FACTORS IN ENSURING CONSTRUCTION READINESS IN SARAWAK'S BUILDING CONSTRUCTION

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FACTORS IN ENSURING CONSTRUCTION READINESS IN SARAWAK'S BUILDING CONSTRUCTION

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ABSTRAK

Kesediaan pembinaan dikenalpasti sebagai penyumbang utama kepada kelewatan dalam pembinaan. Penentuan aktiviti dan prosedur yang perlu diselesaikan adalah sangat penting sebelum permulaan projek pembinaan. Disebabkan kelewatan projek, akan berlakunya peningkatan kos, dan hal ini meletakkan kontraktor dalam bahaya. Mereka mengalami kerugian akibat projek itu, bukannya keuntungan. Ini kerana pasukan projek lebih cenderung tergesa-gesa untuk memulakan pembinaan tanpa menilai kesediaan projek. Oleh hal demikian, adalah perlu untuk menilai kesediaan projek. Justeru, tujuan penyelidikan ini adalah untuk membincangkan kesediaan pembinaan bagi projek pembinaan bangunan di Sarawak. Terdapat tiga matlamat kajian ini: untuk mengetahui faktor-faktor yang mempengaruhi kesediaan pelaksanaan projek pembinaan; untuk menilai kedudukan faktor kritikal kesediaan dalam pelaksanaan projek bangunan di Sarawak; untuk mengkategorikan faktor kesediaan pembinaan kritikal bagi projek bangunan di Sarawak. Pada peringkat petama kajian, soal selidik dibangunkan daripada Faktor Kesediaan Pembinaan (CRF) yang dikenal pasti, daripada kajian literatur. Kemudian, pada peringkat kedua, data daripada sembilan puluh satu respons dianalisis menggunakan Indeks Kepentingan Relatif (RII) untuk menentukan kedudukan CRF. Seterusnya dalam peringkat ketiga, mengkategorikan faktor kesediaan pembinaan kritikal bagi projek bangunan di Sarawak. Skop kajian ini adalah projek pembinaan bangunan di Sarawak. Sebanyak tiga puluh tujuh CRF kritikal untuk projek pembinaan bangunan dikenal pasti. CRF kritikal dikategorikan kepada empat kumpulan, iaitu "kerja awal dan kelulusan pihak berkuasa," "perolehan dan pelaksanaan," "dokumentasi dan pengesahan," dan "keupayaan dan skop projek." Secara ringkasnya, kesediaan pembinaan adalah perlu bukan sahaja pada permulaan projek tetapi juga semasa fasa awal. CRF ini boleh membantu pengamal industri menilai kesediaan projek mereka dan juga membantu penyelidik untuk membangunkan alat penilaian kesediaan pembinaan untuk projek pembinaan bangunan melalui garis panduan, rangka kerja dan senarai semak.

ABSTRACT

Construction readiness is determined as the main contributor to delay in construction. It is vital to determine the activities and procedures that should be completed prior to construction kick off. These delays often lead to increase of costs, putting contractors at risk. They suffer losses as a result of the project rather than gains. This is because project teams tend to rush into construction without assessing the readiness of the project. Therefore, it is necessary to evaluate a project's readiness. The goal of this research is to examine Sarawak's construction readiness for upcoming development projects. This study aims to accomplish three objectives that have been identified in the study. Firstly, identify the factors influencing the construction project's readiness for implementation. Secondly, rank the critical readiness factors for the project's implementation in Sarawak. Thirdly, categorize the critical construction readiness factors for building projects in Sarawak. In stage one of the studies, the questionnaire is developed from the identified Construction Readiness Factor (CRF), from the literature review. In stage two, the CRFs are ranked based on data analysis from ninety-one replies using the Relative Importance Index (RII). Stage three involves categorizing the critical construction readiness factors. This study focuses on Sarawak's building construction projects. A total of thirty-seven critical CRF for building construction projects are identified. The critical CRF are categorized into four groups, which are “preliminary work and authorities approval”, “procurement and execution,” “documentation and verification” and “capability and project scope”. To sum up, construction readiness is necessary not just at the start of the project but also during the early phase. These CRFs can assist researchers in creating a construction readiness assessment tool for building construction projects, as well as assist industry practitioners in evaluating the readiness of their projects through guideline, framework and checklist.

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LIST OF SYMBOLS

α	Cronbach' Alpha Coefficient
W	Weighting given to each factor by the respondents
A	Highest Weight
N	Total number of populations
nf	Sample size from finite population

LIST OF ABBREVIATIONS

3D	3 Dimensional
BIM	Building Information Modelling
CCTV	Closed Circuit Television
CE	Concurrent Engineering
CRF	Construction Readiness Factor
EoT	Extension of Time
FA	Factor Analysis
GDP	Gross Domestic Product
HSSE	Health, Safety, Security, Environment
IFC	Issued for Construction
IoT	Internet of Things
JKR	*Jabatan Kerja Raya*
KMO	Kaiser-Meyer-Olkin test
LOA	Letter of Award
M.Sc	Master of Science
PhD	Doctor of Philosophy
PMP	Project Management Plan
RFI	Request for Inspection
RII	Relative Importance Index
SESCO	Sarawak Electricity Supply Corporation
SPSS	Statistical Package of Social Science

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Construction significantly contributes to Malaysia's economic growth, fulfilling socioeconomic needs and improving quality of life. Particularly in Sarawak, where geographical factors such as the location limit access to construction materials which sea transport is vital for supply. Zainordin (2016) emphasizes the importance of readiness and support in the Sarawak construction sector, highlighting their role in overcoming logistical barriers and optimizing project outcomes. This chapter discusses many studies on construction problems and what this research aims to do. It also describes about what the research will look at and why it is important.

