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DISTINGUISHING DRIVERS AND BOUNDARIES TO PERFORMING CHANGE ADMINISTRATION WITHIN THE CONSTRUCTION INDUSTRY BY EMPLOYING IT ARRANGEMENTS

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Abstract

The construction sector is renowned for being labor-intensive and having little impact on IT. To produce high-quality and useful results for the stakeholders, current building processes are combined with IT-based software and hardware solutions. Therefore, it has been determined that construction industry risk management is a discipline with limited IT involvement and that in order to achieve effective IT-based implementations for the construction industry risk management, it is necessary to increase knowledge and awareness among construction industry professionals. Based on a questionnaire survey of 165 respondents, the drivers and challenges for risk management in the construction industry using IT solutions were validated. The data was analysed using Relative Important Index (RII). The research followed the positivism research philosophy along with the deductive research approach and quantitative research method. The effectiveness of risk management is the main hurdle to IT-based risk management in the construction industry, according to the research's findings. Comprehensive risk identification and efficient risk management are other factors influencing construction risk management. An IT-based framework was created to address risk management procedures specific to the construction industry based on the identified risk management driers and barriers. According to this study, professionals in the construction sector should become more knowledgeable and conscious of risk management in order to better grasp how it differs from IT applications in the sector.

Keywords: Barriers, Construction Industry, Drivers, Information Technology, Risk Management

Introduction

One of the key drivers of economic growth in any nation is the building sector. Construction projects can occasionally show how a nation's infrastructure is developing as well as its investment strategies. A construction project entails a variety of interrelated and separate tasks, including building, renovating, maintaining, and making repairs before demolishing the structures (Chen, 2019). Sustainable growth, with increased awareness of the environmental and social aspects of the construction industry, is the major trend in the business as demand for the sector grows. The building industry does, however, face a number of challenges, including a higher than average incidence of construction disputes, high risk, health and safety concerns, cost overruns, and delays. The high development of many sorts of players, including clients, consultants, prime contractors, subcontractors, suppliers, financial institutions, public agencies, and others, has also contributed to the construction industry's complexity. The construction industry's risk management will be covered in this study.

The problems of implementing risk management in construction projects are explored along with the risk factors involved and current risk management strategies. Utilizing current knowledge and research on risk management in the construction industry and the IT business, prevalent solutions utilizing IT for the risk management industry are presented.

1.1 Background

The Gross Domestic Product (GDP) and economic growth of any nation are both significantly influenced by the building industry. However, the construction business is a complex, dynamic, and risk-prone industry because of the substantial participation of uncertain project settings. The danger of technical, construction, social-political, economic, and organizational risks in the construction business are very high (Landage, 2016). Technical hazards include incomplete design, frequent scope changes, inadequate specifications, inadequate site investigations, and inadequate resource availability. Construction projects may be affected by risks related to worker productivity, site circumstances, labour disputes, equipment breakdowns, design revisions, cutting-edge technologies, and increased quality requirements. Physical dangers are connected to the project's resources being damaged. Organizational concerns include contractual connections, stakeholder attitudes, the contractor's experience, a shortage of skilled workers, and communication problems. Legal, political, social, and cultural issues are tied to socio-political risks, while all cost-related risk factors fall under the category of financial hazards.

Therefore, it is crucial to use risk management strategies from the start of the project in order to keep the construction project on the right track. In construction projects, the project manager is primarily responsible for risk management. A systematic technique that combines the necessary skills and expertise is crucial for an effective and efficient risk management strategy (Serpella, et al., 2014). Although there are a number of ways to monitor the performance of a construction project in order to identify associated risks, such methods have not produced the expected results. Project teams are thereby failing to meet the project's minimum operational and quality goals, which results in cost overruns and delays (Landage, 2016).

The steps in the risk management process are risk identification, quantitative and qualitative risk assessment, risk handling through risk factor control, and risk factor monitoring (Landage, 2016). Application of risk management, resource allocation, responsibilities, available technologies, risk identification, risk analysis, risk response, and risk monitoring are the eight steps that Serpella & et al. (2014) suggested for the risk management process. The implementation of each phase in the risk management process also uses a variety of various ways. Risks are identified via brainstorming, the Delphi Technique, expert interviews, experience, and checklists. Decision trees, probabilistic analysis, scenario analysis, and sensitivity analysis are some examples of quantitative analysis methodologies. For qualitative analysis, the following tools are used: risk categorization, risk urgency evaluation, risk probability and impact assessment, and probability/impact risk rating matrix. In the construction sector, risks are dealt with using risk avoidance, risk transfer, risk mitigation, risk exploit, risk sharing, risk enhancement, risk acceptance, and contingency planning (Landage, 2016).

For risk management, several methods have been developed. In that instance, a risk maturity model has been developed, and it aids organizations in determining their capacity to address specific hazards (Hopkinson, 2011). In addition, Hillson (1997) introduced a risk maturity model with four maturity levels—Ad Hoc, Initial Repeatable, and Managed—for businesses to successfully implement risk management approaches in the organization or use as reference materials to assess the current conditions in terms of the organization. Hillson again produced a Risk Management Maturity Model (RMMM) without altering the model's structure after that model was further developed as Project Risk Maturity Model (RMM) by HVR consulting services. The levels were just expanded, and it was the only change made. After that, some researchers elaborated on this model. These models assist in determining the organization's risk process, and priorities, determining whether the current risk management is sufficient to address the risk, and creating action plans to improve the risk management process (Serpella, et al., 2014).

On the other hand, while taking into account the use of IT solutions in the construction industry, the industry is embracing the adoption of getting the help of IT to increase the productivity of construction projects due to the rapid improvement of Information Technology (IT). Industrialized HouseBuilding (IHB) systems are used by the majority of construction firms worldwide to collect customer requirements and factor them into the project scope. It serves as a technological remedy in the Technology Transfer (TT) industry. As a result, the risk of uncertainty in technology transfer for construction projects has been reduced by construction businesses (Uusitalo & Lavikka, 2021). According to Froese (2010), today's construction products can benefit from more computer-aided tools, such as email, web-based project management (WBPM), and building information modelling (BIM) (BIM). For the construction industry's procurement process, there are a few web applications and digital technologies (Ibem & Laryea, 2014). To communicate with stakeholders, share knowledge, and coordinate efforts, several technology techniques are also employed (Whyte & Lobo, 2010). The construction sector heavily utilizes cloud computing, smart devices, the internet, and data processing technologies to enhance communication, data transmission, and data handling dependability, and minimize the impact of those limits (Chowdhury, et al., 2019). The improvement of the visualization of the design and building processes is achieved via the use of digital technology. Other ideas employed in the construction sector using IT solutions include ubiquitous access to information both on- and off-site, safety control, communication, and progress tracking.

Additionally, the IT sector currently offers incredible solutions to challenges faced by the construction sector, including those posed by artificial reality, 3D printing, autonomous vehicles and robotic systems, artificial neutral networks, bar-code technology, case-based reasoning, geographic information systems (GIS), global positioning systems (GPS), virtual and augmented reality, and the Internet of Things (IoT). Other new technologies in the construction sector include mobile devices like smartphones and tablets, big data and analytics, as well as mobile and wearable technologies. Using the correct site design, GPS-guided equipment, nanotechnologies, smart materials, and building components can enhance material handling procedures and on-site productivity (Sepasgozar, et al., 2016). Additionally, photos taken on-site are utilized to track timetable deviations using photogrammetry. So that the discrepancies can be corrected, the project manager and his team can take the necessary safeguards (Omar & Nehdi, 2016).

According to Froese (2010), emerging IT-related technologies are embracing the construction sector, integrating with the design, and building phases, and enhancing profitability, productivity, and affordability. On the other hand, by integrating many processes into the construction project, the synergistic application of digital technologies in the construction sector enables the availability of real-time information (Miettinen & Paavola, 2014). For instance, augmented reality and BIM can work together to create an on-site information system for construction site activities. Adopting innovative technology has a beneficial impact on cost, quality, productivity, competitive advantage, market share, safety, marketing, and market expansion, according to Gambatese & Hallowell's (2011) analysis of the construction sector. By integrating with GIS technology, barcode and RFID technologies can be used to collect data, track costs and schedules, and monitor the progress of the project. This increases the data's dependability, speed, and accuracy. As a result, the main driver of increased productivity and industrial growth in the construction sector may be attributed to information technology. Even though these strategies have a direct connection to risk management, some of them can be connected to risk management by monitoring the development and performance of the building project.

1.2 Problem Statement

Risk management is a necessary barrier to every building. Whatever measures the project team takes to maintain the smooth functioning of the construction projects, the risk may still be present at any time. The hazards also differ from project to project because of the particular characteristics of each project (Sharma & Swain, 2011). Construction projects demand exceptional levels of project management techniques be completed due to the significant involvement of risk factors and the higher degree of project requirements. Several sorts of project failures, including cost overruns, schedule overruns, and compromised quality, can be brought on by improper project management techniques, putting the project in danger (Violante, et al., 2018).

The construction industry has a high propensity to be linked with risk because of its particular characteristics, however, managing risk effectively in this sector is insufficient. Risk concerns can harm a project no matter its functionality, size, location, or any other feature. There isn't a project out there that can be deemed risk-free. Projects may fail in their operation if the risk factors are not effectively identified and appropriate methods are not implemented to manage those risks (Landage, 2016).

With the growth of the construction sector, the use of automation technologies is increasingly important for all types of construction projects. The majority of construction project end users expect a greater return on their investment through minimizing risk. For that, automation and information technology are crucial to the project's efficacy and efficiency since they prevent human errors (Oke, et al., 2019). As a result, information technology can be used to control risk effectively. With the growth of the construction sector, the use of automation technologies is increasingly important for all types of construction projects. The majority of construction project end users expect a greater return on their investment through minimizing risk. For that, automation and information technology are crucial to the project's efficacy and efficiency since they prevent human errors (Oke, et al., 2019). As a result, information technology can be used to control risk effectively.

