

PINPOINTING PROJECT PITFALLS: A STUDY OF CRITICAL RISK FACTORS IN BUILDING CONSTRUCTION PROJECTS IN SRI LANKA

Samindi Perera¹, K.V.P. Madushan² and G.H.S.P. De Silva³

ABSTRACT

The design phase of a construction project sets the layout for the entire endeavour but is prone to different risks. Identifying the impact of such risks may help manage them properly and achieve project objectives. The research aims to determine the effect of risk factors on the performance of building construction projects in Sri Lanka. Identification of risks and their impact was accomplished by administering a questionnaire survey and adopting the quantitative approach. The data analysis contained 42 professional insights based on experience in the design stage of building construction projects. Using a Likert scale analysis, the data was analysed employing descriptive statistical tools such as weighted averages, percentage counts, to name a few. The research findings revealed the existence of design, legal, construction, environmental, financial, management, and political risks during the design stage. The design team faces frequent legal and design risks, notably from insufficient drawings and insolvency issues. Most risks moderately affect time, cost, and quality, except for future budget considerations, which significantly impact cost parameters in Sri Lankan building projects. This study emphasises the need for a keen awareness of risks associated with the design stage to streamline the project with the set project parameters: time, cost, and quality. It sets a parameter for project practitioners engaged in the design stage of building construction projects in Sri Lanka, the level of attention they should pay to risk factors to be within the set parameters of the project.

Keywords: Building Projects; Design Stag; Risk Factors; Sri Lanka.

1. INTRODUCTION

Building and infrastructure construction, which serves as the nation's primary economic platform, are among the various duties the construction industry performs (Madushanka & Tilakasiri, 2020). In the construction industry, successful project completion requires meeting the three primary parameters: time, cost, and quality (Qazi et al., 2021). However, due to risks associated with these construction projects, the majority of construction projects fail to meet set objectives and miss targets (Yousri et al., 2023; Zou et al., 2007). According to Schwartz (2021), a risk is anything that might affect the project's budget, time, and quality. Risks can occur at any stage in the construction project

¹ Academic, Quantity Surveying, Kotelawala Defence University, Sri Lanka, samindi3d@gmail.com

² Student, Liverpool John Moores University, United Kingdom, kvpmadushan67@gmail.com

³ Academic, Department of QS, SLIIT, Sri Lanka, priyanwadadesilva@gmail.com

life cycle, from project initiation to project closure (Qazi et al., 2021). Therefore, identifying risks is essential to managing a construction project (Yousri et al., 2023). As responsible professionals, project managers must monitor every event and know its impact on the project's success or outcome (Ghaleb et. al., 2022).

Construction requires a variety of activities, making construction projects complex (Bahamid et al., 2019). The construction industry mainly engages with unknown, unexpected, unpredictable, and undecided factors (Kishan et al., 2014). On the other hand, the unique nature associated with construction activities also makes the construction industry a risky trade (Abeyasinghe & Jayathilaka, 2022) and makes risks a part of the day-to-day life of construction projects (Yousri et al., 2023; Zou et al., 2007). With such a nature, achieving the set project objectives is easier if the project is well-planned and managed (Yousri et al., 2023). These risks include design, logistics, environmental, management, finances, construction, and politics. Many scholars, such as Kishan et al. (2014), Zou et al. (2007), and Yousri et al. (2023), indicated that every project must adopt a systematic risk management process to implement an appropriate plan for construction projects. Moreover, most of these scholars agreed that the first step of this process would be identifying risks (Goral, 2007; Qazi et al., 2021; Yousri et al., 2023). Thus, it is factual that proper risk identification can help the attainment of the objectives of a project (Qazi et al., 2021).

