

Risk Management in Commercial Building Construction using PESTEL and SWOT Analysis

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Abstract— The aim of this paper is to manage risks in the commercial building construction. Since construction is highly risk prone industry, proper management of the risks is the key to the success of the project. First step in the risk management is the identification of risks. Risk identification is done by questionnaire survey, separate questionnaires are prepared for internal (SWOT- Strength, Weakness, Opportunities, and Threats) and external (PESTEL- Political, Economic, Social, Technological, Environmental, and Legal) risks. Risk analysis is done by using SPSS software based on PESTEL and SWOT analysis. Risk management is thus done based on the analysis report.

Keywords— Risk identification; risk analysis; risk management;

I. INTRODUCTION

Studies confirm that construction is a highly risk-prone industry because of certain distinctive characteristics of construction projects. Construction projects are characterized by their varying degrees of uniqueness and complexity, the active involvement of multiple stakeholders, capital intensiveness, dynamic environments, non-tradability of output, long production durations, and exposure to external environment and weather conditions.

Risks and uncertainties are indeed inherent in every construction project from initiation through to completion and even during the operation phase of the constructed facility regardless of the size, nature, complexity, and location of the project. Failure to deal sufficiently with potential risks and uncertainties throughout the project life cycle can often have detrimental consequences on project objectives. Risk management, therefore, should be applied as an integral part of project management for the successful completion of construction projects in terms of time, cost, quality, safety, and environmental sustainability.

II. OBJECTIVE OF THIS STUDY

The main objective of this study is to manage the risks in the commercial building construction, through which the productivity and the quality of the commercial building construction can be improved. If the risks in the construction is properly managed and mitigated then, a project can complete within the scheduled time and cost. So risk management become a tool to ensure delay and quality management.

III. LITERATURE REVIEW

A number of Studies have been carried out to understand risk identification tools and techniques.

Shubham Sharma (2021) conducted a research on risk identification and management in construction projects and found out that risk management is still very less among the construction industry. The most commonly used risk classification method was based on the nature of the risk and the most commonly used tool and technique for the risk identification was a questionnaire survey.

Abroon Qazi (2021) conducted a research on Prioritizing risks in sustainable construction projects using a risk matrix-based Monte Carlo Simulation approach and concluded that two risk ranking schemes revealed significant differences relative to the identification of critical risks and their relative importance. It also says that assessment of sustainable related risks are difficult than normal risks.

Huseyin Erol (2020) in this study of exploring the relationship between complexity and risk in mega construction projects concluded that Complexity and risks are interconnected by several dynamic links affected by uncertainties and management strategies. Risk analysis involves examining how project outcomes and objectives might change due to the impact of risks. The results showed that a high level of complexity makes it more difficult to predict the impact of risks on the megaprojects.

Kerim Koc (2020) conducted a research on stakeholder-associated life cycle risks in construction supply chain and found out that the supplier, main contractor, and client were the key stakeholders for successful supply chain management. Assessment of risks considering interdependencies can be valuable to determine the most significant risk. One of the main reasons to determine risks of a project is to deliver effective management practices.

Nasir B. Siraj (2019) this paper examines common risk identification tools and techniques, risk classification methods, and common risks for construction projects. The majority of the selected articles concentrated on the identification of negative risks and overlooked opportunities that could have a beneficial effect on achieving project objectives. The findings of the content analysis show that a combination of two or more risk identification tools and techniques were widely used.

Wei Pan (2019) this paper examines the nature of the constraints on productivity enhancement and explores the rationale underpinning the productivity enhancement strategies at the industry level. A comprehensive literature review used a political, economic, social, technological, environmental, and legal (PESTEL) framework to reveal the major strategic themes of construction productivity enhancement.

Dimosthenis Kifokeris (2019) conducted a research on analysis of impartial implementation in practice of risk identification in technical projects and found that the consideration of risk sources in the risk identification process as a means to bridge the identified gap and reduce discrepancy. The paper presents the results of the process-in and analysis of real projects 'risk data through unstructured interviews with the experts who provided the data, and examines their correlation with a comprehensive risk sources checklist drawn from previous research.

A.Q. Adeleke (2018) concluded from the research on the influence of organizational external factors on construction risk management among Nigerian construction companies and concluded that Political, economy, and technology factors helped the construction companies to reduce the chance of risk occurrence during the construction activities. Rules and regulations also helped to lessen the rate of accidents involving construction workers as well as the duration of the projects.

