International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 02 | Feb 2024 www.irjet.net p-ISSN: 2395-0072

" A research article on Management of risks implied by conditions of contract and specifications"

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Abstract – *Effective risk management in construction projects is crucial for achieving project objectives related to time, cost, quality, and scope. This project focuses on identifying and analyzing risks accompanying with infrastructure ventures, utilizing a inclusive assessment of contract conditions to categorize these risks. Through quantitative risk analysis, it becomes evident that factors such as "opposition from social bodies," "change in design," and "suspension of work" exert the most significant influence on project objectives. Furthermore, this research identifies best practices for mitigating these critical risks. It emphasizes the need for collaboration among clients, contractors, designers, and government organizations from the project's possibility phase forward to proactively address impending risks. Contract documents play a pivotal role as tools for risk management, including contractors, clients, and investors, should begin a risk management policy that spans the entire project life cycle. Ultimately, this approach ensures a more robust and successful execution of construction projects.*

The study of various risks and their management is becoming pre-requisite for many construction projects and can significantly beneficial most all parties. The construction activity involves a number of agencies like owner, consultant and contractor may have conflicting interests. In order to establish the duties, obligations, rights, responsibilities amongst the agencies, a contract is required to be made between them which will establish a mutual relationship to do a work. The contracts may be used as a risk managing tool by allocating risks to the various agencies through the various contracts between them and client, contractors and investors. The qualitative risk analysis is used for analysis which helps to predict severity of risks. Risk management includes identification of risks in contract documents, risk classification, risk analysis and then risk control. It has been found that severities of important risks have been calculated considering the suitable control measures from client and contractors point of view. The findings of study may be used as reference to similar construction projects in India i.e. for local clients, contractors, investors and also for government. Managing risks in construction projects has been recognized as a very important management process in order to achieve the project objectives in terms of time, cost, quality and scope. In this identification and analysis of risks associated with the infrastructure projects. Based on a comprehensive assessment of conditions of contracts, this paper identifies risks and classifies them into different categories.

Key Words*: *Risk, risk management, construction projects, contract, qualitative risk analysis.

1.INTRODUCTION

Building projects are inherently unique & resist standardization due to their complex and dynamic nature. These endeavours are shaped by various environmental factors such as weather conditions, geographical location, transportation accessibility, and labour availability, which often lie beyond the contractor's control. Furthermore, the entities involved in construction projects can differ significantly, including various agencies, owners with diverse requirements, distinct site conditions, and fluctuating market conditions. Consequently, the construction industry is characterized by volatility, marked by cyclical and seasonal ups & downs. Therefore, each building project demands meticulous handling and attention due to the ever-evolving landscape of the erection sector. In the realm of erection, multiple stakeholders play crucial roles, with differing interests and objectives. The primary players typically include the client, an architect/engineer, and the contractor, each harboring somewhat conflicting interests. The client desires the successful completion of the project while ensuring their specific requirements are met, all while minimizing costs, hassles, and responsibilities. In contrast, the contractor aims to maximize profits while minimizing operational challenges. This inherent tension among stakeholders necessitates the establishment of clear duties, obligations, rights, and responsibilities through a formalized contract. Contracts serve as the cornerstone of the construction industry, with the majority of civil engineering work conducted under contractual agreements. These contracts serve as "self-

contained statements of obligations" between the involved parties, outlining the terms and conditions governing their collaboration. Contracts are pivotal to the success of construction projects, as they mitigate potential disputes and provide a structured framework for project execution. Without contracts, resolving conflicts and ensuring compliance with agreed-upon terms could be a complex, costly, and protracted process. A contract, in its essence, is a legally binding document through which individuals or entities commit to performing work under specified conditions. It emerges from the convergence of mutual intentions, as parties communicate their shared objectives to create binding obligations. However, not all agreements hold the same legal weight. The Indian Contract Act of 1872, in Section 10, stipulates that only those agreements are enforceable by law that meet specific criteria: they must be formed with the free consent of competent parties, entail lawful considerations and objects, and not be expressly declared void by law. Central to the formation of a contract is the concept of offer and acceptance. Parties must engage in a dialogue that leads to a meeting of minds, and this agreement must pertain to actions and outcomes that are legally permissible. When these elements align and the agreement meets the legal criteria, it transforms from a mere agreement into a legally binding contract.

