



## Evaluating and Controlling Potential Risk in Construction Projects

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# “Evaluating and Controlling Potential Risk in Construction Projects”

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**Abstract.** The study's objective is to identify and analyze the severity and likelihood of frequency of risk factor. in Industrial and Residential construction projects and also to gain knowledge on the risk factors that could be the governing factors in Industrial, and resident projects. The analysis is done using the ranking method which identifies the major risk factors in the planning stage, execution stage and completion stage. A questionnaire is prepared based on expert opinion, personal interview and literature review through which major dominating factors in industrial and residential construction projects are taken for survey. The identified factors can have either direct or indirect effects which newline are analyzed through quantitative or qualitative methods. Further, the research also implements super decisions software using the Analytic Network Process (ANP). Software analysis together with the statistical analysis gives the top risk groups, enabling us to focus and eliminate the risk factors for the successful completion of the projects.

**Keywords:** Risk Identifying, Risk Analyzing, Risk Organization, Risk Factors.

## I. INTRODUCTION

The financial development of a nation is significantly told by the construction sector. The volume of development taking place in the residential, commercial, and infrastructure sectors directly affects a country's capability to grow. The construction assiduity has contributed an estimated 3 trillion in Indian rupees to the public GDP in 2022- 23. Threat operation plays a crucial role in achieving design aspirations since building systems are complex and involve several dangers that impact multiple stakeholders. The main cause of exceeding design deadlines, budgets, and other design pretensions is threat. The process of relating hazards, evaluating them both qualitatively and quantitatively, and responding with an efficient control and treatment plan is known as threat operation. The diligence is dispersed, comprising small and medium-sized contractors who operate on a subcontract basis in this field, medium-sized corporations that specialize in niche conditioning, and large companies that are active in construction conditioning throughout the country.

The construction sector is exposed to a wide range of risk that might arise during project cost, design, building, and management of facilities. Because it involves so many resources, the construction sectors are more vulnerable to dangers than other industries. Every activity in a project has its own set of advantages and disadvantages. If not appropriately managed, these risks may generate unpredictability in the time and expense involved in construction projects, affecting the quality and safety of the structure.

As a result, companies/parties typically employ a risk management approach in their projects, which improves

performance and effectively achieves cost, quality, and safety objectives. Construction has traditionally been considered as a high-risk sector. Risk management regulates the degree of risk and mitigates its effects so that the negative consequences are eliminated or neutralized without jeopardizing quality and safety. The literature review indicates several dangers in project construction that have varying consequences on the project's successful completion. Due to the complexity of the construction sector and involve a number of resources, there will be multiple hazards at each step of the project, and identifying these risks is a critical component for each project manager.

### A. Risk

During the 1920s, the concept of risk gained popularity in economics. Since then, it has been successfully included into economics, finance, and decision science decision-making theories. Risk means things to different individuals, therefore how we define risk depends on our perspective, attitudes, and life experiences. Risk is viewed from a technological perspective by engineers, designers, and contractors whereas it is typically viewed from an economic and financial perspective by lenders and developers.

Risk denotes a situation in which there is no knowledge of the result or exposure to loss caused by weak or ineffective internal systems. Risk arises from the unpredictability of occurrences as well as the potential gain or loss they may produce. The core of risk is characterized by three factors: the event, which is a prospective occurrence that may have an influence on success; the likelihood, which is the possibility or probability of the risk event occurring within the time period; and the impact, which is the financial value of the risk event's effect. Uncertainty is an unquantifiable threat; risk is measurable uncertainty.

### B. Risk Evaluation and Management in The Construction Industry

The risk management procedure for a construction project includes identifying influencing elements that might have a negative influence on the project's success. budget, schedule, safety, or quality goals, calculating the potential risk's correlational impact, and implementing mitigation strategies. A proactive examination, assessment, and analysis must be performed to eliminate or prevent the risk based on its appearance along with its frequency and seriousness if a poor decision is made on a dangerous activity.

Risk is a significant element that has an impact on all construction sectors. over the globe. Due to a lack of the necessary infrastructure, handling this is challenging in India. expertise in this field. The field of risk evaluation and management is one that is rapidly expanding in order to prevent economic loss and act quickly finishing the project.

Only someone who is fully aware of the risk Assessment and site management can foresee issues that may arise. develop as a danger and identify the appropriate risk reduction methods time.

A working engineer with expertise may, to a certain extent, identify and oversee the project's risk. They will be able to handle risk more effectively and competently if they keep themselves up to speed on the numerous risk- related fields.

