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A Study on Risk Factors Involved in the Construction Projects

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ABSTRACT: Infrastructure development is the key of success to any country in present scenario. It will generate a large number of jobs and increase in growth of economy as well. Therefore the projects involved in infrastructure development have to invest a huge amount of money. In consideration of the same if any kind of wastage of resources takes place that will result in huge momentary losses. These losses are due to various types of risks associated with such development projects. A crucial role is played by these risks for the completion of project successfully with in the time schedule and allotted budget. This study primarily discusses the critical risk factors and its evaluation techniques by conducting a comparative study of various international and national construction projects. About 50 articles published over the last 15 years were reviewed. The finding was that a simple analytical tool will be developed for each project task to evaluate the risk quickly and effectively to do the risk analysis in the project. By study it was concluded that by the virtue of earlier risk identification during the bidding stage of the construction project will lead to precise estimation of the escalation on cost and time overrun. This will help in rescheduling the construction projects by incorporating the things in the budget for the successful completion.

KEYWORDS: Risk Factors, Risk evaluation techniques, Escalation, Construction projects, Time schedule.

I. INTRODUCTION

1.1 Risks in Construction Project: The construction industry is of very complex and strategic nature. Therefore it is considered as a risky affair due to its peculiarity. Due to involvement of various stakeholders connected with the project , several internal and external factors the chances of risks are very high. Studies reveal that construction industry has a poor track record in risk analysis as compared to other industries. On practical grounds no construction project is risk free. Risk cannot be fully controlled in reality. However by taking adequate and timely precaution it can be reduced to some extent. Risks are bound to happen, in the interest of project some risks are accepted up to certain extent. The effects of risks are multidimensional. In project management the risks are identified and analyzed in every aspect. The project risk management tool (PRMT) is very important for success of any construction project. The probability of occurrence of an event or combination of events which are liable to occur during entire life cycle of construction project are worked out. The construction project consists of a number of variables and interdependencies and correlations ,so determination of exact cause and effect is very difficult. Therefore performance of a project is dependent on risk factors. Uncertainty is responsible for exposure of risks. Identification and evaluation of risks and its impact on construction project may be defined as risk assessment technique. The various stages of life cycle of a construction project are shown in Fig.1. Risk management plays a major role in achieving the project objectives irrespective of the size of construction project. The risks are the uncertainty of future event and should be controlled systematically through risk management and analysis method.

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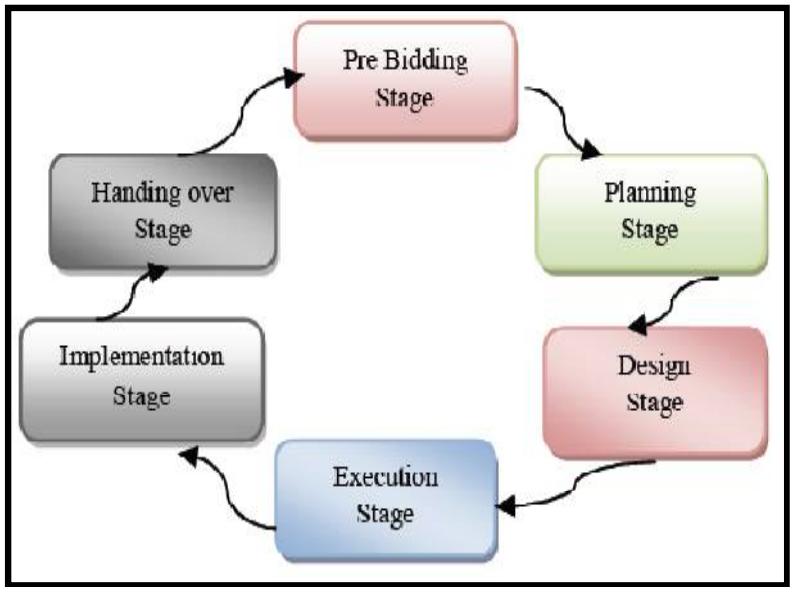

Fig:1 Life Cycle of a Construction Project

II. OBJECTIVES

The purpose of study is to review and compose the previous facts and discussions about risk factors and to provide a complete list of major sources of risk factors in the life cycle of construction projects based on extensive literature study.

