Journal of Civil Engineering and Environmental Technology
Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 2, Number 6; April-June, 2015 pp. 523-527

http://www.krishisanskriti.org/jceet.html

Module Stimulation of Risk Assessment in Construction Industry

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Abstract—*Construction projects are initiated in complex and dynamic environments resulting in circumstances of high uncertainty and risk, which are compounded by demanding time constraints. Construction industry has changed significantly over the past several years. It is vulnerable to the numerous technical & business risks that often represent greater exposures than those that are traditional. Thus risk assessment need arises. Risk assessment is a tool to identify those risks in a project and manage it accordingly with proper treatment. Risk assessment is defined in this study as a technique that aims to identify and estimate risks to personnel and property impacted upon by a project.The general methodology of this study relies largely on the survey questionnaire which was collected from the local building contractors of different sizes by mail or by personnel meeting. A thorough literature review is initially conducted to identify the risk factors that affect the performance of construction industry as a whole. The survey questionnaire is designed to probe the cross-sectional behavioral pattern of construction risks construction industry.The questionnaire prepared for the pilot survey was formulated by seeing the relevant literatures in the area of construction risk management. This research seeks to identify and assess the risks and to develop a risk management framework which the investors/ developers/ contractors can adopt when contracting construction work in India.*

Keywords: *Risk Assessment, Module, Risk Management, Construction Projects*

1. INTRODUCTION

Construction is often the largest employer in any country (Bust et al., 2008). It has been well documented that a large number of accidents occur in the construction industry (Bust et al., 2008; Camino et al., 2008; Gregory and Simon, 2006; Wang et al., 2006). In modern society, the construction industry has been defined as a dangerous profession (Liao and Perng, 2008; Niza et al., 2008). Construction objects are unique and built only once and risks raises from a number of different sources. In addition, the products of construction differ widely in terms of location, production techniques, materials and the quality of the finished product with respect to space, quality and durability. Managers need to ensure delivery of projects to cost, schedule and performance requirement. To achieve this involves identifying and managing the risks to the project at all project stages from the initial assessment of strategic options through the procurement, fabrication, construction and commissioning stage

.Generally, risk is a choice in an environment rather than a fate. BS 6079 (British Standard Institution 1996) defines risk as 'It is the uncertainty inherent in plans and possibility of something happening that can affect the prospects of achieving, business or project goals'. Risk is present in all the activities in a project; it is only the amount which varies from one activity to another. Evaluating and analyzing the risks of a project and planning to manage them are the most critical steps should be done in the project definition stage. Risk evaluation and analysis were ignored. Only after occurrence of unfavorable consequences of risks, managers of projects could understand the importance of risk management. The track record of construction industry is very poor in terms of coping with risks, resulting in the failure of many projects to meet time schedules, targets of budget and sometimes even the scope of work. As a result, a lot of suffering is inflicted to the clients and contractors of such projects and also to the general public. Project related risk management has attracted steady stream of interest in the academic literature (Bannerman, 2008). One of the major steps in project risk management is to identify and assess the potential risks (El-Sayegh, 2008). Despite many scholars and practitioners recognizing the risk identification methods and assessment models in projects insufficient attention has been paid by researchers to select a suitable risk assessment model. This paper attempts to address this limitation and the gap in the current literature and provide a framework for determining optimal risk assessment model.

The current study is focused on concepts of risk management and will cover the related literature on the topic, development of a survey questionnaire and suggestions related to risk management practices in construction industry of India.

2. CONCEPT OF RISK

Risk is a multi-facet concept. In the context of construction industry, it could be the likelihood of the occurrence of a

definite event/factor or combination of events/factors which occur during the whole process of construction to the detriment of the project a lack of predictability about structure outcome or consequences in a decision or planning situation, the uncertainty associated with estimates of outcomes – there is a chance that results could be better than expected as well as worse than expected etc. In addition to the different definitions of risk, there are various ways for categorizing risk for different purposes too. Some categorize risks in construction projects broadly into external risks and internal risks while others classify risk in more detailed categories of political risk, financial risk, market risk, intellectual property risk, social risk, safety risk, etc.