Yousri et al. (2023) indicated that in the initial stage of a project, design errors and design integration errors bring high risks to the project's safety and performance, and the responsibility for these weaknesses directly falls on the consultants and clients with their design liability (Awuni, 2019). Thus, they are responsible for ensuring a well-coordinated and error-free design during the design stage (Goral, 2007). A construction project's design phase has systematic implications that impact the entire project from inception to completion (Wuni, 2023). It also dictates the methodology of construction and other related activities (Zou et al., 2007) and significantly affects the decisions taken during the latter part of the project, specifically in the construction stage (Wuni, 2023). Therefore, the risks and the risk factors during the design stage can extensively impact the entire project (Smith et al., 2014). However, these risk factors may vary depending on various influences, such as the composition of the design team, the approach to mitigate the risk, and demographic factors. A study conducted on Risk assessment by Eskander (2018) indicated the six types of risks influencing Arabian construction projects as acts of God: physical, economic, political, design, and job site-related risks. The risks in Egyptian construction projects are categorised into 35 risk factors under six types: planning and controlling, execution, regulation, project finance, communication, unforeseen conditions and resources (Yousri et al., 2023).

The building projects in Sri Lanka are not an exception but are also vulnerable to risks during the design stage for various reasons. According to a study conducted by Madushanka and Tilakasiri (2020), the possibility of risks during the tendering and designing stages is 11% and 18%. Though these percentages appear slightly trivial, they significantly impact overall project parameters. Therefore, identifying these risks related to the design stage can minimise the impact on the entire project. The literature on risk management in the Sri Lankan construction industry is more focused on the whole lifecycle of construction projects, and there is a lack of studies specifically focused on the design stage of building construction projects. Therefore, this research aims to investigate the impact of risk factors during the design stage on the objectives of building

construction projects in Sri Lanka. Thus, the study's objectives include investigating the likelihood of occurrence of specific risk factors at the design stage and analysing their impact in terms of time, cost, and quality aspects of the building construction projects during the design stage.

2. LITERATURE REVIEW

Every construction project is unique and built once (Yousri et al., 2023). It involves several stakeholders with direct or indirect interests in its outcome. Scholars use different perspectives to define risk (Ghaleb et al., 2022). While financiers and developers examine a project's financial and economic aspects, engineers, designers, and contractors consider risk from a technological standpoint (Baloi & Price, 2003). According to Genc (2023), risk is the probability of negative incidences that impact the project goals. Ignoring risks creates disasters in the project (Genc, 2023; Yousri et al., 2023). Risks also compromise the project's goals, which include scope, budget, schedule, and quality (Genc, 2023). However, risk in the construction business is the existence of opportunities or dangers, whether real or hypothetical, that affect the goals of projects during the project construction. The risk level depends on the construction project's complexity (Ghaleb et al., 2022). When a project gets complex, the level of risks also escalates (Adedokun et al., 2023; Wuni et al., 2023). However, each risk can affect every phase of the construction project as it fills with liabilities and assets (Asaminew, 2021). Among these risks, the risks associated with the design stage can make a huge impact throughout the project lifecycle (Awuni, 2019; Yousri et al., 2023).

2.1 TYPES OF RISKS AND RISK FACTORS

The literature contains different classifications of risks depending on different aspects, such as the project's nature, causes of risks, building elements, to name a few (Awuni, 2019; Goral, 2007; Yousri et al., 2023). The literature identifies many scholars who attempted to classify different risks related to construction projects (Bahamid et al., 2019; Genc, 2023). Accordingly, in studying the Ghanaian construction industry, Awuni (2019) classified risks into eight types: financial, contractual, economic, environmental, political, technological, social, and force majeure. According to Awuni (2019), technological risks include the risks related to the operational and execution of technology in the project, and financial risks are the matters associated with financing the project. They further describe political risk as matters or concerns linked with the local, regional, and state political and governing conditions challenging the project, as well as economic risks as matters or concerns related to the macroeconomic influence of the project on the public and region. Moreover, they identify environmental risks as matters related to environmental problems. Construction risks involve design changes, labour issues, etc. (Mahendra et al., 2013). According to Zou et al. (2007), the design risk involves matters such as specifying requirements and estimating time and resources to complete the design. Legal risks relate to obtaining permits and the vagueness of work legislation. Management risks are related to works that require top management's consent before making decisions (Adedokun et al., 2023).

