

A Case study on “Management of risks implied by conditions of contract and specifications”

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ABSTRACT- Management of risk 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. This project proposes identification and analysis of risks associated with the infrastructure projects. Based on a comprehensive assessment of conditions of contracts, this project identifies risks and classifies them into few categories. After Quantitative risk analysis, “change in design”, “opposition from social bodies”, “suspension of work”, are recognized to influence the project objectives maximum.

Key words- Risk, risk management, construction projects, contract, qualitative risk analysis.

1. INTRODUCTION

Construction projects are unique in character and do not lend themselves to standardization. Projects are constructed under environmental conditions of weather, location, transportation and labor that are more or less beyond the contractor’s control. The agencies involved may differ, the owner requirements may differ, the site conditions would be different, market conditions would vary. The construction business is a volatile one, with many seasonal and cyclical ups and downs. Hence, each construction project requires a lot of care in handling because of the dynamic nature of the construction industry. Also, construction activity involves a number of agencies like the client, an architect/ engineer, the contractor & these agencies have conflicting interests to an extent because the client wants the work to be accomplished with his requirements fulfilled and with minimum cost to him and also with minimum hassles and responsibilities whereas the contractor wants to accomplish the work by making as much profit as possible and with least amount of hassles. Hence in order to establish the duties, obligations, rights, responsibilities amongst the various agencies, a contract is required to be made between them which will establish a mutual relationship to do a work. The most of civil engineering work is performed under contract. A contract provides a “self-contained statement of obligations as between its own parties”. Contracts are vital to the success of a project is important difficult, costly and lengthy proceedings.

2. RELEVANCE

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 to 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 few categories. After Quantitative risk analysis, “change in design”, “opposition from social bodies”, “suspension of work”, are recognized to influence the project objectives maximum.

3. LITERATURE REVIEW

1. B.A.K.S. Perera, Indika Dhanasinghe and Raufdeen Rameezdeen studied cases from srilanka construction industry. In the study the risk of defective design, late approvals, late handling over of the site, tentative drawing and unforeseen site ground condition had thwarted the contractor on many occasions. A few risks that were not relevant to the two cases under study.

2. Dr. Nadeem Ehsan, Ebtisam Mirza, Mehmood Alam, in this paper, the perception of risk by contractors and consultants is mostly based on their intuition and experience. The most

utilized risk response measures are risk elimination and risk transfer. However, the respondents have revealed that these practices cause the problems of delays, low quality and low productivity in projects.

3. Mr. Satish K. Kamane, Mr. Sandip A. Mahadik In this paper, the success of every project depends on how efficiently and effectively the. Risk avoidance may include a review of the overall project objectives leading to a reappraisal of the project as a whole. Depends on how efficiently and effectively the uncertainties are handled. Risk management will not remove all risks from the projects. Its main objective is to ensure that risks are managed most effectively. The formal risk analysis and management techniques are rarely used by construction industry due to lack of knowledge and expertise etc

3. OBJECTIVES

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. RISK IDENTIFICATION TECHNIQUES

4.1 Qualitative risk analysis

Qualitative risk analysis is project management technique concerned with discovering the probability of a risk event occurring and the impact the risk will have if it does occur. All risks have both probability and impact. Probability is the likelihood that a risk event will occur and impact is the significance of the consequences of the risk event. Impact typically affects the following project elements, schedule, budget, resources, deliverables, cost, quality, scope, performance. It includes the individual project risks.

4.2 Quantitative risk analysis method

Quantitative risk analysis does not refer to one specific method of determining potential risk. It is a category of analysis styles, so you can choose the method that best suits your needs. Common types of quantitative risk analysis include the following:

4.2.1 EMV Analysis

In an EMV analysis, all you need is an expected cost of a risk you face and the probability of that risk occurring By multiplying the cost of each risk by its probability and adding up all the resulting numbers, you generate an overall projected risk amount for the project

4.3 RII Method of analysis

Relative Importance Index (RII) is a non-parametric technique widely used by construction and facilities management researchers for analyzing structured questionnaire responses for data involving ordinal measurement of attitudes.

5. QUESTIONNERY SURVEY

Information given by contractor No 1.

List of questions	Answer given by the contractor in interview	Risk identified from the response
1. What are the projects top risks? How sever there impact is and how likely they are occurring?	Risks in construction projects are Project budgets, financial support and fund. Availability of Fund is the most common risks which are faced by the contractor now a days. Because without financial support no business is possible. In case of the big project let-down to carry out the works with contract	Financial risks, Contractual risks
2. How well does the business manage its biggest risks?	Construction is a unique and complex industry. Each building project is distinct and has its own set of opportunities and obstacles. It might be challenging to identify and manage project risks, but it is not impossible with proper planning and execution.	Construction risks, Financial risks
3. Does the business have plans in place for dealing with improbable severe events?	Maintaining thorough records is one of several strategies to improve the effectiveness and efficiency of the risk reporting process. Share risks by using indemnification decrease in worker accidents.	Physical risks, Political risks
4. How the time, cost, and quality of the project will be impacted by contract requirements such as work suspension, design changes, additional work, and labor regulations	Availability of labors is the most common risk and it affects the cost, time, quality of project. In some cases change in design may occurs and it will disturb the project accomplishment time of project i.e. project may delay by some time. Suspension of work also affects quality of project and the time cost	Construction risks, Design risks
5. Is there opposition from	In private construction companies opposition from	Political risks, legal risks