III. LITERATURE REVIEW

3.1. Analysis of risk factors in Construction Industry: Various risk analysis techniques adopted during 1990, 2000 to 2010 and after 2010 are summarized below-

3.1.1. During 1990's: There were no definite risk analysis tools or specified method for analyzing risks involved in a construction project during 1990's decade. Many contractors were dependent on their own thumb rules for assessing and analyzing risk factors, resulted in failure of many projects in achieving their goals on time. Many researchers have given their ideas in 1990's that project risks and uncertainties can be controlled during estimation stage to minimize their effect by taking suitable measures and rectification in the process of analysis. Prominent were Al-Bahar in 1988, Bimie and Yates,1991. As per Akincl,1998 risks were categorized on the basis of manageable and non-manageable factors which has resulted in delay and cost overrun in a project. On the basis of this result various risk assessment models were formed by the researchers named Tah et al., 1993, Wirba et al.,1996 , Mustafa and Bahar, 1991 and Dawood, 1998 ,which are as under-

- Probability-Impact assessment (P-I)
- Fuzzy Set Theory (FST)
- Monte Carlo Simulation (MCS)

The above risk assessment models were used for analysis and identification of risks during the preliminary and bidding stages of a construction project.

3.1.2. Systematic Approaches: There were few efforts till 2000 on identification and assessment of risks factors of the construction projects. This has resulted in inefficient and unorganized approaches to identify and manage the risks of construction projects. Various researchers have categorized risks into various groups . Chapman in 2001 categorized risks into four categories as shown below-

- Environment

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- Industry
- Client
- Project

Similarly Shen in 2001categorized risks into six categories as mentioned below-

- Financial
- Legal
- Management
- Market
- Policy
- Political

Many researchers have tried their best in proposing the limitations and complexity of risk assessment tools like Analytical hierarchy process (AHP), P-I, FST, MCS and decision support system.

3.1.3. Refined Techniques After 2010's: There was a sharp improvement in the number of risk identification and assessment researches after 2010. Various refined models were developed by researchers for risk management and comprehensive decisive framework. Risk factor was classified in three heads by Rezakhani in 2012, as under-

- External
  - Unpredictable
  - Predictable
- Legal
- Internal
  - Non- technical
  - Technical

Rezakhani also suggested that a hierarchy based work breakdown structure (WBS) of risks should be drawn to identify the risk factors in an easier way. Goh et al in 2013 pointed out 19 risk factors in the life cycle of a project under five heads, as below-

- Planning stage
- Design stage
- Procurement stage
- Construction stage
- Handing over stage

Researchers have suggested that risk management workshop will be a boon for identification and analysis of risks as a tool of managing risks. Researchers have made various approaches for representing the interdependencies between project risks and its complexity of the surrounding environment and also reported that risk management implementation is relatively low in small construction projects and this is due to lack of time and budget, low profit margin and not economical. The results indicated a positive correlation between risk management (RM) implementation and improvement in project quality, cost and schedule performance of small projects.

IV. Identification And Assessment Of Critical Risk Factors

4.1. Risks in Construction Projects: There are variety of risks involved in construction projects. Tah et al, in 1993 has categorized project risks into internal and external risks. They also developed a fuzzy model for bidder's risk assessment at the bidding stage. The risks that are widespread in the external environment of projects, may be defined as external risks. Some examples of external risks are given below-

- Due to inflation
- Currency exchange rate fluctuations
- Technology change
- Client induced changes
- Politics
- Climate and weather conditions

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- Natural disaster or major accidents

External risks are factually of non-controllable nature so there is every need to frequently scan and make a prediction about these risks in connection of agency's strategy. Likewise internal risks are relatively more controllable in nature and may vary between projects. Some examples of internal risks are given below-

- Uncertainties due to labour, Plant & material
- Subcontractor
- Resources and site conditions

Many researchers have identified several risk factors, these are grouped in different types on the basis of their nature of risks. Prominent researchers were Mustafa in 1991,Akincl et al, in 1998, Prasanta kumar Dey in 2002, Ghosh et al., in 2004, Wiguna and Scot in 2005, Enshasi and Mosa in 2008, Wang et al., in 2010, Razakhani in 2012 and Goh et al., in 2013. According to them the risk factors are dependent on nature of risks like physical, environmental, design. Financial, contractual, legal, construction, political, management, natural hazards, safety and delay risks.

4.2. Identification of Critical Risk Factors: On the basis of studies on different types of projects like residential ,industrial , commercial and infrastructure development in various foreign countries , the critical risks factors identified are shown in Table-1.

Table- 1 Critical Risk Factors

Critical Risk Factors	Mustafa et al, 1991	Prasanta Kumar Dey, 2002	Ghosh et al, 2004	Lary ea, 2007	Enhassi and Mosa, 2008	Sun & Meng, 2008	Wang et el, 2010	Eybpoosh, 2011	Rezakhani, 2012	Goh et el, 2013
Scope and design changes, Technology Implementation		▲	▲	▲	▲			▲	▲	▲
Site conditions and Unknown Geological conditions				▲	▲	▲		▲		▲
Inflation, Country economic condition and rules and regulations	▲		▲	▲	▲	▲	▲	▲		
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			▲		▲		▲			▲

On the basis of information in Table-1 it was concluded that following are the critical risk factors in various international projects.

