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A Review of the Work Related to the Identification and Administration of Risks in Construction Projects

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Abstract: *In recent years, the importance of risk management has grown, and practitioners in the construction industry have paid more attention to the Critical Risk Factors. There are many risk variables in large, complex construction projects, and the completion of these projects depends on effective risk management. Along with the most widely used risk assessment tools and risk classification methodology, this article analyzes the main risk variables related to building projects. A thorough content review of the literature yielded a total of sixty-seven risk variables for this investigation. Methods for categorizing risk, identifying risks, and rating key risks were based on the number of papers that addressed that specific risk, methodology, and approach, respectively. Lack of funding, poor engineering and design, inadequate site management and supervision, contractual risks, and changes in laws and regulations were the top five hazards that were found. Questionnaire surveys and risk classification methods were the most widely utilized approaches for risk identification and classification, respectively. For early risk assessment and effective risk management in construction projects, engineers, supervisors, project managers, and construction practitioners may benefit from the study results.*

Keywords: Risk Management, Construction Project Risks, Project Risk Assessment

I. INTRODUCTION

The complex and dynamic environment in which construction work must be done makes risk in the process inevitable (Akintoye & MacLeod, 1997). Studies confirm that construction is a highly hazardous business since building operations are unpredictable (Zeng, An, & Smith, 2007). Effective risk management is essential to the successful achievement of project goals and targets. It has been established that risk management is an essential strategy for achieving project goals such as budget, schedule, and quality (Han, Kim, Kim, & Jang, 2008; Radya & Budi, 2019). Development projects are characterized by their variable levels of originality and complexity, the dynamic collaboration of several partners, the severity of the capital, dynamic circumstances, extended generation periods, and different climates (Taroun, 2014). Notwithstanding the project's size, complexity, or location, risks and vulnerabilities are undoubtedly present throughout the whole building process, from the beginning to the end.

Instead of concentrating on every risk at once, which would be time-consuming and very complex, the goal of this research is to identify the main hazards that are present in a building project. A thorough content analysis of the literature is conducted in order to identify the primary risk. After a thorough analysis, the top dangers are rated based on the quantity of publications that address them. The main conclusions of earlier publications are systematically compiled in this work. The findings of this research will improve the capacity of construction practitioners to manage risk in projects by assisting them in identifying project-related risks prior to project initiation. In order to appropriately allocate risk obligations, further risk classification is carried out. Additionally, the greatest risks were grouped according to their type. The study's importance lies in the fact that by recognizing the risk associated with building projects at such an early stage (the project's start), construction practitioners may manage it to minimize negative effects on project goals and maximize good outcomes.

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RISK MANAGEMENT PROCESS

Lack of understanding of the risk management framework is the primary cause of risk management's low popularity in the construction sector. Applying risk management from the beginning of a construction project is crucial because understanding the source of the risk will enable practitioners to address it more effectively. Even though a lot of study has been done on the risks associated with building projects, there are still a number of hazards that must be addressed, such as schedule and cost overruns, quality problems, contractual concerns, etc. To shed further light on the topic of risk management in construction, a review of prior research has been conducted and is presented in this article. The top ten dangers associated with the construction business are listed in this document along with widely utilized risk assessment and classification procedures.

The three main components of risk management are risk identification, risk analysis, and risk response. The goal of risk identification is to evaluate potential risks and how they could affect the project's capacity to meet its goals. Both positive risks and negative risks should be taken into account throughout the risk identification process (Arunplod, 2019; Hillson, 2002). It might come from outside sources or from inside the project. Questionnaire surveys, literature reviews, checklists, documentation reviews, Delphi methodologies, brainstorming sessions, and case studies of previous projects are some of the methods used to identify risks. Probability impact matrices, sensitivity analysis, Monte Carlo simulations, tree analysis, fuzzy approaches, and others are often used techniques for risk analysis. The method utilized to reduce the risk associated with a project is called "responding to the risk." Avoiding risk, transferring risk, reducing risk, and retaining risk are some of the many risk reactions.