Tengyuan Chang (2018) conducted a research on political risk management strategies in international construction projects and found that all the strategies were important for political risk management in international construction projects. Five strategies including (1) choosing suitable projects, (2) building proper relations with host governments, (3) conducting market research, (4) avoiding misconduct, and (5) choosing a suitable entry mode were the most important strategies according to their average values.

Ahmed Mohamed Keshk (2017) concluded through this research that Risk management team should continue its work in any project and do not stop until end of project because risks may emerge their indicators at different stages of project life cycle. Extraordinary interest of capabilities development of risk management team in project in the field of methods of diagnosis, qualitatively and quantitatively assessment of risks, whenever, skills are more high- in this field, results were more accurate and therefore it can be over-come risks or reduce their severity at least.

IV. RISK MANAGEMENT

Risk Management (RM) is a systematic approach to dealing with risk. A RM system should establish an appropriate context, set goals and objectives, identify and analyze the risks, influence risk decision-making and monitor and review risk response. Risk management in construction industry is an important part of the project planning and management. Risk management in construction is designed to plan, monitor and control those measures needed to prevent exposure to risk. To do this it is necessary to identify

the hazard, assess the extent of the risk, provide measures to control the risk and manage any residual risks.

A. Risk Management Cycle

Risk management is a cyclic process. There are several steps involved in the risk management process. Fig.1 shows the steps involved in the risk management cycle. Risk identification is the first step in the risk management cycle. During the risk management process new risks may appear in the construction or the risks which are already appear in the construction cease to exist. Each segment in the risk management cycle is equally as important, hence each process should be carried out in a proper way to manage risks in construction.

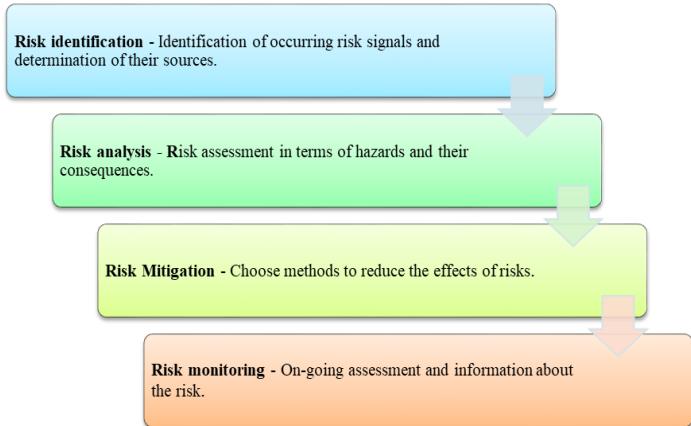


Fig. 1. Risk Management Cycle

B. Risk Classification

Risk classification (or categorization) is the important part of risk identification. The structured classification of risks contributes to the effectiveness and quality of the risk identification process and creates a better understanding of the nature of risks and their sources. Moreover, a logical and structured classification of risks assists in the reduction of redundancy and ambiguity in the risk identification stage and provides for easier management of risks in the later stages of risk management.

There are various methods for classifying risks on construction projects. Risks can be categorized based on their source, nature, occurrence at different stages of the project, impact on project objectives and the party who might be the originator of the risk. Risks can be classified in to two main categories: internal risks (those that are project-related and that usually fall under the control of the project management team) and external risks (those risks that are beyond the control of the project management team).

TABLE 1. RISKS UNDER INTERNAL RISK CONSTRAINTS

Construction	Design
1. Disputes between labors	1. Complexity of project design.
2. Changing sequences in construction activity	2. Design changes by owner or his agent during construction.
3. Non availability of resources	3. Design errors and omissions made by designers.
4. Revision of design	4. Insufficient data collection and survey before design.
5. Availability of camp for labors	