Steps are-

1. Preparing Proposal
2. Communication of the proposal
3. A Communication of acceptance of proposal

The Indian Contract Act of 1872 states that an agreement is a contract if it is created with the free assent of parties who are legally able to enter into contracts, has legal considerations and a legal purpose, and is not explicitly and unambiguously declared to be void. A risk to one individual may present an opportunity to another. This is entirely dependent on the perspective from which the project is being evaluated.

1. A range of probable outcomes
2. Individual significances
3. Probability

2. DEFINITIONS

According to "D van Well- Stam," To retain control over a project, risk management can be summed up as "the entire set of activities and measures that are aimed at dealing with risks."

According to the definition provided by L. Y. Shen, "The goal of risk management is to discover and measure all the dangers that a company or project faces, so that a calculated choice may be taken about how to deal with them."

3. NEED OF STUDY

Risk management aids project control in time, cost, quality, scope, and organization.

Using risk management can:

1. Encourage project activity to move forward
2. Encourages faith in the project
3. Encourage communication within the project;
4. Assist in project decision-making

The following are some of the reasons why risk management is typically not used on every project:

1. Most project participants are unfamiliar with risk management.
2. Some people believe that risk analysis can be used to evaluate an individual's performance.
3. Costs are associated with risk management and the use of control measures.
4. Businesses and organizations often say they lack time or resources for risk management.

4. AIM

To identify, analyse and mitigate various risks in the project from contract documents.

5. OBJECTIVE

The main objectives of study are

1. To identify and classify the types of construction project risks in a given set of contract documents.
2. To study different methods available for evaluating risks
3. To evaluate risk by Relative important index (RII) method, by taking suitable case study
4. Comparative study of the Relative important index (RII) method of risk evaluation with other method of evaluation i.e. Expected monetary value risk analysis

6. SCOPE OF THE STUDY

1. Risks in construction project such as time, cost and quality are minimized.

2. Contract clarity between the owner and contractor.

3. Future forecasting.

4. No debates between owner and contractor regarding the project finances.

Risk management in the construction industry is a critical process for achieving project objectives in terms of time, cost, quality, and scope. Various researchers have explored the nuances of risk management in construction projects, highlighting its importance and shedding light on practical approaches and challenges. This summary provides an overview of their findings.

7. LITURATURE REVIEW

7.1 Borysowich (2008): It is not possible to identify or quantify risk in this manner because, as most organizations are aware, dangers do not manifest in a linear fashion. The true difficulty lies in evaluating and comprehending the interplay between risks and the linked impacts they entail. A distinct set of instruments is necessary to deal with these intricate connections. An organization can start to create a good map of their risk landscape by using tools that simulate various risk scenarios and how those risks are interdependent. To choose the right combination of risk retention and risk remedies, the study set out to comprehend the cumulative effect of risks on value and performance.

7.2 Irem Dikmen et.al. (2013): Instead of being comprehensive systems that can back up risk management, risk management paradigms are more like approaches. While the remaining steps are typically executed outside of the program, the current risk management support tools are typically built around quantitative risk analysis. As decision support systems, risk registers and assessment tools are suggested for usage at certain points in a construction project for particular goals, such as estimating time and costs during the bidding process or evaluating the risk of a country during the selection of overseas markets. On top of that, the suggested risk management methods seldom address subjectivity, fail to take into account the effect of risks on all project success metrics, and fail to promote collaboration among all parties involved in the building supply chain when it comes to risk management. Developing a risk management corporate memory and a decision support tool for effective risk management is the primary goal of this article, which also aims to critically examine current risk management support tools.

7.3 Alfredo Federico et.al. (2014): Project risk management is an important part of a project manager's job. But without proper risk management from the start of the project, this task becomes even more complicated and inefficient. Proper and methodical technique, together with, most significantly, knowledge and experience, are necessary for an efficient and effective risk management approach.

