THE INFLUENCE OF EXTERNAL RISK ACTORS ON CONSTRUCTION PERFORMANCE IN THE SRI LANKAN CONSTRUCTION INDUSTRY

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DECLARATION

I hereby certify that this Dissertation entitled "**The Influence of External Risk Factors On Construction Performance In The Sri Lankan Construction Industry"** written and submitted by me to the University of Moratuwa, in partial fulfilment of the requirement for the award of Post Graduate Diploma in Construction Project Management under the supervision and guidance of Dr. Chandana Siriwardana

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ABSTRACT

The escalating prevalence of external risk factors within the Sri Lankan construction industry has prompted a critical examination of the role these factors play in influencing construction performance. Despite the abundance of construction-related challenges, there exists a notable gap in the literature regarding the direct impact of external risk factors on construction performance, specifically within the Sri Lankan context. While previous research has extensively explored the broader implications of technology in education, its specific effects on construction outcomes remain inadequately defined. This study aims to address this gap by delving into the intricate relationship between external risk factors and construction performance, providing a nuanced understanding of their implications. The research contributes to existing knowledge through a meticulous review of available literature, culminating in the development of a comprehensive model. This model serves as a valuable addition to the ongoing discourse and sets the stage for future investigations in the field. The study employs robust methodology, primarily utilizing multiple regression modeling to test hypotheses. Employing descriptive statistics, regression and correlation analyses, as well as validity and reliability testing, the research methodically explores the depths of the theme. Data collection is executed through a self-administered questionnaire, employing a non-probabilistic convenience sampling method. Statistical analyses are conducted using SPSS, with responses gathered from a representative sample of 48 participants within the Sri Lankan construction industry. The results of this study unveil a profound and significant influence of external risk factors on construction performance, offering a comprehensive understanding of how these factors shape outcomes within the industry.

Keywords: Construction industry, Construction performance, External risk factors, PESTLE

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CHAPTER 01

INTRODUCTION

1.1 Introduction

Construction projects are complex and fraught with uncertainty. Most importantly, unique and sensitive for specific risks which can potentially have damaged or productive consequences for the project outcomes [1]. Therefore, Project risk management aims to increase the likelihood of positive impact of activity while reducing the likelihood and negative impact of the activity caused by a particular risk[2].Construction projects are inherently complicated and fraught with a lot of uncertainty factors. These efforts are complicated and therefore vulnerable to a variety of risks, each of which can have a significant impact on the project's performance and have both positive and negative outcomes [1]. Therefore, while navigating in this difficult region, competent project risk management becomes essential. Project risk management's main goal is to minimize opportunities and adverse impacts of possible risks while raising the likelihood of beneficial effects on project activities[2]. Throughout the project's life cycle, possible dangers and opportunities will be systematically identified, evaluated, and responded to as part of this proactive approach.

To further deepen the complexity of project risk management, it is essential to understand the diverse nature of the risks that construction projects may encounter. These risks can range from financial uncertainty and regulatory challenges to unforeseen environmental factors and work problems. Each risk type requires a tailor-made and nuanced strategy to maximize the project’s chances of success.

In addition, the idea of reference types in project risk management is essential to classifying and comprehending the nature of hazards. With the use of a reference type, project managers can better tailor their risk management methods by having a framework for categorizing risks according to their attributes. Technical, organizational, external, and other risks requiring extra caution and restrictive procedures are examples of these reference categories. In essence, project risk

management is a proactive, dynamic process that is necessary to guide construction projects throughout the inherent uncertainties that they include. Through risk identification, analysis, and strategic response, project teams can enhance their capacity to achieve favorable outcomes while mitigating the adverse effects of unanticipated obstacles.

1.2 Research Background

The majority of researchers in the field of project management usually point to the risk definition "as the degree of probability of appearance of any ignored or unexpected event that can slow down or hinder the project objectives and can be in the form of financial, materials, design, labour and equipment risks"."[3]. Consequently, Risk management in construction projects is extremely vital and has a broad perspective with a systematic way of identifying, analyzing, monitoring[3], [4], and responding to a particular risk to achieve the project goals. It is essential to apply managerial decisions with economically coordinated efforts and effectively managed resources to the construction project management processes to minimize the Probability and/or impact of Risk events in maximizing the perception of project objectives[1]. Principally, Risks in construction projects originate in two main categories: Internal Risk and External risks. Internal risk generates within the project itself, involving the direct stakeholders of the project. Internal risks are primarily organizational or Project specific, and they are available in company databases derived from completed project documents and experiences[5]. Internal risks for a particular organization and stakeholders are somewhat inevitable. The effects on construction projects management processes for a particular organization or construction section are very much defined & predictable[6].

However, external risks are sourced from outside the project and not related to project activities, including risk elements that are completely out of the control of key stakeholders. External Risks are generally hardly predictable, less database is available, and no structured method is available to identify them.[6] As the occurrence and impact of external risk events significantly vary with respect to project classification, further investigations are needed to identify more detailed information about minimizing negative impacts on construction project performance in relation to

project cost, time, and quality objectives[2]. Nerija and Audrius (2012) [5] has carried out more studies on assessment of project-level risk categories and found out that external risk is carried more impact among other risk categories in construction but the Probability or the occurrence of such risks in construction is much lower (Figure 1) than other types of risks.

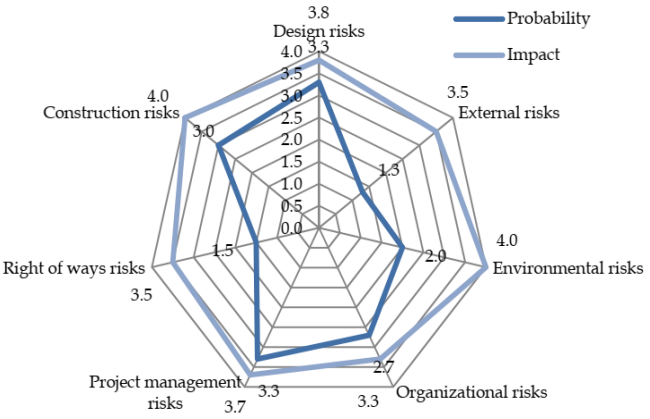

Figure 1: Assessment of project level risk categories

Notably, the internal organizational environment will not affect the construction projects as much as the risk events associated with the external factors and efficient and appropriate techniques are to be used to analyze the organization's external environment to gain productive information[7]. Therefore it is important to identify factors associated with External risk events and their impact on the performance of construction processes with respect to the frequency of occurrence from relevant risk events[2]. Among the various approaches to data management, the PESTEL technique from strategic management techniques of Business management is identified as a reliable tool for identifying external risks in construction projects, thus acting as an aid in the risk management process[8]. The PESTEL method is ideal for use as a strategic framework for understanding external influences on a construction project[5]. The analysis was given the name PESTLE in reference to the abbreviation formed by the initials of the six categories of variables included in the model which is Political, Economic, Social, Technological, Environmental, Legal [7].

According to the study carried out by Bowers and Khorakian (2014), the evidence available for the effective implementation of risk management systems in developing countries is little.[13] In modern Sri Lankan construction sector have failed to place more emphasis on External risks during the construction process due to the lack of investigations and knowledge of the effect of external risk events and by accepting of external risk rather than properly managing has added to occur cost and time overruns construction projects[9]. According to P.O. Akanni, A.E. Oke & O.A. Akpomiemie[10], The performance of construction projects shall be measured and

evaluated using a large number of performance indicators that could be related to various dimensions (groups) such as time, cost, quality, client satisfaction, client changes, business performance, health and safety. Chris Hendrickson, in the Book' Project Management for Construction' [50], points out that potential conflicts between the stated performance measuring characteristics with respect to scope, cost, time & quality, and the constraints imposed on human material and material resources market must be considered in performance analysis in construction projects. Furthermore, The Project Management Institute (PMI) focuses on more process groups relevant to Material management, such as Procurement & scope management techniques confirming. Material management is a direct constraining factor in the performance analysis of modern construction processes. Aleksander Srdić & Prof. Jana Šelih [11] point out that material and construction machinery and equipment issues are one of the primary causes for delay the construction projects beyond their scheduled time frames.

Therefore, the following process in the construction has been identified as the primary performance process for Sri Lankan construction projects.

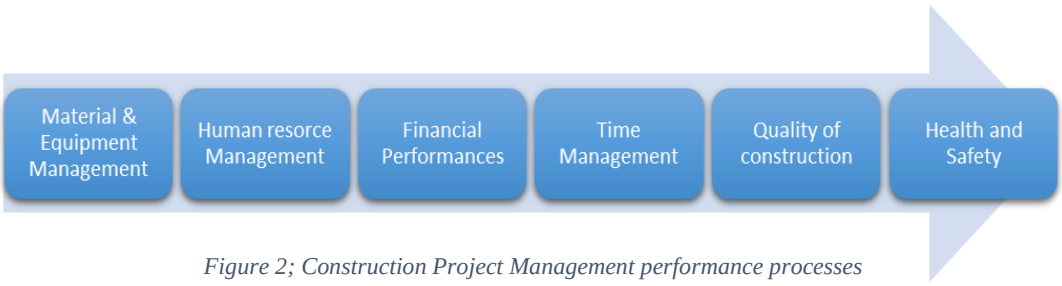

Figure 2; Construction Project Management performance processes

Evaluating from the written documents and the previous cases of when the industry was in process, the main conclusion is that risk management area of the construction industry of Sri Lanka is not advanced in knowledge and most project don't think about risks and use preventive measures, which later on lead to large losses.[11]. Therefore, the present study is conducted to investigate and propose a risk management framework for the Sri Lankan Construction industry for External Risk events that promote and enhance better Construction Performance through proper Planning and risk management techniques.

1.3 Problem Statement

Critical obstacles that the Sri Lankan construction sector must overcome include a dearth of comprehensive research and comprehension on the influence of external hazards on construction projects. The industry's risk management procedures are impacted by this ignorance. Insufficient investigation and comprehension of external risk impacts might expose building projects to unforeseen difficulties and impede efficient risk mitigation. The detected knowledge gap may have significant consequences, one of which is an increase in project uncertainty and disruption. Events involving external risk, such as shifts in laws, regulations, and policy, can have a significant impact on building projects. Proactively monitoring and responding to these risks may be difficult for the industry if there is a lack of information regarding the potential impact of these occurrences on projects in Sri Lanka. This ignorance raises the possibility of unfavorable outcomes, such as project quality jeopardization, delays, and exorbitant expenses.

In addition, a significant issue facing Sri Lanka's construction sector is a lack of in-depth understanding of the cost elements impacted by external hazards. Careful study is necessary to fully understand how external risks and construction costs interact. Changes in the economy, in laws, and in other external factors can have an impact on the cost of materials, labor availability, and the project's overall budget when it comes to construction projects. Building stakeholders may find it challenging to appropriately estimate budgets in the absence of a thorough grasp of these cost dynamics, which could result in discrepancies in finances and even project failures. The complexity of this scientific gap extends beyond the project's current difficulties and unpredictability in terms of funding. They may have an impact on the industry's resilience and general competitiveness. The industry may be less able to adjust to changing circumstances and hence more vulnerable to external shocks such as regulatory changes, economic downturns, or other external risk events if there is a lack of knowledge about the costs associated with these occurrences. This could jeopardize the building industry in Sri Lanka's long-term viability and growth potential.

In addition to lowering risk, closing these knowledge gaps will help the industry adopt a culture of informed decision-making. A comprehensive comprehension of the impacts of external hazards on construction projects empowers project stakeholders to devise risk mitigation tactics, optimize resource allocation, and enhance the project's overall resilience. Furthermore, more accurate project budgeting is made possible by a complete understanding of the cost elements driven by external hazards, which supports both financial stability and good project outcomes. The construction industry has a major issue as a result of the lack of research and knowledge regarding the effects of external risks on construction projects and the inadequate comprehension of cost variables in the context of Sri Lanka. To manage uncertainty, lower risks, and foster sustainable growth, industry must close these knowledge gaps. Prioritizing efforts to close this gap should include collaborative research projects, knowledge-sharing platforms, and incorporating best practices into Sri Lanka's building risk management procedures.

1.4 Research Aim

The research aims the investigating and proposing a comprehensive risk management framework for Sri Lanka’s construction industry with a specific focus on external risk events underlines the need to address the challenges arising from factors outside the project environment. This objective proposes a holistic approach to risk management that recognizes the impact of external elements on construction projects in Sri Lanka. Focusing on external risk events implies an obligation to understand and reduce factors beyond the direct control of project participants. These external risks may include policy changes, economic volatility, social trends, technological development, legal requirements and environmental considerations. Each of these factors can significantly affect the success and performance of the construction project.

The peculiarity of focus on Sri Lanka construction recognizes the unique challenges and dynamics within the local context. A custom approach is proposed, taking into account the socio-economic, political and legislative landscape of Sri Lanka. Such an approach recognizes the need to adapt risk management strategies to the specific circumstances and challenges of the country.

The term "comprehensive risk management framework" implies a proactive approach to risk assessment and reduction. The aim of the study is not only to understand external risks, but also practical tools and methods to systematically identify, evaluate and respond to these risks. This proactive approach is crucial to minimizing the negative effects of external risks on construction projects. Implicit in the research objective is the overall objective of improving construction performance. By developing a comprehensive framework for risk management, the research seeks to contribute to better planning, decision-making and implementation of construction projects in Sri Lanka. This can result in better project results, less uncertainty and higher project success rates.

The choice of focusing on external risks in Sri Lanka's construction industry suggests a recognition of a potential knowledge gap in this specific area. The research aims to fill this gap by conducting thorough research, consolidating existing knowledge and proposing new insights and methods for effective management of external risks.

1.5 Research Objectives

- To develop a control framework for the identifying & evaluating of construction Risk due to the external environment (political, economic, social, technological, legal, and environmental aspects) of construction projects.
- Develop the risk management model to evaluate probability and impact levels of external risk factors for better risk management in construction projects.

1.6 Scope of the Research

With a primary focus on external risk occurrences, the study's goal was to investigate and propose a comprehensive risk management methodology that is specifically customized to the Sri Lankan construction industry. The impact of political, economic, social, technological, legal, and environmental issues on construction projects in Sri Lanka was examined from a variety of angles in this study. The goal of the study was to offer insightful analysis and useful resources for enhancing industry risk management procedures.

