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Qualitative Risk Analysis for Construction Projects

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Abstract - In construction projects, risk is an ever-present challenge, oftentimes viewed as a risk that could impact the design's success and most of the time it leads to delay in completion. These threats are natural in every stage of the construction phase, which may lead to colorful issues. The purpose of this study is to examine the different problems that construction projects or management may face during the time period of a project, estimate their relevancy, and understand how they could affect design sequels. The purpose is to develop an effective strategy for threat management. The focus of this exploration is on relating the implicit threats in construction systems. A check questionnaire is conducted out to guests, advisers, and contractors from multiple construction companies, gathering their input on the threat that they encounter. The collected data is also anatomized using qualitative ways, specifically the probability- impact matrix, to assess both the probability and impact of each associated threat.

1. INTRODUCTION

This risk operation is an elementary practice used across numerous sectors of management, similar to IT, medicine, automotive, and construction. Risk isn't a fixed circumstance; it can have either positive or negative outcomes depending on the situation. To address these risk, each association creates its own set of guidelines to manage emerging threats, which guide their decision-making process. This connection between risk operation and the successful delivery of systems is inarguable. In construction assiduity, managing threats is essential. While it may affect the original cost of a design, the value of mollifying pitfalls outweighs the fresh expenditure. By conducting risk assessments during the early phases of a project design, we will be able to mitigate multiple challenges and their associated outgoes can be avoided. Risk operation is constantly observed as one of the most demanding aspects of construction, and its integration into all plans is critical to minimizing dangers and assuring sophisticated execution. Risk analysis is generally classified into two types. 1. Qualitative Risk Analysis 2. Quantitative Risk Analysis. This project primarily focuses on examining and exercising the methods associated with qualitative risk analysis.

2. NEED OF STUDY

The scale of the construction industry is accompanied by numerous potential challenges—ranging from socio-political and environmental issues to unforeseen issues that can result in significant financial losses for companies. To mitigate these risks, a well-processed and structured approach to project management is essential, with risk management playing a key role throughout each phase of the project. This strategy helps prevent issues such as budget overruns, delays, and safety or quality concerns. Risk management offers practical methods for anticipating and reducing threats both before and during the project, in a systematic manner. This proactive approach ensures that potential threat disruptions, whether related to resources, costs, timelines, quality, or overall project outcomes, are managed effectively, leading towards the successful completion of the project.

3. OBJECTIVE OF STUDY

By reviewing and studying relevant literature and examining real-life situations in building construction projects, we have listed out the following goals for the study: TO-

1. Identifying the various unpredictable threats that may arise during the construction of buildings.
2. Categorizing these risks based on their periodical occurrence (that is probability) and potential impact, ranging from very high to very low.
3. Carrying out qualitative risk analysis to pinpoint the most critical threats and manage effectively.
4. To support risk response planning- that is to encourage proactive planning instead of reactive problem solving.

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4. LITERATURE REVIEW

1. *Vikas Pawar, Prof P.M. Attarde & Abhishek C Ayachit- "Risk in Fast Track Construction".* Paper emphasizes the assessment of various risks and identification in the case of fast-track projects. The evaluation of risk help in prioritizing risks for successful completion of a project and effective risk management. A risk factor (RF= P*I) or combined risk measure is to be then calculated for each category.

2. *S. M. Renuka, C. Umarani and S. Kamal- "A Review on Critical Risk Factors in the Life Cycle of Construction Projects."* This paper mainly discusses the its assessment techniques and critical risk factors, through comparative study of various international construction projects. Review resulted a simple analytical tool was be developed for each project task to assess quickly and risk easily, so that its results encourage the practitioners to do the risk analysis in their project.

3. *Rathna Devi– "A Study on Risk Analysis in Construction Systems".* Author explores the use of earned value operations as a quantitative way to assess threats. Study focus on the fiscal and scheduling threats, which are to be stressed as crucial factors that must be managed effectively for the successful delivery of a construction design.

4. *Pawel Szymanski –"Risk Management in Construction Systems".* Paper addresses the categorization of risk within the construction sector. The author concluded that pitfalls risks are an ineluctable part of life, with construction assiduity being a great illustration of where threats are constantly present and must be managed to ocercome them.

5. *Jameelahammad Nadaf, Mahaboobali Nadaf, Balasaheb Jamada &, K. P. Thejaswi –" Qualitative Risk Analysis for Construction systems".* Study investigates the risk associated with construction systems, focusing on the recognition of these implicit dangers. The exploration assembled data through a questionnaire check distributed to different advisers and contractors involved in the design. This paper utilizes the qualitative risk analysis approach to assess and address these pitfalls.