7.4 Franck Taillandier et.al. (2014): The ability to effectively manage risks is crucial to a project's success. However, such a management is difficult to achieve due to the diversity and dynamic nature of hazards. There is no one-size-fits-all solution to project risk because each participant brings their own set of circumstances, viewpoint, and expertise to the table. We offer an agent-based model called SMACC in this post to help you assess the possible consequences of project risks. The model allows for the assessment of different risk reduction strategies and how they impact the project.

7.5 Amita Pawar et.al. (2017): There are discrepancies and gaps in the understanding and management of construction and project risk. In this article, we look at how the construction industry views the risks involved in their work and how often they employ risk analysis and management strategies. Our data comes from a survey of Pune-based general contractors and project management firms. Findings indicate that risk management plays a crucial role in construction operations for reducing losses and increasing profits. Most people think of construction risk as anything that could derail the project's budget, schedule, or quality goals. Management and analysis of construction site risks rely heavily on gut feelings, best judgement, and years of expertise. Because of misconceptions about their applicability and a general lack of understanding, formal risk analysis and management approaches are underutilized in the construction sector.

8. RISK MANAGEMENT

Risk is the likelihood that an event will occur differently than expected with potential for positive or negative consequence.

Risk is where the outcome of an event, or each set of possible outcomes, can be predicted on the basis of statistical probability.

An additional definition of risk is an event that may or may not happen and could result in:

1. Higher prices
2. Increasing the project's scope

3. Not meeting information standards or requirements
4. Failing to adhere to organizational Risk Management requirements

Phases in Risk Management

The stages involved in management of risk are as follows:

Risk Identification
Risk Classification
Risk Investigation
Risk Attitude
Risk Response

All potential hazards that can have an impact on a building project are recognized and looked into throughout the risk identification process. Identifying "causes and effects" (what would happen and what would follow) or the inverse, "effects and causes" (what outcomes are to be encouraged or discouraged and how each might occur) can be used to detect risks.

site conditions, inaccuracies in cost estimates and schedules, delays, financial challenges, labor strikes, subpar materials, workmanship issues, operational setbacks, and deficiencies in project plans and specifications. Thorough contract To avoid construction project risks following are the measures

1. Know the base cost for construction

2. Establish the network of trusted subbies.

3. Check out the profit

4. Use the integrated construction software

Construction projects are fraught with various types of risks that can impact their successful completion and overall outcomes. These risks can be categorized into several key areas

Risks are classified as following types

8.1 Physical risks – Construction labour poses a number of physical health risks. Due to prolonged exposure to noise, many construction workers get hearing loss, ringing in the ears, and other illnesses. Vibration using hand-held power tools or other equipment that vibrates often while working can result in long-term damage.

8.2 Financial risks- Among the issues include misuse of project funds, poorly funded or underbid projects, and contractor failure

8.3 Legal Risks: Legal risks arise from potential conflicts between the construction project and local laws and regulations. These risks are primarily under the control of the project owner, as they bear legal responsibility for the entire undertaking. Ensuring compliance with legal requirements is crucial to avoid legal disputes and potential delays.

8.4 Construction Risks: These encompass a range of issues such as design errors and omissions, delays in the design process, late stakeholder requests for changes, and failures to adhere to the terms of the construction contract. Effective project management and communication are essential to mitigate these risks.

8.5 Environmental Risks: Environmental risks pertain to the likelihood and consequences of unintended environmental incidents. Poor waste management, transportation, and disposal practices can result in the release of pollutants into the environment, posing significant threats to human health. Stringent environmental management and compliance are necessary to mitigate these risks.

8.6 Contractual Risks: Contractual risks are common in construction projects and encompass various factors like adverse weather conditions, unexpected management and risk assessment are crucial to address these challenges.

8.7 Design Risks: Design risks revolve around the potential failure of the project's design to meet project requirements. This may include fundamental flaws, infeasible concepts, inefficiencies, instability, or designs that fall below client standards. Poor design can result in functional defects or obstacles that hinder project progress.

8.8 Political Risks: Political risks include elements including political unrest, legal restrictions, environmental and product safety regulations local taxation, labor laws, trade policies, and currency regulations. These external factors can significantly impact the project's execution and must be carefully monitored and managed

9. RISK ANALYSIS

A risk's severity can be estimated through risk assessment. Without assessment, a project manager may waste time on minor risks that have no bearing on the project or neglect to give important risks enough attention.

