An Overview of Risk Analysis and Management Strategies in the Construction Industry

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ABSTRACT

Risk assessment is a series of processes consisting of risk analysis, assessment of magnitude of risk, judgment on whether the risk is acceptable or unacceptable, and making and assessing risk control options, to attain this goal. Risk assessment will play an important role when the part relate to the risk within decisions made by an organization is to be rationally implemented. Managing these processes can be quite a challenge for the management. Risk management includes identifying risks, assessing risks either quantitatively or qualitatively, choosing the appropriate method for handling risks, and then monitoring and documenting risks. This study identifies the procedures for risk identification, management and its perception from the Indian construction industry. Time and cost management need to be fully integrated with the identification process. The aim of this study is to advise for a method of risk mitigation which includes a well-documented procedure which serves as a one stop-solution to all the risks that would emanate in the future. We conducted a survey research by applying a questionnaire among in the construction industry. The risk identification techniques more frequently applied in construction are checklist, flowchart, Brain storming, Delphi method, Anova hypothesis etc.

KEYWORDS: Risk Assessment, Risk Management, Risk Identification, Construction Projects India.

INTRODUCTION

Risks will be outline as an occurrence that negatively affects the project objectives, which are:

- Time and Schedule
- Cost
- Quality of Labor

A risk is nothing however a state of affairs. Risks are neglected by construction contractors and consultants while considering bids and tenders. Project risk management is widely recognised as one of the most critical procedures and capability areas in the field of project management. Risks are critical to a project as every critical activity is associated with a risk. The number of risks arising from a task is directly proportional to the number of people working on it. Mismanagement is one of the various sources of risk. Risk mitigation depends a lot on the co-ordination of work between different people on the project. So naturally, less the number of people working on a project, less is the chance of the risk taking place. Nowadays, almost all of the big scale projects are sublet to sub-contractors, and therefore risk assessment and mitigation has become more and more difficult. As a developing country, India has not focused on risk management. This study aims to better understand the risk identification process and other risk processes. It has already been recognized that a clear understanding of the risks born by each participant leads to better risk allocation. The objective of this study is to find means of identifying risk management and other processes that can be utilized and to make new suggestions on the use of these risk management methods.

This study was performed with relation to the surveys and observation of management techniques used in today's construction industry in India. Every project has big important events or milestones with respect to cost and time which are pre-marked by the management at the start of the project. They are tracked regularly. Project managers use these milestones as pointers to risk mitigation. They look out for any negative cost impact or delays in activities of these milestones. Now in most of the cases, these milestones are not met. The main reason for that is the approach of the project manager towards the pertinent risks. Their approach is of the wait and watch type. They react only after they find themselves in a fix, as opposed to being proactive and taking necessary steps to prevent the risk from taking place. There is a need of a whole system to be in place, so before any activity takes place, all possible Risk are identified and acted upon.

LITERATURE REVIEW

Hull (1990) introduces different models, based on Monte Carlo Simulation and PERT, to assess proposal risk from cost and duration point of view.

Mustafa and Al-Bahar (1991) adopt the Analytic Hierarchy Process (AHP) to assess construction project risk. It applied the concept of value and weight to assess risk probability and impact.

Dikmann (1992) discuss, from a theoretical and practical perspective, the issue of applicability and the short coming of risk analysis techniques based upon probability theory.

Paek et al.(1993) proposes a risk-pricing algorithm, using FST, to assist contractors when determining the bid price of a construction project.

A critical literature review (Williams 1995) concludes that limited research had been undertaken on quality risk and there was a lack of research into the impact of risk on different project objectives.

Williams (1996) discuss the limitations of P- I risk models, while advocating a three dimensional risk model : Probability – Impact- predictability, as recommended by Charette (1989).A stochastic model, which combines the randomness of the cost and the duration of a project activity, was developed by Tavares et al.(1998).

Hastak and Shaked (2000) deploy AHP within a framework for assessing international construction projects, with risk modeled as P-I. Using the well established Fuzzy Set Theory (FST) to assess construction risk Tah and Carr (2000) develop a qualitative risk assessment model, which incorporates linguistic variables to assess risk likelihood and impact, and the interdependencies between different risks.

A DSS for managing risk in the early stages of a construction project is proposed by Dey (2001) based on AHP and decision trees. It seeks to identify the best strategy, project scenario, for managing construction project risk through the expected monetary value (EMV) of each risk response strategy.

Baloi and price (2003) compare different theories used for dealing with uncertainty within the construction industry and recommend FST as a vital solution for assessing construction uncertainty. Shang et al. (2005) develop a DSS to facilitate construction risk assessment at design and conceptual stages.

Dikmen and Birgonul (2006) use AHP within a multi-criteria decision making (MCDM) framework for risk and opportunity assessment of international construction projects. They calculate the overall risk level of each project by multiplying the relative impact with the relative probability for each risk and then adding the score up. Hsueh et al.(2007) to develop a multi-criteria risk assessment model for construction joint-Ventures. It merely proposes that decision makers are able to make-

judgements: the higher the expected utility value, the lower the overall project risk. Zayed et al. (2008) use AHP to assign weights to risks before calculating project risk level, which is defined as the sum of the weighted risk effects of risk factors.

RISK IDENTIFICATION AND RISK IDENTIFICATION TECHNIQUE

The risk identification phase as being either one of the most important stages within the risk management process, (Martins, 2006) or even the most challenging and relevant phase in this process (Kloss-Grote and Moss, 2008)

Chapman (1998) divided the risk identification phase into three categories.

1. The Risk identification conducted only by a risk analyst and based exclusively in his practice, knowledge and capacity.
2. The Risk identification was conducted through the interview of the risk analyst with one or many members of the project staff in order to analyze the reviewed data and the project life cycle based on the knowledge and expert of the people interviewed.
3. The Risk identification in which the risk analyst guides one or many work groups applying the risk identification techniques.