### C. Risk Management Process

The risk management process (RMP) is made up of four basic steps: identification, evaluation, action, and risk monitoring. RMP is equipped with a variety of ways and procedures to help control such risks. It is apparent that many sectors are more proactive and aware of the importance of conducting analyses to assess the success of their operations. RMP is becoming a prominent method across multiple industries. However, risk management is not frequently used in the construction industry. Despite the fact that construction companies are aware of RMP, their ignorance of using the models and techniques for managing potential risks contradicts the fact that the construction industry is likely to have more control over the project to achieve its goals by being cost- and time-effective. Regardless of the industry, the basic goal of a project manager is to manage risk comfortably.

The construction business is unique in its complexity and character, functioning in an uncertain environment with potential for risk under a variety of scenarios. Each organization's primary purpose and vision is to succeed, and risk management can help with that. It should be apparent that risk management is not a guarantee of success, but rather a concept that improves the chances of success.

Risk management is a methodical approach to safeguarding the company's assets and revenue from losses so that its goal can be achieved without hindrance. Identifying, evaluating, and responding to risk occurrences during a project in a structured, formal manner is known as risk management. The goal is to achieve the best possible level of risk elimination or control. In construction projects, each of the four key objectives (money, time, quality and safety) is sensitive to risk and uncertainty.

Construction projects can be really complicated and have big budgets, so it's important for every project manager to make sure the risk is taken care of. This thesis investigates how risk management might be implemented at the beginning of a construction project's life cycle. Furthermore, based on interviews, it investigates how risks can alter throughout the project's duration.

Risks of all kinds are a crucial subject in project management and planning because of the potential consequences that can arise from their occurrence and have a negative impact on the project's goals in terms of cost, delivery schedule, additional work, and problems. The initial goals of this are to determine appropriate ways to oppose or sidestep them, or to at least lessen its rigidity or shift it completely to the other side.

### D. Indian construction industry and they are classified under various subgroups.



Fig. 1. Risk Group

The study looked at the risk in the construction sector as a result of accidents, as well as the calculation of risk levels based on the possibility of an event occurring and the magnitude of the repercussions. Risk assessment is crucial, although a precise risk estimate may not be necessary. A methodology that calculates the value of risk would assist contractors in identifying the high risk of major construction conditioning and allowing them to devote safety preventives more effectively. An integrated risk analysis method for tracking the likelihood of hazardous events occurring in construction projects from the conceptual stage to the end of the project was investigated. The risk management framework is based on traditional risk modeling principles that have been integrated with various financial aspects, resulting in an automated risk management process that can identify adverse processes that will occur during the project's life cycle and the necessary action plans to counteract them. Before damaging occurrences occur, dangerous tendencies are identified, and pre-defined action plans can be performed on time.

## II. METHODOLOGY

The study includes site observations, semi structured interviews with industry experts who are directly involved in that project, and literature searches to gather risk variables in building projects. The risk factor contributions that significantly affect projects fall into six groups. To analyze potential risks in building projects, including those related to technical risk, financial risk, construction risk, organizational risk, socio-political risk, and environmental health and safety risk.

Schedule or viability of project with their causes were identified and allocated based on their functionality and relations among the groups of crews under three stages of construction (pre- construction, During construction and completion stage). The factors which have its effects directly or indirectly over the construction project were assessed using a quantitative or qualitative methods. At various stages of the construction process, the risk concerns associated with construction projects, such as residential

and industrial projects, were taken into consideration. Based on statistical analysis, the several possible risk factors that could have an impact on building projects were examined, and the results were verified using software.

### III. RESULT AND DISCUSSION

Potential risks that have been discovered are valued according to their likelihood and potential consequences. Threats can be evaluated with analytical tools that are quantitative or qualitative. Any construction project's ability to be completed on schedule depends on its ability to identify and evaluate project risk. This process is known as "risk analysis," and it involves several steps. Risk analysis will help management devise focused corrective action by providing insight and a clear picture of the individual causes of project risk.

#### A. Ranking Method

Various potential risk variables affecting project progress and the frequency of occurrence of those risk factors are determined based on site observations.

Grounded on their frequency of circumstance, the various possible risks are ranked for each type of the project and those are being repetitively in nature and listing in the top three major are listed then along with their contribution rank. Which their donation situations are arrived to identify the critical factors that has high impact over the project.

The technical risks are observed and assessed, for the site condition under the potential factors like inadequate design, human resource management challenges, inadequate specification, inadequate site investigation, and change in scope, insufficient resource availability, construction procedures, and equipment failure. Similarly, the sub factors under financial risk category for the potential factors such as increased material cost/labor cost, taxes, exchange rate fluctuation, payment delays, improper estimation, operational risk, low market demand, time risk and profitability risk and liquidity risks are correlated. The identified risk sub factors in construction risk are marked against the parameters like labor productivity, BOQ, too high-quality standards, labor disputes, site condition, equipment failure, design changes/inaccurate, incomplete preplan procedure, delay in procurement are noted for each factor. Likewise, the sub factors in Management risk against the potential risk as contractual relations, contractor experience, communication, budget attitude of participants, inexperienced workforce, schedule impact are related for the corresponding The socio-political risk in terms of potential risk threats like alterations to rules and laws, pollution and safety policies, requirements of permits and approval and difficulties in disposing plant, bribery and corruption, language and cultural barrier, law and order, and equipment. The EHS risk under the potential risk as weather implications, sudden unforeseen events, natural disaster, incomplete environmental analysis, unsafe site conditions safety rules and regulations and poor monitoring are assessed for their occurrence and contribution. Herewith the sub factors related to Industrial and Residential construction systems during construction stages are calculated to find out their contribution probability.