Studying the Turkish construction industry, Genc (2023) identified 33 principal risk factors and focused on critical ones in different construction contexts. Bahamid et al. (2019) identified 56 risk factors crucial for developing countries' construction industries. By deepening the study, Shen et al. (2001) classified time-related risks as cost, time

overruns, and not meeting the targets as expected. Analysing these risks, they further stated that cost overruns force scope or quality reductions to stay within the baseline budget, and performance risk arises. Moreover, they described quality risk as the possibility of losses due to poor quality that exceeds the client's expectations. Similarly, Madushanka and Tilakasiri (2020) identified design, political, safety, and fault risks in the Sri Lankan construction industry. Moreover, they indicated that the local construction industry has significant financial and time risks. Another study on financial and economic risks associated with Sri Lankan high-rise apartment building construction projects revealed 17 risk factors. It indicated financial problems due to estimation errors as the most significant risk factor (Perera et al., 2020). Another study on critical factors affecting the performance of large construction projects in developing countries revealed 66 risk factors that impact the construction performance in the Sri Lankan context (Santoso & Gallage, 2020).

2.2 IMPACTS OF RISKS

Risks are inherent to construction projects, and no construction project is free of risks (Samarakkody & Perera, 2023). Productivity, performance, quality, and cost are the primary areas where risk can impact a construction project (Kangari, 1995). Studying the Ghanaian construction project, Awuni (2019) expressed that the risk and uncertainty during the design phase can significantly impact the entire project in terms of time, cost and quality. According to Genc (2023), failure to identify risks may make it unable to achieve the completion date, keep the expenditure within the agreed cost estimate, and thereby fail to achieve the quality and the operational requirements of a construction project. Similarly, Shen et al. (2001) revealed that poor quality can lead to product recalls, client complaints, reduced durability, and cracks in the structure. Apart from the construction project being complex, the lack of coordination among the project team at the early stage will impact the project's performance (Awuni, 2019). Therefore, there is no doubt that the statement made by Andi (2006) stresses the importance of the recognition of risks and their appropriate assignment to contractual partners.

3. METHODOLOGY

The study employed the quantitative research approach, which collects numerical data and analyses it mathematically (Creswell & Creswell, 2017). Reviewing the risks and risk factors associated with the design stage of construction projects was conducted through a comprehensive literature survey using journal articles, conference papers, books, etc. Scholars of construction management commonly use questionnaire surveys to gather information on behaviours, opinions, and attitudes, and they consider them a cost-effective way of gathering data (Genc, 2023). The study explored several risks associated with the design stage of building construction projects in Sri Lanka and their impacts on project parameters: time, cost, and quality by administering a questionnaire survey among the construction project professionals engaged as design team members. The developed questionnaire survey gathered perceptions of 42 industry practitioners. Finally, the study employed descriptive statistical tools such as weighted averages and percentage counts through Likert scale analyses to analyse the data. The Likert scale is a popular technique that measures attitudes, concepts, and values. It is also a principal instrument in measuring general and emotional phenomena (Kusmaryono et al., 2022). Alabi and Jelili (2023) propose five to seven items on a Likert scale as acceptable for most constructs.

Kusmaryono et al. (2022) found that over 90% of research uses five-point Likert scales. The study adopted two 5-point- Likert scales, and Table 1 illustrates the Likert scales used to explain the frequency of occurrence and the level of impact of risk factors on time, cost, and quality of the building project.