The creation of a control system for the detection and assessment of building risks resulting from the external environment was a significant component of the research field. The goal of this framework was to offer an organized method for methodically identifying and evaluating external hazards. Additionally, the goal of the research has been to develop a risk management model that is capable of assessing the influence and likelihood of external risk factors. The model's purpose was to give industry professionals a tool that would enable them to make better decisions and employ more potent risk-reduction techniques. The study's geographic focus was restricted to the construction sector in Sri Lanka, taking into account the particular dynamics and constraints that exist there. By concentrating on one particular area, the study hopes to tailor its conclusions and suggestions to the political, social, and legal context of Sri Lanka.

1.7 Limitations of the research.

While the study has been helpful in identifying and mitigating external risks in Sri Lanka's construction sector, it is important to acknowledge some limitations that have impacted the study's scope and findings. One notable constraint was the temporal and material limitations. The study's vast scope necessitated thorough data gathering, analysis, and validation. But because of time constraints, the research team had to decide how much data to collect and how long to conduct the study. Due to this constraint, the investigation's scope and depth may have been impacted, and some facets of the industry's risk landscape might not have been thoroughly examined.

The accessibility and availability of data was another drawback. Certain external dangers, such as those related to politics or the law, might include private information or restricted disclosure. This limited access to specific data points, which can have an impact on how thorough the risk assessment is. Although this limitation has been lessened by utilizing publicly accessible data and professional judgments, it still has an impact on the study's breadth. The reliance on available public data and expert opinions meant that some critical insights might have been overlooked, potentially skewing the overall risk assessment. Additionally, the veracity of the publicly accessible data may vary, leading to inconsistencies in the findings.

Another restriction that needs to be taken into account is the results' generality. The study concentrated on Sri Lanka's construction sector, and while the knowledge acquired there is insightful, more research may be necessary to see whether the suggested risk management framework can be applied to other areas or sectors of the economy. The construction industry in other regions may face different external risk factors, and the effectiveness of the proposed mitigation strategies may vary accordingly. Thus, further studies in different geographical and economic contexts are necessary to validate the applicability and adaptability of the findings.

Moreover, the research's contemporary relevance is challenged by the dynamic nature of external risk occurrences. The risk landscape of the sector was captured in a snapshot by the study at a specific point in time, but since the study's conclusion, there might have been changes in outside factors or the addition of new risk aspects. External risks are constantly evolving due to changes in the political, economic, and environmental conditions. Therefore, the findings and recommendations of the study might require updates and revisions to remain relevant and effective over time. To overcome this limitation, the suggested risk management system must be continuously monitored and adjusted. Regular updates to the risk management framework, based on the latest data and trends, will ensure its continued relevance and effectiveness.

Focusing on the limitations of the methodology, one significant aspect is the category of data used for the survey. The study primarily relied on data collected from engineers in the construction industry. While engineers are critical stakeholders with valuable insights into the technical and operational aspects of construction projects, this focus may introduce bias and limit the comprehensiveness of the findings. Other stakeholders, such as project managers, financial analysts, regulatory authorities, and community representatives, also play crucial roles in construction projects and their perspectives on external risks might differ. By excluding these diverse viewpoints, the study may not fully capture the multifaceted nature of external risks and the effectiveness of mitigation strategies.

The limitation of relying solely on engineers' input can impact the interpretation of test results. Engineers are typically focused on technical risks and solutions, which might overshadow other important risk dimensions such as financial, legal, and social

risks. This narrow focus could lead to an incomplete understanding of the overall risk landscape and potentially overlook critical risk factors that are not immediately apparent from a technical perspective. Additionally, engineers may have a predisposition towards certain mitigation strategies based on their technical expertise, potentially biasing the recommendations.

Furthermore, the interpretation of test results is constrained by the subjective nature of risk perception. Different engineers might assess risks differently based on their experiences, knowledge, and personal biases. This subjectivity can introduce variability in the data, affecting the reliability and validity of the findings. To mitigate this limitation, the study could have incorporated a more diverse group of participants, including various stakeholders with different expertise and perspectives, to achieve a more balanced and comprehensive risk assessment. In conclusion, while the study provides valuable insights into external risks in Sri Lanka's construction sector, its limitations in terms of temporal constraints, data accessibility, generalizability, and methodological focus must be acknowledged. Addressing these limitations in future research through broader stakeholder engagement, continuous updates to the risk management framework, and inclusion of diverse data sources will enhance the robustness and applicability of the findings.

1.8 Structure Of the Report

The study report contains an introduction describing the context and significance of the study. The report examines the problem explanation, describes the research objectives and introduces the overall structure of the report. This introductory chapter lays the foundation for the follow-up study of project risk management in Sri Lanka's construction industry with emphasis on external risk events.

The literature evaluation, the second chapter provides a comprehensive overview of existing studies and theories relating to project risk management in construction. The evaluation aims to identify shortcomings in the current understanding, synthesize relevant findings and establish a theoretical basis for the study. This chapter critically examines the literature to inform the later stages of the study.

The third chapter explains in detail the chosen methodology with an explanation of the research design, the justification for the selected approach and the specific characteristics of the survey population and the sampling methods. It clarifies the data collection techniques used, whether it is interviews, surveys, document analysis or a combination of methods. Ethical considerations in the research process are also discussed.

Based on the methodology, the data analysis is presented in chapter 4. This part of the report gives a clear picture of the data collected and uses the chosen data analysis methods. Visual tools such as diagrams, graphs or tables are used to support and illustrate important results. The purpose of this chapter is to present a thorough and transparent analysis of the data obtained.

The fifth chapter is dedicated to the discussion of the analyzed data. Here the results are interpreted in relation to the research questions, compared with existing literature and analyzed for patterns or trends. The discussion examines the implications of the results, addresses any limitations or potential prejudices and provides a nuanced understanding of the research results.

As the report develops, the sixth chapter contains the conclusion, which summarizes the main findings, reiterates the objectives of the study, and examines the significance of the survey. This chapter serves as a synthesis of the entire research journey, emphasizing the contributions made to the field and the path of recommendations and future research considerations.

The seventh chapter contains recommendations and provides practical suggestions for practitioners and stakeholders based on the research findings. The study also explores possible opportunities for future research, identifying areas that deserve further research or exploration. This chapter serves as a bridge between the research results and their actual applications.

1.9 Chapter Summary

The introduction highlighted the intrinsic complexity and uncertainty of construction projects, emphasizing the need for effective project risk management to strengthen positive impacts and reduce negative consequences. It highlighted the different nature of risks in the construction sector from financial uncertainty to regulatory challenges and introduced the concept of internal and external risks. The research results relate to the definition of project risk and distinguish between internal and external risks. External risks arising from factors beyond the control of the project have been identified as a major concern in the Sri Lankan construction industry. The PESTEL technique of strategic management was proposed as a reliable tool for identifying external risks. The Notice of Problems identified critical barriers to Sri Lanka's construction sector and highlighted the lack of research into the effects of external hazards and cost variables. The complexity of these gaps extended to project uncertainty, disruption, and industry competitiveness. Filling these data gaps has been crucial for informed decision-making and sustainable growth.

The aim of the study was to propose a comprehensive risk management framework for Sri Lanka's construction sector, with a particular focus on external risks. The objectives of the study include the development of a supervisory framework for the identification and evaluation of external risks, as well as a risk management model to assess their probability and impact. The scope of the study was presented with an emphasis on the external risks of Sri Lanka's construction sector. There are recognized limitations, such as time limits and access to information. The structure of the study was presented with emphasis on the introductory flow of recommendations.

CHAPTER 02

LITERATURE REVIEW

2.1. Introduction

In the pursuit of understanding and addressing the complexities inherent in the influence of external risk factors on construction performance in the Sri Lankan construction industry, this chapter embarks on a critical examination of the existing body of literature that surrounds and informs our research inquiry. A thorough literature review is not merely a retrospective analysis but a strategic engagement with the scholarly landscape, laying the groundwork for our study, and delineating the contours of the intellectual terrain in which our research is situated.

2.2. Construction Risk Management

Construction projects are inherently complex, with various elements like finances, regulations, and unforeseen challenges. Risk management in construction is essential for navigating uncertainties and avoiding potential failures. It's a proactive process aiming to enhance positive outcomes while minimizing negative impacts [12]. Project teams employ systematic identification, thorough analysis, and strategic responses to potential risks and opportunities. Building risk management goes beyond reacting to issues; it's a crucial, proactive strategy to ensure project success amid inherent uncertainties.

2.2.1 Construction Performance

The area of performance measurement is no longer being regarded as an interest among professionals. It has evolved into a focal point of concern over the last three decades. To be very precise, in the past, enterprises were all about profit and turnover. Financial factors were, once upon a time, the only good indicators of a successful company. But the development in performance measurement, that finds a base on financial measures, struggles to adapt to the current environment, specifically due to rapid technology adoption and fierce competition. Past studies have reflected that the main cause of most construction project failures is the project’s performance problems

and underperformance. Much more than simply the reasons and factors that are in fact making up this problem, there are also other issues contributing to this problem. The Iraq cannot deliver in different ways of measures and measurement as well as some systems of projects show in efficiency and effectiveness therefore such this problem is critical.

Definitions of performance measurement

- A performance measurement system can be defined as a set of information, which is at the heart of the performance management process, and it is of critical importance to the effective and efficient functioning of the performance management system [13].
- Performance measurement was defined by [14] as a comparison between the desired and the actual performances.
- Performance measurement can also be defined as the process of quantifying the efficiency and effectiveness of an action.
- Performance measurement has also been defined as the systematic assignment of numbers to entities [15].
- Early definition by [16] suggests that the function of measurement is to develop a method for generating a class of information that will be useful in a wide variety of problems and situations.

2.2.2 Construction Risk Management in Sri Lanka and Challenges

In construction risk management in Sri Lanka, major challenges are the lack of support from government regulations and a shortage of qualified personnel. The absence of strong government support may impede the implementation of effective risk mitigation measures, which may expose construction projects to unexpected challenges. Moreover, the lack of qualified staff increases the risks, as this can lead to delays, quality problems and increased project costs. In addition, the high price of materials in Sri Lanka is a major risk factor that affects the budgets and the overall feasibility of the project. Addressing these issues through strategic planning and cooperation with relevant stakeholders is essential for better building risk management in the context of Sri Lanka.

2.3 External Risks in Construction Projects

In construction projects, external risks play a crucial role in shaping results and influencing project success. Among the various approaches to comprehensive understanding and management of these external influences, the PESTEL analysis stands out as a robust and strategic framework. PESTEL, an abbreviation for political, economic, social, technological, environmental and legal factors, provides a structured method for systematic evaluation and categorization of the various external risks that construction projects may encounter. The PESTEL framework acts as a strategic lens that enables construction projects to analyze and predict external risks, allowing stakeholders to formulate informed decisions and robust risk management strategies.

2.3.1 PESTLE Technique

PESTEL analysis techniques are crucial for building risk management in order to be able to assess external factors that affect projects holistically. Political factors, such as government policies and regulations, can influence the approval and timetables of projects. Economic aspects, including inflation and exchange rate fluctuations, affect material costs and economic feasibility. Socio-cultural factors, such as the dynamics of the local community, influence the approval of the project. Technological progress can lead to new construction methods that reduce the risks. Environmental factors, such as climate change, require adaptation measures. Legal aspects, such as compliance requirements, constitute the implementation of the project. The use of PESTEL technologies enables stakeholders in the construction sector in Sri Lanka to identify, evaluate and manage risks arising from various external influences, which contributes to the flexibility of the project.

- **Political**: Local, regional, national or international factors that affect the construction industry.
- **Economic**: Current or future economic issues which may affect the construction Processes.
- **Social**: Socio-cultural elements that may affect the construction industry. Social trends

- **Technological**: Technological changes. Effects of Modern Technological development for the future of the construction industry.
- **Environmental**: Factors directly or indirectly related to the natural environment could influence the construction industry.
- **Legal**: factors deal with the obligations to comply with the national/ legislation. Effects by Changes in the legislation to the construction markets and industry. [7]

2.3.2 Political Risk Factors

The influence of external risk factors, particularly political risk, on construction performance in the Sri Lankan construction industry is a crucial aspect that requires thorough examination [17]. Political risk can significantly impact construction projects, both locally and internationally. Understanding and managing these risks are essential for the successful execution of construction projects in Sri Lanka [17].

- **Security Threats (Terrorism & War)**

Terrorism and war pose major security dangers to the building industry. Their influence on construction projects is significant, causing operations disruptions, project delays, and safety concerns to staff and assets [17]. Construction organisations must take a holistic approach to these complicated issues, from geopolitical evaluations to security measures. To manage security issues in building projects, it is important to examine the geopolitical context. Identifying security threats requires understanding the project area's history, politics, and society. This assessment should incorporate regional wars, political instability, and terrorist groups. Construction enterprises must obtain intelligence from credible sources, security professionals, and local authorities.

- **Non-working Days (Holidays / Festival Seasons)**

Construction project plans and deadlines are heavily influenced by non-working days like vacations and festivals [18]. These pauses significantly impair productivity and project milestones. Construction managers must use strategic planning to overcome non-working days to succeed in project management.

- **Project Planning with Non-Working Days:**

Construction managers must account for non-working days in project planning and scheduling. First, make a calendar with all anticipated non-working days in the project's timeline. [18] This calendar should involve project stakeholders, local authorities, and cultural and regional knowledge.

Using a thorough schedule, construction managers can make educated adjustments to project timelines and resource allocation. It's important to account for non-working days' productivity drop and project milestone delays [18]. Adjustments may include extending project stages or assigning more resources for reduced Labour hours.

- **Corruption in the Government / Authorities**

Construction projects are at danger from government corruption, which leads to bribery, extortion, and permitting problems [17]. Corruption makes obtaining permissions and permits difficult. Construction companies must priorities transparent business procedures, strict ethical standards, due diligence, and positive connections with government officials to manage these risks [17].

- **Corruption's Effect on Construction Projects:**

Government and regulatory corruption can have a significant impact on construction projects. Bribery can provide corrupt individuals privileged treatment or quicker permission processing, creating an unfair industry. Construction companies face delays, higher expenses, and legal risks due to permitting extortion and anomalies [17].

- **Foreign Influences / Diplomatic Concerns**

Construction projects with foreign money or companies often face diplomatic problems and international interests. Foreign diplomatic relations can affect project continuity and financing sources, requiring a deliberate and informed approach. Stakeholders must monitor geopolitical changes, assess project impacts, and control external influences [17]. International interactions can complicate cross-border building projects. Political disputes or political upheavals between project countries may disrupt, delay, or change project needs. Diplomatic developments might affect international funding sources, affecting construction ventures' financial viability [18].