The typology of the risks seems to depend mainly upon whether the project is local (domestic) or international. The internal risks are relevant to all projects irrespective of whether they are local or international. International projects tend to be subjected to the external risk such as unawareness of the social conditions, economic and political scenarios, unknown and new procedural formalities, regulatory framework and governing authority, etc.

Risk is inherent and difficult to deal with, and this requires a proper management framework both of theoretical and practical meanings. Significant improvement to construction project management performance may be achieved from adopting the process of risk assessment.

The types of exposure to risk that an organization is faced with are wide-ranging and vary from one organization to another. These exposures could be the risk of business failure, the risk of project financial losses, the occurrences of major construction accidents, default of business associates and dispute and organization risks. It is desirable to understand and identify the risks as early as possible, so that suitable strategy can be implemented to retain particular risks or to transfer them to minimize any likely negative aspect they may have.

The risk management process begins with the initial identification of the relevant and potential risks associated with the construction project. It is of considerable importance since the process of risk analysis and response management may only be performed on identified potential risks. Risk analysis and evaluation is the intermediate process between risk identification and management. It incorporates uncertainty in a quantitative and qualitative manner to evaluate the potential impact of risk. The evaluation should generally concentrate on risks with high probabilities, high financial consequences or combinations thereof which yield a substantial financial impact.

Once the risks of a project have been identified and analyzed, an appropriate method of treating risk must be adopted. Within a framework of risk management, contractors also should decide how to handle or treat each risk and formulate suitable risk treatment strategies or mitigation measures. These mitigation measures are generally based on the nature and potential consequences of the risk. The main objective is to remove as much as possible the potential impact and to increase the level of control of risk. More the control of one mitigation measure on one risk, the more effective the measure of risk the process of risk management does not aim to remove completely all risks from a project. Its objective is to develop an organized framework to assist decision makers to manage the risks, especially the critical ones, effectively and efficiently.

2.1 Types of Risk

Risks can be viewed as business, technical, or operational. A technical risk is the inability to build the product that will satisfy requirements. An operational risk is the inability of the customer to work with core team members. Risks are either acceptable or unacceptable. An acceptable risk is one that negatively affects a task on the non-critical path. An unacceptable risk is one that negatively affects the critical path. Risks are either short or long term. A short-term risk has an immediate impact, such as changing the requirements for a deliverable. A long-term risk has an impact sometime in the distant future, such as releasing a product without adequate testing. Risks are viewed as either manageable or unmanageable. A manageable risk is one you can live with, such as a minor requirement change. An unmanageable risk is impossible to accommodate, such as a huge turnover of core team members. Risk factors for this study are classified into eight categories namely.

- Construction risk
- Design risk
- Environmental risk
- Financial risk
- Management risk
- Political risk
- Procurement risk
- Sub-Contractors risk
- Technology risk

3. METHODOLOGY

The general methodology of this study relies largely on the survey questionnaire which will be collected from the local building contractors of different sizes by mail or by personnel meeting. A thorough literature review was initially conducted to identify the risk factors that affect the performance of construction industry as a whole. This study has adopted the more general and broad definition of risk as presented by Shen et al (2001) on China's construction joint ventures and more risk factors from other literature. Also some interviews with industrial practitioners were conducted to produce to check effectiveness of questionnaires. After receiving the responses a model is used to evaluate the risk. The final step is to create a module for risk assessment.

4. QUESTIONNAIRE SURVEY

Questionnaire is a set of printed or online questions with a choice of answers, devised for the purposes of a survey or statistical study. The questionnaire was tested with a pilot survey for clarity, ease of use, and value of the information that could be gathered. The questionnaire survey is divided into two parts. The first part consists of general information like name of the respondent, type of company, experience, designation value of their project e.t.c. and the second part consists of the construction risk factors for evaluation of the risk assessment.38 risk factors are given based upon the pilot study. The questionnaire was prepared for the pilot survey was formulated by seeing the relevant literatures in the area of construction risk. The interviewer was free to ask additional questions that focused on issues arising during the course of the interview. A Likert scale of 1-5 was used in the questionnaire. A Likert scale is a type of psychometric response scale often used in questionnaires, and is the most widely used scale in survey research.