RISK IDENTIFICATION TECHNIQUES

1. Brainstorming – An idea generation group technique is divided in two phases. (i) idea generation phase, in which participant generate as more ideas as possible (ii) idea selection phase, the ideas are filtered, remaining only those approved by the entire group. (Morano et al. 2006).
2. Delphi Technique – Delphi is a technique to obtain an opinion consensus about future events from a group of experts. It is supported by structured knowledge, experience and creativity from an expert panel (Wright and Giovinazzo as cited by Morano et al.,2006)

3. Interview/ Expert judgment – Unstructured, semi structured or structured interviews individually or collectively conducted with a set of experienced project members, specialist or project stakeholder (Morano et al.,2006)
4. Checklist – It consists of a list of item that is marked as yes or no, could be used by an individual project team member, a group or in an interview. (Morano et al.,2006)
5. Influence Diagram – It is a graphical representation containing nodes representing the decision variables of a problem. A traditional influence diagram is formed by three types of nodes: utility, decision and informational. The causal relationship occurs between utility and chance nodes and represents a probabilistic dependence.
6. Flowchart – Graphical tool that shows the steps of a process. This technique is applied for a better comprehension of the risks or the elements interrelation (Morano et al.,2006)
7. Cause-and-Effect Diagrams – These are also called Ishikawa diagrams or fishbone diagram, illustrate how various factor might be linked to potential problems or effects (PMBOK – PMI, 2008). The diagram is designed by listing the effect on the right sides and the causes on the left sides. There are categorized for each effect, and the main causes must be grouped according to these categories (Morano et al., 2006)
8. Tamosaitiene et al. (2013) developed a model using TOPIS-F method with fuzzy criteria values to assess risk in construction projects.
9. The various risk assessment techniques are Project Evaluation and review technique (PERT), Probability and Impact (P&I), Montecarlo simulation (MCS), Analytical Hierarchy process (AHP), Likelihood occurrence of risk (LR), and Fuzzy Logic.
10. Tah and carr (2000) represented a hierarchical risk breakdown structure to establish a proper method for qualitative risk assessment.
11. Questionnaire survey – These are usually obtained from previous experience to specific project criteria. They are prepared by a manager in a structured manner and then distributed to the whole project team members. Potential risk sources are exposed for observation. The questionnaire can take two forms; the general form or the detailed form. It is recommended that this method should be used in combination with other methods. The main advantage of using questionnaires is that they allow open and frank disclosure of risk without the domination from stronger personalities. They also allow for a consistent presentation of answers, ease of analysis, and a relatively short response period. The main disadvantage of questionnaires is that they originate from only one person ideas (The manager). It consists of questions at the attribute level, with specific tips, examples and questions for subsequent investigations. In general, the questionnaire is tailored to each software development project in particular, and for each development phase. The questionnaire application occurs in two phase: (i) Question and Answer phase; (ii) Issue clarification (Morano et al., 2006).
12. Feedback from similar projects – Make use of near neighbor comparisons of similar projects, locations, suppliers, customer etc. Close examination of a current system or project may help to identify risk and may also be inherent to a new project.
13. Previous experience – Make use of near neighbor comparison of similar projects, Location, Suppliers, Customer etc. Close examination of a current system or project may help to identify risk and may also be inherent to a new project.
14. Pondering – It is a simple and basic approach involving the use of one single person to identify risks and 'may serve as a default option if other approaches are not feasible or suitable (Chapman and Ward, 2003).

METHODOLOGY

1. Data collection for risk assessment
2. Analysis of Data by – Risk Significant Index Method

The accumulated data will be grouped into categories risk and its magnitude of consequence on project objective in term of Cost, Time, Quality, Environment and Safety. The three point scales for the risk α (Highly likely, likely, less likely) and the consequence β (High magnitude, Medium magnitude, Low magnitude) will be converted into numerical scales. The numerical values and the calculation of the Risk Significance Index depending on the design of the questionnaire, different value can be assigned to α and β. A three point rating scale is chosen according to Shen et al and Zon et al.(2001) and Wang and Liu (2004), High, Highly take value of 1, Medium takes a value of 0.5 and Less or Low take a value of 0.1. The average score for each risk considering its significance an a project can be calculated by

To assess the relative significance among risks, previous literatures study suggests establishing a risk significance index by calculating a significance score for each risk. For calculating the significance score is to multiply the

probability of occurrence by the degree of impact. The significance score for each risk assessed by each respondent can be obtained through the model

$$s_j^i = \alpha_j^i \beta_j^i$$

Where s_j^i = significance score assessed by respondent j for risk i; α_j^i occurrence of risk i, assessed by respondent j; and β_j^i = degree of impact of risk I, assessed by respondent j. By averaging scores from all the responses, it is possible to get an average significance score for each risk, and this average score is called the risk index score and is used to rank among all risks. The model for the calculation of risk index score can be written as

$$RS^i = \frac{\sum_{j=1}^{T} s_j^i}{T}$$

Where Rs^i = index score for risk i; S_j^i = significance score assessed by responding j for risk i and T = total number of responses. To calculate s_j^i the five point scales for α and β, this will be converted into numerical (Likert scale) scales.

CONCLUSIONS

This paper is based on a literature review on the risk assessment methods. The risk assessments approaches are applied in various areas and the problems solve. It was found that the currently used methods for risk assessment are Brainstorming, checklist, Flowchart Delphi method, Risk significant index method. Each method of risk assessment has their limitation therefore this paper attempt to formulate integrated risk assessment tools. It was observed that currently used risk assessment methods can be integrated into new approach that can aid the decision makers applying the risk assessment effectively.

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