

# Managing Risk in Infrastructure Projects

**Mr. Vasant B. Patil**, Post graduate student of Trinity Academy of Engg, Pune

**Prof. S. S. Deshmukh**, Head of Department & Asso. Professor of Civil Engineering

Department Trinity Academy Of Engineering, Pune

## ABSTRACT

*It is very important to Manage risks in infrastructure construction projects has been recognized as management process in order to achieve the project objectives in terms of time, cost, quality and scope. Paper aims to identify and analysis of risks involved with the infrastructure projects. Based on a comprehensive assessment of conditions of contracts, this paper identifies risks and classifies them into eight types. It is observed by qualitative risk analysis, opposition from social bodies, changes in design and suspension of work are recognized to influence the project objectives maximally. This study has been found that few suggestions to mitigate construction project risks. The contract documents are used as a tool to manage risk and client, contractors and investors need to establish risk management policy throughout the project life. It is concluded that clients, designers, contractor and government bodies must work cooperatively from the feasibility phase onward to address potential risks in time.*

**Keywords**— Construction projects, Contract, Qualitative risk analysis, Risks, Risk management

---

## INTRODUCTION

It is said that “no business is more exacting or requires greater effort and determination than construction,” since Construction is a complex and challenging process and requires interpretation of and conformance with myriad laws, codes and regulations among other activities. Since the construction industry involves a multitude of people, from different organizations, with different skills and interests; a great deal of effort is required to coordinate the wide range of activities that are undertaken. A variety of unexpected events may occur during the process of procurement, execution and many of them can cause losses to the parties involved. Such uncertain events or set of circumstances that have an effect on achievement of one or more of project’s objectives, are commonly called risks. The most of civil engineering work is performed under contract. A contract provides a “self-contained statement of obligations as between its own parties”. The analysis has also identified several factors responsible for time and cost overruns - some within the control of the enterprises and some beyond their control. Contracts are vital to the success of a project is important difficult, costly and lengthy proceedings. The contract documents can be used as a tool to manage risk by allocating risks to the various agencies through the various contracts between them [4]. It is very important for all the agencies that they are aware at all times of the extent of risk exposure or the risks that they have to manage. If this awareness is lacking then it may lead to a number of disputes, disagreements and disruptions. One of the major reasons of disagreement and conflict is inadequate and defective contract documentation and also inappropriate contract arrangements and an unreasonable burden of risk being allocated to one of the parties by the contract. This study is on the risk management in construction contract aims to identify the key problems in certain critical areas of a construction contract, which if not attended to properly have the potential to become major roadblocks in the progress of the project. Problems have been identified in the areas of the Variation, Contract price and payment, Commencement, delays and suspensions, Insurances,

Takeover/Handover after completion of works, opposition from local bodies. In present work, a case study infrastructure project in Pune city of Maharashtra state, India, has been referred. The study identify, classify of various risks in a given set of contract documents and on basis of qualitative risk analysis find out severity of these risks, suggests methods to mitigate risks in construction projects from the client's and contractor's view point.

## **LITERATURE REVIEW**

There are various research papers on the risks management in construction projects. During literature study, D. W. Stam, and L. Y. Shen, proposed a Risk a risk management is explained as "a system which aims to identify and quantify all risks to which the business or project is exposed so that a conscious decision can be taken on how to manage the risks." It also include; various risks; agencies involved, their roles; exposure of projects to risk; effects of project phase on risk. Contracting in Construction is also discussed and the contract documents essential are enlisted and their significance is spelt. The bridge between the two topics of Contracting and Risk is then discussed and the qualities of a "good" construction contract are enlisted. There are various techniques are available for assessment of risks as per purpose of study.

## **AIM**

Risk is defined as the potential to suffer a loss. From the Oxford dictionary, risk is defined as - possibility of meeting danger or suffering harm. From this definition, it is clear that there is a need to avoid risks while managing projects. Hence, risk management is described as a collection of methods which are designed to ensure that an organization is ready to fight against these risks as much as possible. But unfortunately, risk can never be avoided but it can be reduced. And unfortunately again, often risks are ignored. By applying some constraints and giving more emphasis on reducing ambiguities, risk can be minimized. Project risks may be overlooked by those who just do not have time to look into it or those who want to avoid delays. To manage the risk that has been exposed, there is a need to fix that risk, and to fix that risk, it will cost more money, resource that a project usually lacks. Risk management should be conducted throughout the whole project lifecycle i.e. from the initiation phase till the decommissioning of the project. Risk Management may often contribute to project success through improvements due to the loopholes it uncovered.