BACKGROUND STUDIES

Only publications that specialize in risk-related articles and have published more than two papers on risk in construction were chosen for this literature review research. This study has addressed the risk variables that are involved in building projects, as well as popular approaches for identifying and categorizing risk. Zhi (1995) investigated risk management for building projects abroad. Project risks were divided into internal and external categories by Zhi (1995). The four primary steps of the risk management process are (a) risk categorization, (b) risk identification, (c) risk assessment, and (d) risk response. Every risk was evaluated using two criteria in order to determine its criticality. The first factor was the risk's frequency of occurrence, and the second was how seriously it affected the goals. Risk was ranked using the formula R = P*I, which is the multiplication of frequency and severity. According to Zhi (1995), the top five hazards associated with building projects abroad were lack of education, bureaucracy, corruption, inadequate social security, and inflation. The response strategy used in international projects should be appropriate for the project type; it may also vary for comparable projects based on location and other important factors.

The study of risk analysis and management in the construction sector was the main emphasis of Akintoye and MacLeod (1997). Project managers and contractors in the UK completed a questionnaire survey that was created. One hundred leading companies in the UK received the survey forms; of them, thirty were project managers and seventy were contractors. Thirteen project managers and thirty contractors filled out the survey questionnaires and returned them, yielding a 43% response rate. Each risk factor was rated on a five-point Likert scale. The survey data was analyzed using the organization risk premium index. Contractual agreements, financial stability, construction-related, market/industry, and project (design information) were the top five hazards identified in the UK construction sector.

Critical risk factors associated with subterranean train projects in Thailand were highlighted by Ghosh and Jintanapakanont (2004). Based on the research, a questionnaire survey with 59 risk variables was created. These considerations were centered on risk factors that had an impact on the project's overall budget, schedule, and requirements. Survey data were analyzed using a factor-analysis technique. Each risk factor was rated on a five-point Likert scale. Out of the 150 responders who received the questionnaire, 122 completed forms were returned. Project managers, site supervisors, engineers, architects, and project operation officers were among the respondents. Subcontracting risk, contract and legal system risk, design-related risk, financial issues and economic risk, and completion delay risk were the top five risk factors found in Thailand's subterranean train project.

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Wang, Dulaimi, and Aguria (2004) concentrated on the framework for risk management in building projects in poor nations. A survey questionnaire with 28 important risk variables was created. These risk indicators were separated into three levels: project, market, and nation. The primary goal of this study is to provide a framework for risk management that can be used to building projects in developing nations to achieve favorable results. Alien Eyes, a risk model that illustrates the many degrees and breakdown of dangers, was suggested. Using a 7-degree assessment scale, 22 of the 28 risk variables were determined to be critical. Every risk factor was examined and mitigation strategies were recommended. Government clearance and consent, legal changes during a project, unreliability and delays in justice, creditworthiness of local partners, and political party volatility were identified as the top five hazards in developing nations.

Bing, Akintoye, Edwards, and Hardcastle (2005) used a question-survey approach to investigate risk distribution in PPP/PFI building projects in the United Kingdom. The results of this study will assist practitioners in the construction industry in developing more effective risk allocation frameworks from the outset. It became evident from the survey data analysis that the risk was either shared with the private sector or came from the governmental sector. Three degrees of risk were distinguished: macro, meso, and micro. 500 questionnaires were sent by postal service; 61 of them were returned, and only 53 of these were suitable for risk allocation analysis. The study's conclusions demonstrate that the public sector should monitor risks associated with sites and political concerns. Both parties should bear the risks associated with relationships and legislation. The meso-risks should fall within the purview of the private sector.

According to Zou, Zhang, and Wang (2007), there are many significant dangers in China's building sector. Risks were rated according to how they affected the project's life cycle and goals (cost overrun, delays, environment, quality problems, safety, etc.). The questionnaire survey approach was used to gather information. Out of the 177 survey forms that were issued, 86 (46% of the total) were returned, and 83 were deemed legitimate for data analysis. The top 25 risk variables were identified. The frequency of occurrence and the severity of the repercussions are the two components of the survey feedback. According to the study's findings, everyone involved in the project should understand their roles from the outset. This result was contrasted with that of related Australian research. Money problems, inexperienced contractors in project management, payment issues, a lack of insurance, and a disregard for pollution and safety during construction were the top five unique concerns in the Chinese construction sector.