Risk assessment could be used to:

- Achieve more control over a project;

- Improve the setting of priorities;

- Make a well-founded decision

- Obtain better foundation for an estimate or plan.

Risk analysis in project management encompasses several critical components:

Qualitative Risk Analysis: This process involves evaluating risks based on subjective criteria, such as their likelihood and potential impact. It helps project stakeholders identify and understand the nature of risks.

Risk Quantification: Risk quantification involves assigning numerical values to risks, enabling a more precise assessment of their potential consequences. This step provides a basis for decision-making and prioritization.

Quantitative Risk Analysis: In quantitative risk analysis, mathematical models and data are used to quantify risks in terms of probabilities and potential financial impacts. This approach offers a more rigorous and quantitative understanding of risks.

Risk Attitude: People's perception of risk varies, with most individuals associating risk with unpleasantness and a preference for certainty over uncertainty. However, risk attitudes can differ among individuals, and some may be more willing to embrace uncertain projects.

Risk Response: Project contracts typically outline four strategies for addressing risks

Following are the four strategies

1 Risk Avoidance: This involves taking actions to eliminate the risk's impact on project objectives.
2. Risk Transfer: Risk transfer involves shifting the risk to a third party, often through mechanisms like insurance, performance bonds, or warranties.
3. Risk Mitigation: Mitigation aims to reduce the probability or impact of adverse risk events through proactive measures.
4. Risk Acceptance: Acceptance means acknowledging the risk and planning for how to manage it if it occurs.
For every project to succeed, effective risk analysis and management are crucial. The project team does quantitative & qualitative risk analysis as part of the risk examination process in order to develop risk response plans to address both positive and negative risks.
Normally, project risk management has seven steps.

1. Organize risk management.

2. Identify risks

3. Conduct a qualitative risk examination

4. Conduct a study of quantitative risk.

5. Plan your risk reaction

6. Use risk-reduction strategies

7. Track risk

Any task must be planned out before hand to ensure effective execution and benefits from a cost, time, and quality perspective. Therefore, the first stage in risk management is planning the procedure. The next step after planning is recognizing risk. There are eight different categories of risk: contractual risks, political risks, legal risks, financial risks, environmental hazards, and physical risks. Project risks are identified from these distinct risks. The following step is a qualitative and quantitative study of the risk

10. METHODS OF RISK ANALYSIS

10.1 QUALITATIVE METHOD OF RISK ANALYSIS

Qualitative risk examination is a project administration method focused on uncovering two crucial aspects of risks: the likelihood of a risk event happening and the magnitude of its potential impact if it were to occur. In essence, all risks encompass these two dimensions. Probability represents the chance or probability that a particular risk event will come to pass, while impact signifies the gravity of the consequences associated with that risk event. These impacts ripple through various facets of the project, affecting elements such as schedule, resources, budget deliverables, cost, quality, performance and scope. Qualitative risk analysis delves into individual project risks, systematically evaluating their unique characteristics, and appraising their capacity to disrupt project progress or outcomes. By considering both the probability and impact of these risks across the spectrum of project elements, project managers can make well-informed decisions about risk response strategies and effectively prioritize their risk management efforts.

	High		Medium		Low
Level	Very high	High	Medium	Low	Very low
Score	5	4	3	2	1
For threats	RED		Yellow		GREEN

10.2 QUANTITATIVE METHOD OF RISK ANALYSIS

The quantitative evaluation of the likelihood and effects of the greatest risk on the project to

1. Select the risks and events that require a reaction.

2. Calculate the total project risks

3. Establish the qualified probability of achieving the project's goals.

4. Establish budget and time reserves.

5. Determine which hazards need the most attention.

6. Establish reasonable and attainable cost, schedule, or scope objectives

Quantitative risk analysis is an essential aspect of project management that helps in assessing and managing potential risks by assigning numerical values to various risk factors. Several methods are available for conducting quantitative risk analysis, each with its own unique approach and advantages.

Five common quantitative risk analysis techniques are Expected Monetary Value (EMV), Decision Tree, Monte Carlo, Sensitivity and Three-Point analysis.