Even though several studies have been conducted to assess the importance and requirement of IT applications in the construction industry. There are very limited previous researchers have been conducted to assess the suitability of IT based solutions for the construction industry to identify the change administration. Therefore, this research is intended to review the solution to the following research question.

"What are the drivers and barriers in the Sri Lankan construction industry when performing risk management using IT solutions?"

1.3 Aim and Objectives

1.3.1 Aim

This research aims to identify drivers and barriers to performing risk management in the Sri Lankan construction sector via Information Technological solutions.

1.3.2 Objectives

The aim of the research is achieved with the fulfilment of the research objectives.

- Identify drivers to perform risk management in the construction industry
- Identify barriers to performing risk management in the construction industry
- Evaluate the importance of information technology in the construction industry
- Assess the impact of risk management on the construction industry
- Develop an IT-based framework to address risk management in the construction industry

1.4 Limitations of the Report

When looking at the report's limitations, it should be noted that the country-wide travel restrictions put in place as a result of the COVID-19 pandemic crisis made it exceedingly impossible to physically gather information. As a result, it was unable to adequately undertake information gathering from industry experts, visit libraries, and discover material physically referencing books and periodicals. Online platforms were used to acquire all the data and information. There were certain signal problems in that situation, which made it more difficult to find the information for the report. The study topic was constrained by a dearth of open-access journal publications addressing IT solutions for risk management in the construction industry.

On the other side, a lack of time posed the biggest challenge in carrying out this study. It was the major obstacle to getting access to more knowledge and specialists. It was quite challenging to match this research's time requirements with academic obligations.

2.0 Literature Review

2.1 Construction Sector

Around the world, everyone is impacted by construction. De Silva (2021) estimates that the construction sector contributes 6% of the world's GDP and serves as a significant driver of economic expansion. In 2020, 600,000 people were employed in Sri Lanka, contributing 6.2 per cent of the country's GDP.

The International Trade Administration (2021) reports that there are numerous domestic and foreign construction enterprises operating in this market. The expected yearly turnover value of US$ 4.3 billion offers Sri Lankan construction companies the opportunity to expand abroad. After COVID-19, the economy slowed down, but economists anticipate that demand will build up as the economy recovers and as low prices present chances for developers. Realtors are showing fresh interest in flats and homes as low interest rates are luring consumers.

According to the International Trade Administration (2021), this market is home to a large number of domestic and international construction companies. The anticipated yearly revenue of US$ 4.3 billion gives Sri Lankan construction enterprises the chance to grow internationally. The economy slowed down after COVID-19, but experts believe that demand will increase as the economy recovers and as low costs give developers opportunities. Realtors are indicating renewed interest in apartments and houses as buyers are being drawn in by low interest rates (Construction tuts, 2021).

2.1.1 Diversification of the construction sector

Residential, agricultural, and industrial building construction is included in this sector's classification; Highways, bridges, sewers, marine constructions, flood control projects, and trains are all considered to be infrastructure construction, while electrical work, plumbing, fixtures, and paintings are considered to be special trade construction.

Newly created and developing nations serve as a base, advancing national development with a solid infrastructure that will ensure alternative industries, which will foster a thriving, energizing workplace. Through the improvement of infrastructure (roads and trains) and the implementation of environmental health and safety systems, the construction sector contributes to the growth and stability of the economy. Thus, the construction industry is the process of building and maintaining a built environment when combined with developing technologies (Foulkes and Ruddock, 2011).

2.2 IT Applications in Construction Sector

The resource planning, risk management, and logistical issues that plague the construction industry are well-known to frequently lead to design flaws, project delivery delays, cost overruns, and legal battles. To assist with diagnostic and prescriptive analysis of causes and preventive measures, research has been conducted on the application of advanced machine learning techniques, such as deep learning. However, the attention given to AI and its applications to unstructured data by digital giants like Google, Facebook, and Amazon is not the end of the field. Deep learning has a wide range of uses, notably in the construction industry where it hasn't yet been fully investigated in areas like site planning and management, health and safety, and cost prediction (Akinosho, Oyedele, Bilal, Ajayi, Delgado, Akinade & Ahmed, 2020).

Stakeholders, project teams' communication, and information processing challenges are causing the construction sector to disintegrate, which adds to the antagonistic relationships between the project's parties. The use of information technology (IT) can help to mitigate the issues brought on by fragmentations (Matheu, 2005).

The implementation of IT in the construction sector hasn't advanced much, despite the fact that many project planning, management, and control processes can be considerably aided by IT. Construction technology must advance if constructions are to be more durable, taller, and ecologically benign (Jones, 2020). The web is transcending the limitations of many forms, such as servers and sophisticated browsers. The same program can be shared over the web by independent participants utilizing various hardware platforms (Rojas and Songer, 1999). IT has undoubtedly made websites safer, employees more productive, alliances stronger, and complex projects easier to manage.

2.2.1 Introducing Technology towards the construction

Project managers are aware that in order for productivity to increase, it is essential to adopt the appropriate tools to support a more productive job site. Numerous new technologies aimed at the business and financial sectors have emerged since the turn of the twenty-first century. These include blockchain, the Internet of Things, and big data. Data that is dispersed across several places, nations, or organizations can be replicated, shared, and synchronized using blockchain, a sort of distributed database. Blockchain's primary characteristic is its lack of a single administrator or centralized data storage system. Consensus algorithms control the decentralized peer-to-peer network. Blockchains have gained popularity across a wide range of enterprises due to their many advantages and applications, but is this the case in the construction sector? Analysis of the possible effects of blockchains as a potentially disruptive technology is crucial given the construction industry’s lack of digitalization and resistance to change (Perera, Nanayakkara, Rodrigo, Senaratne, & Weinand, 2020).

On job sites around the world, technologies like Building Information Modeling (BIM) software, artificial intelligence, telematics, mobile apps, autonomous heavy equipment, drones, robots, augmented reality, virtual reality, and 3D printed models are currently being used. Due to easy access to the internet, creating software apps to address specific issues facilitates and supports construction projects (Qazzaz 2010). The use of a web-based project management system (WPMS) will improve project documentation and reorganize how a manager and team go about their work. WPMS may be developed and run with little technical, financial, and human resources, according to Mathieu (2005).

Since most software programs are cloud-based, revisions to reports and alterations to schedules are possible, speeding up communication and improving teamwork. The data entry time is reduced by hundreds of hours a year, and files are automatically organized, providing information on areas that require optimization (Bello and Owolabi, 2020). Data from successive stages are saved in separate locations, whether on a team server, desktop, laptop, or mobile device. Purchasing a high-end capacity system to store, process, and analyze data from its subcontractors is the conventional IT approach.

2.2.2 Importance of communication

Communication is crucial when there are numerous parties present on the job site to avoid mistakes, reorganization, or delays. With IT, a team can work together to create a communication plan that eliminates the need for requests or manual folder-flipping (Conqa, 2018). Data is streamlined by straightforward technology, and project teams may provide accurate information on expenses, equipment, and labour, increasing efficiency.

In the construction sector, effective communication is a crucial skill for project success. However, it has always been a difficult task to execute efficient communication because the industry is described as fragmented, dynamic, and includes many parties (client, consultant, contractor, authorities), which results in the presence of inadequate communication. There hasn't been a publication that deals with inadequate communication in a general sense, particularly when it comes to identifying and evaluating the causes and impacts of this problem in the construction business. However, this article sought to identify and evaluate the importance of these characteristics by ranking each one according to its level of significance or severity (Rahman[1] and Gamil, 2019).

The group H&S climate and employees' self-reported H&S behaviours were all positively and significantly connected with the transformational and transactional leadership styles of supervisors as well as communication techniques. The biggest predictor of H&S participation was the transactional leadership element of giving a contingent compensation, whereas the communication styles of supervisors and the transformational leadership element of offering an acceptable model were the strongest predictors of H&S compliance. The connection between supervisory leadership and employees' self-reported H&S behaviour was completely mediated by the H&S climate (Lingard, Zhang, & Oswald, 2019).

Although digital technology is becoming more widely used in construction, productivity reports have remained underwhelming. Given that the factors impacting productivity are neatly covered within that literature, the present research advises leaning on organizational competitiveness literature to build insights into the causes of this conflict. The article examines the opinions of managers in the UK construction sector regarding the impact of building information modelling (BIM) and big data analytics (BDA) on organizational competitiveness through a questionnaire survey (Madanayake & Cidik, 2019).

2.3 Risk Management in the Construction Sector

According to BigRentz, Inc. (2019), risk management identifies the hazards that exist in a company and assesses the steps that may be taken to lessen their impact through thorough planning, monitoring, and risk control situations.

According to Jonas (2021), virtually all projects involve some level of risk, but successfully managing risks will result in higher earnings, stronger customer relationships, and the capacity to grow the firm by securing more contracts. Although it is impossible to predict exact risk or cost levels, a decentralized risk management strategy in the construction sector is unquestionably advantageous.

A thorough examination and content analysis of 130 publications from reputable and pertinent academic journals that were published in the previous three decades was done. The results of the content analysis revealed that the majority of the chosen articles indicated hazards for building projects, particularly infrastructure projects, in Asia and Europe, and that the risks were typically either listed without any categorization or classified based on their type. Combinations of various information-gathering strategies, rather than diagramming and analysis-based procedures, were frequently used for risk identification in the chosen papers. Unexpected increases in the rate of inflation, bad engineering and design decisions, and modifications to the project's governing laws, regulations, and policies were the most often mentioned concerns (Siraj & Fayek, 2019).

2.3.1 Sources of Construction Risks

Every construction project is considered successful when it is completed on schedule, within budget, and to the clients' satisfaction with the fewest possible conflicts. The stakeholders must make sure that a project is operating as effectively and efficiently as feasible before it can be deemed successful. Any project that wants to be more effective and efficient needs to come to an agreement on the cost factors that could influence technical performance or practical approach in carrying out some processes that will reduce the likelihood that certain risk factors will occur and effectively manage them (Adeleke, Bahaudin, Kamaruddeen, Bamgbade, & Ali, 2019).