5. FACTORS INFLUENCING RISK

Construction Risk

- Disputes between labours
- Changing sequences in construction activity
- Non availability of resources
- Revision of design
- Availability of camp for labours
- Change in quantities of work
- In Time work permissions for executing work
- Safety of workers
- Stoppage of work due to Medical outbreak example: Madras eyes

Design Risk

- Late changes of design from client side
- Will the level of details of design delivered by the owner affect over all construction time?
- Improper specifications
- Inadequate and incomplete design

Environmental Risk

- Impact of weather condition on completion of project
- Pollution by construction waste
- Procedure to facilitate construction waste cleanup or disposal

Financial Risk

- Delay from clients
- Increment for staff benefits
- Unprecedented price in raw materials
- Fluctuations in Estimated finance than expected

Management Risk

- Documents and process directed as per agreement for mitigation of risk
- Project team discussions on risk
- Use of WBS and project milestones to help identify project risks
- Time for planning
- Loosing of critical staff at crucial point of construction
- Documented process for identifying project risks

Political Risk

- Pressure from any political party
- Local bodies (political/rowdies) compelling to use their resources
- Union Issue

Procurement Risk

- Temporary demand of increase in price of materials
- Specialized labour for fixation/Installation
- Is there a chance of procurement team to know the sales chart of client?

Sub-Contractors Risk

- Chances of sub-contractor walk out
- Delay in work execution of sub-contractor
- Revision of price

Technology Risk

- Knowledge on equipment’s
- Service for damaged equipment’s
- Loss of data or software/hardware of computer

6. DELPHI METHOD

The Delphi technique is a method for systematic collection and collation of judgment from isolated suitable individuals on a specific topic. It is done through carefully designed questionnaires with sections for summaries and feedback from earlier responses. The Delphi technique is done over at least two rounds where the participants get the chance to revise their opinion, through the answers from the earlier questionnaire. After each round the estimates for the variables are collected and summarised along with reason for the estimation. The rounds continue until the estimates stabilises.

7. FUZZY DELPHI METHOD

Fuzzy Delphi Method was proposed by Ishikawa et al. (1993), and it was derived from the traditional Delphi technique and fuzzy set theory. Noorderhaben (1995) indicated that applying the Fuzzy Delphi Method to group decision can solve the fuzziness of common understanding of expert opinions.

The FDM Steps are as follows

- Collect opinions of decision group
- Set up triangular fuzzy numbers. This study used the geometric mean model of mean general model proposed by Klir and Yuan (1995) for FDM to find out the common understanding of group decision. The computing formula is illustrated as follows: Assuming the evaluation value of the significance of No. *j* element given by No. *i* expert of n experts is $w_{ij} = (a_{ij}, b_{ij}, c_{ij})$, i =1, 2, 3….., n, j= 1, 2, 3….m. Then the fuzzy No. *j* element is $w_j = (a_j, b_j, c_j)$, j= 1, 2, 3 …m.

Among which aj= Min $\{a_{ij}\}$

$b_j = 1/n\sum_{i=0}^{n} b$

c_j =Max $\{c_{ij}\}$

- Defuzzification: Use simple center of gravity method to defuzzify the fuzzy weight wj of each alternate element to definite value Sj , the followings are obtained

$$S_j = \frac{aj+bj+cj}{3}$$

- Screen evaluation indexes: Finally proper factors can be screened out from numerous factors by setting the threshold. The principle of screening is as follows:

If $S_j \geq \alpha$, then No. j factor is the evaluation index.
If Sj < α, then delete No. j factor.
α is considered as '2.90'
If $S_j \geq 2.90$, then No. j factor is the evaluation index
If Sj < 2.90, then delete No. j factor

8. RESULT AND DISCUSSION

Most of contractors and construction manager's in Indian construction industry are oblivious of formal risk management techniques. The questionnaire survey is distributed all over the India via online and some interviews, the responses received are mostly from Kolkata, A.P, T.N, etc., Using fuzzy analysis we were able to determine among the 38 factors only 22 risk factors found to be above the threshold limit. Among these 22 risk factors project team discussion on risk was determined to be the highest. Majority of factors after analysis belongs to the Management and Construction risk.