social bodies or political issues during project construction work.	social bodies or political issues may not affect to carry out project.	
6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Due to pandemic project completion time of project may increase and it affects the estimated cost of project. Also due to pandemic labor shifts to their villages. So work may delay and penalty will be paid by contractor.	Contractual risks
7. If extra works occurs it will affect the estimated cost.	Extra works affects the estimated cost of the project and also the completion period.	Design risks
8. What about insurance and indemnity is it affect financial?	Every company has insurance so it will not affect financial.	Contractual risks

5. Is there opposition from social bodies or political issues during project construction work.	Social bodies or political issues does not opposes the project construction work.	Political risks
6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Pandemic conditions or labor availability affects the cost and time of project.	Contractual risks
7. If extra works occurs it will affect the estimated cost.	Extra work increases estimated cost of project.	Design risks
8. What about insurance and indemnity is it affect financial?	There will be no problem of insurance and indemnity.	Contractual risks

Information given by contractor No 3

1. What are the main project risks? How serious are the effects, and how likely are they to happen?	Project budget, labor rates, change orders, design errors and omissions and financial support these are the main project risks in construction	Financial risks
2. How well does the business manage its major risks?	Once risks have been identified, you must be able to appropriately analyze, manage, and keep an eye on them in order to prevent tragedy.	Construction risks, Financial risks
3. Does the business have plans in place for dealing with improbable severe events?	Extreme events occurs in rare cases and company have the plans to overcome them	Physical risks, Political risks
4. How the time, cost, and quality of the project will be impacted by contract terms such as work suspension, design changes, additional work, and labor regulations.	The term "technical conditions of contract" refers to a document with the title "technical specification" that, when read in accordance with the contract, outlines the objective, scope, design requirements, and other technical standards for the job.	Construction risks, design risks
5. Is there opposition from social bodies or political issues during project construction work.	The opposition from social bodies and political issues are very less or negligible.	Political risks

Information given by Contractor No. 2

List of questions	Answer given by the contractor in interview	Risk identified from the response
1. What are the projects top risks? How sever there impact is and how likely they are occurring?	The project risks are financial support and fund. Logistic risks physical risks, contract language, project budgets, labor rates	Financial risks
2. How well does the business manage its major risks?	Avert dangers. Shift the risks minimize risk. Accept danger. To fulfil their obligations and reduce any harm to the cost-performance of construction projects	Construction risks, Financial risks
3. Does the business have plans in place for dealing with improbable severe events?	For improbable extreme events, there exist response strategies.	Physical risks, Political risks
4. How the time, cost, and quality of the project will be impacted by contract requirements such as work suspension, design changes, additional work, and labor regulations.	Changes in design, labor laws, additional work, and contract suspension will all have an influence on the project's timing, level of quality, and cost.	construction risk, Design risks

6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Due to pandemic the estimated cost of project affects and also the project completion time of project.	Contractual risks
7. If extra works occurs it will affect the estimated cost?	According to owners requirements there may be change in design occurs so in that case estimated cost may increases	Financial risks, constructional risks Design risks
8. What about insurance and indemnity is it affect financial?	Subcontractor handles the insurance and indemnity it not affects financially.	Contractual risks

	work.	
6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Due to pandemic conditions there is problem in availability of construction material and there is fluctuation in cost of material and labours so it will affect the estimated cost.	Contractual risks
7. If extra works occurs it will affect the estimated cost.	As per owner requirements extra works may occurs and it will affect the cost of project.	Design risks
8. What about insurance and indemnity is it affect financial?	Company already have insurance so there is no issues of insurance and indemnity.	Contractual risks

Information given by contractor no 4.

List of questions	Answer given by the contractor in interview	Risk identified from the response
1. What are the main project risks? How serious are the effects, and how likely are they to happen?	Contractual risks, financial support, legal aspects, fund these are some risks and they occur due to pandemic conditions, labor availability, material availability, change in rates etc. their impact is mainly on time completion of project and estimated cost.	Financial risks
2. How well does the business manage its major risks?	By executing risk management plans company tries to overcome risks	Construction risks, Financial risks
3. Does the business have plans in place for dealing with improbable severe events?	Unlikely extreme events occurs in rare cases.	Physical risks, Political risks
4. How the time, cost, and quality of the project will be impacted by contract terms such as work suspension, design changes, additional work, and labor regulations.	If change in occurs in RCC then it affects completion time to redesign structure	Construction risks, Design risks
5. Is there opposition from social bodies or political issues during project construction work.	There is no opposition from social bodies and political issues in project construction	Political risks