According to Jonas Construction (2011), a risk strategy will identify variables jeopardizing the projects and workflow. Construction frequently introduces new expectations for the contractor. Both internal and external hazards are many:

1) Safety Risk – worker accidents in a construction site resulting in serious injuries
2) Financial Risk – lack of sales, a fluctuating economy, unexpected rise in material costs, payment delays and competition impacts the financial flow
3) Legal Risk – disputes in fulfilling contracts with clients, conflicting language,
4) Project Risk – no manpower, poor management of resources, lack of proper principles, miscalculating time and misunderstandings with project deliverables
5) Environmental Risk – floods, earthquakes, pollution and other severe weather conditions that damage sites, making work inaccessible (BigRentz, Inc 2019).

Because there is still a dearth of information about risk management in Sri Lanka, local players in the business are slow to incorporate it into their operations. Most parties given risks through contract terms in road construction projects bear them; nevertheless, certain parties who were not so assigned bear the repercussions. The most widely utilized technique in Sri Lanka's building industry is brainstorming, which heavily relies on personal experiences (Madushanka and Tilakasiri, 2020).

Risk management enables customers, contractors, consultants, and suppliers to complete projects on schedule and within budget while minimizing unfavourable effects on the project's ability to meet its quality, time, and cost goals. Contractors must manage risks on their own as a result of the current economic slump, which creates difficulties in this fiercely competitive sector, particularly in emerging nations.

In the complex project construction industry, where everything is unpredictable, certainty is a rare commodity. The management must rank risks when they have been discovered and create the position of risk owner. The plan's risks can be identified with the aid of a schedule risk analysis or a risk assessment matrix tool, which will also help mitigate unneeded hazards for improved long-term results and prevent future losses (Jonas construction, 2021).

2.4 Impact of Risk Management on the Construction Industry

Even though it is becoming more difficult to achieve schedules and cost and quality requirements, risk management techniques have greatly enhanced building projects (ALSaadi, 2021). Poor risk management can have an impact on a corporation and impede project benefits, sales, and profit margins.

Six (2017) identified seven impacts of such risks:

1) Poor User Adoption – team members must follow a plan and methodology. Since this is too red tape and if the project seems complicated, the managers do what they think well.

What to do: change of attitude from the management whilst talking to the stakeholders and making certain the process reviews are workable.

2) Unrealised Benefits – Risks destroy a project overnight. With an inefficient team, additional admin tasks add time and money, affecting benefits undelivered.

What to do: make certain risk management efforts are the correct size to fit the company. Advocacy will not suffocate the team with bureaucracy, eating up benefits in the unnecessary admin.

3) Late-running Projects – unforeseen risks and delays slow a project; it takes time to prepare a management plan to monitor, act and track the project.

What to do: as delays are inevitable, early identification is crucial. Risk workshops prompt review and identify new risks.

4) Overspent Budgets – when actions relating to effectively managing risks are not budgeted, or if pitfalls are not identified, the team must find funds before the project fails.

What to do: calculate costings, management activities, and risks that could happen. This will track the project and avoid ad hoc spending.

5) Unhappy Clients – clients prefer minimal risk. They must be informed of potential threats and a Plan B if needed.

What to do: involve clients in risk management so they can secure themselves and their stakes; frequently inform them of how risks are managed and monitored.

6) Reputations Damage – client confidence that the company can handle risks efficaciously holds positivity for future work.

What to do: one bad review can be damaging; a good risk identification process will cover anything that has the probability to sabotage the company's reputation.

7) Project Failure – once managing risks becomes a failure, the project collapses. Objectives cannot be reached, wasting capital, time, and effort.

What to do: adding risk management in project controls will figure early warnings. Executing a robust escalation process will inform the team of acting without panicking when risks are identified (Rad and Yamini, 2017).

Jobs in Audit (2013) Thus, within a good framework, right-sizing tactics with a risk management approach, balancing hazards and opportunities, is the foundation for a current firm.

Technology is the view of an environment that must be taken into account in a country's strategic objectives, claim Akanni, Oke, and Akpomiemie (2015). The presence of locally manufactured machinery and equipment, the quantity of locally sourced building materials and their level of utilization, as well as the availability of skilled labour, are all indicators of an appropriate and proper construction technique (Obalola, 2006). One of the biggest issues facing the country was thought to be a lack of managerial talent and inadequate technological knowledge.

In addition to the activities of the global economy, the economy and finances of construction enterprises are also impacted by the availability of resources to complete the work, including the economic competition at many levels around the appointment of all parties participating in building projects. The construction project appears to have a financial deficiency. Obalola's research suggests that financial environment drivers can be differentiated from economic factors because the former is related to resource deployment while the latter is only related to money constraints (Obalola, 2006). However, there is a paucity of empirical studies in the construction industry about the relationship between the economic component and construction risk management.

The influence of environmental variables such as safety, community perception, and legal acceptability, political and social impacts on the project is mostly high (Jaafari, 2001). The author further highlighted discriminatory legislative, covering tax regimes, riots, strikes, civil unrest, wars, terrorism, invasions and religious turmoil as derivatives of political factors (Adeleke, Bahaudin, Kamaruddeen, Bamgbade, & Ali, 2019).

2.5 Risk management drivers in the construction industry

Any country's economy may be primarily gauged by the construction sector, and new construction projects show this expansion. When the building business expands steadily, it will have a favourable impact on the standard of living for people (Hung et al., 2019). The construction sector is seen as having a higher level of risk, nevertheless. So while managing building projects, risk management is a crucial task. According to Walewski and Gibson (2003), a project's main success elements are its thorough risk identification and good risk management. Kolman (1992) asserts that determining the associated risk is crucial because it helps identify both severe disasters and potential daily accidents that could cause financial hardships and unfulfilled plans for stakeholders such as site members and organizations.

When performing a risk analysis, the project risk management systems used must take into account the quantitative risk analysis, such as the risk matrix. But the research by Forbes, Smith, and Horner (2008) demonstrates that there are numerous risk management strategies accessible, notably for the construction sector. Not every situation calls for the use of every one of these approaches. Additionally, these quantitative risk methodologies do not address the dangers, difficulties, circumstances, and corrective actions encountered in earlier initiatives (Tah and Carr, 2001). A few of the risk management strategies utilized in building projects include the Delphi technique, brainstorming, and checklists. According to Lyons and Skitmore (2004), construction companies frequently employ the brainstorming technique to identify risks and to give qualitative elements of risk assessment. According to Schieg (2006), projects with effective risk management plans produce information based on quantitative factors. Although the decision-making process always has access to the necessary information with high quality elements, it focuses on accessible and comprehensive information.

Since these situations are seen as opportunities for learning and obtaining new experiences, the majority of modern organizations actively seek out new opportunities and challenges. Their competitive advantage is increased by drawing on the knowledge of tested occurrences (McGill et al., 1992). Since the majority of risk assessors rely on experience, organizational learning and organizational behaviour are therefore seen as two factors that directly affect risk management (Chan et al., 2005). Reactive organizations prioritize risk retention and risk transferring aspects while launching new projects (Smallman, 1999). However, if Murphy's Law is used, it shows that poor project management practices are considered if anything is not working in the right format. This brings us to the second proactive strategy, where businesses acknowledge that forecasting may be constrained by scientific ambiguities and obscured by cultural dynamics. As a result, these occurrences will have a negative impact on the creation of models and policies with guidelines since it is difficult to transfer or accept risk when there are no or very inadequate good management practices in place. Staff inertia or resistance to change is one of the most frequent obstacles to efficient project risk management and leadership, according to Lundy and Morin (2013). Allen et al. (2015) take into account how risk management affects budgeting. Project cost management practices include planning, estimating costs, funding, financing, and a few additional ways to keep costs in check. Although risk mitigation techniques often require higher costs, such could worsen project cash flows (Sato and Hirao 2013). On the other hand, a major barrier to risk management adoption is the lack of committed leadership and strategic direction.

According to Perera et al. (2009), the contracting parties should reveal a continuous learning approach to the risk management process, especially in terms of risk identification. The live scenarios learned from previous projects are what could put the stakeholders in a favourable position going forward. As a result, it is possible to identify the risk that a new project is likely to encounter. The parties to the contract must support a continuous learning approach to risk management, particularly in the identification of risk, as these previous projects serve as real-world examples from which to learn. This will help the parties in the future be better prepared to identify potential risks early on in new projects. On the other hand, a crucial element of a successful project risk management effort is the management of a construction project's knowledge and understanding. Therefore, a learning management system could be an interesting and useful paradigm for addressing the shortcomings of the risk management system.

2.6 Risk management barriers in the construction industry

Performance in the construction sector is gauged by how well a product works. When compared to other industries, the industry's quality characteristics and productivity measurements are fundamental (Gann, 2000). Considering how little innovation occurs in the construction sector, low performance indicators are maintained (Gann, 2000; Winch, 1998). Because of the workers' low levels of education, experience, and competence, productivity levels are still poor, especially in developing nations. Additionally, the performance of the construction sector is directly impacted by new technologies, techniques, and project sizes (Alaghbari, Al-Sakkaf, & Sultan, 2019). Risk management for construction projects entails detecting uncertainty conditions, minimizing uncontrollable risks, qualifying risks, and managing risks that can be handled with maximum and minimum capacities through risk allocation (Liu et al., 2003). Tah and Carr (2001) claim that inadequate risk management techniques for identification, evaluation, formalization and control can lead to ineffective risk management applications. Poor integration between risk management and other operational functions, such as design, forecasting, preparation, production, transportation, cost estimation, fabrication, quality control, durability, timeline assessment, assistance (example: maintainability), and testing and elaboration; furthermore, a lack of cohesiveness in risk management across the construction process. Depending on their skills, the employees are divided into various functional groups.

Huo et al. (2016) have identified a number of variables that influence the interpersonal challenges that come with cross-functional or multi-functional endeavours. Despite a vast body of knowledge and the risk management industry's continual expansion. Additionally, according to Baloi and Price (2003), specialists won't be able to appreciate its value. The biggest barriers to efficient risk compliance management included academic challenges, linguistic challenges, application costs, and feelings of unease. Due to these, the main obstacles to better risk management may be a lack of awareness of risk management and the challenge of implementing such a framework. Chinese construction companies experience this scenario.