6. Change in quantities of work	5. Lack of design team experience in construction projects.	procedures)	7. Changes in tax regulation
7. In Time work permissions for executing work	6. Mistakes and delays in producing design documents.	8. Outbreak of hostilities (wars, revolution, riots, and terrorism)	8. Poor financial market or unavailability of financial instrument resulting in difficulty of financing
8. Safety of workers	7. Misunderstanding of owner's requirements by design engineer.	5. Corrupt local government officials demand bribes or unjust rewards	9. Unfavorable economic situations in the country (instability of economic conditions)
9. Stoppage of work due to Medical outbreak	8. Poor use of advanced engineering design software.	6. High level of bureaucracy of the authority	10. Market demand changes
	9. Unclear and inadequate details in drawings.	7. Expropriation and nationalization of assets/facilities without reasonable compensation	
	10. Incomplete project design.	8. Government's improper intervention during construction	
	11. Defective design made by designers.	9. Poor relations with related government departments	
		10. Government restrictions on foreign companies (e.g., import/export restrictions, mandatory technology transfer, differential taxation of foreign firms, etc.)	
Financial		Management	
1. Delay from clients.	1. Documents and process directed as per agreement for mitigation of risk	Social	
2. Increment for staff benefits.	2. Project team discussions on risk	1. Land acquisition and compensation problems (the cost and time for land acquisition exceeds the original plans)	1. Design errors and poor engineering.
3. Unprecedented price in raw materials.	3. Use of WBS and project milestones to help identify project risks	2. Public opposition to the project (public objections, social grievances)	2. Poor constructability.
4. Fluctuations in Estimated finance than expected	4. Documented process for identifying project risks	3. Differences in social, cultural, and religious backgrounds	3. Complexity of design.
Consultant		4. Insecurity and crime (theft, vandalism, and fraudulent practices)	4. Technology changes.
1. Lack of consultant experience in construction projects.	1. Frequent change of subcontractors.	5. Strikes and labor disputes	5. Incomplete design.
2. Conflicts between consultant and design engineer.	2. Inadequate contractor experience.	6. Poor public relations with local contacts	6. Delay in design.
3. Delay in approving major changes in scope of work by consultant.	3. Inappropriate construction methods.	7. Unfavorable social environment	7. Inadequate study and insufficient data before design.
4. Delay in performing inspection and testing.	4. Incompetent project team.	8. Societal conflict and/or public unrest	8. Unclear and inadequate details in design drawings and specifications.
5. Inaccurate site investigation.	5. Ineffective project planning and scheduling.	9. Poor public decision-making process	9. Unanticipated engineering and design changes.
6. Inadequate project management assistance.	6. Poor communication and coordination between owner and consultant.	10. Disturbances to public activities	
7. Late in reviewing and approving design document.	7. Poor site management and supervision.	Environmental	
8. Poor communication and coordination between owner and contractor.	8. Unreliable subcontractors.	1. Force majeure (natural and man-made disasters which are beyond the firm's control, e.g., floods, thunder etc.)	1. Recycling, minimum wage increase
	9. Inadequate site investigation.	2. Adverse environmental impacts of the project	2. Disability discrimination
	10. Inappropriate contractor's policies.	3. Pollution associated with construction activities (dust, harmful gases, noise, solid and liquid wastes, etc.)	3. Adhering with transportation rules, import / export procedures.
	11. Poor financial control on site	4. Strict environmental	4. Complement with standard and metrology authority.
Client			5. The labors office conditions (labor rate).
1. Client's cash flow problems.			6. Migration rules.
2. Slow decision making.			
3. Delay in revising and approving design documents.			
4. Change order by owner during construction.			

TABLE 2. RISKS UNDER EXTERNAL RISK CONSTRAINTS

Political	Economic
1. Changes in government laws, regulations, and policies affecting the project	1. Unpredicted changes in the inflation rate.
2. Political instability of the government (unfavorable political environment)	2. Project-funding problems. 3. Fluctuations in currency exchange and/or difficulty of convertibility
3. Delay or refusal of project approval and permit by government departments (excessive approval)	4. Unpredicted changes in interest rates 5. Escalation of material prices 6. Delay in payments

V. DATA COLLECTION

Risk identification is done by questionnaire survey. Questionnaire is designed based on PESTEL and SWOT analysis. For the questionnaire survey thirty commercial construction sites are selected. Respondents for the survey includes engineer, contractor, consultant, client, supervisor, project manager and labors. Like hood and the impact of risks are identified through this questionnaire survey.

A. PESTEL Analysis

PESTLE is a shortened form for political, economic, social, technological, legal and environmental. Pestle is a strategic management tool and is used in the construction industry and its objective is to find out how the external environment affects the industry. The external environment affects industries in many ways, but there is not much that can be done to change the external environment whereas the internal environment can be changed to a certain extent. The Pestle technique can be used successfully and effectively in external risk identification process.

B. Questionnaire for PESTEL Analysis

Questionnaire for PESTEL analysis is designed based on six external risk factors, political, economic, social, technological, environmental, and legal. There are certain risks are listed under each risk factor. Ranked questionnaire is prepared as the probability of each risk noted as never, rare, sometime, often, very frequent, starting from one to five ranges. Impact of risks range is very low, low, somewhat high, high, and very high numeric range from one to five.