6. *Agnieszka Dziadoz, Mariusz Rejment –" Risk Analysis in Construction Systems: A Named System".* In this study, authors argue that while risk cannot be directly quantified and various queries can be linked and measured. The paper introduced three distinct threat analysis styles, agitating their pros and cons, as well as guidelines for opting for the right approach during the design's intial estimation phase.

5. LIYERATURE SUMMARY

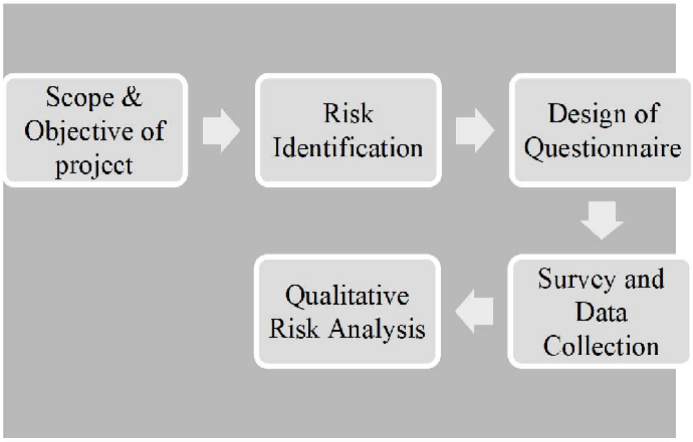
The literature viewed covers various aspects of risk analysis methods, including threat factors and styles for assessing threat. The crucial points are as follows:

- The study particularly explores the application of qualitative styles for threat analysis, using existing funds to claw into this approach.
- Qualitative risk analysis focuses on assessing associated threats grounded on their implicit impact on the project quality.
- On the other hand, quantitative risk analysis, involves assessing threats in terms of measurable criteria, similar to design deliverables fiscal value.
- To collect applicable data, checkups are assigned to contractors and counsel working on the design to gather perceptivity on perceived threats.
- This analysis follows the qualitative approach, where a risk matrix based on probability and impact is used to distinguish and point out high-precedence threats.
- The risks associated are framed on a matrix, and high-threat factors are visualized using a graph to assist in prioritizing responses.

6. METHODOLOGY

The motive of conventional work is to study various threats in construction designs, their significance and impact on the design and the identification of high threats utilizing qualitative risk analysis. Then, an effort is made to recognize and estimate threat in construction master plans.

In this part, we've expressed the stages usually preferred for qualitative risk analysis in structure design. The analysis is done by utilizing a risk matrix. Exploration stages are defined as follows-



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6.1. Risk Identification

Risk identification is a repetitive procedure because as the design progresses new threats develop throughout the life cycle of the project. The threat valuation should be nonstop to allow comparison between the goods of one threat and indeed to the other. Identification operation in the association includes the design crew members. For this purpose, the various threats arising in the construction process from the expressioncand construction stage are distributed and listed.

Different phases of threat identification are:

I. Project crew members suggest implicit threats sometimes to the project managers. As required by the project, design teams carry out threat discussions when required.

II. It includes suggestions from stakeholders and guests in which design crew checks the cost, scope, schedule of the project plan for the identification of threats. Assignments are considered by the project team during the identification procedure.

III. A factual database of threats arising to be used by project teams as a template.

IV. Assignments learned, and factual database is made available for other systems. The threat identification process is completely used by large companies to mitigate threats.

V. The nonstop process of threats, data collection and analysis of the performance of methods used for threat identification, enhancement of the process is carried out. For enhancement of the process, formal practices and assignments are to be considered.

6.2. Design of Questionnaire

The information collection process utilized in this investigation had the choice of two essential strategies: individual discussions and questionnaires. As the result of the pilot overview, these are the types of risks which influence the risk occurs in construction. Types are listed below:

- Management risk
- Environmental risk
- Construction risk
- Technical risk
- Financial risk

6.3. Survey and Data collection

To successfully negotiate the ideal of the study, one of the vital stages is the collection of inaccurate information. Data collection is a way of collecting important information recorded by different company for a certain test or observations of experienced people in the construction industry. Questionnaires were transferred to the construction industry by correspondence and interviews were conducted among the construction labor force, specifically advisers, clients, architects, contractors, engineers and labor workers.

6.4. Qualitative Risk Analysis

This kind of approach is used to classify the threats according to their effects on the design functioning and the project objectives. Risk analysis aslo involves estimating the probability of the risk occurance and its impact on the project. In this approach, the exact numerical value of the probability and impact isn't set up, but it's expressed in terms of very high, high, moderate, low, very low, referring to the reviews of experts and stakeholders. This technique is used to prioritize the threats according to their implicit effects on the project performance and the project objectives.