Refusal to disclose risk: According to Bhoola et al. (2014), avoiding risk is one strategy to improve communication between the project team and top management because there is a fear of sharing negative information. To gain positions on the project team, people emphasize only benefits and minimize hazards while seeming more enthused and upbeat. Ritchie and Marshall (1993) contend that a person's views and beliefs that affect their personal ideas ultimately determine their risk management decisions as a result of their social contacts with other people and organizations, their experience, and their prejudice. It was also believed that a company's size could affect how risk-averse it is (Smallman, 1999). Level of concern, attitudes, actions taken, perceived responsibility, and information utility were all listed by Smallman (2004) as risk priority judgments. Similarly to this, voluntarism, immediacy, information, control, condition, acceptance, and severity all have an impact on attitudes toward risks (Smallman, 2004). The goals of risk management can differ from one decision maker to the next. However, they frequently involve one or more of the following: making sure the company survives, boosting its market value, influencing the behaviour of subsidiaries and employees, enhancing profitability, minimizing cash flow fluctuation, minimizing price volatility, reducing taxes, and enhancing reported results (Fatemi and Glaum, 2000).

Due to a shortage of construction supplies, the Sri Lankan construction industry is currently experiencing severe problems. Consider tiles, ceramic fixtures, cement, sand, equipment, and a wide range of other materials. Assume that the building companies have carefully considered and identified the potential risk of resource shortage. In that circumstance, it would be possible to manage missed short-term objectives or planned deadlines with no negative impact. However, Silva, Wu, and Ojiako's (2013) study found that there are a number of dangers in the Sri Lankan construction industry, including a lack of expertise, a lack of knowledge about effective risk management methods, and the time and money needed for risk management as barriers.

The same study also reveals a knowledge gap regarding risk assessment and management procedures in Sri Lanka's construction sector, which is acknowledged as a further obstacle to efficient risk management. Similarly to this, Liu, Low, and He (2011) found that due to RAMP's limited exposure in China, Chinese construction enterprises lacked the knowledge and experience necessary to implement RAMP.

2.7 Application of IT for construction risk management

Construction projects today follow cutting-edge technical advances. Modern construction management applications including construction ERP systems, blockchain, MXROAD, Road Estimator, and Micro Station make it easier to manage the supply chain, administer projects, model them, design them, set budgets, and coordinate them (Shojaei, 2019). However, the specific issues of risk management in the construction business are not covered by this program. The technological components of risk management in the Sri Lankan construction industry have thus been covered by the author. According to Tatum (1991), construction companies that actively embrace innovation and new technology advancements draw in more projects and produce greater financial returns on such projects. When businesses aren't experimenting with new technologies, there's a significant risk that their brands will decline, they'll make less money than their rivals, and they won't be able to keep up with emerging market trends (Tatum, 1991). On the other hand, implementing these technology efforts allows for advances in the operational, technical, and management of construction projects and businesses while consuming less time and labour. Forbes et al. (2008) presented a matrix to help in the selection of appropriate risk management approaches at each stage of building projects in order to address these characteristics of the construction industry. The stakeholders developed these new approaches, which include decomposition, sensitivity analysis, artificial intelligence, probabilistic analysis, and decision trees.

All occupations in the construction industry require a solid understanding of construction technology. Tasks like site investigations, budget management, project planning, contract administration, building project safety, and many more can be aided by construction technologies. Using construction techniques to complete a project in a productive and efficient manner can be quite advantageous because productivity and efficiency are so crucial in the construction business. Building a framework might be straightforward to create, develop, or assemble thanks to construction technology. Furthermore, because ERM necessitates a large amount of computer capacity, advancements in digital technology (IT) have been seen as a key external driver (Liebenberg and Hoyt, 2003). Segal (2011), stated these developments have aided businesses in gathering superior data for the risks listed below, prototyping complex threats, precisely quantifying risks, and truly understanding risk interconnectedness throughout an organization (Jablonowski, 2001).

The biggest project risk is thought to be the health and safety of the construction employees. Therefore, new technological applications are used to develop automated safety-ensuring applications like firefighter systems, safety scanners, and OSHAS other quality regulations. The safety of employees may be adversely impacted if these systems experience any breakdowns. Due to the ongoing introduction of new ideas, models, materials, processes, and approaches, the construction sector is recognized as being very varied. When compared to the past, the building sector has changed with time. The community generally expects building companies to focus on sustainability and resource scarcity. As a result, the communities anticipate the companies' appropriateness efforts, and the interest of the community represents another risk related to the construction companies. Prefabricated building components, computer technology, and green technology are all employed to create environmentally friendly construction projects.

3.0 Methodology

3.1 Chapter introduction

The entire description of how research is conducted is referred to as research methodology. As a result, this chapter discusses the methodology, sample, data collection, and analysis steps of the research. The structure for outlining this study's research approach is provided by the research onion (Figure 1). This chapter demonstrates the selection of the research philosophy, approaches, strategies, choices and time frame along with the general discussion on the available methods. The relevant justifications were provided to ensure the relevance of the research outcome.

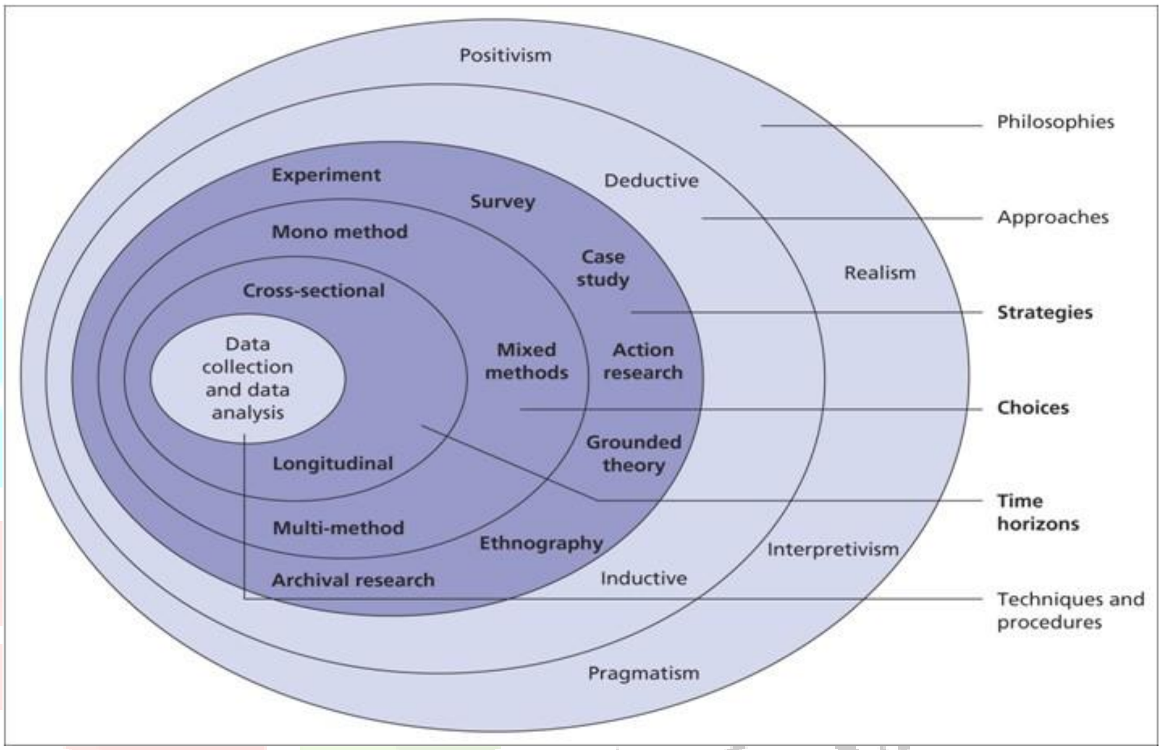

Figure 1 - Research Onion

Source: (Almalki, 2016)

3.2 Research Philosophy

The research philosophy refers to the generally accepted guidelines for a certain study that outline its techniques for data collection, evaluation, and interpretation. Research philosophy specifically influences a study's technique (Almalki, 2016). Research philosophy is thus recognized as the foundation of a given field of study. As seen in the research onion (Figure 1), researchers have recognized four major research philosophies: positivism, interpretivism, realism, and pragmatism, which they perceive as universal research principles (Antwi & Hamza, 2015).

Positivism holds that knowledge in the world is independent of people or other subjects. As a result, the knowledge contained in a given study is unrelated to the respondents (Barnham, 2015). As a result, positivism is a method of scientific inquiry that verifies occurrence. As a result, positivist studies adopt a quantitative methodology (Almalki, 2016). Similar to positivism, realism is based on the idea that reality and truth are independent of how people perceive them. As a result, studies of realism also use a quantitative methodology (Etikan, 2014).

The complete antithesis of positivism is known as interpretivism. According to interpretivism, every member of a society has their ideas about what is real and true. As a result, knowledge is intrinsic to people and cannot be separated from them (Flick, 2015). This means that when conducting research, understanding the subject is just as important as comprehending the knowledge. Therefore, interpretivism studies adopt a qualitative methodology that delves deeply into the knowledge that respondents have already internalized (Queirós et al., 2017).

The key component that distinguishes the research philosophy, according to pragmatism, is the philosophy's focus on the research question. Even though there isn't a consensus on something, pragmatism believes in proving its existence. As a result, it suggests the "mix technique," a flexible way to integrate quantitative and qualitative research approaches (Mackey & Gass, 2015).

Intractable metaphysical and epistemological problems may be clarified (and in some circumstances, resolved) through pragmatism (Stuhr, 2015). The practical pragmatist advises quarrelling metaphysicians to develop the practice of asking the following query. Furthermore, theories and models should be evaluated primarily based on their results and ramifications rather than their beginnings or relationships to prior information or facts (Shusterman, 2016).