## **OBJECTIVES**

The broad objectives of the project risk management process are:

- To enhance the capability of the organization
- To extend the organization's overall risk management processes to projects, and apply them in a consistent way; and
- To enhance the management of projects across the organization and obtain better project outcomes, in terms of schedule, cost and operations performance, by reducing risks and capturing opportunities.

**RESEARCH METHODOLOGY:**

Basically there is no law that is available exclusively for construction industry. Therefore it becomes much more important to have a methodology which can minimize risk of all parties involved. No project can be called totally risk free. However considerable amount of risk can be minimized by carefully drafting the contract document. Emphasis here should be given not only in drafting but also implementing it effectively. The role of a contract administrator is more vital for achieving risk free situation. A study of existing system indicates that the projects are open to wide spectrum of risk. i.e. risk in terms of defaulting in timely completion, in terms of cost over run and time over run. It is also seen that the exposure to risk and subsequent disputes result in projects getting aborted wasting time and money spent on that project. The methodology of risk management can be achieved by studying shortcomings in contract document & finding out the legal aspects related to risk. The methodology should be arrived at by identifying those areas which affect the performance of the projects to a great extent. Specific standards should be arrived at for specifying quality and to what extent quality variation shall be accepted should also be decided while awarding the contract. The contractor should also be provided with detailed drawings, specifications and schedule of supply of material. Incase of delays the contract should have a provision of issuing notice to the contractor to give him reasonable opportunity to accelerate the progress of the work.

Therefore Risk Management requires

- Identification of the particular risks
- Examination of the engineering and legal responses to allow the risk

**RISK MANAGEMENT IN CONSTRUCTION**

The risk is the likelihood of variation in the occurrence of an event, which may have either positive or negative consequences. Risk can also be defined as an event that may or may not occur and can lead to higher costs, extension of the project, failure to quality requirements/ norms, failure to satisfy information requirements/ norms and failure to satisfy specified organizational Risk Management [8]. The nature of risk is such that the risk for one person may be inopportunity for another. This entirely depends on, from whose point of view the project is being judged i.e. a range of possible outcomes, individual consequences and probability. D. W. Stam, and L. Y. Shen, proposed a risk management is explained as “a system which aims to identify and quantify all risks to which the business or project is exposed so that a conscious decision can be taken on how to manage the risks.” Risk management provides support for attempts to gain better control over a project when it comes to time, cost, quality, scope and organization. Risk management can help to promote progress of the activities within a project, instills confidence in the project, promote communication within the project and support the decision-making process within project. Company does not have time or capacity to engage in risk management, mostly company not familiar or thinking cost involving process, so that risk management is generally not applied to every construction project.

The steps in the process of risk management are:

- Risk Identification
- Risk Classification
- Risk Analysis
- Risk Response

Construction projects have an abundance of risks, contractors cope with, and owners pay for. When developing a contract strategy it is important for the client to communicate his objectives to the contractor to ensure that the most appropriate risk-sharing strategy is chosen. The risk is best placed with that party involved in the management of the project who is best able to manage the factor which gives rise to it. In addition to the legislative and policy requirements, the following Common issues in contracting that are relevant throughout the project life are Managing risks, Managing relationships, Managing resources, Specifying responsibilities, Keeping records, Behaving ethically.

**RISK MANAGEMENT STRATEGY**

The parties to contract should understand that **RISK MANAGEMENT** is not the responsibility of one party but the combined effort of all those involved. Each one should know the quantum of risk they are exposed to and prepare themselves for the risk. Risk is to be redirected or avoided or transferred to a particular project participant is a question that needs to be answered.