El-Sayegh (2008) investigated risk in the construction sector in the United Arab Emirates. For this study, a questionnaire survey was created using 42 risk variables derived from previous research conducted in China, Hong Kong, Indonesia, Kuwait, and the United States. Out of the 200 questionnaire surveys that were sent out, 70 were returned, and 65 completed survey forms were selected for analysis. Using the relative relevance index approach, risks were ranked according to their frequency and potential influence on the project's goals. Risk variables were divided into two categories: external risk and internal risk. Additionally, external risks were categorized into five groups: political, social and cultural, economic, natural, and others. Internal risks were further separated into five groups: owners, designers, contractors, subcontractors, and suppliers. In the UAE's construction business, the top five major risks were price inflation, a tight deadline for finishing the project, poor management of subcontractors, decreased productivity, material shortages and delays, and owner design modifications. In the UAE building business, political, cultural, and social hazards were the least important.

In 2010, Zavadskas, Turskis, and Tamosaitiene conducted research on risk assessment in building projects. Multi-attribute decision-making techniques were evaluated. Three categories of risk were distinguished in this paper: internal, project, and external. Only risk factors that have an impact on the real estate and construction sectors were chosen. To rank and assess the optimality of various qualities, the TOPIS gray and COPRAS-G techniques were used. The suggested model may be used to increase the likelihood of favorable results and prevent negative effects. In construction management, decision-making is crucial. According to the research's findings, there are several building project levels, and losses may be reduced with a thorough risk assessment.

In 2012, Subramanyan, Sawant, and Bhatt investigated construction risk in India's building sector. After a study of the literature, 93 risk variables were identified and categorized into different subgroups. Fifteen respondents with over 20 years of experience in the Indian construction business completed the questionnaire, which contained all of these risk variables. The fuzzy Analytical Hierarchy Process (AHP) was used for analysis. The risk was separated into two

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categories: resource-specific risk, which includes contractors, project managers, and owners; and environmental risk, which includes consultants, contract clauses, and so on. If properly implemented, the mitigation strategies recommended in this study may improve the likelihood of favorable results.

El-Sayegh (2008) collected data for analysis using a questionnaire survey approach. The study's main emphasis was Pakistani bridge building. For survey purposes, thirty-seven risk variables were taken into account. Sixty-nine of the seventy-seven completed forms that were received were complete and suitable for data analysis. These thirty-seven hazards were then divided into seven categories: contractual, managerial, construction, health, financial, design-related, and external risks. The survey data was analyzed using the Monte Carlo Stimulation and the Relative Importance Index. Cost and schedule goals were shown to be most impacted by the financial category. Lack of funding, unclear responsibilities, insufficient site study, and poor project planning were the top five dangers associated with building bridges in Pakistan.

According to Serpella, Ferrada, Howard, and Rubio (2014), effective risk management requires a solid methodology, knowledge, and expertise in the area. This study, which is based on the Chilean construction sector, demonstrates that both owners and contractors never appropriately use risk management techniques, which leads to unfavorable outcomes and losses. This study employs a knowledge-based approach and proposes a three-pronged technique that includes the use of a best practices model, an evaluation of risk management, and a model of risk management.

The first finding was that because of a lack of awareness of the risks associated with building techniques, risk management is still mostly ineffective. Employing the suggested strategy will assist customers and contractors in managing risk more effectively and preventing losses. Furthermore, by considering additional factors based on a certain project or region, this risk management model may be enhanced.

Using a fuzzy methodology, Ameyaw and Chan (2015) assessed and prioritized a number of risk variables in PPP water delivery projects in poor nations. A questionnaire survey form with a 40-factor risk list was created. These dangers were derived from earlier research and case studies conducted in underdeveloped nations. These 40 aspects were separated into three primary categories: technological, legal, social, and political, and financial and economic. In this poll, a seven-point grading system was used. After calculating the mean scores for probability and severity independently, the square root of the frequency times severity is used to determine the risk factor's impact. Unpredictable currency rates, bribery and corruption, water theft, payment delays, and political concerns were the top five hazards identified.