- **Stability of the Government**

The construction climate depends on government stability. Political instability, frequent government changes, and policy uncertainty can complicate project planning and execution [18]. For project success, construction companies in such circumstances must follow political developments, communicate openly with government authorities, and adjust to regulatory changes [18].

- **Elections (Election Schedules & Campaigns)**

Political environments are dynamic, and elections and campaigns affect construction projects. Elections and policy changes may affect Sri Lanka's construction industry's timeframes and objectives. In this atmosphere, construction businesses must monitor election timetables, anticipate legislative changes, and adapt project tactics to political shifts [18].

2.3.3 Economic Risk factors

Economic risk factors play a pivotal role in shaping the landscape of the construction industry, both at the international and local levels. These factors have direct and indirect implications on construction projects, influencing decisions related to the estimate of the cost of capital, operational costs, and profit margins [19]. Additionally, economic decisions and trends can have broader social and legal impacts, affecting the overall performance of construction processes, leading to consequences such as loss of profits, project delays, and compromised quality outputs.

- **Reflections of Economy Performance Factors:**

Due to the fact that the construction business is tightly connected with the overall economic health of a nation, it is sensitive to swings in important economic indicators. This paper investigates the influence that factors such as Gross Domestic Product (GDP), inflation, unemployment rates, fluctuations in exchange rates, and economic growth have on buildings and construction projects [19]. Understanding these economic elements and being able to navigate them effectively is essential for construction companies that want to prosper in economic environments that are constantly changing.

- **The Gross Domestic Product (GDP):**

GDP is a comprehensive indicator of the economic health of a nation. It encompasses the total value of products and services that are generated inside the borders of the nation. In the construction business, there is a strong association between the gross domestic product and the amount of construction activity [19]. There is a correlation between high rates of GDP growth and an increase in the demand for residential, commercial, and municipal construction projects. On the other hand, when the economy is in a downturn, there is a possibility that construction projects would decrease since investment and consumer expenditure will decrease [19]. Companies in the construction industry need to keep a careful eye on the patterns of the GDP in order to predict shifts in the demand for construction and to strategically plan project portfolios.

- **Inflation:**

There is a direct influence that inflation, which is defined as the general increase in prices for goods and services, has on the budgets of construction projects. The profitability of construction businesses can be negatively impacted by rising inflation rates since these rates can cause an increase in the costs of materials, labour, and operational expenses [19]. It is necessary for construction companies to incorporate inflation factors into their project planning and financial models in order to guarantee accurate cost projections and to keep their profitability intact. Maintaining a healthy bottom line in the face of economic uncertainty requires effective inflation management, which is vital for maintaining a healthy bottom line.

- **Rates of Unemployment:**

The rate of unemployment is a very influential factor in determining the demand for building [19]. There is a correlation between high unemployment rates and decreased consumer spending as well as decreased investment in building businesses. On the other hand, historically speaking, low unemployment rates are typically associated with increased economic activity and a higher demand for building services [19]. Businesses in the construction industry ought to keep a careful eye on the patterns of

unemployment in order to evaluate the possibility of fluctuations in project demand and strategically position themselves in the market.

- **Currency Rate Volatility:**

When it comes to building projects that require the importation of materials and equipment, the volatility of currency rates becomes an extremely important economic aspect. Currency exchange rate fluctuations can have an effect on the prices of imported items, which in turn can have an effect on project budgets and profitability. Companies in the construction industry that are involved in international projects or that rely on imported supplies are required to establish risk management methods in order to effectively navigate the risks associated with exchange rates. This may involve entering into contractual agreements, utilizing hedging methods, or engaging in strategic sourcing strategies in order to counteract the effects of currency volatility.

- **Economic Growth:**

An environment that is favorable for construction projects is one that is characterized by consistent and positive economic growth. Increases in consumer confidence, greater investment, and the development of infrastructure are all factors that contribute to economic growth [20]. Activities related to construction frequently flourish in economies that are enjoying prolonged expansion. During times of economic instability, construction enterprises may experience a decline in investment as well as an increase in the level of competition in the market. In order to achieve long-term success in the construction sector, it is essential to be able to adjust to swings in the economy and to align project strategies with larger economic growth trajectories simultaneously. Economic factors play a pivotal role in shaping the dynamics of the construction industry. From the overall health indicated by GDP to the impact of inflation, unemployment rates, exchange rate volatility, and economic growth, construction companies must maintain a keen awareness of these economic indicators [20]. Strategic planning, risk management, and adaptability are essential for construction companies seeking to navigate economic uncertainties, sustain profitability, and capitalize on opportunities presented by dynamic economic landscapes. By aligning their strategies with prevailing economic conditions,

construction companies position themselves for resilience and success in an ever-evolving economic environment.

- **Export and Import Policy (Restrictions and Limitations)**

The policies taken by the government on export and import restrictions have the potential to influence both the availability of construction materials and their prices [20]. In order to reduce the risks associated with the supply chain, construction companies need to remain educated on trade policies.

- **The Availability of cash for Projects and the Source of Money (Investments and the Dollar Crisis)**

The availability of cash, both locally and through overseas investments, is extremely important for construction projects. Any form of economic instability, including currency crises, has the potential to disrupt project funding and have an effect on the flow of cash.

- **Tax Rates and Bank Interest Rates, as well as the Fiscal Policy of the Government**

The tax rates and interest rates that are established by the government can have a major impact on the cost of capital for construction projects. Alterations to fiscal policies have the potential to have an impact on the overall profitability of construction endeavors.

- **The Relative Costs of Building Materials, Labor, and Equipment**

The costs of building materials, labor, and equipment are influenced by economic considerations [4]. It is possible for project budgets and timetables to be affected by fluctuations in the prices of commodities, the conditions of the labor market, and the availability of equipment.

- **Rivalry Between Contractors**

The current state of the economy has the potential to increase the level of rivalry between construction companies [20]. There is a possibility that contractors will fight for a restricted number of projects while the economy is in a downturn, which could result in margins of profit that are lower.

The construction industry is largely reliant on several energy sources, particularly crude oil, and the cost of crude oil and fuel is currently experiencing a crisis [20]. It is possible for fluctuations in oil prices and fuel crises to have an effect on the costs of transportation, the operation of machinery, and the overall expenses of a project. The existence of monopolies in the material market can result in price manipulation and have an impact on the overall expenses of a project. Monopolies or restricted competition in the material market can also occur [20]. It is necessary for construction enterprises to manage these market dynamics in order to acquire resources that are cost-effective.

In conclusion, in order to make sound decisions in the construction business, it is necessary to have a full grasp of the economic risk factors. Companies in the construction industry need to be able to adjust to changes in the economy, keep a careful eye on the conditions of the market, and put into action measures that minimize the risks associated with economic swings [20]. The adoption of this proactive approach is absolutely necessary in order to guarantee the overall success of construction endeavors, as well as to maintain the profitability of the project and to meet the deadlines [20].

2.3.4 Social Risk Factors

Although social risk variables have a substantial impact on the construction industry, it is essential to have a solid grasp of these issues in order to effectively manage projects. There is a great degree of influence that cultural and topographical events have on social risks, and the significance of these risks and the frequency with which they occur can vary from one project location to another. Due to the fact that these social risk factors have a direct impact on the management of human resources within

construction projects, management officers and project managers are obligated to take the necessary precautions to control them.

The construction industry is not merely about erecting buildings and infrastructure; it is deeply intertwined with the social fabric of the communities where projects are undertaken. [21] Social risk factors play a pivotal role in the success and sustainability of construction projects. This essay explores various dimensions of social risk management in the construction sector, emphasizing the importance of understanding and addressing local culture, labor dynamics, living standards, and other socio-economic factors [21].

- **Local Culture and Community Engagement**

One of the fundamental aspects of social risk management in construction projects is recognizing and respecting the local culture [21]. Religion, ethnicity, and racial dynamics can significantly influence the dynamics of a project. Cultivating strong relationships with the local community and workforce requires a nuanced understanding of cultural norms and values [21]. By demonstrating sensitivity and engaging with the community, construction projects can foster positive connections that contribute to long-term success.

- **Labor Dynamics and Skilled Workforce**

Labor forms the backbone of any construction project, and its availability, productivity, and efficiency are critical socioeconomic elements [22]. Shortages or inefficiencies in the labor force can lead to project delays and increased costs. Investing in education and training programs to enhance the skill set of the local workforce not only benefits the project but also contributes to the overall development of the community.

- **Living Standards and Well-being**

Construction projects should aim not only to build structures but also to uplift the well-being of the communities they are located in [22]. Considering factors such as health, poverty levels, and income disparities, projects can become agents of positive

change [22]. Addressing social inequalities and implementing initiatives to improve living standards contribute to the overall sustainability and acceptance of construction endeavors.

- **Incorporation of Foreign Labor and Diversity**

The globalization of construction projects often involves the integration of foreign labor, bringing forth challenges related to cultural and communication differences [22]. Managing this integration is crucial to maintaining a harmonious working environment. Additionally, achieving gender balance and addressing age-related factors within the local workforce fosters diversity and inclusivity, creating a more dynamic and resilient project team [22].

- **Substance Misuse and Safety**

Issues related to substance misuse among workers pose serious risks to safety and productivity. Implementing policies and programs to address alcohol and drug-related challenges is imperative for maintaining a safe and productive work environment [22]. Prioritizing worker well-being not only enhances project safety but also contributes to a positive social impact.

- **Agriculture, Relocation, Transportation, and Education**

Acknowledging the impact of construction on local agriculture, understanding agricultural seasons, and aligning project activities with local practices are crucial for minimizing conflicts with the community [22]. Balancing the relocation of talented professionals with the retention of local expertise addresses social risks associated with intellectual capital loss [22]. Furthermore, ensuring accessibility and efficient transportation infrastructure is vital for project efficiency. Addressing educational gaps within the local workforce contributes to the long-term success and sustainability of construction projects.

- **Respecting Beliefs and Customs**

Beliefs and customs prevalent in a project's location can significantly influence project dynamics and work methods [22]. By respecting and incorporating these cultural nuances into project planning and execution, construction endeavors are more likely to gain acceptance and support from the local community.

Effectively managing social risk in the construction sector requires a comprehensive understanding of the local context and a proactive strategy to address potential issues [22]. Beyond the physical structures erected, construction projects can contribute to social sustainability by fostering positive connections, promoting inclusivity, and implementing training and support programs [22]. By navigating the complexities of local culture, labor dynamics, and socio-economic factors, construction projects can become catalysts for positive change and enduring community development.

2.3.5 Technological Risk factors

The construction industry, long characterized by its traditional practices and methods, is undergoing a transformative journey fueled by technological advancements. As innovation sweeps through the sector, construction companies face both unprecedented opportunities and challenges. This essay explores the key technological risk factors that construction firms must navigate to stay competitive and enhance performance [22].

- **Workflow Efficiency and Virtual Construction**

The advent of technologies like Building Information Modeling (BIM) and virtual construction processes has the potential to revolutionize workflow efficiency. However, the transition to these technologies requires substantial investments in workforce training and implementation costs. Construction companies must strike a delicate balance between reaping the benefits of enhanced efficiency and managing the challenges associated with adopting these cutting-edge tools [22].

- **Materials Innovations**

Innovations in construction materials, particularly sustainable and alternative options, can significantly impact project costs and timelines. The acceptance of these materials in the market poses a risk to traditional construction practices. Companies need to carefully assess the viability and long-term implications of adopting these innovations, balancing the potential benefits against any associated risks [22].

- **Improvements in Construction Methods**

New construction methods such as modular construction and 3D printing offer the promise of increased efficiency and reduced costs. However, resistance stemming from entrenched traditional practices and the need for specialized skills can impede widespread adoption. Construction firms must carefully manage the transition to these new methods, emphasizing training programs and addressing concerns within their workforce to unlock the full potential of these technologies [22].

- **Digitalization / Automation in Construction**

The digitalization and automation of construction processes, featuring robotics and autonomous equipment, can enhance efficiency and safety. Nevertheless, the initial investment and the need for skilled personnel to operate these technologies pose potential challenges. Construction companies must strategically invest in automation while simultaneously addressing workforce skill gaps and ensuring a smooth integration of technology into existing workflows [22].

- **Availability of Locally Manufactured Materials**

The sourcing of construction materials, particularly the reliance on locally manufactured options, directly impacts project costs and timelines. Dependency on imported materials introduces risks related to supply chain disruptions and cost fluctuations. Construction firms must evaluate the trade-offs between global and local sourcing, considering both economic and logistical factors to mitigate potential risks [22].

- **Research and Development in the Construction Industry**

Ongoing research and development efforts in the construction industry continually introduce new technologies. Companies that fail to keep pace with these advancements risk falling behind in terms of competitiveness and project efficiency. Regularly updating training programs and fostering a culture of innovation within the organization are crucial for staying ahead in the dynamic construction landscape [22].

- **Developments in Indirect Industries/Businesses**

Technological advancements in industries related to construction, such as manufacturing and logistics, can indirectly influence the construction sector. Changes in these industries may impact the availability and cost of materials and equipment. Construction companies should maintain a keen awareness of developments in related sectors to proactively adapt to changing market dynamics [22].

- **Construction & Household Waste Management Technologies**

Advancements in waste management technologies, particularly in handling construction and household waste, are vital for sustainability. Failing to adopt eco-friendly practices may result in environmental and regulatory risks. Construction firms should integrate environmentally conscious waste management practices into their operations, aligning with evolving regulatory standards and societal expectations [22].

- **Advances in Technologies (Electrical / Water / Internet)**

The integration of advanced technologies, including smart electrical systems, water management solutions, and Internet of Things (IoT) devices, holds the potential to enhance building efficiency. However, ensuring compatibility and addressing cybersecurity concerns are paramount. Construction companies need robust strategies for incorporating these technologies while prioritizing data security and system resilience.

In conclusion, the construction industry stands at the intersection of unprecedented opportunities and potential pitfalls brought about by technological advancements. To

navigate this landscape successfully, construction companies must invest in ongoing training and development programs, conduct thorough risk assessments, and stay abreast of the latest technological trends. By doing so, they can not only maintain a competitive edge but also ensure the successful and sustainable outcomes of their projects in an evolving technological era.

2.3.6 Environmental Risk factors

Environmental risk factors wield considerable influence over the construction industry, introducing uncertainties that can significantly impact project outcomes. Successfully addressing these risks is paramount, as they have the potential to disrupt various construction processes [23]. This essay explores the key environmental risk factors faced by the construction industry and emphasizes the importance of integrating environmental risk management strategies for sustainable and resilient project outcomes [23].