To conduct qualitative risk analysis is carried out by marking the following matrix.

Probability- Impact Matrix: Probability is the liability of the threat occurance and its frequency, whereas impact is the effect of the threat on design functioning. Before making the P- I matrix, we had to identify threats, collect threat data, determine probability and impact situations. After doing these tasks, the P- I matrix is made. First, the probability and impact are given, ranking generally from 1 to 6.

Table -1: Rating is assign using below table

RATING	PROBABLITY	IMPACT
1	Rare	Very Low
2	Occasional	Low
3	Somewhat frequent	Moderate
4	Frequent	High
5	Very Frequent	Very High

Risk Factor = Probability * Impact

Lowest risk factor= 1 * 1 = 1

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Highest risk Factor= 5* 5= 25

Ratings can be assign between 1-5 as per requirement.

P-I Matrix:

Very Frequent-5	5	10	15	20	25
Frequent-4	4	8	12	16	20
Somewhat frequent-3	3	6	9	12	15
Occasional-2	2	4	6	8	10
Rare-1	1	2	3	4	5
^Probability^ Impact --→	Very low-1	Low-2	Moderate-3	High4	Very high-5

7. RESULTS

After completion of the Questionnaire survey with different firms and the official management of the construction company, the average results were calculated and mentioned according to the type of risks (using PI-Matrix).

P-Probability; I-Impact.

Risk Factor(RF) = Probability * Impact

Management Risks

SR.NO	RISKS.	P	I	RF
M1	Poor project planning and scheduling.	4	5	
M2	Inaccurate documentation or contract management.	3	4	12
M3	Relations of Company.	2	3	6
M4	Lack of clearly defined roles and responsibilities.	1	4	4
M5	Insufficient experience or competency of project team.	3	5	15
M6	Lack of coordination between subcontractors and vendors	4	4	16

Environmental Risks

SR.NO	RISKS.	P	I	RF
E1	Natural Calamities.	1	5	5
E2	Uneven Weather Conditions.	4	3	12
E3	Legal actions related to environmental non-compliance.	5	2	8
E4	Issues related to waste management or disposal.	3	1	3
E5	Noise, air, or water pollution	1	1	1

Technical Risks

SR. NO	RISKS.	P	I	RF
T1	Use of untested or new construction technologies.	2	2	4
T2	Inadequate site investigation or soil testing.	5	5	20
T3	Incorrect or incomplete design specifications.	3	5	15
T4	Frequent design changes during construction phase.	5	4	16
T5	Errors in structural, electrical, or mechanical design.	5	3	15
T6	Delays in obtaining permits due to technical issues.	3	4	12

Financial Risks

SR. NO	RISKS.	P	I	RF
F1	Project Investments.	3	3	9
F2	Cash flow issues during different phases of construction	5	5	25
F3	Unpredictable fluctuations in material costs	4	4	16
F4	Delay in securing project financing or loans	3	4	12
F5	Insufficient insurance coverage	2	4	8
F6	misallocation of funds	3	4	12

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Construction Risks

SR. NO	RISKS.	P	I	RF
C1	Labor shortage or labor strikes.	4	4	16
C2	Accidents or on-site safety issues.	4	5	20
C3	Disruption due to rework or change orders.	2	4	8
C4	Delay in delivery of construction materials or equipment.	4	3	12
C5	Equipment malfunction or breakdowns.	3	2	6
C6	Insufficient quality control or inspection procedures.	3	5	15

The sample of P-I matrix is as follows:

Very Frequent-5		E3	T5	T4	F2
Frequent-4			C4,E2	F3,M6,C1	M1, C2
Somewhat frequent-3	E4	C5	F1,T5	F4,F6,M2	M5, C6
Occasional-2		T1	M3	F5,C3,	
Rare-1	E5			M4	E1
^Probability^ Impact --→	Very low-1	Low-2	Moderate-3	High4	Very high-5

According to risk factor. Risks are compartmentalized into 3 color codes.

a. Green represents threats that can be overpassed.
b. Yellow represents threats that need additional analysis and investigation.
c. Red represents threats that require an immediate response.

8. CONCLUSIONS

The strategies to categorize project threats that have been individualized for construction projects, have been presented from colorful point of view (by contractors, advisers, and government contractors) and construction companies and firms that may be supporting the development of dealing with projects in the planning and construction stages. The matrix for probability-impact, impact-urgency, probability urgency and precedence-urgency plotted, and high threats were individualized.

Using this study analysis/results, it is to be concluded that the maturity of the construction systems have no methodical procedure in place to deal with risk. Threat operation is done in a veritably informal mode.

All the risks were recorded and conditions were given for their probability of circumstances, their impact on the design and urgency of resolving a particular threat.

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