Table 1: Likert scales

1a: Frequency of occurrence of risk factors during the design stage			1b: Level of impact of risk factors against the quality, time, and cost parameters of the building project		
Result	Value	Range	Result	Value	Range
Never	1	1.00 – 1.80	Very Low	1	1.00 – 1.80
Very Rare	2	1.81 – 2.60	Low	2	1.81 – 2.60
Rare	3	2.61 – 3.40	Moderate	3	2.61 – 3.40
Often	4	3.41 – 4.20	High	4	3.41 – 4.20
Very Often	5	4.21 – 5.00	Very high	5	4.21 – 5.00

The Likert scale, 1a: where “very low” = 1 and “very high” = 5 and 1b: where “never” = 1 and “very often” = 5, to investigate the frequency of occurrence of risk factors during the design stage and to explore the level of impact of risk factors against the quality, time, and cost parameters of the building project respectively.

Moreover, the study made the following assumptions when using the two Likert scales: identifying risks and exploring their impacts. The distance between “very often” and “often”, “very high” and “high” is the same as “often” and “moderate” and “high” and “moderate” in 1a and 1b Likert scales, respectively. With this assumption, the distance between “never” and “very rare”, “very low” and “low” in 1a and 1b Likert scales is five times greater than the distance between “very often” and “often”, “very high” and “high” in 1a and 1b respectively. This study considers only limited risk factors under design, construction, environment, legal, financial, management and political risks.

Though different researchers identified many risk factors within the Sri Lankan context (Perera et al., 2020; Santoso & Gallage, 2020), the study examined only a limited number of risk factors under identified risks during the design stage of building construction projects in Sri Lanka. Accordingly, under the *design risks*, the study considered the lack of drawings and designs, lack of design team skills competencies, the durability of the building, suitability of structure (design) for climate conditions, misunderstanding site conditions, the complexity of the building, the orientation of the building, and consideration of the future maintained budget. *Legal risk*: insolvency litigation matters; *construction risk*: durability of the building; *environmental risk*: suitability of structure (design) for climate conditions, misunderstanding site conditions, health safety issues; *financial risk*: consideration of future maintained budget, *management risk*: an impermanent workforce and under *political risk*: only the country's economic situation considered for further studies.

4. DATA ANALYSIS AND DISCUSSION

4.1 DETAILS OF THE RESPONDENTS

According to the data collected, the majority of 52% of respondents were Quantity Surveyors while 21% were Engineers. The rest consist of 10% Architects, planning engineers, managerial level offices, Environmental and Safety Officers, and Technical Officers. Figure 1 shows the respondents' working experience during the design stage of building construction projects in Sri Lanka.

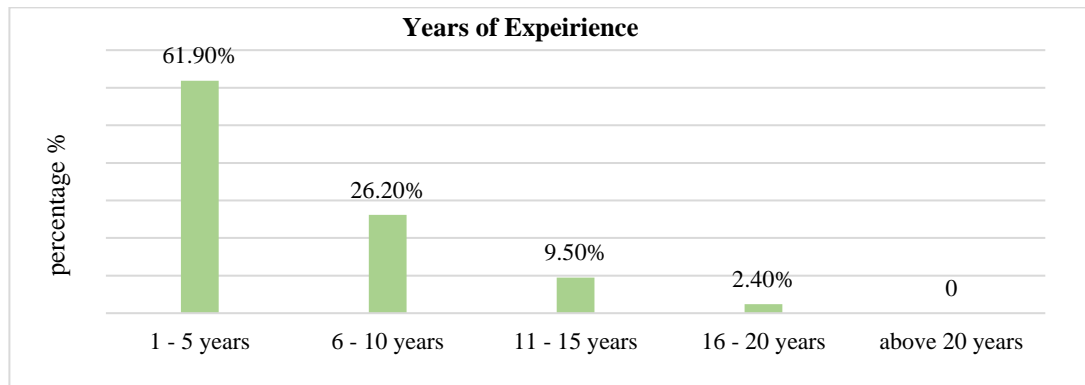


Figure 1: Working experience during the design stage in building construction projects

Table 2 provides the respondent's details of the questionnaire survey.