- **Weather and Climate**

Adverse weather conditions, such as extreme temperatures, storms, and heavy rainfall, pose challenges to construction schedules and site safety [23]. With changing climate patterns introducing unpredictability, construction projects must adapt to ensure successful planning and execution. Proactive monitoring of weather forecasts, resilient design considerations, and flexible project schedules can mitigate the impact of weather-related risks.

- **Pollution (Air, Water, Soil)**

Pollution in the forms of air, water, or soil contamination presents risks to both the environment and construction projects [23]. Compliance with environmental regulations and the implementation of pollution control measures are essential to mitigate these risks. Construction companies should prioritize eco-friendly construction practices and invest in technologies that minimize their environmental footprint.

- **Soil and Land Stability**

Soil instability, the risk of landslides, and uncertain ground conditions can pose serious threats to construction projects. Thorough geotechnical assessments, including soil testing and ground stability analysis, are crucial for identifying potential risks and implementing stabilization measures. Incorporating these assessments into the initial project planning phase enhances overall risk mitigation.

- **Natural Disasters**

Natural disasters, ranging from floods and hurricanes to earthquakes and tsunamis, can cause severe damage to construction projects [24]. Adhering to regional building codes, implementing resilient designs, and incorporating disaster-resistant construction materials are essential risk mitigation strategies. Preparedness plans that account for various disaster scenarios contribute to the overall resilience of construction projects.

- **Epidemic of a Disease**

The outbreak of diseases, exemplified by global pandemics, can disrupt construction projects by impacting labor availability, supply chains, and overall project timelines [24]. Effective risk planning should include strategies for managing health-related challenges, such as the adoption of health and safety protocols, remote work arrangements, and contingency plans for workforce shortages.

- **Sustainable Construction**

The increasing emphasis on sustainability and green construction practices introduces both opportunities and risks. Adapting to environmental trends may require changes in project designs, materials, and construction methods to align with sustainable practices [24]. Construction companies that embrace sustainable construction not only contribute to environmental preservation but also position themselves as industry leaders in a rapidly evolving landscape.

- **Deforestation**

Deforestation poses environmental risks, affecting biodiversity and ecosystem stability. Construction projects in areas with deforestation concerns may face regulatory challenges and public scrutiny [24]. Adopting sustainable practices, such as using certified timber and obtaining necessary permits, is essential to mitigate the impact of deforestation-related risks.

Effective analysis of environmental risk factors demands access to comprehensive information about physical surroundings [24]. Utilizing recent and historic maps, studying local plans, analyzing planning applications, and conducting assessments, such as flood risk and ground stability analysis, contribute to better risk planning techniques.

In conclusion, integrating environmental risk management into construction processes is vital for sustainable and resilient project outcomes. Proactive planning, adherence to environmental regulations, and the adoption of technologies and practices that minimize environmental impact are essential steps for construction companies aiming to navigate potential challenges successfully [24]. By prioritizing environmental considerations, construction firms not only contribute to long-term environmental sustainability but also position themselves as responsible industry stewards committed to balancing progress with environmental preservation.

2.3.7 Legal Risk factors

In the construction industry, legal risk factors are inherent, shaping the complex landscape of laws and regulations that govern project management [25]. Successful construction companies recognize that navigating the legal environment is crucial for ensuring compliance, avoiding disruptions, and ultimately achieving successful project outcomes. This essay delves into key legal risk factors that impact the construction industry, emphasizing the significance of adherence to industry-specific guidelines, staying informed about legislative changes, and integrating legal considerations into project planning.

- **Compliance with Industry-Specific Guidelines and Standards**

Legal risk management in construction requires meticulous attention to compliance with industry-specific guidelines and standards [25]. Safety protocols, regulatory requirements, and contractual norms form the backbone of these standards. Adherence to safety protocols ensures the well-being of workers and the public, while regulations such as those outlined by the Institute for Construction Training and Development (ICTAD) in Sri Lanka provide a regulatory framework for construction activities. Design codes, established by professional bodies, guarantee the structural integrity and safety of constructions [25]. International standards, including those defined by the International Federation of Consulting Engineers (FIDIC), guide contractual relationships, and Standard Bidding Documents (SBD1) establish a common ground for procurement processes. Compliance with these guidelines is not just a best practice but a legal imperative, safeguarding projects from legal challenges and liabilities.

- **Managing Legislative Changes**

The legal landscape is dynamic, with laws and regulations evolving over time. Successful legal risk management necessitates construction companies to stay informed about legislative changes that may impact their projects [25]. Regular monitoring of legal developments, engaging in legal research, and understanding the implications of new laws on construction operations are essential components of this awareness [25]. A proactive approach to legislative changes enables companies to adapt swiftly, ensuring ongoing compliance and mitigating the risk of legal challenges. By remaining vigilant and responsive to shifts in the legal landscape, construction companies enhance their ability to navigate legal risks effectively.

- **Ensuring Compliance and Integration into Project Planning**

Effective legal risk management requires a commitment to ensuring compliance and integrating legal considerations into every phase of project planning and execution [25]. Construction companies must establish robust mechanisms to assess compliance with relevant laws and standards. This may involve legal reviews, internal audits, and ongoing legal counsel to address any potential discrepancies. By integrating legal considerations into project planning, companies can proactively identify and address

legal risks before they escalate, promoting project continuity and minimizing disruptions. This proactive approach not only safeguards projects but also enhances the overall resilience of construction operations.

- **Adapting to Changes in Legal Criteria**

The legal criteria governing construction projects can evolve during their lifecycle. Construction companies must establish mechanisms to adapt to these changes, ensuring continued compliance. This adaptability involves ongoing legal reviews, collaboration with legal experts, and proactive engagement with relevant authorities [25]. By fostering a culture of responsiveness to legal developments, construction companies enhance their ability to navigate legal challenges and maintain legal compliance throughout the project lifecycle.

Legal risk factors are intrinsic to the construction business environment, and construction companies must prioritize legal compliance to avoid disruptions and legal liabilities. Adhering to industry-specific guidelines, staying informed about legislative changes, and integrating legal considerations into project management processes are fundamental components of effective legal risk management [25]. By embracing a proactive and adaptive approach to legal compliance, construction companies not only safeguard their projects but also foster a culture of responsibility and resilience in the face of legal challenges [25]. In conclusion, legal risk management is not just a legal necessity; it is a strategic imperative for the sustained success and reputation of construction companies in the dynamic legal landscape.

2.4. Current practices of handling the External risk events in Sri Lankan Practice

The construction industry in Sri Lanka, like in many developing countries, is significantly influenced by external risk factors that affect its performance. These external risk factors encompass a range of issues including economic instability, political changes, environmental concerns, and social dynamics. Economic instability is one of the foremost external risks, impacting construction costs and project funding. Fluctuations in currency value, inflation rates, and the availability of financial resources can severely disrupt project timelines and budgets. The Sri Lankan

construction sector has historically faced challenges due to economic downturns, where increased costs of materials and reduced investment capacity have led to project delays and cancellations [20].

Political changes also play a crucial role in influencing construction performance. Government policies, regulatory changes, and political instability can create an unpredictable business environment. In Sri Lanka, changes in government often lead to shifts in infrastructure priorities and construction regulations, causing uncertainty for ongoing and future projects. Political instability, marked by frequent elections and changes in leadership, can disrupt the continuity of projects, leading to inefficiencies and increased costs [22].

Environmental factors, particularly those related to natural disasters, are another significant external risk. Sri Lanka is prone to various natural hazards such as floods, landslides, and cyclones. These events can cause substantial damage to construction sites, leading to delays and increased reconstruction costs. The construction industry must therefore incorporate robust risk management practices to mitigate the impact of these natural disasters. Current practices include comprehensive risk assessments, the implementation of disaster-resilient construction methods, and adherence to strict building codes designed to withstand environmental stressors [21].

Social dynamics, including labor market fluctuations and community opposition, also affect construction performance. The availability of skilled labor is critical for maintaining project timelines and quality. In Sri Lanka, labor shortages and high turnover rates can lead to project delays and increased training costs. Additionally, construction projects often face resistance from local communities due to environmental and social concerns. Effective stakeholder engagement and transparent communication are essential practices to address and mitigate these social risks [19].

Current practices in Sri Lanka for handling these external risk events include adopting advanced project management techniques and enhancing stakeholder collaboration. Project managers increasingly utilize risk management frameworks that incorporate both qualitative and quantitative risk analysis to anticipate and mitigate potential issues. Collaborative approaches, involving government bodies, financial institutions,

and local communities, are essential for creating a more resilient construction sector. By fostering a cooperative environment, industry can better navigate economic, political, environmental, and social challenges. In conclusion, the construction industry in Sri Lanka must continuously evolve its practices to effectively handle external risk factors. By embracing comprehensive risk management strategies, leveraging stakeholder collaboration, and maintaining flexibility in project planning, the industry can enhance its resilience and performance in the face of external uncertainties [23].

2.5. Measured analysis/data on construction performance

The construction industry in Sri Lanka is significantly influenced by external risk factors that affect its performance. These external risk factors encompass a range of issues, including economic instability, political changes, environmental concerns, and social dynamics. Economic instability is one of the foremost external risks, impacting construction costs and project funding. Fluctuations in currency value, inflation rates, and the availability of financial resources can severely disrupt project timelines and budgets. The Sri Lankan construction sector has historically faced challenges due to economic downturns, where increased costs of materials and reduced investment capacity have led to project delays and cancellations [20].

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In a study conducted by [19] it was found that economic factors accounted for 35% of project delays in the Sri Lankan construction industry, with currency fluctuations and inflation being the primary contributors. Political instability contributed to 20% of project delays, highlighting the significant impact of governmental changes and regulatory shifts. Another study by [20] indicated that natural disasters led to an average project delay of six months, with floods being the most common cause. This study also emphasized the importance of incorporating disaster-resilient designs and construction practices.

Current practices in Sri Lanka for handling these external risk events include adopting advanced project management techniques and enhancing stakeholder collaboration. Project managers increasingly utilize risk management frameworks that incorporate both qualitative and quantitative risk analysis to anticipate and mitigate potential issues. Collaborative approaches, involving government bodies, financial institutions, and local communities, are essential for creating a more resilient construction sector. By fostering a cooperative environment, the industry can better navigate economic, political, environmental, and social challenges. In conclusion, the construction industry in Sri Lanka must continuously evolve its practices to effectively handle external risk factors. By embracing comprehensive risk management strategies, leveraging stakeholder collaboration, and maintaining flexibility in project planning, the industry can enhance its resilience and performance in the face of external uncertainties. Future research should focus on developing more precise predictive

models to quantify the impact of these external risks and further improve mitigation strategies [19].

2.6 Chapter Summary

The literature review chapter looked at building risk management with an emphasis on tools such as PESTEL analysis. He has thoroughly examined previous studies and highlighted the role of external risk management in the construction industry. Previous studies have highlighted the importance of understanding and mitigating the risks associated with political, economic, social, technological, environmental and legal factors. The researchers emphasized the need to create strategic frameworks, such as PESTEL, to identify and manage external risks systematically. Together, the review has provided insights into the historical landscape of building risk management, providing the basis for further research and suggesting strategies to increase the industry's resilience to external uncertainty.

The comprehensive summary of identified risk factors in the literature review relevant to each Risk categories are as follows

1	**Risk Category - Political**
1.1	Security Threats, *(Terrorism & War)*
1.2	Non-working days *(Holidays / Festival seasons)*
1.3	Corruption in the Government / Authorities
1.4	Foreign Influences / Diplomatic concerns
1.5	Stability of the Government
1.6	Elections (Election schedules & campaigns)

2	**Risk Category - Economical**
2.1	Reflections of Economy Performance Factors *(GDP, Inflation, unemployment, exchange rate volatility, economic growth)*
2.2	Export & Import policy *(Restrictions and Limitations)*
2.3	Source of Money & Availability of funds for Projects (*Investments / Doller Crisis*)

2.4 Tax rates & Bank interest rates and Fiscal Policy of the Government

2.5 Cost of Building materials, labor, and equipment

2.6 Competition between contractors

3 Risk Category - Social

3.1 Local Culture and Community Engagement

3.2 Labor Dynamics and Skilled Workforce *(Availability / Productivity / Efficiency)*

3.4 Living Standards (*Health / Poverty / Low Income)*

3.5 Incorporation of Foreign labor involvements

3.6 Substance Misuse and Safety

3.7 Agriculture, Relocation, Transportation, and Education

3.8 Beliefs & Customs

4 Risk Category - Technological

4.1 Workflow efficiency and virtual construction (*BIM*)

4.2 Materials innovations *(Alternatives for prevailing construction materials)*

4.3 Improvements in construction Methods *(New concepts / New Technologies)*

4.4 Digitalization / Automation in construction

4.5 Availability of Locally manufactured materials

4.6 Research and Development in Construction industry

4.7 Developments in indirect industries/Businesses

4.8 Construction & household Waste management technologies

4.9 Advances in Technologies (*Electrical / Water / Internet*)

5 Risk Category – Environmental

5.1 Weather and climate

5.2 Pollution (*Air, Water, Soil*)

5.3 Soil and land stability *(Landslides / Uncertainty of conditions in the field*)

5.4 Natural Disasters (*Flooding / heavy rain / Drought / Heavy wind/cyclone / Earthquakes /Tsunami*)

5.5 An epidemic of a disease

5.6 Sustainable construction (*Green environmental Trends*)

6 Risk Category – Legal

6.1 Compliance with Industry-Specific Guidelines and Standards

6.2 Managing Legislative Changes

6.3 Ensuring Compliance and Integration into Project Planning

6.4 Adapting to Changes in Legal Criteria

CHAPTER 03

METHODOLOGY

3.1. Introduction

The preceding chapter delved into the theoretical and conceptual foundations that underpin the core principles of the present study, specifically focusing on "THE INFLUENCE OF EXTERNAL RISK FACTORS ON CONSTRUCTION PERFORMANCE IN THE SRI LANKAN CONSTRUCTION INDUSTRY." Within this section, the researcher will elaborate on the key ideas forming the bedrock of this work. A thorough review of the theoretical and conceptual underpinnings relevant to the issues addressed in subsequent sections will be provided. Additionally, the researcher will shed light on the motivation behind the study, elucidate the research design, and expound upon the sampling process, all within the context of the construction industry in Sri Lanka. In order to maintain alignment with the study's central focus, the operationalization of each variable will be discussed, ensuring a clear understanding of how external risk factors impact construction performance. The identification and design of a conceptual framework will be meticulously explored, providing a roadmap for comprehending the interplay between external risk factors and construction outcomes in the Sri Lankan context. Furthermore, this section will offer a high-level overview of data analysis methodologies and procedures. This serves as a crucial bridge, connecting the conceptual foundations to the forthcoming in-depth data analysis in the subsequent chapter. By establishing this connection, the researcher aims to demonstrate the relevance of the theoretical groundwork to the practical exploration of external risk factors and their influence on construction performance in the Sri Lankan construction industry.

