

RISK IDENTIFICATION AND MITIGATION IN CONSTRUCTION PROJECTS: A REVIEW

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Abstract: Risks are very usual in construction industry. It affects various project objectives like safety, quality, and the cost of the overall project as well as the environment. Risk is uncertain and this uncertainty depends on many critical risk factors like (history, management stability, team size, resources availability etc.). Risk comes from anywhere and anytime and specially in construction industry it doesn't matter how the project size is (in terms of budget). It is required to manage all those risks properly with proper risk mitigation techniques and also the proper risk management otherwise there will be possibility of delay in the project. Risk management basically falls in four steps, first step is to identify the risks, second is assessment of risk with qualitative and quantitative methods, then the second last step is to prepare a plan to respond to that particular risk and the last step is to control the risk. This paper presents a review of previous study conducted on to identify the risks and how to eliminate it with proper techniques and risk management and also discuss about factors affecting during the project under construction.

Keywords- Risk, Construction Industry, Risk Management, Risk Mitigation, Construction Project Management.

I INTRODUCTION

For any developing country, construction industry plays a vital role in GDP as well as the overall economic growth of the nation. Indian construction companies give a jobs nearly 30 to 32 million and the market size is about 6,71,769 crores 2012-13 to the national Gross Domestic Product (a share of around 7 to 9%). Construction industry is a service industry and indirectly it provides employments to some production sectors like cement, steel, bitumen, bricks construction equipment etc. Every construction projects are exclusive and that's why the risks come anytime from any sources.

Construction risks are related to business risks, project risks, political risks, financial risks as well as technical risks. For each and every types of risks there are different types of risks mitigation techniques are there. Also the risks management is very helpful for project to eliminate the risk before it will effect on the construction project (in terms of finance). The main aim of the risk management is to identify the risks and control it as soon as possible and solve it so the next construction project events did not affect. There are some risk identification

methods like, brainstorming, Delphi technique, Interview/Expert opinion, past experience etc.

There are two types of risks:

(1) The risk which is affect the project and also the chances of financial losses and there are no chances to financial improvement.

(2) The risks which have two types of probability of financial increase (gain) or decrease (loss). There are several risks that a construction companies should eliminate before it will affect the entire projects like, Cost risk, Schedule Risk, Technical risks, some physical actions over the direct controller.

II. CRITICAL LITERATURE REVIEW

Literature review is the core of the review paper. Following are some literature review from various national and international journals on some case studies and risks elimination techniques as well as risk management process.

Alexander Fekete et al. (2012) conducted study on risk management goals and to identify the critical infrastructures in Germany. The main aim of this study is

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to first identify the critical infrastructures as well as to identify the risks which is occur if proper planning is not there. Risk management goals helps to what is important to measure, which time, where it has to be measure and what is the reason behind the measurement. In case of some difficult problems of infrastructures the risk management is very helpful, but the effective work is requiring for this process (risk management). Finally they concluded that their concept is useful if it will apply on multiple scales.

K. Jayasudha et al. (2016) conducted study on analysis of major risks in construction projects. They conducted one questionnaire survey (use Likert Scale 1-5) and this survey done by project manager, site engineers, and project engineer of that particular project. The result of this study shows that in India the uses of construction equipment's is very low and also the lack of awareness is responsible. This study enhance the knowledge also helpful for developers and investors for PPP projects.

Robin K Mcguire (1999) conducted study on Analyzing of Risk Factors in Construction. The study helpful for any construction projects before and after construction, like which type of risks factors are involved in projects during the construction phase or Execution phase, because time, cost, quality as well as cost is a main parameters for any successful project completion.

J.H.M. Tah et al. (2002) carried out study on knowledge based approach to construction project risk management, also proposed that the consistent methodology is very useful for any construction project for risk management. Concluded that the lack of proper risk mitigation techniques and proper risk management procedure the project was suffering from risks. So if proper risk management is done during the project so it will helpful for better understanding of project risks also it will helpful for better development of the any project performance.

Mulholl. B et al. (1999) conducted study on the risk assessment in construction schedules. Recommended that a explanation of efficient way to consider and calculate uncertainty generally occur in construction plans. Concluded that each and every construction projects has different environment and it is a unique every time so obviously the complexity and uncertainty are there. Because of uncertainties and complexities the probability of risk is very high.