#### 4.1.1 INDUSTRIAL CONSTRUCTION

The survey of significant construction site, observation, literature reviews, experts' opinion, all effects to be carryout from the site and computation and ranking the which major risk factors are contribution in Industrial construction.

TABLE I. RANKING OF HIGHEST RISK IN INDUSTRIAL CONSTRUCTION

Stage	Risk	Risk Factors
Planning	Technical	Inadequate Design
	EHS	Safe Work Process
	Social	Permits/Approvals
Execution	Financial	Time Risk
	Management	Impact Schedule
	Technical	Plan & Design
Completion	Financial	Delay of Payments
	EHS	Site Unsafe
	Technical	Plan& Design

The analysis on various risk factors during the stages of industrial construction depicts that the technical, EHS, and social risk due to Inadequate design, safe work process and permits/approvals is the major contributor during the preconstruction stage. During the construction stage of industrial building the major risk contributing factor is financial, management, technical risk which is due to the time risk factor, Impact on schedule and plan and design. During the completions stage of industrial building the major risk contributing factor is financial, EHS, and technical which is due to the Delay of payment, site unsafe, and plan and design. The results obtained from ranking method for an industrial construction project is tabulated in table.

TABLE II. OUTPUT AS PER SUPER DECISION SOFTWAREMOST TOP-RANKING RISK IN INDUSTRIAL CONSTRUCTION

Stage	Risk	Validation
Planning	Technical	0.23857
Execution	Financial	0.21342
Completion	Financial	0.22587

#### 2.2 RESIDENTIAL CONSTRUCTION

The survey of significant construction site, observation, literature reviews, experts' opinion, all effects to be carryout from the site and computation and ranking the which major risk factors are contribution in Residential construction.

TABLE III. RANKING OF HIGHEST RISK IN RESIDENTIAL CONSTRUCTION

Stage	Risk	Risk Factors
Planning	Technical	Inadequate Design
	Financial	Operational Risk
	Construction	Site Conditions
Execution	Financial	Time Risk
	Management	Impact Schedule
	Construction	Delay Procurement
Completion	EHS	Natural Disaster
	Financial	Payment Delay
	Construction	Inadequate Pre Plan

Generally, in Residential construction due to unclear vision in planning the objective of the facility, the execution of the project is delayed. Thus, the technical, financial and construction risk is the major contributor during planning stage due to inadequate design, operational risk, and site condition. During the execution stage Financial, management, and construction. Due to time risk, impact of schedule, and delay in procurement not proper management is the major concern. During the completion stage EHS, financial, and construction. Due to natural disaster the payment delays, and inadequate pre plan is the major contributor. The results obtained from ranking method for a Residential construction project is tabulated in table.

TABLE IV. OUTPUT AS PER SUPER DECISION SOFTWARE MOST TOP-RANKING RISK IN RESIDENTIAL CONSTRUCTION

Stage	Risk	Validation
Planning	Technical	0.28214
Execution	Financial	0.24509
Completion	EHS	0.20190

The above results are attained from the analysis of the risk factors in varied constructions at various sub factors. The highly contributed sub factors of various construction are observed from the software outputs.

#### IV. CONCLUSION

This Research, concluded that we need to focus on these different potential factors in various phases of the project to mitigate the relevant impacts. Regard to on the outcome of the analysis, the main impact group was established and summarized in the table. In industrial construction Major impact risk in project as financial risk because many things are not proper manage like delay in payments, due to delay in execution work and also effect in the finishing of the project. In Residential Construction Major impact risk in project as Construction risk is identify three phases of the

construction. Due to site unsafe condition, delay in procurement, and not proper planning. This Research recommendation to Construction site to focus Technical, Financial and Management but also focus on Environmental Health & Safety and Social-Political Risk is important in the industrial and residential Construction. This Research also help improve company economic. Which risk are focused Planning, Execution, and completion stage. What type of steps to be considered to reduced risk in construction projects.