**The general approach to an identified risk is to decide:**

- whether to take up the risk; or**
- to mitigate the risk; or**
- to apportion the risk; or**
- to transfer the risk to another participant;**

When a project involves state-of-the-art or unusual structures or unusual locations in under-developed countries, then this lack of experience of risk management can itself create serious risks to the engineering of the project. This is accentuated by the increasing use of analytical and design software, a structured approach to the identification of risks is again appropriate. Engineers whether acting directly for Owners or for Contractors should be encouraged to prepare the design methodology identifying the risks and uncertainties and the data on which the design criteria is based. Litigation never gives adequate compensations for a project that has been unsuccessful. It is always best to examine carefully the options for reducing the risk than rely on the doubtful compensation of litigation if the assessment proves inaccurate.

**Risk Mitigation Steps**



The evaluation of the criticality of risk is a complex subject concealed in uncertainty and vagueness. The vague terms are unavoidable because it is easy for project managers to access risks in qualitative linguistic terms. To improve the preciseness and reliability of survey replies, a six-degree rating system for the criticality of risk and the effectiveness of mitigation measures have been adopted. (*Six Degree of rating system is a concept used by Dan Armstrong in an article "Six Degrees of Project Management"*) as shown in Table 1,

**Table-1:** Rating system for risk criticality and mitigation measure effectiveness

Ratings	Risk criticality	Mitigation measure effectiveness
0	Not applicable	Not applicable
1	Not at all critical	Not at all effective
2	low	Only slightly effective
3	medium	Effective
4	high	Very effective
5	Very high	Very much effective

Risks	Probability	Impact	Probability	Impact
Change in Design	Medium	Low	High	Low
Opposition from Social Bodies	Medium	High	Medium	Low
Suspension of Work	High	High	Medium	Low
Extra Works	High	High	Medium	Low
Accidents and safety	High	Low	Low	
Penalty for delay	Medium	Low	Low	Low
Disputes	Medium		Low	Low
Extension of time			Low	Low
Insurance and Indemnity	High	Medium	Medium	Low
Prevention of property	High	Medium	High	High
Price variation	High	Medium	High	High
Quality assurance	High	Medium	Medium	High
Labour regulations	High	Medium	Medium	High
Excessive approval by government		Medium	Medium	Medium
Material management	High	High	Low	Medium
Traffic diversion	High	High	Low	Medium
Dispute and Arbitration	High	High	Low	Medium

**Table ii -** Rating for Risks Identified in Contract



## RESULTS AND DISCUSSIONS

While making the contract agreement, there are various clauses can make conflicts between client & contractor, so for avoiding any disputes the risk identification was performed on the conditions of contract and specifications.

For that infrastructure projects in Pune are studied. From the study of various contract clauses from contract document it knows that there various risks can be generate. Those risks identified in the contract documents were classified under the categories of physical, financial, legal, construction, political, design, environmental and contractual risks; depending on the nature of its impact. The risks identified in the contract documents are placed against each condition of contract.

The risk assessment matrix is formed according to the impact of risks on client & contractor. Because every clause of contract is may be converted into the risk & it may effects on different perspectives of the project i.e. time, cost, scope, quality. The probability & impact is combined to determine whether the activity is very high risk, high, medium, low, or very low risk for each objective or clause. While studying the qualitative risk analysis there is contract document it is observed that the client of project have made the contract agreement like that they have minimized the majority of risk which can affect them. In between that some risks are kept same which have low probability & low impact on them. The risks are transferred to the contractor.

The major risks factors were found to be the agreement of the contract, change in design, opposition from social bodies, suspension, price escalation and renegotiations. Finally, some suggestions are find out to reduce or mitigate construction project risks are identified which are the stable cash flow of project funding, more precise geotechnical data, consulting constructability reviews from experts, set a realistic contract performance times, work and rework cost estimates, introducing phased pricing, pre-plan for permits & approvals, information regarding utilities and zoning, predefine rates, equations and procedures, use of experienced project personnel, proper material management, minimize communication gap by periodic meeting ,inspection & reviews and last but not least use the contracting process as a risk avoidance measure.

