. For examination purpose a residential building project was chosen for case study and interviews carried out simultaneously. This research also represents how risk change during project construction progresses, this thesis also explains the basics of available tools/theories for calculating risk management. Techniques such as Probability theory, Certainty factors, dempster shafer theory of evidence, Fuzzy logic are discussed within. It is also Concluded that the nature of risks under consideration is must in selection of techniques.

Keywords: Risk Management Theory, Construction, risk management, Fuzzy logic.

#### I. INTRODUCTION

Risk management plays key role in all industries either it is technology or pharmaceutical, automobile or construction related. Each industry has well developed their risk management standards. Project Management institute (PMI) has itself stated that project risk management is one of the nine most difficult part of project execution. Which indicates a strong relationship between managing risk and project success, the basic concept remains unchanged across sectors? It is applicable to all projects in order to avoid non positive consequences.

Concept, which is widely applied in the field of Risk management process, has four steps as mentioned below:

- Identification
- Assessment
- Action
- Monitoring risk

For above mentioned steps there are various tools/ techniques which facilitate handling risks

There is huge awareness in all sectors & are using analysis in projects considering construction industry, risk management is not used always. Construction industries are getting aware of 'Research Management' process but fail to implement same for managing risk. Which is contradictory to the fact that the industry is getting more time cost efficient as it is related to each other and trying to gain more control over the projects as well as resources.

Risk is attached to every project and it comes along with it regardless of the sector and it should also be responsibility of the project manager. Risks keep on changing as per projects because every project is different particularly in construction sector, still many entrepreneurs has not yet realized the need of risk management in the cycle of project completion

Although there is awareness of risk and its impacts some organizations remain neutral and avoid approaching them with established RM tools.

#### **Purpose:**

This master thesis has goal to calculate hoe the RMP is used in construction industry and how professionals are managing risk in day-to-day situations. RMP theory will be matched to the on-going process to identify similarities and dissimilarities.

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The main purpose is to know whether the construction sector is working with risk management as it is described in literature about the methods and techniques presented further.

To achieve this goal following questions has been raised to safe guard the goal:

- How risk changes during project phase?
- How risk management is achieved in projects?
- How risk management process is used?

#### **II. LITERATURE SURVEY**

Name: Fuzzy Logic and Fuzzy Hybrid Techniques for Construction Engineering and Management

Authors: Aminah Robinson Fayek, Ph.D., P.Eng., M.ASCE Conference details: 10.1061/(ASCE)CO.1943-7862.0001854. This work is made available under the terms of the Creative Commons Attribution 4.0 International license, https://creativecommons.org/licenses/by/4.0/.

Summary: Fuzzy logic and fuzzy hybrid techniques are essential to many aspects of construction modelling and decision support, especially when these involve expert judgment and subjective uncertainty. Fuzzy logic has been applied in construction for at least four decades; however, more recent applications recognize its limitations.

Name: Fuzzy Randomness Simulation of Long-Term Infrastructure Projects

Authors: Meghdad Attarzadeh, Ph.D.; David K. H. Chua, Ph.D., M.ASCE; Michael Beer, Dr.Eng., M.ASCE; and Ernest L. S. Abbott, Ph.D.

Conference details: J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng. 3 (3): 04017002. https://doi .org/10.1061 /AJR UA6.0000902.

Summary:. The conventional simulation model used in the prediction of long-term infrastructure development systems such as public-private partnership (PPP)-build-operatetransfer (BOT) projects assumes single probabilistic values for all of the input variables. Traditionally, all the input risks and uncertainties in Monte Carlo simulation (MCS) are modelled based on probability theory. Its result is shown by a probability distribution function (PDF) and a cumulative distribution function (CDF), which are utilized for analysing and decision making. In reality, however, some of the variables are estimated based on expert judgment and others are derived from historical data. Further, the parameters' data of the probability distribution for the simulation model input are subject to change and difficult to predict. Therefore, a simulation model that is capable of handling both types of fuzzy and probabilistic input variables is needed and vital. Recently fuzzy randomness, which is an extension of classical probability theory, provides additional features and improvements for combining fuzzy and probabilistic data to overcome aforementioned shortcomings. Fuzzy randomness-Monte Carlo simulation (FR-MCS) technique is a hybrid simulation method used for risk and uncertainty evaluation. The proposed approach permits any type of risk and uncertainty in the input values to be explicitly defined prior to the analysis and decision making. It extends the practical use of the conventional MCS by providing the capability of choosing between fuzzy sets and