Table 2: Details of respondents

Profession	Usage
Quantity Surveyors	52%
Engineers	21%
Architects	10%
Project Managers	5%
Planning Engineer	2%
Deputy General Manager	2%
Quality Assurance Engineer	2%
Environmental and Safety Officer	2%
Technical Officer	2%

As per Figure 1, 61.9% of respondents who participated in the survey have 1-5 years of experience in building construction projects, while 26.2% have 6-10 years of experience, 9.5% have 11-15 years of experience, and 2.4% have 16-20 years of experience. However, in the sample, all respondents reported having less than 20 years of experience in building construction projects.

4.2 FREQUENCY OF OCCURRENCE OF RISK FACTORS DURING THE DESIGN STAGE IN BUILDING CONSTRUCTION PROJECTS

Figure 2 illustrates the frequency of occurrence of different risks during the design stage.

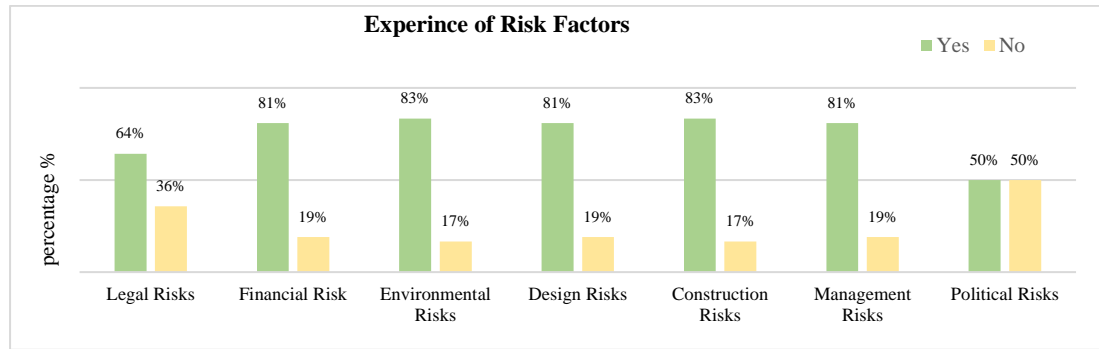


Figure 2: Frequency of occurrence of different risks during the design stage

According to the respondents, the majority confirmed the existence of all the listed risks in Figure 2 above during the design stage of building construction projects in Sri Lanka. Accordingly, 83% of the population confirmed they had experienced environmental and construction risk factors during the design stage of building construction projects in Sri Lanka. Similarly, 81% of respondents confirmed the existence of design risk factors and management risk factors. In contrast, only 50% indicated the presence of political risk factors during the design stage of building construction projects in Sri Lanka. Therefore, the review of responses confirms that Sri Lankan construction projects face all potential risk factors during the design phase. Table 3 indicates the frequency of different types of risks.

Table 3: Frequency of occurrence of different risks

Risk factors	Weighted average	Frequency of Occurrence
Design risk	3.619	Often
Construction risk	3.167	Rare
Environment risk	3.167	Rare
Legal risk	3.643	Often
Financial risk	3.333	Rare
Management risk.	3.071	Rare
Political risk	3.000	Rare

Moreover, the respondents indicated that design and legal risks occur often, while financial, construction, environmental, management, and political risks occur rarely during the design stage in building construction projects.

Table 4, indicates the frequency of occurrence of risk factors identified under different types of risks and their impact on project performance.