## CONCLUSIONS

On the basis of survey, this study has systematically examined major risks affecting the infrastructure project. In this paper qualitative risk analysis technique provides an effective insight and clear picture of the risks involved in infrastructure construction in Pune city. The contract documents are used as a tool to manage risk by allocating risks to various agencies through various contracts. To minimize the chances of failure or under-performance, risk management policy must be implements and evaluate regularly into the construction project. This study provides useful references to any infrastructure construction projects in India. It is concluded that clients, designers, contractor and government bodies must work cooperatively from the feasibility phase onward to address potential risks in time. The analysis and findings in this paper also present valuable data for the Indian government and local construction agencies to have an in-depth understanding of the risk environment in construction in Pune city of India. Such understanding is very important for implementing further effective measures to ensure the right direction of future development to construction professionals.

## REFERENCES

- [1]Albert P. C. Chan ., John F. Y. Yeung ., Calvin C. P. Yu.,Shou Qing Wang., and Yongjian Ke . “*Empirical Study of Risk Assessment and Allocation of Public-Private Partnership Projects in China.*” *Journal of Management in Engineering*, Vol. 27, No. 3, July 1, 2011. ©ASCE, ISSN 0742-597X/2011/3-136–148.
- [2].Schaufelberger.J.E, Isr Wipadapisut, “*Alternate Financing Strategies for Build-Operate-Transfer Projects.*” *Journal of Construction Engineering and Management*, Vol. 129, No. 2, April 1, 2003. ©ASCE, ISSN 0733-9364/2003/2-205–213.

- [3]. Waghmare.A.P, Dr.Pimplikar.S.S, “*Risk Analysis in Feasibility Study of Road Construction Project: Case Study Construction of the Four Laning Of Amravati –Talegaon Section Nh-6.*” International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 3, May-Jun 2012, pp.3166-3169
- [4]. Shou Qing Wang, Robert L. K. Tiong, S. K. Ting and D. Ashley, “*Evaluation and management of political risks in china’s BOT projects.*” Journal of Construction Engineering and Management, Vol. 126, No.3, May/June, 2000. qASCE, ISSN 0733-9634/00/0003-0242–0250.
- [5]. J.H.M.Tah, V. Carr, “*Knowledge-based approach to construction project risk management.*” Journal of Computing in Civil Engineering, Vol. 15, No.3, July, 2001. ASCE, ISSN 0887-3801/01/0003-0170–0177.
- [6] Richard Clough, Construction Contracting, Wiley- Interscience, New Mexico, 1972.
- [7] A guide to the Project Management Body of Knowledge; Project Management Institute, Edition -2004.
- [8] M. H. McCallum, A Quick Primer on Construction Risks and Contracting Practices, American Corporate Counsel Association Annual Meeting October, 2000.
- [9] R. Flanagan & G. Norman, Risk Management and Construction, Blackwell Scientific Publications, London, 1993.
- [10] G. Smith and C. M. Bohn, “Small to Medium Contractor Contingency and Assumption of Risk, Journal of Construction Engineering and Management,” ASCE, vol. 125 no. 2, pp. 101, 1999.
- [11] N.J.Smith, Managing Risk in Construction Projects, Blackwell Science, Oxford, 1999.
- [12] D. W. Stam, Project risk Management- An essential tool for managing and Controlling projects, Kogan Page Limited, Dutch, 2005.
- [13] L. Y. Shen, “Risk management,” International Journal of Construction Engineering and Management, vol. 127, no.1, pp 76-81, Jan/Feb, 2001
- [14] S.Q. Wang, M.F. Dulaim & M.Y. Aguria, “Risk management framework for construction projects in developing countries,” Construction Management and Economics, vol. 22, pp. 237-252, March 2004.
- [15] A. S.Akintoye, and M. J. MacLeod, “Risk Analysis and Management in Construction,” International Journal of Project Management, vol. 15(1), pp. 31-38, 1997
- [16] R. Graves, Qualitative Risk Assessment, The Professional Magazine of the Project Management Institute1, pp. 80, October 2000.
- [17] M. Jamil, N. H. mufti and A.H. Khan, “Risk Identification for Construction Projects,” Advancing & Integrating Construction Education, Research & Practice, Karachi, Pakistan, pp. 4-5, August 2008.
- [18] L. Galway, Quantitative Risk Analysis for Project Management, Working Paper, Rand Publication, Feb 2004.
- [19] W. Baker and H. Reid, Identifying and Managing Risk, Frenchs Forest, N.S.W.: Pearson Education, 2005
- [20] Contract Documents of Infrastructure Projects in Pune, 2012.