probability distributions. This is done to quantify the input risks and uncertainties in a simulation. A new algorithm for generating fuzzy random variables is developed as part of the proposed FR-MCS technique based on the aa-cut. FR-MCS output results are represented by fuzzy probability and the decision variables are modeled by fuzzy CDF. The FR-MCS technique is demonstrated in a PPP-BOT case study. The FR-MCS results are compared with those obtained from conventional MCS. It is shown that the FR-MCS technique facilitates decision making for both the public and private sectors' decision makers involved in PPP-BOT projects. This is done by determining a negotiation bound for negotiable concession items (NCIs) instead of precise values as are used in conventional MCS results. This approach prevents prolonged and costly negotiations in the development phase of PPP-BOT projects by providing more flexibility for decision makers. Both parties could take advantage of this technique at the negotiation table.

Name: Dempster-Shafer Theory of Evidence: Potential usage for decision making and risk analysis in construction project management Authors Taroun, A. and Yang, J.B.

abdulmaten.taroun@postgrad.mbs.ac.uk Conference details: Manchester Business School, The University of Manchester, UK

Summary: This paper has illustrated the limitations of the existing methods and theories which are used for risk assessment in construction industry. It has also provided an alternative risk assessment methodology based on an evidential reasoning and Dempster-Shafer Theory of evidence. To conclude, the existing tools for supporting decision making and risk assessment in construction industry have not fully appreciated the special nature of this industry. Practical experience, personal judgment and intuition are still playing a crucial role in decision making. Besides the technical limitations of any decision making The Built & Human Environment Review, Volume 4, Special Issue 1, 2011 164 methodology, its usability and popularity among practitioners should be a matter of concern. Despite the large number of available DSSs for construction practitioners, unfortunately such DSSs are not widely used. The usual practice, however, is to make decisions on the basis of intuition, derived from a mixture of gut feeling, experience, and guesses (Ahmad 1990). Hence, researchers have to facilitate practitioners' experiences by suitable but robust methodologies.

Name: Probability theory in construction

Authors: E A Okunkova1, I V Sharova2, V N Burkov3, I V Burkova4, D Passmore5 and Z Daulbaeva

Conference details: 1,2 Plekhanov Russian University of Economics, Stremyannyi Pereulok, 36, Moscow, 115093, Russian Federation 3 V.A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, st.Profsouznaya 65, 117997, Russia.

Summary: The article deals with the modeling of logistic processes of construction with the help of probability theory. Random deviations accompany any natural process, and even more so logistic processes in construction. Practice sets such tasks in which various factors play a significant role in

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the processes under consideration, but the number of these factors is so large that it is not always possible to trace cause-and-effect relationships between them. Elements of uncertainty, complexity, multiple causes inherent in random phenomena and processes in logistics, and therefore require special methods for their investigation, study and management. Such methods are developed by probability theory.

Random deviations accompany any natural process, and even more so logistic processes in construction. Practice sets such tasks in which various factors play a significant role in the processes under consideration, but the number of these factors is so large that it is not always possible to trace cause-and-effect relationships between them. Elements of uncertainty, complexity, multiple causes inherent in random phenomena and processes in logistics, and therefore require special methods for their investigation, study and management. The provided model of determination of material stock in warehouses of the construction organizations can be used both for civil, and for industrial construction.



## **III. METHOS AND MATERIAL**

Fig 1. Structure to how to manage risks

A research process consists of series of steps carried one after the another. It begins with finding the data related to research and data collection techniques. At the end the collected data is analyzed & interpreted leading to conclusions.

It is a method or technique for collecting data which involves tools like self-completion, questionnaires or structured interview. For the purpose of this master thesis a qualitative research method has been chosen to give idea about how people experience the application of RM in the complex project organization.

The selection of method should be based on the nature of research problem.

Qualitative methods are based on facts which are socially build based on people's experience.

Qualitative research is an inductive way where theories are created from data collection.

This method is most appropriate for thesis as it uses people's experience. For understanding the application of RM in construction industry the case study was chosen as research design. Case study is in the form of research and is not intended to study of entire organization.

It consists of direct observation of study. The case study in this thesis is a House Construction Project of a residential house of Mr.. Shailesh Jadhav.

## **Data Collection:**

In order to create appropriate data for study of different sources have been used for theoretical background. A literature study was conducted using both scientific articles written by professionals in the field as well as books in the area of project & risk management.