- Inflation, (Country economic condition)
- Environmental and geological risk (weather & climatic conditions)
- Statutory Clearance before planning a project

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- Design risk
- New technology implementation
- Poor safety procedures
- Construction delays
- Inadequate managerial skills
- Improper coordination between teams
- Resource risk (lack of availability of resources)

It was concluded that there is necessity for a information map which represents the sources of critical risk factors on successful completion of a construction project. Accordingly information map was developed.

4.3. Information Map: From the study and review of literature the major sources of risks and their impacts were identified. The information map representing the sources of critical risk factors and its affect on project success is shown in Fig. 2.

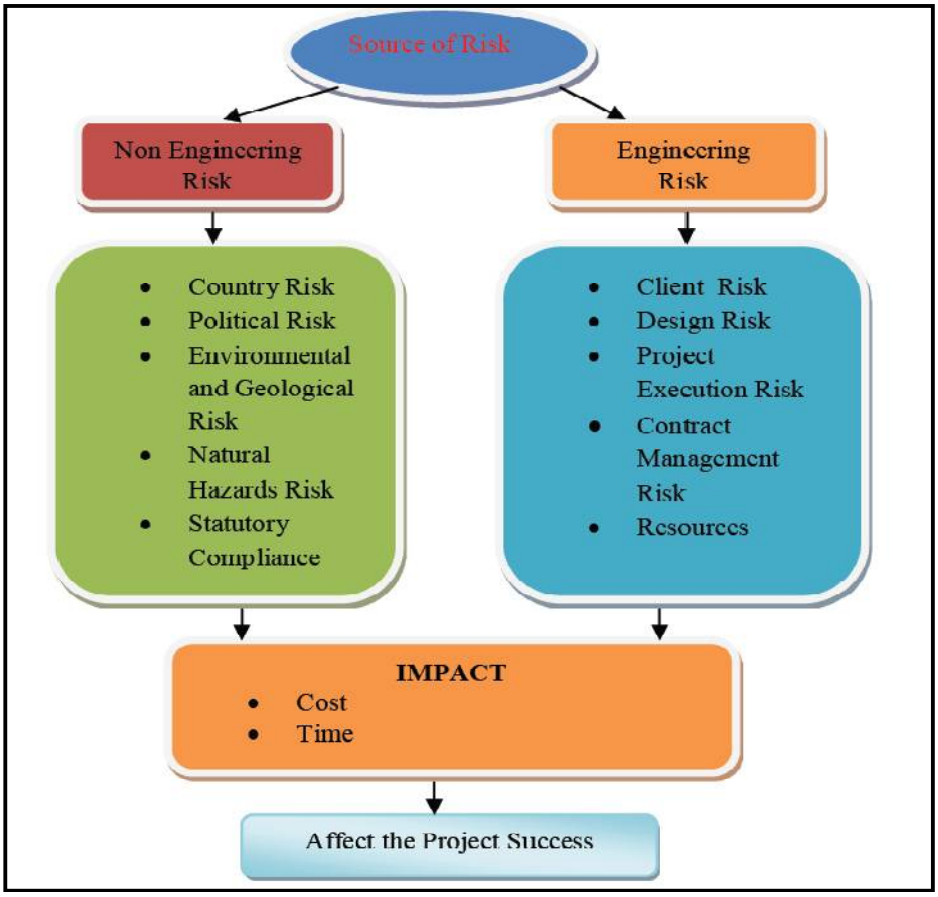

Fig: 2. Information map representing the risk sources affecting the project success

Various risk factors are shown in flow chart as shown in Fig.2. Engineering risks are predictable whereas non engineering risks are unpredictable. The prediction should be forecasted in earlier stages of projects whereas unpredictable factors involve uncertainties, this should also be accounted for successful completion of project to avoid any adverse effect on cost, time and quality of the project.