Dr Patrick. X.W. Zou et al. (2003) carried out study on identifying key risks in construction projects: life cycle and stakeholder perspectives. Highlighted 20 key risks which is affect the overall project life cycle and also effect on the project objectives. They concluded that for any project manager, project engineers the broad knowledge of construction projects is mandatory, this study is very helpful for them in terms of time, cost, quality as well as environmental aspect and safety.

Krantikumar Mhetre et al. (2016) conducted study on risk management in construction industry. According to them in construction industry the risks are managed but not in proper structural way, as per the literature has been described. The other researcher in construction industry the Risk Management and Risk Management in Projects is zero, apart from that the risk management is common in construction industries.

Nerija Banaitiene et al. (2007) carried out research study on risk management in construction projects. If the proper risk management process has been done so it was very useful as well as it was very helpful for any construction companies. Because of effective risk management process it was easy to identify the risks, so it was easy for risk mitigation. The result shows that the Lithuanian construction company is different compare another construction companies in terms of acceptance of risk management techniques. Concluded that for better risk management practices it is mandatory to know types of risks, its responsibilities, as well as which type risk is mandatory to eliminate first by contractor.

Yadav Ashwini Ashokat et al. (2004) conducted study on risk analysis and management for PPP infrastructure project in India. Concluded that particular risk management structure suggested by that project it was very easier to apply compared to other structures. Also it was easier for those companies who are interested to invest in India (future infrastructures projects). It has likely to help country, regional, and city administration to inspect their method and amenities in support of BOT infrastructure developments.

Prof A. A. Talukhaba et al. (2012) carried out study on evolution of risk management practice in construction industry in Swaziland. The risk identification methods normally used in two types of companies. First one is brainstorming and second is documentation review.

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The risk assessment method engaged by the original construction companies are the risk management probability method in which the global construction companies are used the possibility and influence matrix. There are two types of companies in which they applied ninety five (95) facility of insurance to risk reaction approach. The original companies prepared uses of risk allocation as a part of policy for controlling risk on other hand the global companies implemented risk decrease as the strategy.

T.H. Nguyen at al. (2016) carried out study on risk assessment: a case study for transportation projects in India. The case study specify that some of the risks emphasized have an extraordinary effect even the possibility of existence is small like, insolvency of a contractor. Other main kind from study is that the designer is serious for the achievement of a particular project. An in appropriate or an incomplete design are a large impact on plan and cost of an assignment. Also assumed from the study, project management members are not operative (in terms of making communication channels) with project investors and in expert of expressing the accurate approaches when project are not in decent condition.

Rinaj Pathan at al. (2002) conducted case study on risk assessment of BOT Road projects. The case study define simplifies the study of economic feasibility of BOT project are affect by concern time duration, a demonstration done through study are defined background of the project, contractor of the project, and the funding of the particular project, also the risk involvement in each and every stage; the technique which is used for bound the risk, the difficulty met the present position of the project, and all over the valuation.

Mr. Satish K. Kamane at al. (2010) conducted study on risk management in construction industry. Every project depends on professionally and efficiently. Risk escaping may contain analysis of the whole project aims lead to a project reassessment as a entire. It is depending on how proficiently and efficiently the uncertainty is handle. To managing the risks will not eliminate it from the project. The main goal is to manage the risk. But the methods are infrequently used in construction project because of dearth of skill.

B.A.K.S. Perera at al. (2009) carried out study on risk management in road construction: the case of Sri

Lanka. Concluded that the risk of imperfect plan, late agreements, and late treatment on site, uncertain drawing, and unexpected site ground situation had disagree the contractor on various events. There are some risks which is not related to two cases in the study.

A. Suchith Reddy (2002) conducted study on risk management in construction industry. In the study. During the production period there will be more chances to risk have occur. The contractors, have excessive effect on the risk management procedure. The proprietors and contractors should make a plan and also gave exertion to the risk mitigation. There will be a chance delay in project if there is no proper risk management are there and because of this, the cost of the project also increased due to the delay in time.

N. V. Patil at al. (2007) studied on risk management in road construction. During the overall development of road project there are many types of risk have been occur, some are minor risks and some are consider as major risks depending upon the types of risks. Concluded that the risks chances on project is very high during the execution phase as well as designing phase. Proper method require for how the risk management applied on the project. Mitigation measurement should be worked in advance stage so the project will be finish in specified time as well as cost.

Aitwar Vishambar at al. (2006) carried out study on risk planning in construction of highway project. To manage the risk so the flow chart from the different activity is necessary. Actual risk management procedure motivates the construction industry to recognize and all aviate the risks, and if all risks manage properly so definitely it will helpful for the projects in terms of time, Cost, quality as well as for better judgement.