3.3 Research Approach

Deductive and inductive research methodologies are considered to be standards. Deductive research establishes a hypothesis that is not the main objective, whereas inductive research establishes a hypothesis. Analysing multiple pieces of evidence and creating a synthesis to reach bigger conclusions is what inductive reasoning entails (Almalki, 2016). Deductive reasoning, in contrast, focuses on creating hypotheses based on empirical research and theories already in existence and then creating a study plan to test those assumptions (Barnham, 2015). Deductive reasoning is used in the positivist research technique.

Since new theories, variables, and hypotheses are discovered through observations and data gathering, inductive reasoning begins with these steps. Interpretivism uses inductive reasoning in the research process. The inductive approach, also known as inductive reasoning, begins with observations, and theories are presented as a result of those findings towards the conclusion of the research process. It is crucial to emphasize that while developing research questions and objectives, using an inductive method does not imply ignoring theories (Saunders, Lewis, & Thornhill, 2012). However, the inductive technique does not preclude the researcher from employing an existing theory to frame the research issue to be examined. This strategy seeks to develop meanings from the data set obtained in order to uncover patterns and links to build a theory (Liu, 2016).

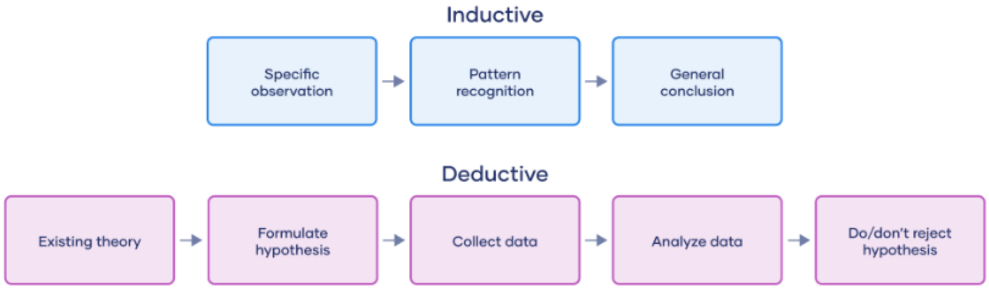

Figure 2: Difference between inductive and deductive research approach

Deductive and inductive reasoning can be combined flexibly in pragmatism, making the mixed technique of data collection possible (Antwi & Hamza, 2015).

3.4 Research Strategy

The application of research procedures or tactics to a subject might be based on deductive and inductive reasoning. Based on the study aims, inductive and deductive reasoning have different sets of research methodologies. Experimental studies closely follow the rules of the scientific process (Etikan, 2014). Using both controlled and uncontrolled factors, the researcher evaluates the hypothesis before drawing a conclusion. Utilizing statistical techniques, the researcher analyzes the information gathered to confirm or deny the hypothesis (Mackey & Gass, 2015). Another scientific research technique that is mostly applied in social studies is the survey. In surveys, researchers give out questionnaires containing the testing variables to participants in order to collect precise data. The surveys can be carried out as in-person interviews, paper-based surveys, or online surveys (Mackey & Gass, 2015).

Action research, case studies, ethnography, grounded theory, and archive research are some of the most important non-scientific or qualitative research methods (Mackey & Gass, 2015). By conducting the study while implementing the suggested solution, action research is a common method for utilizing social science to bring about transformative change. Action research needs a high level of critical thinking. Case studies seek to gain comprehensive multidimensional knowledge about complex issues that arise in practical contexts (Flick, 2015). In order to gather in-depth insights, ethnographic research involves interacting with, participating in, and observing the respondents in their real-life situations (Queirós, et al., 2017). In order to create theories and hypotheses, grounded theory gathers and assesses qualitative evidence. Secondary data are generally used in archival research. To finish a certain study, archival research is done by obtaining secondary data from documents (Flick, 2015).

Research Strategy	Description	Source	The rationale for the unfeasibility of the present study
Experiments	focuses on confirming or refuting a study idea using the scientific method in a controlled setting. The experimentation strategy is geared more toward testing established hypotheses that are better appropriate for investigations that are deductive in character.	(Crossley & Jansen, 2021)	The experiment technique cannot be modified for the study because the current study concentrated on an in-depth investigation of people in an uncontrolled environment.
Action Research	Action research is a procedure in which the researcher, participants, and other stakeholders collaborate to address a research issue pertaining to interactions in the real world. Action research employs practical methods, is frequently carried out through fieldwork, and includes a regulated set of data gathering.	(Ragsdell, 2009; Saunders et al., 2019)	Since the current study does not call for any practical strategies or fieldwork, action research is not appropriate.
Ethnography	Ethnography is the study of people's experiences and social-cultural characteristics in which the researcher spends a significant amount of time interacting with the research population.	(Yin, 2014)	With the time constraints of this study, ethnography is not viable because it takes a significant amount of time to collect data.
Grounded Theory	The hypothesis is created using evidence that has been gathered about the social environment and human behaviour. In general, grounded theory is employed when no theory currently in existence provides an explanation for the phenomenon being studied.	(Sridarran, 2018; Toloie-eshlaghy et al., 2011)	In anticipation of a specific degree of data that would disprove the grounded theory for the strategy, the current study is based on some previously produced ideas of disaster preparedness.
Case study	A case study is an in-depth examination of a bounded system that represents a certain kind of event.	(Burt et al., 2017, p.130)	Case studies are not appropriate because this study is not constrained by any one system or context.
Archival research	Archival studies are undertaken simply by reviewing the secondary data that are already available and are based on those materials. This approach is ideal for historical research.	(Crossley & Jansen, 2021)	This approach cannot be used because the study calls for primary data from an empirical investigation.

Most of the construction based researchers are conducted using a survey strategy. It allows the researcher to avoid the subjectivism of the research. Additionally, the reliability of the research is increased with this research strategy. Hence, the survey strategy is the ideal method for this research to achieve the intended research aim and objectives.

3.5 Research choices

The third exterior layer of the study onion's methodological option mainly entails choosing between qualitative, quantitative, and mixed methodologies. The quantitative approach is the method of gathering data from gathered records and supporting evidence (Naoum, 2007). Additionally, Creswell (2003) noted that the quantitative approach primarily emphasizes statistical techniques. The quantitative study would be more suitable for studies that begin with the words "what," "who," "where," "how much," and "how many" in the research question (Smith, Thorpe, & Lowe, 2007).

For situations assessing social, attitudinal, and exploratory behaviours and beliefs, the qualitative research approach is most appropriate (Naoum, 2007). The qualitative method is significant in that it takes into account a particular set of people and represents their perspectives and aspects (Yin, 2011). When the research issue begins with "how" and "why," Ritchie and Lewis (2003) stated in their study, a qualitative method is more appropriate.

The mixed approach, which combines both approaches and avoids their drawbacks, is not a replacement for either the qualitative or quantitative approaches (Johnson & Onwuegbuzie, 2004). Therefore, combining many research methods rather than relying just on one gives scholars a greater understanding (Nguyen et al., 2018).

In this study, qualitative research was chosen because it was meant to analyse the problems with current preparedness systems and the user needs for a digitally upgraded system that required subjective and attitudinal information.

3.6 Time horizon

This section of the research onion explains how long the study took. In light of this, there are two categories of research: longitudinal and cross-sectional (Saunders et al., 2019). The term "longitudinal study" describes the examination of a phenomenon across time in order to compare the results (Caruana et al., 2015). A "Snap-shot" study, in which the phenomenon is examined at a particular point in time, is a cross-sectional study (Setia, 2016). In general, surveys and case studies (long-term) use a longitudinal time horizon, while ethnography, action research, archive research, and case studies (short-term) adopt a cross-sectional time horizon, according to Saunders et al. (2019). A cross-sectional time horizon was used since this study took into account the current difficulties of disaster preparedness and user needs for a suitable information and coordination system without requiring chronological qualities of data.

3.7 Critical Evaluation of Research Methodologies

The purpose of this study is to pinpoint factors that promote and inhibit the use of IT solutions for risk management in the construction sector. The study looks primarily at IT solutions to try and pinpoint the research topic's drivers and obstacles. The construction business in Sri Lanka is a multi-layered, diversified sector. Gaining in-depth knowledge from a smaller section does not provide a complete understanding of the construction industry because it does not account for all of its sub-segments. The knowledge examined in this study is, however, industry driven. Consequently, this study adopts the ***positivist research philosophy***.

The study examines how IT services are used in the construction sector for risk management. Thus, generalizing the results to the entire industry is a key goal. By developing hypotheses, the research aims to test already established theories and empirical research findings. The study adopts a positivist methodology as a result. Deductive reasoning is therefore applied in this study. As a result, the study adopts a ***scientific deductive reasoning strategy***, collecting data using numerical forms and statistical analysis.

This study adopts a scientific methodology since it adheres to the positivist research attitude and uses logical reasoning. The goal is to pinpoint the factors that influence and obstruct the use of IT solutions for risk management in the construction sector. In order to generalize findings to the entire construction sector, the study adopts an industrial approach and calls for collecting information from a broad sample. However, the study cannot be carried out in a sterile laboratory setting or by gathering information from a small sample of participants and analyzing in-depth insights. As a result, ***the survey*** was selected as the better research methodology for this study since it allows for the collection of big data sets that span a variety of construction industry strata.

In a similar vein, Ahmed, Azhar, and Eng (2004) produced their research using the questionnaire survey approach in order to gather trustworthy data for the research while looking into problems among Florida construction companies. Additionally, using the questionnaire survey approach, the evaluation of risk management in the construction business has been assessed (Renault & Agumba, 2016). Similar to that study, this one was carried out using a questionnaire survey and a sample size of over 150 people in order to generalize the results and provide a trustworthy research product.

The researcher selected the quantitative research method following the mono method. A similar type of construction related research project follows the quantitative research method as the main choice to follow the process. Hence, this method is suitable for the project to avoid bias and subjectiveness of the research. Furthermore, the researcher emphasises the importance ***quantitative method*** to obtain a reliable mechanism for the research.

The research is based on a particular time frame, and it is expected to complete within 6 months. Therefore, the impact of the time is limited to the research. According to the availability of several time horizons this research is conducted via ***cross sectional time horizons***. Generally, construction related researchers are conducted via a short time frame and it allows the researchers to obtain a reliable and timely outcome.