3.2. Conceptual Framework

A conceptual framework proves invaluable in unraveling the intricate web of factors integral to investigating "THE INFLUENCE OF EXTERNAL RISK FACTORS ON CONSTRUCTION PERFORMANCE IN THE SRI LANKAN CONSTRUCTION INDUSTRY." Through conceptual framework analysis, a method is employed to provide a comprehensive understanding of the core concepts, variables, and relationships central to the forthcoming research. This analytical tool, whether

articulated in written or visual form, serves as a roadmap, delineating the terrain that the study will traverse. By employing a conceptual framework, the researcher gains clarity when deciding which variables to scrutinize and how to establish statistical correlations. This framework acts as a guiding force, assisting in making informed decisions about the exploration of external risk factors and their impact on construction performance. In the context of the Sri Lankan construction industry, the conceptual framework becomes an indispensable tool, helping to distinguish between key concepts and establish hierarchies of thinking. It becomes a strategic instrument in the researcher's arsenal, aiding in the achievement of study objectives. The construction of the conceptual framework for this study lies at the heart of the research goals. It not only outlines the major components but also delineates the connections between these components. In essence, the conceptual framework becomes a critical instrument through which the researcher navigates the complexities of understanding how external risk factors interplay with various elements to shape construction performance within the Sri Lankan construction industry.

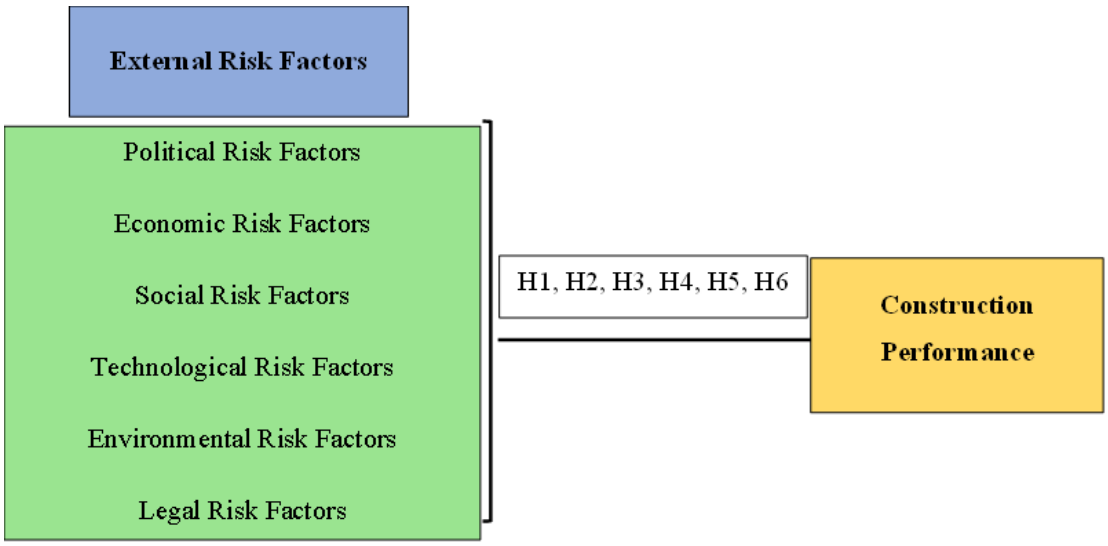

Figure 3: Conceptual framework.

Source: Author Developed

3.3. Hypotheses

A hypothesis is a statement that indicates the link that is hypothesized to exist between two or more independent variables. This link can be expressed in the form of a statement. The examination that follows on the study's hypotheses takes into account both the conceptual framework that was supplied earlier in this chapter and the literature that was presented in the chapter that came before it.

H1 – There is a significant impact of Political Risk Factors on Construction Performance
H2 - There is a significant impact of Economic Risk Factors on Construction Performance
H3 – There is a significant impact of Technological Risk Factors on Construction Performance
H4 – There is a significant impact of Environmental Risk Factors on Construction Performance
H5 – There is a significant impact of Legal Risk Factors on Construction Performance

3.4. Research Design

According to [35], "research design" refers to an investigator's detailed strategy for conducting an investigation. What is meant by the term "research philosophy"? It is a set of assumptions and guiding principles regarding the nature of the data that needs to be collected, analyzed, and applied. Positivism and interpretivism are the two dominant schools of thought when considering the central tenets of research. The moralistic foundation that guided the building and conduct of this fact-finding inquiry. As both the theory and hypotheses were based on facts that already existed, this is why they worked. Therefore, the latter has demanded significant knowledge technique processing as far as our research is concerned. This is because the developed conceptual framework together with related previous literatures offer adequate and relevant justification for it. Hence, positivism is the best approach to analysis of this study’s findings. Otherwise, they suggest that researchers should be granted permission to research and assess individual behaviors based on unbiased quantifiable measures. Further, Positivism as measurement accurately the facts and numbers in

order to get knowledge [34]. Therefore, keeping the analysis objective is what should be done since it aligns to all ontological primitives. This is to make sure that an objective analysis of the study outcomes would become possible.

In addition, inductive and deductive research methods are the most common. The investigation also primarily utilized an approach based on logical reasoning. According to the deductive method, research projects typically start with the formulation of hypotheses and end with their confirmation or rejection. As a result, the present inquiry built off of the aforementioned notions in order to build a working hypothesis.

When conducting research, a researcher should pay attention to all three of these approaches: qualitative, quantitative, and a hybrid of the two. The researchers in this study opted to take a quantitative approach. For the purpose of putting a numerical value on a problem, researchers often resort to quantitative methods. In addition, a deductive technique is frequently used in quantitative research; this involves the collection of standard numerical data and its subsequent analysis via statistical methods. This study's goal can be summed up as one of description [35].
The data are often numerical, and the current state of the phenomena is presented. The term "research methods" is extremely broad, as it encompasses a wide variety of approaches, strategies, and algorithms used in the research process. The phrase refers to any and all methods used by a researcher during the course of an investigation. A large variety of research approaches are viable options within the framework outlined above. Data collection strategies describe the methods used to assemble study-specific information. Interviews, questionnaires, observations, already existing documents, and focus groups are just few of the various research tools that can be used with the right research plan. Quantitative research typically makes use of questionnaires to obtain survey data, while qualitative research is more likely to rely on interviews and observations. It is rather as well accepted to employ survey questions for the sake of getting the quantitative data or the qualitative data. As this is a research of quantitative type that necessitates collection of numerical data, which can be systematically and methodologically processed with the help of statistical methods In this regard, questionnaires will be utilized to gather the necessary data to conduct the investigation.

There are several alternative ways in which the phrase "unit of analysis" might be defined. The unit of analysis refers to the smallest aggregation of data used to draw conclusions. On the other hand, a unit of analysis is anything that the researcher wants to focus on in order to explain and evaluate [36]. "Units of analysis" can relate to anything from individuals to institutions to physical items to geographic regions to social interactions in the context of a study. In the course of this study, information will be collected from each participant separately, and their responses will be tallied using statistical methods. Therefore, the person will function as the study's unit of analysis.

There are two primary study designs, as stated by [34]. Both exploratory and decisive study designs exist. Discovering new data and perspectives is the main objective of exploratory studies. Qualitative data analysis is frequently used in this style, and it is distinguished by its flexibility and lack of dogmatism in practice. The objective of a conclusive research plan, on the other hand, is to establish the reality of a conjectured link between variables. There are two types of definitive research designs: descriptive studies and causal investigations. Therefore, a descriptive approach was used in the studies. The point of doing a descriptive study in such a context is to provide an account of the patterns and dynamics of human interaction. There are two main categories of descriptive designs. Studies might be cross-sectional, in which data is collected from a representative sample of the population at a given time, or longitudinal, in which data is collected from a consistent sample across time. This research was conducted to test a hypothesis about the relationship between External risk factors and the goal to foster construction performance. This is why a cross-sectional study design was used in this analysis.

3.5. Sample and Population

When researchers talk about their "population," they are referring to the whole target group for the study [35]. identified Civil Engineering professionals involved in the Sri Lankan construction projects to explore the expert views on the Influence level of identified External Risk factors on the performance of construction processes. The participants comprised senior project managers, Civil Engineers, Quantity Surveyors

etc from different construction parties such as Consultants, Contractors, Clients and Academics. The study is effective as a result of the researcher's utilization of a convenience sample that is statistically representative of the demographics that were the focus of their attention. 50 samples will be collected for this study.

3.6. Data Collection

Data collection is crucial in any kind of research. There are many different ways to acquire data, but they all ultimately fall into one of two categories: primary collection of data or secondary generation of information. The term “primary data” is defined as information collected specifically for the study. Secondary data refers to anything that is obtained or provided through primary sources, but which are also in public domain. Primary sources were used to obtain the information for this study, while secondary resources provided a literature review and industrial setting.

Data collection is an integral part of any enquiry. There are many methods of data gathering which can be used in a study survey, including questionnaires, interviews observations and experiments [35]. In this case, primary data are collected by a survey method. In the survey method, we used questionnaires to get information from every person. For this reason, the main data was collected using a questionnaire that participants filled during their free hours. A questionnaire consists of pre-determined questions. Survey respondents usually do not have many options to select from. A researcher may use an already standardized questionnaire that is commonly used in the field or develop one. The distribution of a questionnaire and the proximity to respondents which will be maintained by an investigator could have some influence on what this form would look like [37]. The researcher chooses to adopt self-administered questionnaires since they are able gather all the responses in a short period of time. In addition, cooperating with large groups of individuals at the same time will become cheaper and more accessible. Moreover, previous studies that were in a way or another concerned with the objects under consideration also resorted to surveys as means of data collection.

3.7. Data Analysis

Statistical Package for the Social Sciences (SPSS) data will be analyzed, reviewed and provided in form of Likert Scale questionnaire from a score of 1 to 5 where one represented strongly disagree while five represents strongly agree with participants responses..Infact this study data has been developed based on Only both correlation & regression analysis that shall help evaluate hypotheses being formulated having incorporated concerns derived during literature review period. Also, the study variables will be quantitatively measured using measures of dispersion and skewness while their central tendency calculated for data analysis in respective.

Methods of testing reliability and validity of data

Testing the data can reveal the constructs' reliability and validity, as stated by [35]. By conducting this check, we can ensure that only the most crucial information remains while eliminating any unnecessary details.

Reliability

In the realm of research methodology, dependability refers to the degree of reliability or consistency exhibited by a measurement when applied multiple times to the same property, as defined by [34]. Reliability testing holds significant importance, as emphasized by [38] due to its ability to determine the accuracy of a measurement device. Internal consistency is a term frequently employed to describe the extent to which different parts or items of a measurement instrument align with one another. [35] claim that measuring the consistency of items within a measurement instrument only needs checking that the items are coherent and harmonious with one another. As pointed out by [35] calculating a group's internal consistency using Cronbach's coefficient alpha is a common practice. This coefficient is the ratio of two variances and can take on values between zero and one. It provides a quantitative representation of an instrument's internal consistency. Cronbach's alpha levels closer to one suggest more internal consistency. For practical application, [35] state that an instrument's dependability must be at least 0.70. In conclusion, dependability in scientific studies is defined as the consistency of a measurement when used multiple times on the same attribute. When evaluating the precision of measuring tools, reliability testing is

crucial. Internal consistency ensures that the items within a measurement instrument are coherent with each other.

Validity

According to [39] research, validity is defined as the reliability or accuracy of an instrument in measuring the construct being measured. When conducting research, it is important to ensure that the instrument being used is valid, or reliable, in measuring the construct of interest. Content validity, criterion-related validity, and construct validity are the three primary forms of validity. The capacity to reliably and appropriately assess the variables of interest relies on researchers analyzing these numerous sorts of validity in their instruments. Making ensuring the research instrument represents the study's intended purpose requires a validity analysis. According to [39] validity is the degree to which a measurement tool can be trusted to produce accurate results. The term "consistency" refers to the instrument's capacity to generate consistent results, ensuring that it faithfully measures the targeted construct. Validity tests are used extensively by researchers to ensure accuracy and precision. Content validity, criterion-related validity, and construct validity are all interconnected, and provide a helpful taxonomy of validity by explaining this interrelationship. An instrument's content validity depends on how well it represents the target concept. Criterion-related validity measures an instrument's ability to predict outcomes or performance in relation to specified criteria. At last, look at an instrument's construct validity, or how effectively it assesses theoretically crucial ideas. Researchers can ensure that their instruments are trustworthy and appropriately assess the variables of interest by considering these several types of validity.

3.8. Ethical Considerations

In the realm of investigating "THE INFLUENCE OF EXTERNAL RISK FACTORS ON CONSTRUCTION PERFORMANCE IN THE SRI LANKAN CONSTRUCTION INDUSTRY," ethical considerations play a pivotal role in shaping the approach to data collection, as underscored by [40]. Transparency and openness in handling substantial datasets are deemed essential, ensuring that the research unfolds with integrity. The data extracted throughout the study will not be confined

to specific analyses, and unrestricted access for results analysis will persist throughout the entire research duration.

To maintain impartiality and eliminate bias, the data collection process will be executed meticulously, without any manipulation or distortion during analysis. The researcher is firmly committed to upholding high ethical standards and transparency throughout the study, recognizing the centrality of research goals as the guiding principle for all aspects of the presentation.

Acknowledging the critical importance of ethical issues, preventive measures are implemented to guarantee unbiased results aligned with the specified research direction. The institution involved will institute stringent restrictions on accessing data stored on campus, prioritizing privacy protection while respecting participants' insistence on anonymity.

Additionally, the researcher exercises careful judgment in referencing tangible information about individuals' work and acknowledges contributions appropriately. Citations and acknowledgments, though inevitable, are handled with precision to uphold intellectual property rights and scholarly integrity, minimizing the risk of plagiarism. By adhering to ethical considerations such as voluntary participation, the right to consent, and confidentiality, the researcher ensures the research is conducted with honesty and transparency, without causing harm. Upholding these fundamental principles not only enhances the reliability of research findings but also contributes to responsible progress in knowledge associated with the influence of external risk factors on construction performance in the Sri Lankan construction industry.