## Case study and interview:

To determine RM theories Residential Project was used as case study. The project was small but it was as task while putting it all together to get an overview of RM practices nearby local contractors, builders were asked for this research.

The respondents were engineers, architects, labors, contractors, builders project managers as well. Semi structured interviews were conducted with people who had active part in the project. It was important to establish connection between different parts of project, so interviews were aligned along the phases of the project. The actual questions interviewed are listed further.

As a follow-up to the questionnaire an on-liner questions were framed and the answers were used to demonstrate how one of the RM methods can be used in practice. For this reason one of the qualitative RM methods, probability & impact assessment was chosen.

The respondents were asked to answer the pre-defined answers regarding each risk they identified in main interview. The number of risk identified varied among respondents.

Respondents were asked to evaluate probability of risk occurrence. Three other questions impact on time cost and quality was evaluated separately. The scale used for assessment of probability from 0.1 to 0.9

0.1(low probability) ,0.9(high probability) possible choices were 0.1,0.3,0.5,0.7,0.9.

Impact was calculated in a range 0.05 (low impact to 0.8 (high impact).

Possible choices 0.05,0.10,0.20,0.40,0.80.

The same scale was used to evaluate impact on all 3 objectives. Results were presented in matrix used for further analysis.

**IV. CASE STUDY** 



Image 1

The picture shows the area which was developed for construction

Having 3 sites,

Site 1 2.8-acre land on which case study was performed in which land stabilization was done prior construction. Which has risk of both land slide and liquification.



Residential house plan for Mr. Shailesh Jadhav



Image 2

This picture shows material unloaded at side for further construction work.



Image 3

This picture behind me shows the area behind me where the land redeveloped has no firm structure and is about to slide easily it was the scene where stability risk was shown accept that ahead rainfall season and previous year, The house that was intended to be build was at risk if no solution was found. Here risk management theory comes in to action. Necessary measures were adopted to bring stability to land prior construction.

The fact that risk management theory is applicable for high budget construction project is true but it can also be applied for the structure in rural areas if such conditions occur.At least risk identification assessment handling these steps can be followed with due respect and its impact with respect to Time, Cost and quality for successful completion of project.



Construction of house of Mr Shailesh Jadhav on redeveloped land near Dange chi wadi pophali



Image 5

Fig 5 shows the road approaching from above side towards construction.

Figure also shows immediate construction at risk due to the land slide probability.

Image shows house construction on re developed land. The soil conditions are making this site unfit for long terms susceptible to landslides settlement etc

As the soil is of granular structure it is less cohesive to withstand the load

For this purpose, stabling the site was priority and monsoon ahead it was of great risk.



Image 6

Shows the land fill above the structure road.

For this purpose, the soil was replaced with murum and tamping was done and allowed it to settle down for few days, nearby loose soil was supposed to be fixed with the help of construction of retaining walls with providing proper drainage to the structure.

Prior this structure construction was started and is towards completion phase.

#### V. COCLUSION

Risk is perceived as a negative term, even though in theory it can have two dimensions. Professionals in the construction industry are using techniques described in the literature concerning RM, but are not aware of it. Risks are being managed every day in the industry, but not in such a structured way as the literature describes. As also other researchers confirmed, the knowledge of RM and RMP is close to zero, even though the concept of risk management is becoming more popular in the construction sector. There is a willingness among respondents to start using RMP, but it has to bring profits to the organization. By applying a simple method, it is possible to identify potential risks in an easy way. Moreover, it gives possibility to detect which of the identified risks has the biggest impact on time, cost and quality. Those risks should be eliminated or mitigated by taking an appropriate action. The research showed that the most common action was risk mitigation. Moreover, it was proven that the results from probability and impact method may differ among projects due to the fact that each project and its scope are unique. It was important to establish during the interview which phase of the PLC the respondents were taking part in and what their role in the project was. Based on that, we could systematize the answers and see types of risks identified in various phases of the PLC. The conclusion was that there are risks which are characteristic for each project stage.

As the research showed, unstructured form of RM is to some extent used in the construction sector. Thus, application of actual RM into companies should not be difficult. As proved by the research, knowledge is the factor which is missing for organizations to implement RM. Thus, this aspect of application of RM could be further investigated in terms of how to facilitate use of RM in a construction sector. Moreover, a simple RM manual could be developed including basic theoretical information as well as ready-to use guidance for one of the RM methods.

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