Dr. Nadeem Ehsan at al. (2015) conducted study on risk management in construction industry. The observation of risk by consultants as well as contractors is generally centered on their perception and skill. Finally they concluded that the best way to applied risk reaction is to eliminate it or handover (transfer) it.

Dr. M. J. Kolhatkar at al. (2013) conducted study on risks in construction projects. They claimed that to identify the risks and manage it with proper way is the biggest tasks for any construction companies in terms of the project goals like cost of the project, duration, quality maintained as well as environment maintainable. So it is

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require to collect the data regarding the risks from industry and analyze them for proper risk management. Also they defined types of risks and risks mitigation techniques, procedure of risk management. Benefits of risks managements. Drawback of risks management.

Patel Ankit Mahendra at al. (2013) carried out study on risk management techniques for construction projects in developing countries. Described risk management procedure and claimed that if this procedure applied on projects so it will very useful for any construction projects during the entire construction period. Concluded that this procedure are very rare used in developing countries, and it is not useful if the lack of knowledge and awareness are there. Also claimed that this risk management procedure must be applied on any projects for extreme profits.

Mubin M.Shaikh at al. (2015) studied on risk management in construction projects. The main purpose of the paper is to recognize the risk and uncertainty in the construction industry. Because of improper experience the risk management process and mitigation techniques are not use in construction projects. Finally concluded that the best way to applied risk reaction is to eliminate it or handover (transfer) it.

Amit Kulkarni et al. (2016) carried out study on risk management and response: comparative study of occupational hazards on construction sites. The purpose of this investigation is to make a relative study for knowing of some critical disagreeable occasions happening in construction project with help of mitigation methods. They use two types of methods to identify occupational hazards on construction sites with the study of limited risk assessment methods. First is the PRAT

and second technique is risk response technique. The results are desirable.

Prof. Shakil S, Malek at al. (2013) conducted study on risk management in construction industry. Concluded that risk management is a lifetime cycle. According to them proper risk management should cover all the phases of construction projects like, designing phase, contract phase as well as project management etc. The analysis should be based on estimates, all types of risks, the risks which will be affect more on construction project is require to eliminate first.

V. Sathishkumar at al. (2015) studied on critical factors influencing to management risk in construction projects. The main purpose of the carry out study is to recognize the risk which is affect the project life cycle. One questionnaire survey has been done to finding out and formulates the different types of risk in construction projects. The data analysis done by ANOVA and Descriptive Statistics. Both the survey Descriptive analysis (Standard Deviation and Mean) and Differential Analysis (ANOVA and t-test) has been done before the top level management eliminate the risk from the construction projects.

Pejman Rezakhani at al. (2012) carried out study on classifying key risk factors in construction projects. This study is an exploration that how many risks are available in the construction projects. Then they discuss project management function and analyze every risk factors is available in every category and defined it. It concluded a hierarchical risk ordering to cover all the operative key risk factors in construction projects. The study showed that applying suggested hierarchical risk analysis, most of the hazards in systematic and multifaceted projects.

III. RISK IDENTIFICATION PROCESS

Risk identification methods:

The following risk identification methods as shown in Table:

Sr . N o.	Techniques	Description	Technique Process	Key Points

1	Brain storming	The Facilitator asks questions to the group of the persons associated with the related project. The questions like, Which type of risks may be occur during the project under construction? Maybe what type of risks we ought to run in to?	All the gathered members (participants) suggested the ideas. Require to designate the persons so that he/she will take notes from the participants. After the meeting over the designated person collect the all the responses. Designate d person provide a one worksheet to the participant so they can rate the most potential risk. Schedule a meeting where the results has been discussed.	Do not get bog down with irrelevant details.
2	Delphi Technique	An arranger collects some an un identified responses from the participants Share these responses or add/remove it as per requirement of the particular project.	Written questions from experts. Feedback (response) collection. The output (response) sent to the experts for reviewing.	Identification of participant s is unknown.
3	Interview	One-on-one conversation has been made to identify the risks. Conduct the interviews Collection of information from different participants	Interview is made for risk identification. Information given to participants related to particular project. The response collected from the interviewee s. The identification is individuals.	The suggested points given by the interviewees should be follow- up so the risk have been mitigate as soon as possible.
4	SWOT Analysis	Identify the strength of the project, the weakness of the project, also opportunities of the project, and threats related to the project.	Identify the weakness and threats which are the sources of the risks in the project. Use the projects strength and opportunities as sources to mitigate the risk.	Useful for the risk identification. Strength Weakness Opportunities Threat

