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Risk Assessment Methods and Application in the Construction Projects

DR. R. K. KANSAL, MANOJ SHARMA

Department of civil Engg. Madhav Institute of Technology, Gwalior

Abstract:
Risks are very common in construction sector. Risk is the Possibility of suffering loss and the impact on the involved parties. Risk is identified and then risk assessment and analysis is done. Then risk management and risk mitigation is carried out. Risk affect construction sector negatively and focusing on risk reduction measure it important. The purpose of this study is to assess the use and method of risk identification techniques in the construction industry. They are classified in specialized industrial construction, infrastructure and heavy construction. 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 etc.

Key words: Risk, Risk identification techniques,

1. Introduction

There are many risks encountered in the projects particularly construction project R Norman G (1993). The possibility of encountering loss and its impact is known as risk. Risk is a negative term referring to loss and impact of loss, but there is also positive risk involving favorable results and their impact is risk involving favorable results and their impact is known as opportunity Vaughan EJ (1986).In accordance with Ferreira (2009) the recovering of the construction area is very important to the engineering service sector. Faced with this increase of demand, we verify that it is necessary to include risk management in project planning and management so as to identify, assess, manage and control the risks that would be adverse to the project goals (Kerzner 2002). This theme is relatively new, though since this methodology was elaborated in the last decade and the companies have been adopting it in their projects in the lasting years. The risk identification phase was considered by many studies in this area as the most important phase in the risk management process. During this phase there is a lot of identification techniques that could help the identification process. The aim of this article is to assess the degree of knowledge and utilization of risk identification techniques in the construction projects.

2 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.

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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.

3. 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.

4. 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 are marked as yes or no , could be used by an individual project team members, 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)

5 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

$$r_{ij} = \alpha_{ij}\,\beta_{ij}^{K}{}^{k}$$

Where

r_{ij}^{k} Significance score assessed by respondent j for the impact of risk i on project objective k

i = ordinal number of risk
k = ordinal number of project objective

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j = ordinal number of valid feedback to risk i
n = total number of valid feedback to risk i ;
α_{ij} = Likelihood occurrence of risk i, assessed by respondent j
k
β_{ij} = level of impact of risk i on project objective k , assessed by respondent j.

The average score for each risk considering its significance on a project objective can be calculated

$$R^k_i = 1/n \sum_{J=1}^{n} \alpha_{ij} \beta^k_{ij}$$

Where R^k_i = Significance index score for risk I on project objective k .

6. 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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APPENDIX I
"Risk in construction industry" Question Survey

Type of risk		Probability level of the risk occurrence (a)						Degree of impact or the level of loss if the risk occurs (b)						Total Risk ab
SN		NA	Very Small	Small	Normal	Large	Very Large	NA	Very Low	Low	Medium	High	Very High	
A	**Financial Risk**	0	1	2	3	4	5	0	1	2	3	4	5	
1	Loss due to fluctuation of interest rate													
2	Low credibility of shareholder and lender													
3	Change in bank formalities and lenders													
4	Loss due to rise in fuel prices													
5	Insurances risk													
B	**Legal Risk**													
1	Breach of contract by project partner													
2	Lack of enforcement of legal judgment													
3	Improper verification of contract document													
4	Uncertainty and unfairness of court justice													
C	**Management Risk**													
1	Change of top management													

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2	No past experience in similar project													
3	Short tender time													
4	Internal management problem													
5	Improper project feasibility study													
6	Poor relation and disputes with partner													
7	Team work													
8	Time constraint													
9	Project delay													
D	**Market Risk**													