10.2.1 Expected Monetary Value (EMV) Risk Analysis: EMV analysis is a straight forward method that calculates the overall projected risk amount for a project. It relies on two primary factors: the expected cost of a risk and the probability of that risk occurring. To determine these values, data analysis, expert consultations, and past experience are often utilized. The EMV is obtained by multiplying the cost of each risk by its probability and summing up these values. This yields an estimate of the total expected risk cost for the project.

10.2.2 Decision Tree Risk Analysis: Decision trees are a valuable tool for evaluating multiple choices and their associated costs and risks. Each branch of the tree represents a decision or choice, with assigned probabilities and costs. By traversing the tree and summing the costs along each path, you can identify which decision paths offer the lowest risk. This method is particularly useful for complex decision-making scenarios.

10.2.3 Monte Carlo Risk Analysis: Monte Carlo analysis is best suited for assessing risks related to project duration or yield. It generates a range of potential outcomes and assigns probabilities to each outcome. Typically, the highest probability is assigned to the expected outcome. As outcomes deviate from this expectation, lower probabilities are assigned. Costs are estimated for each outcome, and by combining these costs with their associated probabilities, you can calculate the total expected cost, providing a more comprehensive view of risk.

10.2.4 Sensitivity Risk Analysis: Sensitivity analysis focuses on identifying the elements responsible for uncertainty within a risk analysis. It allows you to pinpoint which components or factors have the most significant impact on overall uncertainty. For instance, in a project with multiple components, even if one is less expensive but highly variable, it can contribute more to overall uncertainty than a stable but costly component. Recognizing sensitive components enables you to explore strategies for reducing uncertainty and improving estimation accuracy.

10.2.5 Three-Point Risk Analysis: The three-point analysis assesses the expected cost of a risk by considering three values: the most likely cost, the most optimistic cost, and the most pessimistic cost. For a basic triangular three-point analysis, you add these three values and divide by three. Alternatively, the beta distribution approach is commonly used, where you multiply the most likely value by four, add the optimistic and pessimistic values, and then divide the total by six. This method provides a more nuanced estimate of risk compared to a simple average

10.2.6 Relative important index method of risk analysis

Researchers in the fields of construction and facilities management frequently utilize the Relative Importance Index (RII), a non-parametric method, to analyze structured questionnaire responses for information containing attitudes measured ordinary.

Relative importance index = $\sum w/AN$

$= 5n5+4n4+3n3+2n2+1n1/5N$

where w is the weighing given to each factor by the respondant, ranging from 1 to 5. For example, n1 = number of respondants little important, n2 = number of respondants for some important, n3= number of respondants for

By applying the above method here,

Following is the average rating (from 1 to 5) given by the contractor for each questionwhich was asked in interview

Higher value of RII more important was the cause of delays

Importance level from RII

High = 0.8 < RII <1
High medium = 0.6 < RII <0.8
Medium = 0.4 < RII < 0.6
Medium low = 0.2 < RII < 0.4
Low = 0 < RII < 0.2

11. CASE STUDY

Contract records from the infrastructure project to build a bridge with approaches over the Krishna River on the Haripur to Kothali Road ODR-112 Tal-Miraj, Dist-Sangli were

used for this study. Client of the project is Public work division, Miraj. Consultant of project is Manoja Sthapatya. Krishna River is having length of approach is 175m from kothali and 115m from Haripur. Basic advantage of this project is easy transport from district Kolhapur to sangli.

Name of work-Construction of major bridge with approaches across Krishna River on Haripur to Kothali road ODR 112 Tal-Miraj, Dist-sangli.

As per development plan 2001-2021, the road between Haripur and Kothali (ODR-112) km 0/00 to 10/340 is classified as MDR-93. The total length of 10.34 km is in Sangli and Kolhapur district. A road length from Ch.9/340 i.e.0.50 km is under P.W. Division, Miraj for maintenance & repairs. Road length from Haripur side is 115m. Road length from Kothali side is 175m. I n - between these village 210m length bridge and total 290m approach road are proposed in the work. The average rainfall is 400 to 500 mm per year. The average road width is 11.40m with height of embankment varies from 0 to 11.50m. This road passes through BC soil with adjoining cultivated land.