IV.DIFFERENT STRATEGY OF RISK MITIGATION

Basically there are four types of mitigation strategy categories are as shown in table:

**TABLE II
Mitigation strategy Categories**

Response to the risks	Strategy to avoid risks	Examples
Avoid	It is a strategy where the project related persons take an action to risk threat removing.	Extend the schedules. Reduction of the Scope. Change the strategy applied in execution phase.
Transfer	Risk threat and impact (caused by threat) transfer to the third party. This strategy does not eliminate the risks, but the responsibility transfer to the third party.	Purchase of Insurance. Performance of the bonds. Warranty. Contract Lump sum.
Mitigate	It is a strategy where the project team persons try to decrease the probability of the risks before it occur. This strategy doesn't eliminate the risks or its impact but it will help to reduce the occurrence of risks.	Increasing the tests. Change in suppliers. Reduction of the process difficulty.
Accept	Risk acceptance means that the team accepts the risk and its possible impact, but chooses not to take any Precautions to stop it. It only happens when the risk occur in the project	Contingency reserve budgets Management schedule float Event contingency

TABLE III
Factor affecting project

Authors Factors	Semple et al. (1994)	Assaf et al. (1995)	Satyanarayana et al. (1996)	Chan et al. (1997)	Iyer et al. (2005)	Aibinu et al. (2006)	Lo et al. (2006)	Faridi et al. (2006)	Sambasivan et al. (2007)
Increase in scope of work	*	*							*
Restricted access at site			*			*	*		
Delay in material to be supplied by the owner			*		*				
Consultant or architect's reluctance for change			*		*				*
Obtaining permission from local authorities		*	*		*				
Lack of motivation for contractors for early finish				*				*	*

V. CASE STUDY

Bayu Aditya FIRMANSYAH at al. conducted case study on risk analysis in feasibility study of building construction project: case study - pt. perusahaan gas negara in Indonesia.

A. Objective of Study

The aim of the study is to identify the possibility of project savings by counting the risk causes. The matrix of risk possibility is use for find the different risk

importance, which is constant with monetarist investigation for the feasibility study and sensitivity analysis.

B. Research Methodology

Questionnaires survey method used for collecting data from the specialists in the industry of construction who have more information of as well as experience of risk management. The decision of risk is given by experts in form of effects and risk occurrence. The findings of

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effect illustrate stage of risk variables will affect to the success of project and regularly shows prospects of the risk occurrence.

The 2nd study is on economic (financial) analysis. This analysis used for to know whether the investment is proper or not. And then they compare the parameters of these values and gave some suggestion. Investment judgments has been done by NPV (Net Present Value), IRR, and ARR, Payback Period, as well as the Profitability Index and Profits of Costs Ratio.

C. Research Result

Risks are only occurred if the revenue decreased by 25%, if the investment price increased by fifteen percentage, staff plus managerial cost increased by fifteen percentages, if the loan interest amount increased by fifteen percentages. And the treatments are possible if marketing cost is increased by 5% as well as staff plus managerial cost increased by five percentages. And insurance cost increased by one percentage from the overall interest time.

Increase Net Present Value between the analysis without and with treatment reached to 175.74%. The achievement of the result from the study is shown in below table:

TABLE IV

Investment feasibility parameter

No	Scenario	NPV	IRR
1	Before process	190.372.382.052	21,34%
2	In process	85.986.702.273	15,78%
3	After process	151.110.904.586	19,33%

VI. CONCLUSIONS

From the above literature reviews following conclusion can be made:

- Cost and schedule are major factors to achieve a success in construction projects.
- From, literature review it is confirmed that the proper risk management have require for any successful construction projects, also the mitigation techniques require to eliminate the risk before it comes and effect the project lifecycle.

- A good risk management possible if it involves entire project, in terms of engineering, contracts, business, designing, finance estimating as well as project management.

- Risk management is the procedure that should be applied during the execution phase to achieve the objectives of the construction projects.

- Compared to developed countries in developing countries the reason of delay in project is to lack of knowledge of the risk management and risk mitigation techniques, so it is require to spread the knowledge regarding the risk management process in construction projects.

- There should be better approach towards the risk management instead of the current irregular approach towards the risks which is affect the entire project.

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