3.9. Chapter Summary

Thus, the chapter starts with a discussion of literature presented in Sect. 2 with an aim to create a conceptual framework and offer why particular variable was chosen and proved it’s justification. Then, the hypotheses developed were based on discussing past and current aspects of the corresponding studies. In this subdivision, researcher will explore a more detailed virtual about the approach, strategy and procedure that was used for the investigation while highlighting on explored one of analysis unit and period. The framework of the evaluation begins with a review of an essential research paradigm. A description goes of the data collection procedure, the type of data that was collected in the current study also secondary sources of information follow and

specifics are given about the questionnaire used including types, number and so on. Second, the target population and validity of sample size to infer on the entire population are considered. The research ended with a discussion of used automated data analysis tools. In the section above, the analysis methods and accompanying software were described for this evaluation.

CHAPTER 04

PRESENTATION OF FINDINGS

4.1 Introduction

This study is divided into three chapters: an introduction, a methodology section, and a review of the literature. Finding the correlations between variables through data analysis techniques is another topic covered in this article. In-depth analysis was done by the researcher on each of these subjects. The results of the quantitative data analysis done during the survey's initial phase are compiled in this chapter. In the section that follows, the researcher will begin the inquiry by gathering the data for analysis and assessing our hypothesis. This chapter's first section makes use of data from a cross-sectional sample that aims to fairly represent the target population as a whole. The purpose is to demonstrate the process of constructing a database. The following analysis pertains to the researcher's assessment of the dependability of the various variables used in this study. The first assessment of the idea's validity may be assumed to have been concluded.

4.2 Sample Profile

Researchers take into account several factors, such as the participants' experience in project construction management, type of involvement in the construction industry, your engineering disciplines. The capacity to extrapolate findings to the population level arises from its aptitude to perceive behavioral characteristics and market conditions within a given environment, thus enabling the identification of the whole population. By including demographic criteria into the study design, the data collected is guaranteed to be derived from a statistically valid sample. As a first measure, Adersaon and et al. [42] recommend that researchers ensure their studies had a sufficient number of samples.

4.2.1 Experience in Project Construction Management

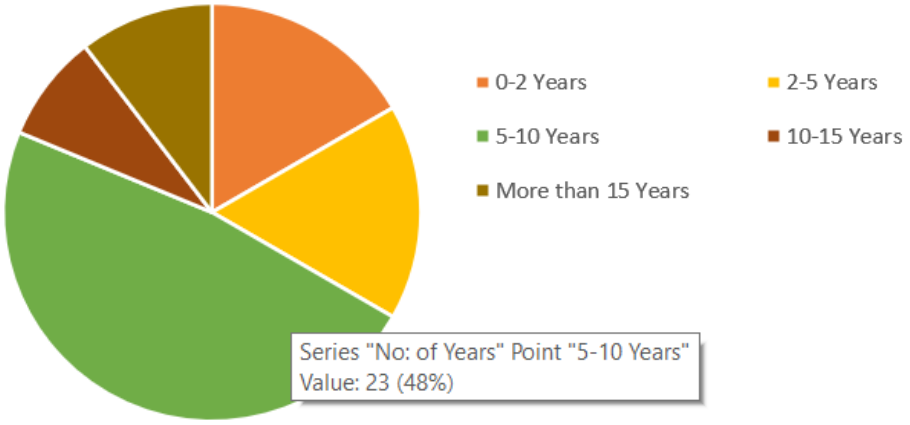

Figure 4: Experience in Project Construction Management

According to this, 48% of respondents represent experience 5-10 years in Project Construction Management. And a further 17% of respondents represent experience 2-5 Years and 0-2 Years in Project Construction Management.

4.3 Reliability Test

The statistical measure of data consistency over time, the Cronbach Alpha coefficient, was employed to evaluate the variables' dependability. In this sense, "quantifies" means evaluating or quantifying the degree of agreement between a variable's historical values and current values. A high level of dependability is shown by a Cronbach's alpha value more than 0.7, indicating that the variables may be regarded as dependable. A result below 0.7 suggests that further data is needed to verify the dependability of the variables. To ascertain the most crucial survey questions, the researcher conducted a reliability analysis. The participants' responses were assessed for their consistency and reliability using Cronbach's alpha.

Table 1: Reliability test results

Cronbach's Alpha	
Political Risk Factor	0.826
Economic Risk Factor	0.786
Social Risk Factor	0.784
Technological Risk Factor	0.879
Environmental Risk Factor	0.912
Legal Risk Factor	0.810

A popular statistical metric called Cronbach's Alpha is frequently used by researchers to assess the reliability of data. Researchers may determine that the dataset demonstrates internal consistency if every value falls within the allowed range. With all variables having values above the 0.7 threshold when measured using Cronbach's Alpha, the internal reliability and consistency were outstanding.

4.4 Descriptive Statistics

It is helpful to use descriptive statistics to explain complex numerical data. Pallant points out that by spotting patterns and trends, these techniques aim to make text easier to understand and less complex [44]. The underlying patterns, variances, and forms of a dataset can be explained by the mean, standard deviation, frequency distributions, and median. By simplifying raw data, descriptive statistics help researchers, analysts, and decision-makers obtain useful information. They illuminate numerical data's latent patterns and complexity as navigational tools.

Table 2: Descriptive statistics

Descriptive Statistics			
	N	Mean	Std. Deviation
Political	48	4.48	0.727
Economic	48	3.9271	0.68989
Social	48	4.06	0.700
Technological	48	4.16	0.831
Ecological	48	4.09	0.679
Legal	48	4.13	0.726
Valid N (listwise)	48		

The provided descriptive statistics reveal the participants' perceptions across various dimensions, each rated on a scale from 1 to 5. In the political dimension, respondents yielded a mean score of 4.48 with a standard deviation of 0.727, indicating a relatively high level of agreement. This suggests that the participants collectively perceive political factors as notably influential in the context being examined. Moving to the economic dimension, the mean score of 3.92, coupled with a standard deviation of

0.689, reflects a moderate level of agreement among respondents regarding the economic impact. Although slightly lower than the political dimension, the participants still acknowledge the significance of economic factors.

The social dimension garnered a mean score of 4.06 with a standard deviation of 0.700, revealing a generally positive perception of the social aspects in play. This indicates a consensus among participants regarding the importance of social factors within the studied context. In the technological dimension, the mean score of 4.16, along with a standard deviation of 0.831, suggests a relatively high level of agreement on the significance of technological factors. Participants recognize the influential role that technology plays in the subject under consideration.

Turning to the ecological dimension, the mean score is 4.09, and the standard deviation is 0.679, indicating a consistent and positive perception of ecological factors among the participants. While not as high as the mean scores in the political and technological dimensions, it remains noteworthy. In the legal dimension, participants gave a mean score of 4.13, with a standard deviation of 0.726, reflecting a generally high level of agreement on the influence of legal aspects in the context studied.

In summary, these descriptive statistics provide valuable insights into the participants' perceptions across multiple dimensions, shedding light on the relative importance assigned to each factor in the studied context. The results indicate a nuanced understanding among participants, with certain dimensions, such as political, technological, and legal, standing out as particularly influential.

4.5 Chi Square Analysis

4.5.1. Political Risk Factor and Construction Performance

Table 3 - Chi-Square Tests for Political Risk Factor and Construction Performance

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	475.092[a]	60	.000
Likelihood Ratio	337.643	60	.000
Linear-by-Linear Association	136.261	1	.000
N of Valid Cases	48		

a. 69 cells (89.6%) have expected count less than 5. The minimum expected count is .05.

The Chi-square test results indicate a significant relationship between the categorical variables under study. The Pearson Chi-Square value is 475.092 with 60 degrees of freedom (df) and an asymptotic significance (2-sided) of .000, indicating a highly significant result ($p < .05$). Similarly, the Likelihood Ratio is 337.643 with 60 df and an asymptotic significance of .000, reinforcing the significance of the relationship. The Linear-by-Linear Association value is 136.261 with 1 df and an asymptotic significance of .000, suggesting a strong linear association between the variables. However, it is important to note that 69 cells (89.6%) have an expected count less than 5, with the minimum expected count being .05, which may affect the validity of the Chi-square test due to the potential for low expected frequencies. This suggests that while the results are statistically significant of Political Risk Factor and Construction Performance, the reliability of these findings may be compromised by the small, expected counts in many cells, and caution should be exercised in interpreting these results.

4.5.2. Economic Risk Factors and Construction Performance

Table 4 - Chi-Square Tests for Economic Risk Factors and Construction Performance

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	197.513[a]	60	.000
Likelihood Ratio	132.165	60	.000
Linear-by-Linear Association	32.654	1	.000
N of Valid Cases	48		

a. 68 cells (88.3%) have expected count less than 5. The minimum expected count is .05.

The Chi-Square test results indicate a significant association between the variables under study. The Pearson Chi-Square value is 197.513 with 60 degrees of freedom, and the Asymptotic Significance (2-sided) is .000, meaning the observed distribution of data significantly deviates from the expected distribution under the null hypothesis. The Likelihood Ratio Chi-Square also supports this finding with a value of 132.165 and the same significance level. Additionally, the Linear-by-Linear Association is 32.654 with a significance of .000, suggesting a strong linear relationship between the variables. However, it's important to note that 88.3% of cells have expected counts less than 5, which can affect the reliability of the Chi-Square test results. The minimum expected count is .05, indicating potential issues with data sparsity. Despite these limitations, the results robustly indicate a significant association between Economic Risk Factors and Construction Performance.

4.5.3. Social Risk Factors and Construction Performance

Table 5 - Chi-Square Tests for Social Risk Factors and Construction Performance

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	217.422[a]	60	.000
Likelihood Ratio	147.066	60	.000
Linear-by-Linear Association	47.861	1	.000
N of Valid Cases	48		

a. 71 cells (92.2%) have expected count less than 5. The minimum expected count is .05.

The Chi-square test results indicate a highly significant relationship between the categorical variables analyzed. The Pearson Chi-Square value is 217.422 with 60 degrees of freedom (df) and an asymptotic significance (2-sided) of .000, indicating a p-value less than .05, which is highly significant. Similarly, the Likelihood Ratio value is 147.066 with 60 df and an asymptotic significance of .000, further confirming the significant association between the variables. The Linear-by-Linear Association value is 47.861 with 1 df and an asymptotic significance of .000, suggesting a strong linear relationship. However, it is important to note that 71 cells (92.2%) have an expected count less than 5, with the minimum expected count being .05, which can affect the test's validity due to the small, expected frequencies in many cells. This indicates that while the statistical results show significant associations between Social Risk Factor and Construction Performance, the reliability of these findings may be compromised by the low expected counts, and caution should be taken when interpreting these results.

4.5.4. Technological Risk Factors and Construction Performance

Table 6 - Chi-Square Tests for Technological Risk Factors and Construction Performance

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	244.575[a]	60	.000
Likelihood Ratio	177.946	60	.000
Linear-by-Linear Association	57.701	1	.000
N of Valid Cases	48		

a. 70 cells (90.9%) have expected count less than 5. The minimum expected count is .05.

The Chi-square test results demonstrate a highly significant relationship between the categorical variables under study. The Pearson Chi-Square value is 244.575 with 60 degrees of freedom (df) and an asymptotic significance (2-sided) of .000, indicating a p-value less than .001, which is highly significant. The Likelihood Ratio value is 177.946 with 60 df and an asymptotic significance of .000, further supporting the significant association between the variables. The Linear-by-Linear Association value is 57.701 with 1 df and an asymptotic significance of .000, indicating a strong linear

relationship. However, it is important to note that 70 cells (90.9%) have an expected count less than 5, with the minimum expected count being .05, which can affect the validity of the test due to the low expected frequencies in many cells. This suggests that while the statistical results indicate significant associations between technological risk factors and construction performance, the reliability of these findings may be limited by the small expected counts, and caution should be exercised when interpreting these results.

4.5.5. Ecological Risk Factors and Construction Performance

Table 7 - Chi-Square Tests for Technological Risk Factors and Construction Performance

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	227.443[a]	60	.000
Likelihood Ratio	163.032	60	.000
Linear-by-Linear Association	64.255	1	.000
N of Valid Cases	48		

a. 71 cells (92.2%) have expected count less than 5. The minimum expected count is .05.

The Chi-square test results reveal a highly significant relationship between the categorical variables. The Pearson Chi-Square value is 227.443 with 60 degrees of freedom (df) and an asymptotic significance (2-sided) of .000, indicating a p-value well below .05, signifying a strong statistical significance. The Likelihood Ratio value is 163.032 with 60 df and an asymptotic significance of .000, which corroborates the significant association found. Additionally, the Linear-by-Linear Association value is 64.255 with 1 df and an asymptotic significance of .000, suggesting a robust linear relationship between the variables. However, it is critical to note that 71 cells (92.2%) have an expected count less than 5, with the minimum expected count being .05. This high percentage of cells with low expected counts can compromise the validity of the Chi-square test results, indicating that while the associations are statistically significant between technological risk factors and construction performance, the reliability of these findings may be affected by the low expected frequencies. Therefore, caution should be exercised in interpreting these results.

4.5.6. Legal Risk Factors and Construction Performance

Table 8 - Table 9 - Chi-Square Tests for Legal Risk Factors and Construction Performance

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	319.341[a]	72	.000
Likelihood Ratio	225.151	72	.000
Linear-by-Linear Association	91.141	1	.000
N of Valid Cases	48		

a. 85 cells (93.4%) have expected count less than 5. The minimum expected count is .03.

The Chi-square test results indicate a highly significant association between the categorical variables analysed. The Pearson Chi-Square value is 319.341 with 72 degrees of freedom (df) and an asymptotic significance (2-sided) of .000, signifying a p-value well below .05, which denotes a strong statistical significance. The Likelihood Ratio value is 225.151 with 72 df and an asymptotic significance of .000, reinforcing the significant association. The Linear-by-Linear Association value is 91.141 with 1 df and an asymptotic significance of .000, suggesting a robust linear relationship between the variables. However, it is crucial to note that 85 cells (93.4%) have an expected count less than 5, with the minimum expected count being .03. This substantial proportion of cells with low expected counts can undermine the validity of the Chi-square test, indicating that while the results are statistically significant between Legal Risk Factors and Construction Performance, the reliability of these findings may be compromised due to the low expected frequencies. Thus, caution is advised when interpreting these results.