In their 2016 study, Iqbal, Choudhry, Holschemacher, Ali, and Tamosaitiene examined risk management in building projects. The construction sector in Pakistan served as the study's foundation. A questionnaire survey with 37 risk variables was created specifically for this investigation. The goal of the research was to determine the importance of the many risk variables that finally caused them.

Using the same method as the relative relevance index, the age score was determined for each risk factor. The risk was categorized according to shared bases, contractor, and client responsibility. Both preventative and corrective risk management strategies were used. Payment delays, poor design, insufficient funding, accidents during construction, and poor performance were the top 5 dangers associated with the construction sector in Pakistan.

Dandage, Mantha, and Rane (2018) assessed the ranking of risk categories in global projects. The risk categories were ranked using the TOPSIS approach. This study's primary goal was to identify the key risk categories that have an impact on project success. The questionnaire survey was prepared using a literature review. After that, TOPSIS was used to assess the survey results and rank the risk categories based on their significance. Out of the eight risk categories that were found, the top three were political, technical, and design-related. This research will assist risk managers in better risk management.

Important risk indicators for multinational PPP projects were found by Yu, Chan, Chen, and Darko (2018). For this study, 37 papers on TPPP were examined using a literature review methodology. The chosen articles were published between 1991 and 2015. It was discovered that case studies, questionnaires, conversations, hybrid approaches, etc. were the most often used techniques for the research of TPPP. Legal risk, tariff risk, public-private sector collaboration risk, funding risk, and political risk were the top five hazards that were found. Additionally, a list of TPPP important risk factors is created, which may be used for additional investigation and evaluation. Additionally, checklists are useful for

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anticipating risk and controlling it for better outcomes. The research's scope may be expanded by adding additional TPPP-related studies. Data analysis may also be done using software tools.

Siraj and Fayek (2019) noted typical hazards in the building sector. A total of 110 risk factors were taken into consideration when the risk was divided into the following categories: management, environmental, construction and resource-related, technical, contractual & legal related, economic & financial related, social, political, site conditions, and health-safety. Each category included 10 risks. All of the dangers were rated in their respective categories as well as the top 10 risks overall, based on the quantity of publications that examined these concerns. A total of 130 articles were chosen for this research. The majority of the chosen articles focused on infrastructure initiatives in European and Asian areas. Design flaws, changes in inflation rates, poor engineering methods, and changes in government regulations that might impact project results were the main hazards found in this study.

In order to improve the project's value, Willumsen, Oehmen, Stingl, and Geraldi (2019) concentrated on risk management. To improve the project, an empirical investigation and literature evaluation were conducted for this work. For the empirical investigation, expert interviews and qualitative analysis were conducted. It was shown that stakeholders' perceptions significantly influence how much weight is given to a given item. The findings show that, in order to improve the risk management process, a deeper comprehension of the various hazards as perceived by stakeholders is required. Risk management adds value to the project in terms of project results and indicates the degree of danger posed by risk. Risk managers may overlook project hazards in order to win a contract. In the construction business, there is still a dearth of understanding about risk management, which leads to many losses in terms of money, time, quality, etc.

In 2019, Ugwu, Osunsanmi, and Aigbavboa investigated risk management practices in Nigeria's construction sector. An key factor in boosting economic development is construction. There are dangers associated with any building project. These dangers can only be controlled; they cannot be eliminated. Because it is founded on the experience, knowledge, opinions, and views of a subject-matter expert, a quantitative method was used for this research. Only fifty of the two hundred questionnaires that were provided were suitable for examination. The data was analyzed using a factor analysis technique using SPSS. The findings demonstrate that risk may be controlled by appropriate risk identification, management, and control. Measures to reduce risk are also crucial to a project's successful conclusion.