3.8 Data Collection

As data is only collected once, the study is cross-sectional. This study does not collect data from the same respondents over an extended period of time (Barnham, 2015). Either primary or secondary data can be gathered for a study. Primary data are gathered expressly for the given study that has a high level of validity and reliability. Secondary data are data that have already been gathered for another study by a third party. They are selected based on which ones are most pertinent to a certain study, although reliability and validity are poor (Flick, 2015).

As a result, this study uses a primary data gathering approach because its findings can be applied to a sizable population. As a result, it is anticipated that the study will use quantitative primary data gathering to conduct statistical data collecting and analysis. The main tool for gathering survey data was an online questionnaire. Key study factors and hypotheses are included in the questions. Selected individuals in Sri Lanka's construction industry will receive the questionnaire online from specific geographic locations. The purpose of this study is to determine what hinders and encourages the use of IT solutions for risk management in the construction sector. As a result, the information gathered is directly relevant to the construction sector, IT integration, and risk management. The five-point Likert scale is used to design the surveys. Prior to the actual distribution, a pilot study will be carried out to evaluate the questionnaire's validity and reliability among 25 respondents from the sample. A homogenous sample ought to produce answers that follow a predictable pattern. It is assessed during the pilot research, and improvements are made as needed based on the findings. Statistical software called SPSS is used to evaluate the data.

3.8.1 Population and Sample Size

The total group to whom research findings are extrapolated is referred to as the research population. The sample is the chosen subset of the research population with uniform features. A significant problem is determining the precise number of employee profiles in the construction business. Additionally, only large-scale businesses are able to integrate IT into the construction sector (Etikan, 2014). To determine the sample size, utilize the Krejcie and Morgan table (Etikan, 2014). To ensure that every member of the population has a chance to be chosen for the sample, simple random sampling procedures are used.

3.8.2 Data Collection Process

Those involved in the risk management of construction sector projects, including professionals and stakeholders, participated in this study. 180 people make up the chosen sample size, which was determined using the Morgan table based on the research's accessible population. In addition, the research reveals that information is gathered via a questionnaire survey that is circulated among professionals in the construction industry via Google Forms in order to research all potential respondents despite geographical limitations. The first four study objectives are covered by 10 questions in the questionnaire survey. To validate the findings of the literature study on risk management in the construction industry, the questionnaire survey is anticipated to receive more than 80% of the target response rate.

3.8.3 Data collection instruments

To better understand the questionnaire survey respondents, data was gathered based on the following questions that were asked in the survey.

Demographic questions

The following questions are asked in the questionnaire survey to obtain an overview of the respondents and their demographic factors.

Table 1: Demographics questions

Questions	Evaluation Criteria
Gender	Male, Female
Age	20 – 30 years 30 – 40 years 40 – 50 years Above 50 years
Highest educational qualification	Mention your qualification
Professional experience in the construction industry	Less than 5 years 5 – 10 years 10 – 20 years Above 20 years

Descriptive questions

To achieve the goals of the research, the following questions are answered in the questionnaire survey to gain an understanding of risk management and IT applications in the construction business.

Table 2: Descriptive questions

Questions	Evaluation Criteria
IT application in the construction sector	1 – not significant 2 – less significant 3 – neutral 4 – significant 5 – highly significant
Factors affecting risk management in the construction sector (sources of risks)	
Impact of risk management on the construction industry	
Risk management drivers in the construction industry	
Risk management barriers in the construction industry	
Application of IT on risk management in the construction industry	

3.9 Data Analysis

The results of the questionnaire survey are analysed using SPSS statistical software, and the literature review's highlighted factors are ranked according to their significance using the mean and RII values. The following formula illustrates the relationship between the mean and RII value.

Mean value x 0.2 = RII

To get a trustworthy picture of the elements' relevance, the RII value is obtained for each factor ranked in the questionnaire survey.

3.10 Ethical Issues

The recruitment of the sample is where the biggest ethical dilemma occurs. The researcher should carefully choose the sample participants by soliciting their informed consent without coercion and then abruptly terminating the study. When answering questions and freely participating in the proceedings, the recruitment sample should not affect the researchers' bias. Additionally, pilot research was carried out to improve validity and reliability. All the questionnaire survey participants were given consent forms before the commencement of the questionnaire survey. Furthermore, the respondents have the right to declare the questionnaire survey at any time without giving any reasons.

The collected data is separately recorded and only researcher has the access to the database. All the collected data will be disposed of after 2 months from the completion data and none of the data is used for any other personal usage except the research analysis.

3.11 Chapter Summary

This chapter provided an explanation of the study's research methods. In order to execute risk management in the construction business using IT technologies, this study intends to identify drivers and impediments. Instead of limiting the investigation to a single business or region, identifying barriers and drivers call for a broad-based approach. As a result, the study adopts a positivist methodology and uses survey research and deductive reasoning. Due to the scientific character, a five-point Likert scale questionnaire is used to collect numerical data as part of a quantitative study strategy. The study is cross-sectional, and data are particularly collected from personnel in the construction business with sufficient IT exposure.

4.0 Results and Analysis

4.1 Chapter Introduction

The primary research data gathered from a questionnaire survey are covered in this chapter. 180 business stakeholders in the industry got it, and 165 of them responded. Based on the drivers and barriers for risk management IT solutions in the construction industry that were identified, a questionnaire survey was undertaken. The results of the questionnaire survey are included in the framework's development along with research findings. The response rate has been shown in this research to be 91.6 per cent, per the research findings. it gives healthy weight to the research's conclusions and its effectiveness.

4.2 Method of Analysis

Frequency statistics and descriptive statistics were used in the analysis with the use of SPSS to produce the demographic and RII analyses, respectively. Frequency analysis was utilized for the demographic analysis of the study to identify the key characteristics of the questionnaire survey respondents and how those characteristics affect the risk management-related outcomes in the construction industry.

The Relative Important Index (RII) is used to rank the survey results based on secondary data from the research. Based on the average value of the elements discovered through literature research, the RII is created. The conclusions have an immediate impact on the framework being developed for the drivers and barriers of risk management as well as the use of IT for risk management in the construction industry.

Using the average values The level of significance of the discovered factors is demonstrated by RII. In light of this, the following Table 01 is Used to Determine the Level of Importance of the Identified Factors.

Table 3: RII and level of importance relationship

Mean	RII Range	Level of Importance
0.00 – 1.00	0.0 – 0.20	No Importance
1.00 – 2.00	0.20 – 0.40	Less importance
2.00 – 3.00	0.40 – 0.60	Neutral
3.00 – 4.00	0.60 – 0.80	Important
4.00 – 5.00	0.80 – 1.00	Highly important

According to the outcome of Table 03, the RII range and level of importance have shown a relationship to emphasise the research analysis related information. Hence, the RII values above 0.6 indicated the importance of the research outcome and it is upgraded to a highly important section with the 0.8 RII value. RII values below 0.4 are less important. This relationship supports the research outcome to illustrate its importance and to obtain better relevance for the research outcome.

4.3 Demographic Analysis

4.3.1 Gender

According to the demographic study, about one-third of the respondents were female. Male respondents make up over 70% of the questionnaire survey participants. It also shows how heavily dependent on men in the construction sector is, and how the outcomes of survey questions may also be contributing to this dominance.

Table 4: Gender differentiation of the questionnaire survey respondents

Gender

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Female	50	30.3	30.3	30.3
	Male	115	69.6	69.6	100.0
	Total	165	100.0	100.0	

In addition to the male dominance of the research outcome, 30.3% of the female contribution was also recorded for the research. Therefore, despite the male dominance the research analysis has shown the female contribution to the research.

4.3.2 Age

All of the relevant age groups are used to categorize the respondents to the questionnaire survey. However, 70 respondents—representing the 30–40 year age group—represent the bulk of respondents. The second-highest age group with the greatest number of respondents is between the ages of 40 and 50. 9.0 per cent of all respondents to the questionnaire survey are in the 20 to 30 year age group, which is the lowest percentage.

Therefore, the greater proportion of respondents—79% of the respondents—represent the 30–50 age range. As a result, the vast majority of respondents are responsible and qualified to produce positive results from the questionnaire survey.

Table 5: Age differentiation of the questionnaire survey respondents

Age

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	20 - 30 years	15	9.0	9.0	9.0
	30 - 40 years	70	42.4	42.4	51.4
	40 - 50 years	60	36.3	36.3	87.7
	Above 50 years	20	12.1	12.1	100.0
	Total	165	100.0	100.0	

Therefore, the majority of the questionnaire survey respondents are in the middle age range. For the research, the outcome is highly reliable.

4.3.3 Educational qualifications

Many different types of respondents with a wide range of educational backgrounds filled out the questionnaire survey demonstrating that several businesses combine to work under one roof in the building industry. In light of this, the vast majority of responders hold master's degrees in science, which is 35.2% of the total response rate. Approximately 35% of all responders fall under this category. With 30 responders, a master's in business administration is the second-highest educational achievement. Additionally, 25 respondents represent the category of people with a bachelor's degree in science. Accountants, Bachelor of Arts recipients, and respondents with a diploma only made up less than 5% of the total respondents.

Table 6: Educational qualifications of the questionnaire survey respondents

Highest educational qualification

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Accountant	2	1.2	1.2	1.2
	Business administration	10	6.1	6.1	7.3
	Bachelor of Science	25	15.1	15.1	22.4
	Bachelor of Technology	15	9.1	9.1	31.5
	Master of Business Administration	30	18.2	18.2	49.7
	Master of Science	58	35.2	35.2	84.9
	Bachelor of Arts	4	2.4	2.4	87.3
	Bachelor of Information Technology	19	11.5	11.5	98.8
	Diploma	3	1.2	1.2	100.0
	Total	165	100.0	100.0	

The educational qualification of the research is showing the combination of different educational qualifications ranging from bachelor’s degrees to Masters degree programmes. Hence, the research outcome has a variety of contributions from the primary data to illustrate better applications. As a result, there is little chance that the questionnaire survey results will deviate from their original purpose.