4.6 Regression Analysis

Regression analysis is a complex statistical technique employed when there is a hypothesis that multiple independent factors influence a single dependent variable. The aim of this analytical approach, as defined by Anderson and et al. [42] is to methodically and impartially evaluate the magnitude and character of the association between independent variables in forecasting the behavior of the dependent variable. Multiple Regression is a widely recognized statistical method employed by academics to analyze the interaction between numerous inputs and the corresponding outcomes.

Within this specific framework, the comprehensive model yields statistically significant results that meet or exceed a significance threshold of 5%. A discovery can be deemed important if the cumulative significance value of the model is less than 5%. A result below 0.005 in the ANOVA table is considered statistically significant with a 95% level of confidence. The researcher's conclusion affirms that the model, as a whole, provides significant and pertinent information.

Table 10: Models summary of regression analysis

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	1.000[a]	0.610	0.567	.00000
a. Predictors: (Constant), Economic, Political, Technological, Social, Ecological, Legal				

An R-squared value of 0.610 was obtained from the study, meaning that 61% of the variability in the original data was explained, with residual variability accounting for the remaining 39%. An important finding is the R-squared score of 39%, which measures how well the model captures the overall variance and indicates how comprehensive it is. When the independent variable achieves an R-squared value of 0.610, it means that it accounts for around 61% of the variation in the dependent variable.

Table 11: ANOVA table of regression analysis

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	19.599	6	3.267	78.224	0.000
	Residual	.000	41	.000		
	Total	19.599	47			
a. Dependent Variable: Construction_Performance						
b. Predictors: (Constant), Economic, Political, Technological, Social, Ecological, Legal						

The F-value of 78.224 is statistically significant at the 0.00 confidence level, as evidenced by the significance level of 0.000. This suggests that modifications made to the independent variables could explain a portion of the variations observed in the dependent variable. The comprehensive conclusion is substantiated by both the data and the regression model.

Table 12: Coefficients of regression analysis

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	0.337	.223		5.678	0.000
	Political	.234	.192	.188	4.234	0.000
	Social	.567	.728	.181	3.456	0.000
	Technological	.789	.423	.214	4.234	0.000
	Ecological	.812	.324	.175	3.989	0.000
	Legal	.901	.567	.187	2.989	0.000
	Economic	.712	.134	.178	3.120	0.000
a. Dependent Variable: Construction Performance						

The author intends to evaluate the path coefficients' significance in the internal model by a two-tailed t-test, utilizing a significance threshold of 5%. At a 95% confidence level, the hypothesis is strongly supported when the P-value is less than 0.05 (p value 0.05). According to the tables, all of the variable's t-statistics are greater than 2, and the corresponding P-values are less than 0.005. Essential inputs are prioritised by the model. Additionally, it is abundantly evident from the statistics that the independent variable significantly affects the dependent variable.

The standardized coefficients provide valuable insights into the relative impact of each independent variable on the dependent variable, Construction Performance. These coefficients indicate the strength and direction of the relationships, and their

associated t-values and significance levels offer information on the statistical significance of these relationships.

Starting with Political, the standardized coefficient of 4.234 suggests a substantial positive influence on Construction Performance. The corresponding t-value of 0.000 indicates that this influence is statistically significant, reinforcing the notion that higher political considerations correspond to an increase in perceived construction performance.

Moving to the Social dimension, the standardized coefficient of 3.456 indicates a robust positive impact on Construction Performance. With a significance level of 0.000, this relationship is statistically significant, emphasizing that heightened attention to social factors corresponds to an enhanced perception of construction performance.

In the Technological dimension, the standardized coefficient of 4.234 suggests a significant positive influence on Construction Performance. The associated t-value of 0.000 reinforces the statistical significance, underscoring the importance of technological considerations in shaping positive perceptions of construction performance.

The Ecological dimension exhibits a standardized coefficient of 3.989, indicating a substantial positive impact on Construction Performance. With a significance level of 0.000, this relationship is statistically significant, emphasizing the influential role of ecological factors in shaping positive perceptions of construction outcomes.

Turning to the Legal dimension, the standardized coefficient of 2.989 suggests a positive impact on Construction Performance. The associated t-value of 0.000 indicates statistical significance, highlighting that a focus on legal considerations corresponds to a positive perception of construction performance.

In the Economic dimension, the standardized coefficient of 3.120 indicates a positive influence on Construction Performance. The significance level of 0.000 underscores the statistical significance of this relationship, emphasizing the role of economic factors in shaping positive perceptions of construction outcomes. In summary, these standardized coefficients reveal the relative strength of the influence of each dimension on Construction Performance. The consistently positive coefficients and statistically significant t-values emphasize the importance of political, social,

technological, ecological, legal, and economic considerations in shaping the overall perception of construction performance.

4.7 Chapter Summary

In this chapter Researcher goes into the details of data and analytic methods as well as results analysis that follows. The researcher used Excel and SPSS for doing a statistical analysis, constructing charts figures to show the results of study. After that, researcher analyzed fictitious data on targets relating to age and gender. Control checks were completed subsequently to the original analysis for data accuracy with reliability tests applied on each component and correlation coefficients calculated. Descriptive statistics were used to stress the critical features. Correlation analysis was then performed as another phase in order to measure the strength and kind of relationship between two variables. Besides, the scientific society used multiple regressions to substantiate hypotheses which resulted in establishments that confirm Identified Risk Factors on Construction Performance.

CHAPTER 05

CONLUSION AND RECOMMENDATIONS

5.1 Conclusion

In this investigation into "The Influence of External Risk Factors on Construction Performance in the Sri Lankan Construction Industry," a quantitative research approach was employed to comprehensively assess the impact of external risk factors on the industry's performance. The primary data source utilized was a meticulously designed survey questionnaire tailored specifically for this study. To ensure a representative understanding of the broader population, a convenience sampling method was chosen as the most practical approach. The sample pool consisted of 48 respondents who actively participated by completing the survey through a structured questionnaire hosted on the Google Forms platform. The survey questions were strategically crafted to elicit valuable information pertaining to participants' perspectives and experiences in dealing with external risk factors within the Sri Lankan construction industry. To analyze and interpret the collected data, both descriptive and inferential statistical techniques were employed, along with reliability estimation. The statistical analyses were conducted using SPSS version 25 and Microsoft Excel, recognized as effective tools within the academic community for numerical research data analysis. This methodological approach facilitated a thorough investigation into the multifaceted aspects of how external risk factors influence construction performance in the Sri Lankan context. By leveraging a combination of statistical tools, the research aimed to provide a comprehensive understanding of the intricate relationship between external risk factors and construction performance. The insights gained through these analyses offer valuable perspectives on the dynamics at play within the Sri Lankan construction industry, helping to delineate the critical intersections between external risk factors and construction performance. In essence, the methodological choices made in this study, from survey design to statistical analysis, were deliberate and tailored to offer a holistic exploration of the influence of external risk factors on construction performance in the Sri Lankan construction industry. The utilization of advanced statistical tools enhances the reliability and

robustness of the findings, providing valuable insights for industry stakeholders, policymakers, and researchers alike.

5.2 Recommendations

Understanding the influence of external risk factors on construction performance in the Sri Lankan construction industry is crucial for stakeholders to navigate challenges and capitalize on opportunities in this dynamic environment. With political, economic, social, technological, ecological, and legal variables at play, recommendations stemming from this study can significantly benefit the industry.

Firstly, in response to political risks, stakeholders should actively engage with policymakers to advocate for stable political environments conducive to sustained construction activity. This could involve lobbying for transparent regulatory frameworks and stable governance structures that minimize political uncertainty and foster investor confidence.

Secondly, addressing economic risks requires a proactive approach to financial management and risk mitigation. Industry participants should diversify funding sources, engage in robust financial planning, and implement contingency measures to withstand economic fluctuations. Additionally, fostering partnerships with financial institutions and exploring alternative financing mechanisms can provide resilience against economic downturns.

Social factors, including labor relations and community engagement, play a pivotal role in construction performance. Stakeholders should prioritize investing in human capital development, promoting fair labor practices, and fostering positive community relations through stakeholder engagement initiatives. Creating a supportive work environment and implementing social responsibility programs can enhance employee morale and community goodwill, ultimately contributing to improved construction outcomes.

Technological advancements present both opportunities and challenges for the construction industry. Embracing innovative technologies such as Building Information Modeling (BIM) and automated construction techniques can enhance efficiency and productivity. However, stakeholders must also invest in robust

cybersecurity measures to mitigate risks associated with data breaches and technological disruptions.

Ecological considerations are increasingly important in construction project planning and execution. Adopting sustainable construction practices, incorporating green building principles, and minimizing environmental impacts through responsible resource management are imperative. Embracing renewable energy sources and implementing eco-friendly construction materials can contribute to long-term sustainability and mitigate ecological risks.

Finally, navigating legal risks requires a thorough understanding of regulatory requirements and compliance frameworks. Stakeholders should invest in legal expertise, engage in ongoing training programs, and prioritize adherence to local laws and regulations. Establishing clear contractual agreements and resolving disputes through alternative dispute resolution mechanisms can mitigate legal risks and enhance construction performance. In conclusion, by addressing political, economic, social, technological, ecological, and legal factors, stakeholders in the Sri Lankan construction industry can enhance construction performance and foster sustainable growth. Embracing proactive strategies, fostering collaboration, and prioritizing risk management are essential for navigating external risk factors and driving industry success.

5.3 Limitations

In the exploration of the impact of external risk factors on construction performance within the Sri Lankan construction industry, this research adheres to stringent ethical and management science criteria. Despite the meticulous methodologies employed to ensure precision, certain limitations warrant consideration. The utilization of a cross-sectional study design, coupled with a convenience sample, limits the depth of the study to a single data collection stage. The reliance on self-administered measuring tools, while convenient, constrains the research team's ability to glean nuanced insights that could have been obtained through in-depth interviews. Budgetary and time constraints-imposed restrictions on the study's scope, hindering a comprehensive exploration of the effects of external risk factors on construction performance and the potential influencing factors. Attempting a longitudinal study faced challenges, diminishing the study's precision in representing the evolving reality over time.

Moreover, the non-probabilistic convenience sampling method used for participant selection, wherein only those voluntarily completing the survey were included, poses a limitation on the generalization of findings to a broader context within the Sri Lankan construction industry. The acknowledgment of these limitations extends to the fact that participants were not randomly selected, and the findings may not fully represent the industry's general population. Cultural diversity disparities observed across different construction settings further impact the applicability of research findings. Despite these acknowledged shortcomings, the active participation of the respondents underscores their commitment, enabling the collection of valuable data under the given constraints.

5.4 Future Directions

In the exploration of "The Influence of External Risk Factors on Construction Performance in the Sri Lankan Construction Industry," there are numerous avenues for further investigation and in-depth analysis of both sub-variables and the overarching variable. The introduction of the novel concept necessitates subsequent analyses that lay the foundation for future studies, contributing to the evolution of broader generalizations. Recognizing the preliminary nature of this groundwork, future research endeavors should incorporate qualitative research methods to supplement the quantitative findings

While the present study primarily relied on quantitative methods, future investigations could benefit from a more comprehensive approach by integrating qualitative methods such as focus groups and in-depth interviews. These qualitative approaches offer the potential to delve deeper into the intricacies of the relationship between external risk factors and construction performance in the context of the Sri Lankan construction industry. Addressing the current study's limitation of exclusively quantitative methods, a mixed-methods approach would enhance the overall understanding of the dynamics at play.

A future research agenda should consider exploring qualitative aspects inherent in how construction stakeholders perceive and navigate external risk factors, thereby providing nuanced insights into the intersection of risk and construction performance. This methodological diversification could shed light on the experiences, challenges,

and opportunities faced by industry participants in the face of external risks. The synthesis of qualitative and quantitative findings would likely yield a more comprehensive understanding of the nuanced relationship between external risk factors and construction performance.

Such multifaceted research approaches are crucial for bridging gaps in current knowledge and refining strategies within the Sri Lankan construction industry. By expanding the scope to include qualitative dimensions, future research can offer specific insights into the advantages and drawbacks associated with particular external risk factors. This nuanced understanding will contribute to ongoing progress and improvement in the domain of construction performance amidst external risk factors in the Sri Lankan context, fostering agility and diverse perspectives.

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ANNEXTURES –

ALTERNATIVE ANALYSIS FOR MOST INFLUENTIAL RISK FACTOR

Questionnaire Survey Data / Delphi technique

1.1 Data Collection Technique

The participants were requested to rate the Influence of identified External Risk events on following construction management processes under 'No effect', 'Minorly Affected', 'Moderately Affected', 'Significantly Affected' and 'Extremely Affected'.

- Material & Equipment Management (Eg. Purchasing, Storage, maintenance)
- Human resource management / Workforce (Eg. Labour availability, skill factor)
- Financial Performances (Eg. Cost, Profit, Budgets)
- Construction Project Timeline (Eg. Project Milestones, Completion date)
- Quality of construction (Eg. Construction Processes, Methods, Technologies)
- Construction Safety Aspects (Eg. Health & safety and welfare)

1.2 Phase 03 – Preliminary data analysis / Relative Important Index – (RII method)

Based on the responses of participants of Delphi technique, the questionnaire rating followed the five-point scale (point 01 for effect & point 5 for Extremely affected) and converted into a Relative Important index for each factor on different Construction Processes. The total RII value of a particular External risk event /Factor in all construction processes was considered the influential performance mark for a defined external risk.

1.2.1 Analysis No 01- Most Influential External Risk Event

The total of RII values from different Construction processes was considered assuming that all considered construction processes contribute to the construction Project performance at an equal level.