Quantitative risk analysis is the method of analysis of risks which includes numerical analysis. In this project RII (Relative important index) method for the analysis of risks is used. The risks are identified by the taking walk in interview and responses of contractors and then top five risks are identified from the response of contractors. For the case study bridge under construction site is considered. There are many methods for analysis of risks. (Expected Monetary Value) EMV method of analysis of risk is also applied for the analysis of case study apart from questionnaire survey. As per the information given by the site engineer, risk in terms of cost is identified which may occurred in the project.

Bridge under construction site for case study

As per the information given by engineer of construction site of bridge and according to the government tender & conditions of contract, the following risks may occur in the project. After studying the contract document and the conditions of contract the risks for particular clause is identified. Below table shows the different risks in the project's contract documents and those are listed, investigated, and evaluated. Using the site engineer's provided checklist, multiple provisions pertaining to general conditions, technical specifications, and special circumstances are identified. Every aspect of a contract has the potential to become a risk, which in turn can affect various aspects of a project, such as its timeline, budget, scope, and quality. To help, identify and categorize these risks, an evaluation is developed based on their potential influence on the client and contractor.

11.1 STUDY OF CONTRACT DOCUMENT

By analysing the terms and conditions of the contract, one can have a better understanding of the risks involved, many of which pertain to the client.

Below table shows risk associated with each clause included in tender document

Conditions of contract	Risk
Clause 1. Supply of the materials by thecontractors	Design , construction
Clause 2. Execution of work	Construction
Clause 3. Execution of work	Design
Clause 4. Control over work	Construction
Clause 5. Alterations in drawings and specifications	Design, contractual
Clause 6. The power to make additions and alterations in drawings or specifications	Design, construction
Clause 7. Materials left on site	Financial
Clause 8. Removal and substitution ofmaterials	Financial
Clause 9 Workmanship	Construction
Clause 10. Action and compensation payable in case of bad work	Contractual, Financial
Clause 11. Responsibility of contractor due to damage by fire	Construction, contractual, environmental
Clause 12. Execution of work included inthe contract	Contractual
Clause 13. Action when work is notcompleted	Contractual, Financial,
Clause 14. Final certificate	Contractual
Clause 15. Action when contractor becomes bankrupt	Contractual

Clause 16. Payment to contractor for workdone	Contractual, financial
Clause 17. Certificate	Contractual
Clause 18. No compensation for alteration in or restriction of work done to be carried out	Contractual
Clause 19. Compensation	Contractual
Clause 20. Refund of quarry fees royalties	Financial
Clause 21. Security deposit	Financial, contractual, construction
Clause 22. Compensation for delay	Contractual, Design
Clause 23. Action when the progress of any particular portion of the work is unsatisfactory	Contractual
Clause 24. Liability for damages arising from non-provision of light fencing	Physical, Environmental
Clause 25 Liability of contractor for damage done in outside work area	Environmental
Clause 26. Work on Sunday	Contractual
Clause 27.Minimum age of persons employed the employment	Legal
Clause 28.	-
Clause 29. Minimum age of persons employed the employment	Legal
Clause 30. Employment of scarcity labor	Contractual
Clause 31. Employment of scarcity labor	Contractual
Clause 32. Employment of scarcity labor	Contractual
Clause 33. Employment of scarcity labor	Contractual
Clause 34. Action when whole of the security deposit is forfeited	Contractual
Clause 35. Condition for material	Physical, environmental
Clause 36. Condition relating to insurance of contract works	Contractual
Clause 37. Condition relating to insuranceof contract works	Contractual

ANALYSIS BY USING EMV METHOD

Determining areas of uncertainty

From the information which is given by engineer following are the uncertainties occurs at site during construction

As the project is started in 2020, it had faced pandemic condition. Due to pandemic condition labours shifted to their villages and work is stopped in lockdown. So there is delay in project completion

Availability of material in lockdown

Financial problem: due to change in design cost of project has increased

Natural hazards: As Krishna River is a perineal river, it faces flood situation in every year so due to this natural hazard construction work was stopped 1 month every year.