4.3.4 Professional experience

Professional experience is a key issue in the demographic study. Less than 20 years of professional experience in the field are held by more than 50% of respondents. 32% of the respondents had between 10 and 20 years of professional experience working in the construction business. About 16% of those who answered the poll had worked in the construction industry for more than 20 years. 48 of the 165 survey participants who responded to the questionnaire made it clear that they had less work experience in the construction industry.

However, 48.2% of those who responded to the questionnaire poll had more than 10 years of professional experience in the building business. Overall, the results are positive and show that the majority of responders have extensive knowledge of the relevant topics.

Table 7: Professional experience in the construction industry of the respondents

Professional experience in the construction industry

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	10 - 20 years	51	31.9	31.9	31.9
	5 - 10 years	35	21.9	21.9	53.8
	Above 20 years	26	16.3	16.3	70.0
	Less than 5 years	48	30.0	30.0	100.0
	Total	165	100.0	100.0	

More than 50% of the respondents have less than 10 years of industry experience. Nevertheless, the research outcome is not hindered by the level of professional experience of the respondents. However, it indicates the reliability and acceptability of the research outcome. Consequently, the research's findings are quite favourable.

4.4 Descriptive Analysis

The descriptive analysis of the research is illustrating the drivers and barriers to the risk management process in the construction industry while identifying the IT related applications. Furthermore, the descriptive analysis is conducted to assess the importance of IT applications and risk management strategies to show the relevance ad achievement of the research objectives.

4.4.1 Sources of risk in risk management in the construction sector

In order to apply appropriate risk management procedures, Jonas Construction (2011) claims that a number of sources of risk have been discovered in the construction industry. Risk has the highest priority among all potential sources of risk in the construction sector, according to Table 6 Financial. The RII value, however, was 0.604, which is also not of the utmost significance. Environmental risk is the risk that is least related to the building business, as seen in Table 6 below. It is almost neutral with an RII score of 0.584. Environmental risk, safety risk, legal risk, and project risk are consequently in the neutral region, indicating that the respondents' overall understanding of those issues is restricted and they are unable to make an appropriate judgement on those. However, the sole important risk for the sizeable risk for risk management in the construction sector has been identified as financial risk.

Table 8: Sources of risk of the risk management of the construction industry

Descriptive Statistics

	N	Mean	RII
Environmental risk	165	2.92	0.584
Safety risk	165	2.93	0.586
Legal risk	165	2.95	0.59
Project risk	165	2.98	0.596
Financial risk	165	3.02	0.604
Valid N (listwise)	165		

According to Table 08 outcome, except for financial risk, all the other types of risks have recorded similar RII values. As per the initial demonstration of the RII value, all these types of risk are in the neutral range. Therefore, concluding the response of the primary data and secondary data findings all the types of risks are related to risk management in the construction industry.

4.4.2 Drivers to perform risk management in the construction industry

In the construction sector, risk management is motivated by a variety of different sorts of drivers, according to the literature review. In light of those highlighted major drivers Table 7 shows how important those are to risk management techniques in the construction sector. Key authors who have proven knowledge of the drivers of risk management in the construction sector are Hung et al. (2019), Gibson (2003), and Kolman (1992).

The results of the questionnaire survey have shown that every one of the risk management drivers is above 0.800, which is an area of high importance. Comprehensive risk identification among those drivers, however, has the highest RII value of all other drivers with a score of 0.872. The second most significant risk management driver in the Sri Lankan construction sector is the effectiveness of risk management, which has an RII value of 0.858. A lower level risk management technique, with an RII value of 0.834, has been identified among all risk management driving checklists.

Table 9: Drivers performing risk management in the construction industry

Descriptive Statistics

	N	Mean	RII
Checklists are some of the risk management techniques	165	4.17	0.834
Risk-retention and risk transferring factors	165	4.21	0.842
Delphi technique, brainstorming, and checklists, are some of the risk management techniques	165	4.21	0.842
Quantitative risk analysis such as risk matrix	165	4.24	0.848
Organisational learning and organisational behaviour	165	4.25	0.85
Challenges, situations, and remedial measures experienced from previous projects	165	4.26	0.852
Effectiveness of risk management	165	4.29	0.858
Comprehensive risk identification	165	4.36	0.872
Valid N (listwise)	165		

Although none of the risk management factors can be ignored, they are all within a very crucial area, thus individuals working in the construction sector need to be concerned about all of those facts.

4.4.3 Barriers to performing risk management in the construction industry

The limitations impacting risk management in the modern construction business were further discussed by Gann (2000), Carr (2011), and Liu et al. (2003). Through the cooperation of specialists in the construction sector, a questionnaire survey was undertaken to validate the findings of the literature.

Except for one obstacle, all of the barriers were found to be in the neutral area. When adopting risk management using IT applications in the construction sector, professionals must take into account a key barrier that has been recognized as the effectiveness of risk management. The results show that risk management effectiveness has a 0.690 RII score, which is in the important category.

Table 10: Barriers to performing risk management in the construction industry

Descriptive Statistics

	N	Mean	RII
Low performance indicators	165	2.35	0.47
Lowest in innovations	165	2.38	0.476
Low productivity levels	165	2.47	0.494
Sense of insecurity	165	2.48	0.496
Poor consideration of cohesiveness in risk management across the construction process	165	2.50	0.5
Low levels of skills, knowledge and experience	165	2.54	0.508
Communication gap	165	2.63	0.526
Effectiveness of risk management	165	3.45	0.69
Valid N (listwise)	165		

The respondents' inadequate understanding of the obstacles to risk management and IT applications in the construction industry is indicated by the fact that all other criteria are in the neutral group. Low-performance indicators have the lowest RII value of all of the elements, at 0.470. Hence, the acceptance of these factors as barriers to performing risk management in the construction industry is questionable. Even though the literature review has identified those as affecting the construction industry risk management the research questionnaire survey outcome has overturned the decision.

4.4.4 Importance of information technology in the construction industry

In the contemporary environment, information technology is significantly influencing the building sector. However, this study found that the modern construction sector has very little IT engagement in risk management procedures and that with the right amount of thought, risk management may be more effective and efficient than it now is.

Therefore, the following aspects have been highlighted in light of the literature's findings. Therefore, all of the characteristics in the highly significant category show that the value of information technology in the construction business has been recognized by industry professionals. Similarly to this, Matheu (2005) highlighted the significance of IT in the construction industry for its continued development and risk management procedures.

Since the construction sector is facing significant issues as a result of low productivity, increasing productivity is identified as the construction industry's most vital importance with the application of information technology. The necessity of increased efficiency in the construction industry was emphasized by Rojas and Songer (1999). Technology is another important aspect of IT engagement in the construction business, with an RII value of 0.888. Increased support for project planning, execution, and management in the construction sector is the third crucial aspect. It has a 0.886 RII score, which indicates that it is more important than other factors.

Table 11: Importance of information technology in the construction industry

Descriptive Statistics

	N	Mean	RII
The construction industry has limited involvement in IT	165	4.05	0.81
IT is a tool to loosen the problems caused by fragmentation	165	4.28	0.856
The web has the capability to overcome servers and smart browsers	165	4.28	0.856
Increase site safety	165	4.32	0.864
Improved alliances	165	4.32	0.864
Better to handle complex projects	165	4.37	0.874
IT helps in project planning, operation, and control	165	4.43	0.886
Advancement of construction technology is essential	165	4.44	0.888
Increase productivity	165	4.46	0.892
Valid N (listwise)	165		

Another crucial element for the adoption of IT in the construction industry has been highlighted as the industry's limited IT participation. However, it shows as the lowest important factor among other factors, with higher importance according to the RII value of 0.810.

4.4.5 Impact of risk management on the construction industry

As it helps the sector to identify hazards and lessen their impact on the construction sequence, BigRentz Inc (2019) emphasized the significance of risk management in the construction business. As a result, Table 10 lists the various elements that were discovered throughout the literature analysis addressing how risk management affects the construction business. According to Jonas (2021), an accurate risk assessment helps a building project or company make more money. Additionally, it has been discovered that effective risk management encourages the growth of stronger bonds with project stakeholders.

Table 10 illustrates that the key variables cited by questionnaire survey respondents as demonstrating the impact of risk management in the construction industry are overspent budgets, unrealized benefits, and late-running projects. Overspent budget is the primary effect of risk management in the construction sector among those three variables.

Therefore, risk management aids the project team in preventing budget overruns in the construction sector. Additionally, respondents to the questionnaire survey with RII values between 0.500 and 0.600 are neutrally identifying with dissatisfied clients, poor user adaption, project failure, and reputational damages. Poor risk management in the construction business has the least negative effects on these reputations for construction organizations. As a result, the respondents to the questionnaire survey are less aware of the reputational harm, project failure, low adoption, and dissatisfied clients caused by poor risk management practices in the construction business.

Table 12: Impact of risk management on the construction industry

Descriptive Statistics

	N	Mean	RII
Reputation damage	165	2.84	0.568
Project failure	165	2.86	0.572
Poor user adoption	165	2.88	0.576
Unhappy clients	165	2.95	0.59
Late-running projects	165	3.02	0.604
Unrealised benefits	165	3.04	0.608
Overspent budgets	165	3.08	0.616
Valid N (listwise)	165		

Additionally, it has been reported that efficient risk management aids in the prevention of projects running late, benefits not realized, and budgets being overspent in the construction business and on contemporary construction projects. The reputation damage, project failure, and poor user adoption. And unhappy clients are of lower importance for risk management in the construction industry in Sri Lanka.

4.4.6 Application of IT on risk management in the construction industry

The significance of IT application for risk management in the construction industry is shown in Table 11 To determine the elements that are highly important, important, neutral, less important, and not important for the application of IT on risk management in the construction industry, all the most recent study findings have been graded based on their RII values.