FACTORS	Min	Max	Mean	De Fuzzy
Project team discussions on risk	2	5	3.88	3.63
Revision of price	2	5	3.81	3.60
Time for planning	2	5	3.42	3.47
Disputes between labours	2	5	3.26	3.42
Safety of workers	1.00	5	3.88	3.29
Use of WBS and project milestones to help identify project risks	1.00	5	3.86	3.29
Knowledge on Equipments.	1.00	5	3.86	3.29
Service for damaged equipments.	1.00	5	3.77	3.26
Specialized labour for fixation/Installation	1.00	5	3.44	3.15
Impact of weather condition on completion of project.	1.00	5	3.40	3.13
In Time work permissions for executing work	1.00	5	3.14	3.05
Unprecedented price in raw materials	1.00	5	3.14	3.05
Availability of camp for labours	1.00	5	3.12	3.04
Fluctuations in Estimated finance than expected	1.00	5	3.12	3.04
Loss of data or software/hardware of computer.	1.00	5	3.09	3.03
Temporary demand of increase in price of materials	1.00	5	3.05	3.02
Delay from clients	1.00	5	3.05	3.02
Non Availability of Resources	1.00	5	2.88	2.96
Will the level of details of design delivered by the owner affect over all construction time?	1.00	5	2.88	2.96
Pressure from any political party	1.00	5	2.77	2.92
Union Issue	1.00	5	2.72	2.91
Loosing of critical staff at crucial point of construction	1.00	5	2.70	2.90

Graphical representation of risk management is shown below. It allows decision maker to follow steps for risk mitigation. The assessment in this study is carried out by Fuzzy Delphi method.

9. CONCLUSION

The construction companies need to include risk as an integral part of their project management. Decision making such as risk assessment in construction projects is very important in the construction management. The identification and assessment of project risk are the critical procedures for projecting success. This study determines the key factors of risk in construction industry. A total of 38 factors influencing

risks in construction are analyzed through pilot survey which include experts of academic (Professors), governmental sectors and construction industry were interviewed, and 22 evaluation criteria were obtained as the key factor by interviewed experts. The proposed fuzzy Delphi method enables decision analysts to better understand the complete evaluation process and it considers the unavoidable fuzziness in the interview process. This approach provides a more effective, accurate and organized decision support tool.

REFERENCE

[1] Yu-Lung Hsu, 2010, "The application of Fuzzy Delphi Method and Fuzzy AHP in lubricant regenerative technology selection" Expert Systems with Applications 37 (2010) 419–425.

[2] Taroun. A "Construction Risk Modelling and Assessment: Insights from a Literature Review",*The Built & Human Environment Review, Volume 4, Special Issue 1, 2011.*

[3] Babak A. Samani, 2012, "A Fuzzy Systematic Approach to Construction Risk Analysis"Journal of Risk Analysis and Crisis Response, Vol. 2, No. 4 (December 2012), 275-284.

[4] *P. Rezakhani, 2012,* "A Review of Fuzzy Risk Assessment Models For Construction Projects" Slovak University Of Technology.

[5] Mehdi Tadayon, 2012, "An Assessment of Risk Identification in Large Construction Projects in Iran" *Journal of Construction in Developing Countries, Supp. 1, 57–69, 2012.*

[6] Akbar Etebarian, *et.al* "The application of Fuzzy Delphi Method (FDM) and Fuzzy Analytic Hierarchy Process (FAHP) for Evaluating Marine Casualties", Recent Advances in Computer Science and Applications.

[7] Samaneh Zolfagharian, *et.al*, 2011, "Risk Assessment of Common Construction Hazards among Different Countries" Sixth International Conference on Construction in the 21st Century (CITC-VI).

[8] Dr. Nadeem Ehsan, et.al, 2010, "Risk Management in construction industry" IEEE.

[9] Akintola S Akintoye and Malcolm J MacLeod "Risk analysis and management in construction" International Journal of Project Management Vol. 15, No. 1, pp. 31-38, 1997.

[10] Building futures council, 2011, "RAP (Risk Assessment Planning) for construction Industry". http://www.thebfc.org/uploads/Riskassessment planning.pdf

[11] Li Bing and Robert L. K. Tiong, "Risk management model for international construction joint ventures" Journal of Construction Engineering and Management, ASCE, Vol. 125, No.5, September/October, 1999, 377-384.

[12]