C. SWOT Analysis

SWOT analysis is a strategic management tool, mainly employed in the internal risk management. SWOT stands for Strengths Weaknesses, Opportunities, and Threats. It is a framework by which organizations and teams assess the pending internal and external influences that can affect a project, product or institution positively or negatively.

Strengths and weaknesses are generally related to issues that are internal to the organization. Strengths examine what the organization does well or its assets, skill, core competencies. Weaknesses are areas the organization could improve upon that is lacking or missing from the organization. Typically negative risks are associated with the organization's weaknesses and positive risks are associated with its strengths. In terms of Risk Management, we call negative risks as threats and positive risks as opportunities. Opportunities and threats are usually external to the organization.

D. Questionnaire for SWOT Analysis

Questionnaire for SWOT analysis is designed based on seven internal risk factors, so that all the internal risks can be identified.

E. Risk Analysis

Risk analysis is regarded as the procedure involving the critical evaluation of prospective risks, arranging them according to importance, and allowing the management team to select the important ones. Risk analysis is the most tasking procedure in managing risk.

This is due to the fact that it involves assessing the chances of the event of a risk and their outcomes on a project's objectives. Its main aim is to evaluate risk by separating the unnecessary events, the chances of the unwanted event happening, and the size of such events.

F. Risk Analysis Using SPSS Software

SPSS software is used for risk analysis. In the analysis like hood and impact of each risk both external and internal is considered. For each risk factor its possibility of occurrence and the impact will not be same range. Some risks happen frequently in the construction industry but the impact will be low. There for the method used for the analysis are descriptive statistics -frequencies and compare means - paired sample T test. Like hood of the risk and its impact is compared using compare means - paired sample T test.

VI. RESULTS AND DISCUSSION

Risks in the construction industry can be managed by ranking of the risks, which are most frequently affect the commercial building construction. Risk ranking enable to understand and mitigate the major risk in construction industry.

A. Risk Ranking

Through the questionnaire survey and risk analysis it is found that, some risks are frequently happening in the construction industry and some risks have high impact on project objectives. These risks can be properly managed and mitigated by risk ranking. It will helps to identify and categorize risks according to their occurrence and their impact. The major risks under each risk factors both external and internal are ranked based on their like hood and impact. Top ten risks in commercial building construction is listed in the table 3 below.

TABLE 3. TOP TEN RISKS IN COMMERCIAL BUILDING CONSTRUCTION

Risk	Rank
Escalation of material prices	1
Unfavorable economic situations	2
Design changes by owner or his agent during construction	3
Market demand changes	4
Unpredicted changes in the inflation rate	5
Client's cash flow problems	6
Adhering with transportation rules	7
Changing sequences in construction activity	8
Force majeure	9
Inaccurate site investigation	10

VII. CONCLUSION

From the above study it is clear that construction industry possess a complex environment, which has many uncertainties in the form of risk. Proper risk management contribute to the successful completion of the project and can improve the quality of the project. There are many kinds of risks in the construction firm. Complete risk avoidance is not practical but risks can be mitigated and reduced to an acceptable level. The top ten risks listed are the risks which need immediate care since they are frequently appearing in the construction industry and having high impact.

There are four alternative strategies for managing risks namely, risk avoidance, risk transfer, risk mitigation, and risk

acceptance, for treating risks in a construction project. There are certain risks which cannot be avoided completely, so such risks need to transfer or mitigate or sometimes accept under control, in a view that doesn't harm the project. Reviewing the previous project is an effective way to understand about risk, its impact and control measures have taken.

VIII. SUGGESTIONS

Risks in the commercial building construction can be treated by various methods. These methods are chosen based on the type, nature, and source of the risk. In this study it is seen that escalation of material price is the most frequent risk in the commercial building construction. Hike in the material prices can be cured by the following methods

A. Risk Reduction By Barter Trading

Barter trading is known from ancient times, in which trading of good or services between two parties is done without the use of money or a monetary medium such as credit card. Bartering involves the provision of one good or service by one party in return for another good or service from another party. In the construction industry construction materials are exchanged between two parties.

B. Economic Risk Reduction by Barter Trading

Bartering involves the provision of one good or service by one party in return for another good or service from another party. In the construction industry construction materials are exchanged between two parties.

Covid pandemic has made many changes in our lifestyle. Many businesses turn in to online platform. Covid brings a new world in front of us. All things are going to be digitalized in the post Covid world. So the barter system can also be implemented by digital marketing. A website is made to sell the construction materials. It will connect a pair of people; who can exchange their products according to their needs and economic situations.

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