Table 13: Application of IT on risk management in the construction industry

Descriptive Statistics

	N	Mean	RII
Low productivity levels	165	2.78	0.556
Lowest in innovations	165	2.78	0.556
System failures	165	2.81	0.562
Sense of insecurity	165	2.81	0.562
Low levels of skills, knowledge and experience	165	2.81	0.562
Poor consideration of cohesiveness in risk management across the construction process	165	2.85	0.57
Low performance indicators	165	2.87	0.574
Communication gap	165	2.88	0.576
Workplace safety issues	165	2.88	0.576
Effectiveness of risk management	165	3.78	0.756
Valid N (listwise)	165		

The results of the above table show that only the effectiveness of risk management matters when applying IT to risk management in the construction industry to reduce risk and boost income. However, in the questionnaire survey, respondents gave all other characteristics listed in the literature study neutral ratings. That demonstrates the respondents to the questionnaire survey's lack of comprehension of the use of IT in risk management in the construction business. Low productivity level is also the least significant factor taken into account for the implementation of risk management in the construction industry among the other aspects that have been found. Table 13 workplace safety issues, communication gaps, poor performance indicators, a lack of cohesiveness in risk management, throughout the construction process, low levels of skills, knowledge, and experience, a sense of insecurity, system failures, the lowest levels of innovation, and low productivity levels are the limited level of IT application on the risk management of the construction industry in the modern world. This highlights the fact that experts in the construction business are still reluctant to recognize the value of IT for risk management, and their lack of familiarity with the IT industry serves as a significant roadblock to its adoption. Although IT application for construction risk management has been emphasized by researchers, industry experts have not acknowledged this, showing significant knowledge gaps and a lack of knowledge transformation among academicians and industry practitioners.

4.5 Develop an IT-based framework to address risk management in the construction industry

Modern construction projects and the development of the IT framework for risk management in the construction industry are highlighted while only taking significant elements into account. For the building of the framework, all other components that were identified in the literature review but weren't solely validated by questionnaire surveys were left out. Table 12 shows the identification of the knowledge and practices of the construction sector risk management.

Sources of Risk	**Drivers for performing risk management**	**Barriers to performing risk management**	**Recommendations**	**Importance of Information Technology**
Financial Risk	Checklists are some of the risk management techniques	Effectiveness of risk management	Increase the awareness of the construction industry professionals regarding the importance of risk management in the construction industry	The construction industry has limited involvement in IT
	Risk-retention and risk transferring factors	**Impact of risk management on the construction industry**		IT is a tool to loosen the problems caused by fragmentation
	Delphi technique, brainstorming, and checklists, are some of the risk management techniques	Overspent budgets	Maintain the financial risk at a controllable level Implement cost constraints	The web has the capability to overcome servers and smart browsers
	Quantitative risk analysis such as risk matrix	Unrealised benefits	Maintain the accountability of the project Review project objectives on continuous levels	Increase site safety
	Organisational learning and organisational behaviour	Late-running projects	Maintain project programme Identify and forecast possible project-based shortcomings	Improved alliances
	Challenges, situations, and remedial measures experienced from previous projects	Developing technology-based processes to identify and mitigate construction risk		Better to handle complex projects
	Effectiveness of risk management	Provide possible risk registers with frequent updates		IT helps in project planning, operation, and control
	Comprehensive risk identification	Implement a personal responsibility charter to identify the responsible personalities		Advancement of construction technology is essential

Table 14: Developed IT-based framework

Table 14 illustrates that the financial risk is the key risk that the construction industry is facing and the only risk that needs the intervention of the IT industry for rectification. Hence, the developed IT based framework has been focused on the financial risk of the project. Nevertheless, the IT based development in the construction sector supports the project team to achieve site safety and avoid other project related complexities. Hence, that allows the project team to obtain better risk management practices and findings the project team to ensure the completion of the project within the time frame.

The framework suggests that increasing the awareness of construction industry professionals regarding the importance of risk management helps to increase the effectiveness of risk management. then maintaining financial risk at the controllable level while implementing cost constraints avoids the cost overrun of the project. application of IT solutions and reviewing continuous project objectives continuously avoid the unrealised benefits which can be obtained by the construction professionals and employees. maintaining the project programme and forecasting the project outline avoid time overrun the project.

4.6 Chapter Summary

With the help of experts in the construction industry, this chapter corroborated the findings of the literature analysis by identifying the most significant forces influencing and impeding risk management in the sector. The framework was established to evaluate risk management in the construction industry in an IT-based environment in order to get the pertinent aspects that are affecting the construction sector, according to the research's findings. The last chapter summarizes the research's findings and offers suggestions on how practitioners and consumers in the construction sector might use the IT sector to manage risk in a way that is dependable.

5.0 Recommendations and Implementation

5.1 Chapter Introduction

The chapter comes to the conclusion that there are both motivating factors and obstacles to the adoption of construction industry risk management strategies. This chapter provides a concise summary of the research findings to help with risk management in the construction industry. the chapter is consisting of the conclusions, recommendations, implementation, limitations and further research areas.

5.2 Conclusion

Objective 01 - Identify drivers for performing risk management in the construction industry

Through a literature study and survey, the first goal was achieved. All of the drivers were recognized as key aspects of the risk management of the construction industry, per the validation of the questionnaire survey. According to the study section's findings, factors that influence risk management in the construction business include comprehensive risk identification, the effectiveness of risk management, and difficulties, situations, and corrective actions learned from earlier projects. The literature review and primary data analysis outcome has combined and demonstrated that all the drivers revealed in the literature review have been accepted as highly important drivers to perform risk management.

Accordingly, Challenger situations and remedial measures experienced from previous projects, organisational learning and organisational behaviour, and quantitative risk analysis such as risk Metrix. Additionally, the use of the Delphi technique, brainstorming and checklists are effective risk management techniques. Furthermore, risk retention and risk transferring factors have to be implemented to perform better risk management in the construction industry. Therefore, the combination of all these drivers supports the construction industry to perform risk management.

Objective 02 - Identify barriers to performing risk management in the construction industry

Utilizing a literature review and questionnaire survey, the second goal of the study was accomplished in order to validate the results. However, it was determined from the results of the questionnaire survey that there is just one barrier that has been identified as a significant element for risk management in the construction business. The data analysis indicates that in order to get a successful research outcome, the effectiveness of risk management must be taken into account in the risk management of the construction business. Although, all the barriers that were identified through the literature review were not affecting the Sri Lankan construction industry.

Objective 03 – Evaluate the importance of information technology in the construction industry

All of the elements highlighted in the literature research have been regarded as being extremely essential for the assessment of IT engagement in the construction industry in the evaluation of the significance of IT in the industry. The concerns about IT and its effects on the construction industry are thus well known to the responders. However, this aim has shown that despite the fact that business professionals are aware of the significance of IT in the construction industry, they are unaware of the significance of IT's implications for risk management procedures. The main issue raised by the questionnaire poll was how much risk management procedures are harming the construction industry as a result of overspent budgets, unrealized benefits, and late-running projects. Due to the participants in the questionnaire survey who are referred to as professionals in the construction industry lack comprehension, all other aspects mentioned in the literature review have been left out.

Objective 04 – Assess the impact of risk management on the construction industry

Risk management in the construction sector has an impact on the final product. The risk management techniques of the construction sector are being impacted by environmental risk, safety risk, legal risk, project risk, and financial risk, according to the literature review. However, according to experts in the construction business, the only significant aspect of risk management in this sector is financial risk. Additionally, risk management in the construction industry does not take project risks, environmental risks, safety risks, legal risks, or other risks into account.

Objective 05 – Develop an IT-based framework to address risk management in the construction industry

The development of the IT-based framework to address risk management in the construction industry has revealed implications and revealed recommendations for the industry to overcome the challenges and barriers in the industry while giving priority to the drivers of risk management in the construction sector. According to the framework created using IT, it can be used at any stage of a building project to reduce risk using appropriate risk management techniques provided in an IT-based environment.

5.3 Recommendations

It is advised that industry specialists learn more about IT-based solutions in order to address challenges facing the construction sector and improve their ability to implement risk management strategies. In order to adopt effective risk management procedures, it is also crucial to identify the most significant construction industry elements and risks. This makes sure that there are no hidden risks that could affect the construction projects. Additionally, the use of contemporary IT-based technological implications has greater initial costs but lower overall project costs. Provide proper training for the construction professionals to use IT based technological applications. Implement IT based technology for the construction industry related educational curriculum. Conduct an extensive risk assessment for every construction project before the commencement and also during the construction process.

5.4 Implementation

The primary impact of this project is to handle miscommunications and disconnections in the construction business in order to acquire trustworthy IT-based software and hardware applications and prevent unwarranted effects on the project's output. The developed IT based application in the construction industry supports the construction sector in overcoming financial risk, which is the main issue that is confronting the construction sector. Additionally, the review of the given framework helps construction industry professionals to identify suitable solutions and practices to rectify barriers and risks of construction projects. Moreover, the identified drivers are possible to apply to the relevant sections to achieve the highest outcome from the project.

5.5 Research Limitations

The shortage of time and the Covid 19 pandemic's impact on the data collection method were two significant research limitations. Furthermore, while identifying the primary project problems and risk management-based methods, the research was unable to locate trustworthy construction specialists due to the aforementioned constraints, which also had an impact on the conclusion. However, the time plan developed at the commencement of the project helped the researcher to achieve the time targets. Furthermore, the restricted data collection process due to the COVID-19 pandemic was not affecting the research outcome. since the researcher has obtained 165 responses from the construction industry which allows the researcher to avoid any bias.

5.6 Further Research Area

It is anticipated that the research will continue by identifying potential and dependable IT solutions for risk management in the construction sector. In order to acquire a trustworthy project outcome, focusing the research topic on either building or civil engineering construction projects in the construction business helps to produce more effective and targeted research results. Based on the conclusions and recommendations of this research and focus on the foundation of the research outcome following further research area has been suggested by the researcher.

- Evaluate the method of implementing IT for construction preliminary cost estimation
- Assess the involvement of the construction industry stakeholders to manage IT related services during the construction process
- Develop an IT based framework for incorporating construction professionals for LCCA in high rise building construction
- Assess the importance of IT based modern technological development for the construction cost certainty

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