In their 2019 study, Viswanathan, Tripathi, and Jha examined how risk mitigation strategies affected the outcome of foreign building projects in India. Nine risk mitigation strategies and three project success criteria cost, schedule, and firm performance were identified using the literature review approach. Data from a questionnaire survey of 105 respondents was modeled and analyzed using factor analysis and structural equation modeling. Three linked risk-reduction strategies were found: contract selection, local engagement, and project pre-planning. The main goal of this study is to provide a risk mitigation model that can be used to address the various hazards. The research's conclusions will assist builders in raising project success rates in India and other comparable nations.

RESULTS AND DISCUSSIONS

Several risk categorization techniques were found based on the literature study, as shown in Table 1. The most popular approach is based on the kind of risk, i.e., the risk category (financial, technical, management, etc.). Since this classification makes it apparent which party is accountable for a given risk, these risk classification techniques will aid in risk management.

Table 1: Risk Classification Methods

Sr. No.	Risk Classification Methods	Example
1.	The initial source of risks	Internal or external
2.	Nature of risks	Management, financial, etc.
3.	Occurrence of risks at various levels of the project	Planning, design, etc.
4.	The originator of the risk	Client, contractor, etc.
5.	No classification	Listing risk directly

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Table 2 lists commonly used risk identification methods. The most popular methods for identifying risks in this article were the Delphi methodology, literature review, questionnaire survey, and brainstorming. The questionnaire was created with the assistance of a literature review, as is the case with the majority of papers. In a building project, risk should be recognized on a regular basis. As building projects go forward, new dangers continue to surface. Therefore, as soon as new risks are discovered, they should be incorporated, and appropriate mitigation strategies should be created.

Table 2: Risk Identification Techniques

Sr. No.	Tools and Techniques Used
1.	Questionnaire survey
2.	Literature review
3.	Brainstorming and Delphi technique
4.	Expert interview and Checklist
5.	Past projects/historical project data
6.	Documentation review

As the most widely used approach for classifying risks, critical risk variables were identified based on the literature and are categorized according to the nature of the risk. Based on the number of studies that examined that risk in their research, the top 10 essential risk factors were determined. Therefore, these are the top 10 hazards that exist in the construction sector out of the 67 significant risk variables that have been identified by prior research.

Table 3: Top Ten Risks Identified from the Literature

Sr. No.	Risk Factor	Nature of Risk
1.	Unavailability of funds	Financial risk
2.	Design errors and poor engineering	Technical risk
3.	Poor site management	Supervision & Management risk
4.	Contractual risks	Legal risk
5.	Laws and regulations changes	Political risk
6.	Severe environmental conditions	Environmental risk
7.	Change in inflation rate	Financial risk
8.	Natural disaster	Environmental risk
9.	Inadequate safety measures	Health & Safety risk
10.	Change in project scope	Legal risk

II. CONCLUSION

This study looked at the main risk variables, risk identification strategies, and risk classification approaches for building projects. Since the study presented here is generic for construction projects, which include a broad variety of projects, risk may vary somewhat for every given project, such as building projects, infrastructure projects, power projects, etc. Depending on a project's size, location, financing, and other factors, risks might change. The aforementioned analysis makes it very evident that the construction sector still has very little expertise of risk management. As a consequence, it causes significant losses in quality, money, and time. Funding shortages, poor engineering and design, poor site management and supervision, contractual risks, changes in laws and regulations, extreme environmental conditions, fluctuations in inflation, natural disasters, insufficient safety precautions, and project scope changes are the top ten risks that have been identified. A questionnaire survey and literature review were the most often utilized tools and techniques

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for risk identification, while the most popular way for classifying risks was based on their nature. Both scholars and the building sector may benefit from these discoveries.

As was previously said, this research addresses a broad topic: the hazards associated with building projects. Another aspect of this research is that, while risks may vary somewhat, the same analysis may be performed project-specifically, that is, for other project kinds, such as infrastructure, nuclear, electricity, and construction. Since risks vary for the same projects in various regions, this study may also be conducted on a region-specific basis, that is, based on the project's location. Depending on investment, risk also differs for various projects; hence, cost might be taken into account in this study. Risk identification and management will be more accurate if the aforementioned aspects are taken into account.

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