Table 4: Frequency of the occurrence of risk factors and their impacts

Risk	Risk Factors	Frequency	Time	Cost	Quality
Design risk	Lack of drawings and designs	Often (3.619)	Moderate (3.143)	Moderate (3.071)	Moderate (3.286)
	Lack of design team skills & competencies	Rare (3.119)	Moderate (2.952)	Moderate (3.143)	Moderate (3.262)
	Durability of building	Rare (3.167)	Moderate (3.071)	Moderate (3.095)	Moderate (3.286)

Risk	Risk Factors	Frequency	Time	Cost	Quality
	Suitability of structure (Design) for climate conditions	Rare (3.167)	Moderate (3.190)	Moderate (3.167)	Moderate (3.238)
	Misunderstanding site conditions	Rare (3.238)	Moderate (3.071)	Moderate (3.214)	Moderate (3.167)
	Complexity of building	Rare (3.262)	Moderate (2.833)	High (3.238)	Moderate (3.262)
	Orientation of building	Rare (3.095)	Moderate (3.024)	Moderate (3.167)	Moderate (3.310)
	Consideration of future maintained budget	Rare (3.333)	Moderate (3.119)	Moderate (3.357)	Moderate (3.310)
Legal risk	Insolvency & litigation matters	Often (3.643)	Moderate (2.833)	Moderate (2.952)	Moderate (3.143)
Construction risk	Durability of building	Rare (3.167)	Moderate (3.071)	Moderate (3.095)	Moderate (3.286)
Environment risk	Suitability of structure (Design) for climate conditions	Rare (3.167)	Moderate (3.190)	Moderate (3.167)	Moderate (3.238)
	Misunderstanding site conditions	Rare (3.238)	Moderate (3.071)	Moderate (3.214)	Moderate (3.167)
	Health & safety issues	Rare (3.095)	Moderate (3.000)	Moderate (3.071)	Moderate (3.000)
Financial risk	Consideration of future maintained budget	Rare (3.333)	Moderate (3.119)	High (3.357)	Moderate (3.310)
Management risk	An impermanent workforce	Rare (3.071)	Moderate (3.095)	Moderate (3.214)	Moderate (3.214)
Political risk	The country's economic situation	Rare (3.000)	Moderate (2.881)	Moderate (3.262)	Moderate (3.214)

According to Table 4, the respondents indicated that under the design risks, the frequency of lack of drawings is often whilst the other risk factors: lack of design team skills and competencies, durability of building, suitability of structure (design) for climate conditions, misunderstanding site conditions, complexity of building and orientation of building rarely appears during the design stage. The respondents recognised that insolvency and litigation matters under legal risks also appear often whilst the other risk factors under construction: durability of the building, environment, suitability of structure (design) for climate conditions, misunderstanding site conditions, health safety issues, financial: consideration of future maintained budget, management: an impermanent workforce and political risk: the country's economic situation rarely appear during the design stage of the building construction projects.

4.3 IMPACT OF THE RISK FACTORS ON TIME, COST, AND QUALITY ASPECTS OF THE BUILDING CONSTRUCTION PROJECTS

As illustrated in Table 4, the respondents confirmed that all the risk factors moderately impact the time and cost of building construction projects in Sri Lanka. Moreover, considering the cost, the data indicated that the factors except for considering future

budget maintenance risk factors under financial risk and complexity of the building under design risk, all the other factors have a moderate impact on the project cost. In contrast, respondents confirmed that considering future budget maintenance risk factors under financial risk and complexity of the building under design risk make a high impact on the project cost.

4.4 DISCUSSION

The design stage is a crucial phase in a construction project as it sets the foundation for the entire endeavour (Goral, 2007; Madushanka & Tilakasiri, 2020; Wuni, 2023). Even though it sets the groundwork for the project's success, it also shows a high vulnerability to risks that can significantly impact the whole project and its outcomes. The design phase faces seven types of risks: design, legal, construction, environmental, financial, management, and political risks. These design stage risks have risk factors that contribute to the project's overall performance in different ways. The data analysis revealed the existence of all these six risks during the design stage of building construction projects in Sri Lanka. Among them, the most experienced risks by the design team professionals are the legal and design risks. Similarly, a study on the Ghanaian construction industry by Awuni (2019) revealed that contractual risks appear to be a significant type with a high impact on the project.