#### REFERENCES

- [1] Agnieszka Dziadosz & Marisz Rejment, 2015 'Risk analysis in construction projects –Chosen methods, Procedia Engineering, vol.122, pp. 258-265.
- [2] Alali, B. & Pinto, A, 2009, 'Project, systems and risk management processes interactions. Management of Engineering & Technology', PICMET 2009 - Portland International Conference, pp.1377-1386.
- [3] Al-bahar & Crandall.K .C. 1990, 'Systematic risk management approach for construction projects, Journal of Construction Engineering and Management', vol. 166, pp. 533-546.
- [4] Alfredo Serpell et al., 2015, 'Evaluating Risk Management Practices in Construction Organization', Procedia Journal, vol.194, pp. 201-210.
- [5] Ana I. Irimia-Diéguezetal,2014,'Risk management in mega projects', Procedia-Social and Behavioral Sciences 119, pp. 407 -416.
- [6] rbara Gładysz et al., 2015, 'Project risk time management – a proposed model and a case study in the construction industry', Procedia computer science, vol. 64, pp. 24-31.
- [7] B.A.K .S.Perera, Indika Dhanasinghe & Raufdeen Rameezdeen, 2010, 'Risk Management in road Construction: In case of Srilanka', International Journal of Strategic property management, vol. 13, issue 2, pp. 87-102,
- [8] Baloi, P. & Price, A. 2003, 'Modelling global risk factors affecting construction cost performance', International Journal of Project Management, vol. 21, issue 4, pp. 261–269.
- [9] Berenger Y . Renault & Justus N. Agumba, 2016, 'Risk management in the construction industry: a new literature review', MATEC web of conferences, vol. 66, pp. 1-6.
- [10] Bon Gang Hwang & Li Ping Toh, 2014, 'Risk Management in small construction projects in Singapore: status, barriers and impact', International Journal of Project management, vol. 32, issue 1, pp. 116- 124.
- [11] Bufaied, A S, 1987, 'Risks in the Construction Industry: their Causes and their Effects at the Project Level' Ph.D. Thesis, University of Manchester, UMIST.
- [12] Cheng Siew Goh & Hamzah Abdul Rahman, 2013, 'The identification and management of major risks in the Malaysian construction industry', Journal of construction in Developing countries, vol. 18, issue 1, pp. 19-32.
- [13] Del Caño A., & De la Cruz, M. P. 2002, 'Integrated methodology for project risk management', Journal of Construction Engineering and Management ASCE, vol. 128, issue 6, pp. 473-485.
- [14] E.W.T Ngai and F.K .T. Wat, 2005, 'Fuzzy decision support system for risk analysis in e-commerce development', Decision Support System, vol.40,pp.235-255.
- [15] Flanagan, R. & Norman, G, 1993, 'Risk Management and Construction', V ictoria: Blackwell Science Pty Ltd, Australia.
- [16] Flanagan, R. & Norman, G, 1993, 'Risk Management and Construction', V ictoria: Blackwell Science Pty Ltd, Australia.
- [17] Muizz O. Sanni-Anibirea, Rosli Mohamad Zinb, Sunday Olusanya Olatunji 'Machine learning model for delay risk assessment in tall building projects' International Journal of Construction Management 2020.
- [18] Ibrahim Yahaya Wunia, Geoffrey Qiping Shena, Robert Osei-kyeib, Stephen Yeboah 'Modelling the Critical Risk Factors for Modular Integrated Construction Projects' International Journal of Construction Management 2020.
- [19] S.Divya Sankar, Dr. Janani Selvam 'Risk Management in Construction Industry' International Research Journal of Engineering and Technology 2020.

- [20] Pouria Ildarabadi, PhD, Student, Javad Alamatian, Associate Professor 'Proposing A New Function for Evaluation of The Financial Risk of Construction Projects Using Monte Carlo Method: Application on Iranian Construction Industry' *Journal of Building Engineering* 2021.
- [21] Adesoji Anthony Adegboyega, Chidiebere Emmanuel Eze, Onyinye Sofolahan 'Health and Safety Risks Normalization in The Construction Industry: The Sme's Perspective' *Independent Journal of Management & Production* 2021.
- [22] Manal Suliman Omer\*, Nawi, M.N.M., A.Q. Adeleke\*, Sitansu Panda, Harun, A.N., and Anas A. Salameh 'Analysis of Organizational Internal Factors Influencing Construction Risk Management Among Construction Industries' *Productivity Management* 2021.
- [23] Shengyu Guoa, Jichao Li, Jiali Heb, Weijia Luoa, Baiben Chenc 'A Modified Risk Matrix Method for Behavioral Risk Evaluation in The Construction Industry' *Journal of Asian Architecture and Building Engineering* 2021.
- [24] Ibrahim Yahaya Wuni, Geoffrey Qiping Shen 'Exploring the critical production risk factors for modular integrated construction project' *Journal of Facilities Management* 2021.
- [25] Reem Al Sharif, Shaligram Pokharel 'Smart City Dimensions and Associated Risks: Review of literature' *Sustainable Cities and Society* 2021.