Information given by contractor No 5

List of questions	Answer given by the contractor in interview	Risk identified from the response
1. What are the main project risks? How serious are the effects, and how likely are they to happen?	Due to increase and decrease of rates of various construction materials, it affects the cost of project and also depends upon availability of materials. Also the financial conditions and fund available	Financial risks
2. How well does the business manage its major risks?	Avert dangers. Shift the risks. Minimize risk. Accept danger. To fulfil their obligations and reduce any harm to the cost-performance of construction projects	Construction risks, Financial risks
3. Does the business have plans in place for dealing with improbable severe events?	Extreme events occurs in rare cases and company have the plans to overcome them	Physical risks, Political risks

4. How the time, cost, and quality of the project will be impacted by contract terms such as work suspension, design changes, additional work, and labor regulations.	Availability of labors is the most common risk and it disturbs the cost, time, quality of project. In some cases change in design may occurs and it will disturb the project accomplishment time of project i.e. project may delay by some time. Suspension of work also affects the cost, quality of project and time.	Construction risks, financial risks, environmental risks, design risks, physical risks
5. Is there opposition from social bodies or political issues during project construction work.	There is no opposition from social bodies	Political Risks
6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Pandemic situation was the most dangerous situation for the construction business. It affects the project completion time and cost of project.	Contractual risks
7. If extra works occurs it will affect the estimated cost.	Extra works are avoided.	Design risks
8. What about insurance and indemnity is it affect financial?	There is no effect of insurance and indemnity on finance.	Contractual risks
List of questions	Answer given by the contractor in interview	Risk identified from the response
1. What are the projects top risks? How sever there impact is and how likely they are occurring?	Financial support and fund are major risks and its impact is very severe as without finance.	Financial risks
2. How well does the business manage its major risks?	Once risks have been identified, you must be able to appropriately analyze, manage, and keep an eye on them in order to prevent tragedy.	Construction risks, Contractual risks
3. Does the business have plans in place for dealing with improbable severe events?	Unlikely extreme events occurs in some rare cases and company overcome it	Physical risks, Political risks
4. How the time, cost, and quality of	Labor regulation may varies so it affects the	Construction risks, Design

the project will be impacted by contract terms such as work suspension, design changes, additional work, and labor regulations.	time completion and also cost of the project. There are rare cases of change in technical conditions while the work of construction is going on, If any change in RCC then it affects time to redesign structure.	risks
5. Is there opposition from social bodies or political issues during project construction work.	There is no opposition from social bodies and political issues.	Political risks
6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Due to pandemic conditions there is problem in availability of construction material and there is fluctuation in cost of material and labors so it will affect the estimated cost.	Contractual risks.
7. If extra works occurs it will affect the estimated cost.	As per owner requirements extra works may occurs and it will affect the cost of project.	Design risks
8. What about insurance and indemnity is it affect financial?	There is no effect of insurance and indemnity on finance.	Contractual risks

Information given by Contractor No 7

List of questions	Answer given by the contractor in interview	Risk identified from the response
1. What are the projects top risks? How sever there impact is and how likely they are occurring?	Risk is the probably most common in construction business. Finance and fund is the most common risk	Financial risks
2. How well does the business manage its major risks?	By executing risk management plans company tries to overcome risks	Construction risks, Financial risks
3. Does the business have plans in place for dealing with improbable severe events?	Unlikely extreme events occurs in some rare cases and company overcome it	Physical risks, Political risks
4. How the time, cost, and quality of the project will be	Change in design, labor regulation, extra work, suspension of	Construction risks, design risks,

impacted by contract terms such as work suspension, design changes, additional work, and labor regulations.	contract will affect cost quality of project and the time	
5. Is there opposition from social bodies or political issues during project construction work.	There is no opposition from social bodies and political issues.	Legal risks, political risks
6. If project completion time is raised due to pandemic conditions or labor regulation, it will affect the estimated cost?	Pandemic conditions affects the cost and time of the project.	Contractual risks
7. If extra works occurs it will affect the estimated cost.	According to owners requirements there may be change in design occurs so in that case estimated cost may increases	Design risks
8. What about insurance and indemnity is it affect financial?	There is no effect of insurance and indemnity on financial	Contractual risks

(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



6. CALCULATION BY RII METHOD

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 Manoj 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. In 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

Risk categorization from response of contractors for particular question	No of contractors strongly agree for the risk identified from response of questions (5)	No of contractors agree for the risk identified from response of questions (4)	No of contractors neutral for the risk identified from response of questions (3)	No of contractors disagree for the risks identified from response of contractors (2)	No of contractors strongly disagree for the risk identified from the questions (1)
Financial risks	9	1	0	0	0
Construction risks	1	4	5	0	0
Physical risks	2	6	2	1	0
construction risks	2	3	2	3	0
Political risks	1	6	0	3	0
contractual risks	2	7	1	0	0
Design risks	2	3	0	5	0
Contractual risks	0	2	6	2	0

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.

7. 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 the contractors	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 of materials	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 in the contract	Contractual
Clause 13. Action when work is not completed	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	Environmental
Clause 26. Work on Sunday	Contractual
Clause 27. Minimum age	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 insurance of 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 risk Expected cost of each risk

1. Financial risk –

- Suspension of work= 60000
- Change in design= 1000000
- 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 expected cost 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

8. 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

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