Under the design risk factor, while lack of drawings and design occur often, the other risk factors such as lack of design team skills and competencies, the durability of the building, suitability of structure (design) for climate conditions, misunderstanding site conditions, complexity of the building, orientation of building and consideration of future maintained budget reported a rare occurrence. Insolvency and litigation under legal risks also often occur during the design phase. In contrast, all the other risk factors under construction, environmental, financial, management, and political risks, rarely occur during the design stage. Similarly, MacMillan et al. (2002) revealed that lack of drawings, state law and economics, and misunderstanding related to site circumstances and weather are the most critical risk factors in the UK construction industry.

Overall, the risk factors under six types of risks associated with the design stage indicate a moderate impact on building projects' time and quality parameters. In support of research findings, Latham et al. (1994) pointed out that delays caused by subcontractors and consultants are significant in government projects and result in time and cost overruns. Furthermore, he stressed that this problem is common in traditional types of contracts, where they proceed with the lowest bid at all times in the projects carried out by the state in developing countries. In terms of the impact against the cost of the building construction projects in Sri Lanka, except for the risk factor: consideration of future budget, which comes both under design risk and financial risks, which showed a high impact, all the other risk factors showed a moderate impact against the cost parameter. The research findings prove that considering risks during the design stage of a building construction project is not just about eliminating the uncertainty but also handling them proactively. Identifying the gravity of potential risks early during the design stage can facilitate planning actions for a smooth run and successful project completion within time, cost, and quality parameters.

5. CONCLUSIONS

Risks associated with the design stage of a construction project can have a domino effect, influencing every aspect of the project. Understanding these risks and risk factors is essential in every construction project to act on today's competitive business landscape. Therefore, identifying them to decide on mitigatory measures during the project's early stages can ensure its goals are successful. This study revealed that the design risk factors can considerably impact the project objectives (time, cost, and quality) of building construction projects in Sri Lanka. Therefore, every building construction project must consider identifying potential risks to integrate risk management practices during the design stage into practice. As a result, it seemed worthwhile to identify risks and risk factors in Sri Lankan building construction projects. Previous research has analysed individual risk factors, neglecting a broader view that identifies hazards and evaluates their potential impact on project parameters. The main focus of this study was to identify the impact of several design risk factors on the project parameters.

This study identified six categories that contributed to the issues in building construction projects: legal, financial, environmental, design, construction, and political risks. Among these risks associated with the design stage, the legal and design risks are the two types that often entangle with the design stage. However, considering risk factors associated with six kinds of risks of the design stage, it showed a moderate occurrence except for lack of drawings and designs under design risk and insolvency and litigation matters under legal risks. All the other risk factors show a rare occurrence during the design stage of building construction projects in Sri Lanka. However, in terms of their impact on the project parameters, time, cost, and quality, except two risk factors: consideration of future budget, which comes under design risk, and consideration of future maintained budget under financial risks, which showed a high impact against the cost parameter of the project, all the other risk factors showed moderate implications against time, cost and quality parameters.

The study revealed that the design stage is associated with risk factors that can impact the project parameters differently. Since the design stage sets the layout for the entire project, it is worth carefully identifying these risks to proactively handle them to minimise the impact on the set parameters of the project. Even though it is impossible to eliminate every risk and risk factor, the best solution would be to identify possible risks associated with the design stage and minimise the number of occurrences and their impact on the project's time, cost and quality.

5.1 LIMITATIONS

The study only focused on specific risk factors under six types of risks that exist in the design stage of building construction projects in Sri Lanka. Similarly, only the practitioners with experience working during the design stage of the building construction projects participated in the data collection.

5.2 FURTHER RESEARCH DIRECTIONS

This investigative study identifies the critical risk factors at the design stage in building construction, which allows the exploration of the impact of the same risk factors in infrastructure projects, including roads, bridges, and dam construction.

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