Annexure Table 1 - Most Influential External Risk Event in Sri Lankan industry based on survey results

Most influential External Risk event	Risk Category	Total of RII values	Rank
An epidemic of a disease	Environmental	4.67	**1**
Improvements in construction Methods & Concepts	Technology	4.48	**2**
Natural Disasters	Environmental	4.44	**3**
Cost of Building materials, labour and equipment	Economical	4.33	**4**
Training and education / Skilled labour factor	Social	4.27	**5**
Weather and climate	Environmental	4.24	**6**
Digitalization / Automation in construction	Technology	4.23	**7**
Workflow efficiency and virtual construction / BIM	Technology	4.23	**8**
New Materials innovations / Alternatives materials	Technology	4.22	**9**
Soil and land stability / Landslides	Environmental	4.18	**10**
Availability of Locally manufactured materials	Technology	4.15	**11**
Local Labor Availability	Social	4.15	**12**
Advances in Technologies (Electrical / Water / Internet)	Technology	4.14	**13**
National policies on construction/ Approval Processes	Legal	4.14	**14**
Source of Money for Projects & availability / Doller Crisis	Economical	4.13	**15**
Level of Education	Social	4.08	**16**
Security Threats, (Terrorism & War)	Political	4.06	**17**

Reflections of Economy Performance Factors	Economical	3.99	**18**
Foreign labor involvements	Social	3.98	**19**
Green environmental issues / Sustainable construction	Environmental	3.92	**20**
Export & Import policy / Restrictions and Limitations	Economical	3.90	**21**
Research funding and Development in Construction industry	Technology	3.89	**22**
Stability of the Government	Political	3.85	**23**
Transportation	Social	3.84	**24**
Migration of skilled professionals	Social	3.83	**25**

1.2.2 Analysis No 02 - Most Influential External Risk Event for respective construction Processes

The RII values for different risk events under Construction processes were ranked to identify the most influential external risk events for a particular Construction Process and first 25 ranks are listed herewith.

01 Material & Equipment Management (Eg. Purchasing, Storage, maintenance)

Annexure Table 2 - Most influential External Risk event for Material & Equipment Management in construction

Most influential External Risk event	Risk Category	RII values	Rank
Cost of Building materials, labour and equipment	Economical	0.8792	**1**
Export & Import policy / Restrictions and Limitations	Economical	0.8750	**2**
Availability of Locally manufactured materials	Technology	0.8375	**3**
Monopolies of Material market	Economical	0.8250	**4**
Source of Money for Projects & availability / Doller Crisis	Economical	0.8208	**5**
Cost of crude oil & fuel crisis	Economical	0.8167	**6**
New Materials innovations / Alternatives materials	Technology	0.8083	**7**
Reflections of Economy Performance Factors	Economical	0.7958	**8**
Transportation	Social	0.7875	**9**
Improvements in construction Methods & Concepts	Technology	0.7875	**10**
Stability of the Government	Political	0.7833	**11**
An epidemic of a disease	Environmental	0.7625	**12**
Tax rates & Bank interest and Fiscal Policy of the Government	Economical	0.7500	**13**

Digitalization / Automation in construction	Technology	0.7458	**14**
Advances in Technologies (Electrical / Water / Internet)	Technology	0.7458	**15**
Natural Disasters	Environmental	0.7458	**16**
National policies on construction/ Approval Processes	Legal	0.7458	**17**
Foreign Influences / Diplomatic concerns	Political	0.7250	**18**
Weather and climate	Environmental	0.7250	**19**
Workflow efficiency and virtual construction / BIM	Technology	0.7167	**20**
Green environmental issues / Sustainable construction	Environmental	0.7083	**21**
Security Threats, (Terrorism & War)	Political	0.7042	**22**
Research funding and Development in Construction industry	Technology	0.7000	**23**
Corruption in the Government / Authorities	Political	0.6875	**24**
Soil and land stability / Landslides	Environmental	0.6833	**25**

02 Human resource management / Workforce (Eg. Labour availability, Subcontractors, skill level)

Annexure Table 3 - Most influential External Risk event for Human resource management in construction

Most influential External Risk event	Risk Category	RII values	Rank
An epidemic of a disease	Environmental	0.8542	**1**
Labor Availability	Social	0.8167	**2**
Training and education / Skilled labour factor	Social	0.7875	**3**
Foreign labour involvements	Social	0.7750	**4**
Level of Education	Social	0.7750	**5**
Migration of skilled professionals	Social	0.7708	**6**
Security Threats, (Terrorism & War)	Political	0.7500	**7**
Health & Living Standard of the society / Poverty	Social	0.7375	**8**
Agriculture and Cultivation activities / Agricultural Seasons	Social	0.7375	**9**
Drugs and Alcohol	Social	0.7250	**10**
Cost of Building materials, labour and equipment	Economical	0.7208	**11**
Natural Disasters	Environmental	0.7208	**12**
Holidays / Festival season / Non-working days	Political	0.7125	**13**
Digitalization / Automation in construction	Technology	0.7125	**14**

Weather and climate	Environmental	0.7125	**15**
Transportation	Social	0.7000	**16**
Workflow efficiency and virtual construction / BIM	Technology	0.6958	**17**
Legislative frameworks / Changes in legal criteria	Legal	0.6917	**18**
Improvements in construction Methods & Concepts	Technology	0.6708	**19**
Developments in indirect industries/Businesses	Technology	0.6708	**20**
National policies on construction/ Approval Processes	Legal	0.6708	**21**
Reflections of Economy Performance Factors	Economical	0.6667	**22**
Gender Balance / Age categories	Social	0.6667	**23**
Soil and land stability / Landslides	Environmental	0.6667	**24**
Advances in Technologies (Electrical / Water / Internet)	Technology	0.6542	**25**

03 Financial Performances (Eg. Cost, Profit, Budgets)

Annexure Table 4- Most influential External Risk event for Financial Performances in construction

Most influential External Risk event	Risk Category	RII values	Rank
Cost of Building materials, labour and equipment	Economical	0.8667	**1**
Source of Money for Projects & availability / Doller Crisis	Economical	0.8458	**2**
An epidemic of a disease	Environmental	0.8250	**3**
Stability of the Government	Political	0.8208	**4**
Tax rates & Bank interest and Fiscal Policy of the Government	Economical	0.8208	**5**
Reflections of Economy Performance Factors	Economical	0.8042	**6**
Corruption in the Government / Authorities	Political	0.7875	**7**
Export & Import policy / Restrictions and Limitations	Economical	0.7833	**8**
Improvements in construction Methods & Concepts	Technology	0.7792	**9**
Cost of crude oil & fuel crisis	Economical	0.7750	**10**
Monopolies of Material market	Economical	0.7708	**11**
National policies on construction/ Approval Processes	Legal	0.7667	**12**
Availability of Locally manufactured materials	Technology	0.7625	**13**
Natural Disasters	Environmental	0.7625	**14**

Advances in Technologies (Electrical / Water / Internet)	Technology	0.7500	**15**
Foreign Influences / Diplomatic concerns	Political	0.7375	**16**
Digitalization / Automation in construction	Technology	0.7333	**17**
Security Threats, (Terrorism & War)	Political	0.7292	**18**
New Materials innovations / Alternatives materials	Technology	0.7250	**19**
Workflow efficiency and virtual construction / BIM	Technology	0.7125	**20**
Green environmental issues / Sustainable construction	Environmental	0.7000	**21**
Weather and climate	Environmental	0.6875	**22**
Labor Availability	Social	0.6792	**23**
Foreign labor involvements	Social	0.6750	**24**
Training and education / Skilled labour factor	Social	0.6708	**25**

04 Construction Project Timeline (Eg. Project Milestones, Completion date)

Annexure Table 5 - Most influential External Risk event for project timeline in construction

Most influential External Risk event	Risk Category	RII values	Rank
An epidemic of a disease	Environmental	0.8750	**1**
Natural Disasters	Environmental	0.8250	**2**
Improvements in construction Methods & Concepts	Technology	0.8000	**3**
Weather and climate	Environmental	0.7958	**4**
Workflow efficiency and virtual construction / BIM	Technology	0.7833	**5**
Security Threats, (Terrorism & War)	Political	0.7792	**6**
Digitalization / Automation in construction	Technology	0.7708	**7**
Soil and land stability / Landslides	Environmental	0.7708	**8**
National policies on construction/ Approval Processes	Legal	0.7708	**9**
Labor Availability	Social	0.7667	**10**
Source of Money for Projects & availability / Doller Crisis	Economical	0.7625	**11**
Availability of Locally manufactured materials	Technology	0.7542	**12**
New Materials innovations / Alternatives materials	Technology	0.7500	**13**

Stability of the Government	Political	0.7333	**14**
Export & Import policy / Restrictions and Limitations	Economical	0.7333	**15**
Advances in Technologies (Electrical / Water / Internet)	Technology	0.7083	**16**
Holidays / Festival season / Non-working days	Political	0.7042	**17**
Cost of Building materials, labour and equipment	Economical	0.7000	**18**
Training and education / Skilled labour factor	Social	0.7000	**19**
Foreign Influences / Diplomatic concerns	Political	0.6875	**20**
Transportation	Social	0.6833	**21**
Reflections of Economy Performance Factors	Economical	0.6792	**22**
Foreign labour involvements	Social	0.6792	**23**
Corruption in the Government / Authorities	Political	0.6708	**24**
Elections schedules / Election campaigns	Political	0.6625	**25**

05 Quality of construction (Eg. Construction Processes, Methods, Technologies)

Annexure Table 6- Most influential External Risk event for Quality of construction

Most influential External Risk event	Risk Category	RII values	Rank
Improvements in construction Methods & Concepts	Technology	0.7792	**1**
Training and education / Skilled labour factor	Social	0.7750	**2**
New Materials innovations / Alternatives materials	Technology	0.7542	**3**
Availability of Locally manufactured materials	Technology	0.7417	**4**
Workflow efficiency and virtual construction / BIM	Technology	0.7292	**5**
Level of Education	Social	0.7250	**6**
Migration of skilled professionals	Social	0.7083	**7**
Research funding and Development in Construction industry	Technology	0.7083	**8**
Green environmental issues / Sustainable construction	Environmental	0.7000	**9**
Cost of Building materials, labour and equipment	Economical	0.6917	**10**
Foreign labor involvements	Social	0.6917	**11**

Digitalization / Automation in construction	Technology	0.6875	**12**
Labor Availability	Social	0.6833	**13**
Changes in construction guidelines and standards	Legal	0.6833	**14**
Advances in Technologies (Electrical / Water / Internet)	Technology	0.6792	**15**
Corruption in the Government / Authorities	Political	0.6667	**16**
Natural Disasters	Environmental	0.6542	**17**
Competition between contractors	Economical	0.6500	**18**
Weather and climate	Environmental	0.6500	**19**
Soil and land stability / Landslides	Environmental	0.6417	**20**
Export & Import policy / Restrictions and Limitations	Economical	0.6333	**21**
Drugs and Alcohol	Social	0.6333	**22**
Energy-efficient guidelines / Trends for Renewable energy	Legal	0.6333	**23**
Monopolies of Material market	Economical	0.6292	**24**
An epidemic of a disease	Environmental	0.6292	**25**

06 Construction Safety Aspects (Eg. Health & safety and welfare)

Annexure Table 7 - Most influential External Risk event for Safety aspects in construction

Most influential External Risk event	Risk Category	RII values	Rank
Soil and land stability / Landslides	Environmental	0.7625	**1**
Drugs and Alcohol	Social	0.7542	**2**
Natural Disasters	Environmental	0.7292	**3**
An epidemic of a disease	Environmental	0.7250	**4**
Training and education / Skilled labour factor	Social	0.7167	**5**
Level of Education	Social	0.6833	**6**
Improvements in construction Methods & Concepts	Technology	0.6667	**7**
Weather and climate	Environmental	0.6667	**8**
Pollution (Air, Water, Soil)	Environmental	0.6208	**9**
Foreign labour involvements	Social	0.6000	**10**
Advances in Technologies (Electrical / Water / Internet)	Technology	0.6000	**11**

Local Labor Availability	Social	0.5875	**12**
Workflow efficiency and virtual construction / BIM	Technology	0.5875	**13**
New Materials innovations / Alternatives materials	Technology	0.5875	**14**
Research funding and Development in Construction industry	Technology	0.5875	**15**
Security Threats, (Terrorism & War)	Political	0.5833	**16**
Digitalization / Automation in construction	Technology	0.5833	**17**
Health & Living Standard of the society / Poverty	Social	0.5625	**18**
Construction & household Waste management technologies	Technology	0.5583	**19**
Legislative frameworks / Changes in legal criteria	Legal	0.5583	**20**
National policies on construction/ Approval Processes	Legal	0.5542	**21**
Changes in construction guidelines and standards	Legal	0.5542	**22**
Green environmental issues / Sustainable construction	Environmental	0.5500	**23**
Environmental regulations and guidelines,	Legal	0.5292	**24**
Migration of skilled professionals	Social	0.5167	**25**

1.3. Discussion n secondary analysis

In this paper, the most significant external risk factors which have a significant effect on construction projects performance are identified and classified through a comprehensive literature survey and professional experiments of experts in construction management field. More importantly, this effort is to cover the most effective external risk factors, to have precise macroscopic view on the Construction industry by Using the PESTEL technique.

A structured questionnaire survey approach was considered to study the impact of various External risk events affecting construction projects performance. Forty-seven (47) factors were considered in this study and were listed under six (6) groups based on the literature review. The results were analyzed, discussed to obtain the most significant performance indicators. The relative importance index method (RII) was used here to determine participants perceptions of the relative importance of the external risk factors in different construction Processes.

The analysis revealed the top ten most Influential external risk are An epidemic of a disease, Improvements in construction Methods & Concepts, Natural Disasters, Cost of construction resources, Skilled labour factor, Weather & climate, Digitalization/ Automation in construction, Workflow efficiency *(BIM)*, New Materials innovations and Soil and land conditions.

Furthermore, Cost of construction resources, Export & Import policy, Availability of Locally manufactured materials, Monopolies of Material market and Monetary issues/Crisis were identified as the most influential factors for the Material Management process in construction.

In the Human resource management process, the most influential external risk events were An epidemic of a disease, Local Labor Availability, Skilled labour, Foreign labour involvements, and Education level in the area.

Moreover, Cost of construction resources, Monetary issues/Crisis, an epidemic, Stability of the Government and Fiscal Policy of the Government control the financial performance in a construction project and An epidemic, Natural Disasters, Improvements in construction Methods & Concepts, Weather and climate and Workflow efficiency *(BIM)* were identified as main reasons for Project Time management performance.

Improvements in construction Methods & Concepts, Skilled labour factor, New Materials innovations, Availability of Locally manufactured materials, and Workflow efficiency (BIM) were exposed as the most influential external risks in Construction quality.

Finally, Soil and land conditions, Drugs and Alcohol, Natural Disasters, An epidemic, and Skilled labour factor was the most ranked external risk events affect the construction safety conditions.

It is important to mention that construction project is a combination of these different processes, and it is unfair to rank the most important construction process as the circumstances of improper management of any of these construction process will cause unique complications affecting the outcomes. Therefore, these external risks shall be considered and properly managed in Risk management process to minimize the loss of performance.

More importantly, this study points out the importance of identification the risk level and their impact, relevant to an External event for better pro-actions in risk management for the all the stakeholders in construction.