Villagers which are living near the bridge started opposing to the construction of bridge so there is delay in project completion and affect the estimated cost

Assess the cost of each riskExpected cost of each risk

1. Financial risk –

   Suspension of work= 60000

   Change in design= 10000000

   Penalty for delay=360000

   Extra works= 100000

   Price variation clause= 200000

   Total financial risk=10720000

2. Environmental risk

   Penalty for delay = 360000

   Labour regulation = 1000000

   Total cost of environmental risk= 13600003.

   Physical risks = 400000

   Political risk= 720000

Step 3: Determine probability of each risk occurring

1. Financial risk= 80%

2. Environmental risk= 60%
3. Physical risk= 50%
4. Political risks= 20%

Step 4: To calculate expected cost by multiplying and adding probability and expectedcost of potential risK

Risk	Cost of potential risk (1)	Probability of occurrence (2)	(1) X (2)
Financial risk	10720000	80%	857600
Environmental risk	1360000	60%	816000
Physical risk	400000	50%	200000
Political risk	720000	20%	144000

12. CONCLUSION

For big projects it is very necessary to identify and mitigate the probable risks to complete the project in time and available resources. The risk identification should be done in early stage of the project. The very first step of risk identification is contract itself. There can be number of clauses in contract that create ambiguity about the responsibility and scope of work

Therefore questionnaire survey was carried out by preparing questions for identifying risks in various stages of construction. The response of questionnaire survey was taken from various contractors and consultants. The analysis of response was done by RII method. From the analysis the top five risks were identified. Those risks are

1. Financial risks
2. Contractual risks
3. Physical risks
4. Political risks
5. Construction risks

Later these risks were related to the different clauses in the contract, in order to categorize the risks with respect to the clauses in contracts

To mitigate the top five risks in construction projects, the suggestions and solutions were taken from the contractors by discussing risks in the project orally. According to the contractors the adoption of risk management practices helps to increase the success rate of project and then enhance the competitiveness of organizations. Risk management aims to identify risks and take actions to reduce or eliminate their probability and impact so that project is kept from being damaged by risks. It is started from the feasibility phase onward, clients, contractors, designers, and governmental agencies must collaborate to address potential hazards in a timely manner and to make good preparations for carrying out safe, effective, and high-quality construction activities. Through the usage of multiple contracts between the various agencies, the agreement are employed as instrument to manage

These include ensuring that the project has sufficient funding, collecting additional geotechnical information, performing constructability reviews, setting reasonable contract performance deadlines, collecting information on work and rework costs, implementing phased pricing, anticipating the need for permits, utilities, and zoning, pre-defining rates, equations, and procedures, and using project staff with relevant experience. A proactive, informed approach to risk distribution and contracting procedures can benefit all parties engaged in a building project in the short and long periods. By sharing construction risks when appropriate and fairly distributing and compensating for those that cannot be shared, contracting parties should aim to closely align their interests.

The major risk affecting the infrastructure project are systematically examined for successful completion of any infrastructure project, also it is necessary to study all aspects of project depending upon contract over major risk involved in project and critical factors responsible for cost and time over runs.

Contract document used as a tool to manage risk by identifying and allocating risk to various agencies through sub-contracts to minimize the chances of failure or under performance of project risk management policy must be implements and evaluate regularly into construction project

13. REFERENCES

1. D van Well- Stam, Project risk Management- An essential tool for managing and Controlling projects"; Kogan Page Limited, Dutch, 2005.

2. L. Y. Shen, Risk management, International Journal of Construction Engineering and Management, Vol. 127,

3. Mark H. McCallum, "A Quick Primer on Construction Risks and Contracting Practices", American Corporate Counsel Association Annual Meeting October, 2000.

4. N.J.Smith, "Managing Risk in construction projects", Blackwell Science, Oxford, 1999.

5. Richard Clough, Construction Contracting, Wiley-Interscience, New Mexico, 1972

6. Roger Flanagan & George Norman, "Risk management and construction", Blackwell Scientific Publications, London, 1993.

7. Paper on Comparison of risk assessment method within the scope of occupational safety in construction sector.

8. Contract document of bridge by public work division miraj.

BIOGRAPHIES

She is an excellent academic person and PG student with intend in Research work. Working on number of projects which is related with construction management.

He is Research scholor having more than 12 years teaching experience. Published number of research paper, guided number of research project and PG,UG student.