4.4. Techniques of Risk Assessment (TRA) : Recently various models have been developed for identification of risks and their management. A concept of decision tree analysis, an analytical hierarchy process was presented by Prasanta

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Kumar Dey in 2002. He also raised a question on probability models like MCS, FST, P-I which required a detailed quantitative inputs which was not generally available at the time of planning and its application is also limited in real project. Thomas et al, in 2006 made an effort to asses risk probability by using fault tree model. Resource management(RM) was explored by Abdelgawad et al in 2010 using combined fuzzy failure mode effect analysis (FMEA) and Fuzzy AHP. A relationship between impact and probability of occurrence and detection and the degree of criticality of risk events was developed by these analysis to support project management team to take corrective measures on time to avoid any adverse effect on project. In 2011 Eybpoosh used SEM technique to demonstrate casual relationship between the risk factors. SEM is responsible for risk identification and to develop an alternate improved strategies at the earlier stage of the project. A model named TOPIS-F with fuzzy criteria values was developed by Tamosaitiene et al, in 2013 to asses risk in construction projects. This model was used to compare risk assessment of three projects. The various risk assessment techniques followed by various researchers in different literatures is shown in Fig. 3. The various risk assessment techniques are as under-

1. Project evaluation and review technique (PERT)
2. Probability and impact (PI)
3. Mantecarlo simulation (MCS)
4. Analytical hierarchy process (AHP)
5. Likelihood occurrence of risk(LR)
6. Fuzzy logic

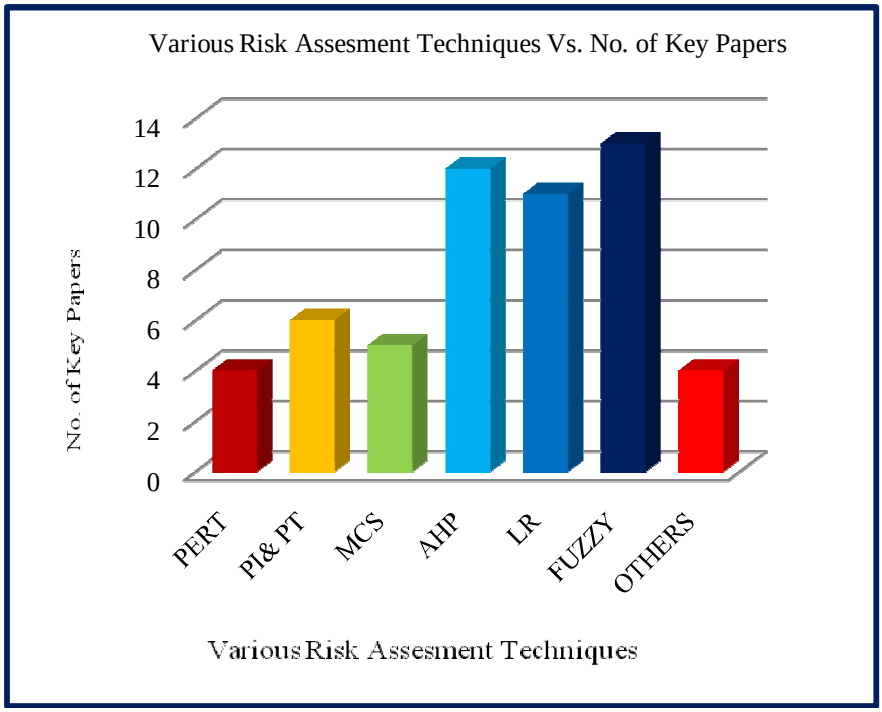

Fig: 3 Various Risk Assessment Techniques Vs. No. of Key Papers

Analytical neural network(ANN), Bayesian belief network(BNN) was used by some researchers for the purpose. It was observed from Fig. 3 that most of the researchers have used the risk assessment model in AHP, MCS ,LR and FUZZY compared to other techniques. The developed model using AHP, MCS and LR techniques have shown good results in assessment of project risks in construction project. Among all the models AHP model is more effective because of its systematic approach to risk assessment problems by providing hierarchical approach. For assessment of project risks at initial stage of the project the researchers may not have sufficient data at that time. Therefore it is necessary to develop

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a regression model for each project specific task. Risk assessment tools should be simple in its application to encourage the professionals.

V. CONCLUSION

This paper discussed a review of literatures of past 2 decades on identification and assessment of risk factors in construction project. Several international projects from various countries like UK, US, Australia, China, Malaysia etc were reviewed in this study. On the basis of study the following conclusion can be drawn-

1. The study was basically focused on the development of various models for assessment of risk factors in construction projects.
2. The critical factors have a vital role on project's performance so the critical risk factors should be managed by adequate risk assessment techniques.
3. The findings from study are tabled in Table-1 above, which shows the various critical risks factors to be managed accordingly in order to achieve a successful result of construction project. An information map was also prepared which represents the sources of critical risk factors and its affect on project success, as shown in Fig. 2.
4. An extensive literature study by various researchers have revealed their noteworthy contribution towards risk management techniques.
5. The study recommends to identify the risk factors of construction projects. Accordingly a suitable outline should be formed to quantify the risk factors on the basis of uncertainties. The success of project should be prime objective so it will be beneficial to develop a simple and suitable risk assessment model for construction projects considering the nature and magnitude of projects, to counter the risks during entire life cycle of projects.

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