1.1.1 Construction Readiness Definition

Appropriately checking the construction readiness could avoid premature starts in construction. Therefore, adverse impacts and delays could be avoided by evaluating a project's readiness before the project starts. Construction readiness refers to the set of tasks that need to be resolved or finished before the project begins (Ibrahim et al., 2021).

The Construction Industry Institute (CII) defines construction readiness as activities and procedures that should be completed prior to construction to productively start and sustain construction operations. It encompasses various factors, including but not limited to planning, resource allocation, stakeholder coordination, and risk management. A project is considered ready for construction when all necessary prerequisites are in place, ensuring smooth execution and timely completion.

In addition, Construction readiness is defined as the series of activities that should be completed or substantially completed before starting the construction to sustain

operations (Ibrahim, 2018). Thus, by assessing a project's readiness before construction, these negative impacts could be avoided, ultimately preventing delays.

1.2 Background of Study

The building and construction industry plays a significant role in the rapidly expanding Malaysian economy, contributing substantially to the global gross domestic product (GDP) and serving as a foundation for the global economy (Tariq & Gardezi, 2023). The growth of Malaysia's economy is largely attributed to the construction sector, which meets crucial socioeconomic demands, contributing to an improved standard of living (Kamaruddeen et al., 2019).

Effectively assessing and managing construction projects demands a meticulous focus on establishing a solid structure through deliberate decisions and strategic measures (Kamaruddeen et al., 2019). This underscores the industry's need for thoughtful planning to ensure the success and efficiency of building projects.

At the core of every construction project lies the primary objective of achieving completion within the established budget, timeframe, and scope. Attaining these ambitious goals necessitates comprehensive construction readiness before project commencement. Unreadiness poses a substantial risk, potentially resulting in delays that not only hinder progress but can also lead to litigation and claims, presenting a serious issue that should be diligently avoided.

Project delays can escalate project costs, impacting the contractor's financial outcomes. Successful projects occur when all parties involved collaborate as one team, completing the project within the agreed-upon scope, budget, and timeframe. A project delay, even for a public agency in Malaysia, essentially extends the project completion time. Delays could raise the project's overall cost, considering the adage that time is money (Aziz & Abdel-Hakam, 2016). Construction delays may lead to increased project costs, encompassing additional direct, indirect, and impact costs.

1.3 Problem Statement

According to the World Bank, the building sector accounts for 6–9% of GDP in developing nations, and construction projects frequently encounter delays and cost overruns (Shah & Chandragade, 2022). Over the course of the last decade, cost overruns took place in Malaysia in 53.2% of all government construction projects and 66.8% of all private building projects (Shah & Chandragade, 2022)

In most cases, the contractor could not reap any benefits from the project's completion and could possibly lose money. Their reputation will be impacted just like the perceptions of others of their reliability in executing their obligations on the project, thereby hindering their ability to secure future contracts and negatively impacting their long-term business prospects.

The construction sector can face various challenges, which can vary based on factors such as location, project scale, and economic conditions. Riddell (2018) mentioned that the lack of competent labour, generational divides, technology adoption, environmental sustainability, and project complexity are the top five problems facing the construction sector. Addressing these challenges often requires effective project management, communication, risk mitigation strategies, and a proactive approach to problem-solving.

Delays tend to be triggered by several issues, including ineffective planning and scheduling, alteration orders, and paying the contractor overdue (Mohd Radzi, 2021). Construction delays are disruptions or extensions to the originally planned timeline for completing a construction project. This is also the outcome of the project stakeholder's desire to start the construction before evaluating the project's readiness.

Construction readiness means having a strategy in place before a building project begins in order to minimise any potential issues that can arise. In order to be certain that the project is running successfully, there must be no delays, cost overruns, or safety vulnerabilities. Having construction plans might forestall the project from going off track and being a greater cost to rectify.

Sarawak oversees 21 out of Malaysia's 92 critical projects, constituting 22.8% of the national total during the pandemic. This highlights Sarawak's pivotal role in the country's infrastructure development. Despite global challenges, Sarawak remains committed to addressing essential needs. These efforts underscore its strategic significance and dedication to national progress during unprecedented times (Gara et al., 2022).

Sarawak faces severe limitations in accessing construction materials, relying heavily on sea transport. Difficult terrain and remote locations necessitate maritime logistics for material supply, emphasizing the critical role of efficient sea transport. These challenges highlight the need for robust maritime infrastructure and effective supply chain management to sustain construction activities in Sarawak (Zainordin, 2016).

Remote areas in Sarawak are often inaccessible by ground transportation, relying on river access for logistical support. This complicates construction project execution, demanding innovative solutions to address accessibility issues. Ensuring effective transportation is crucial for timely project completion, emphasizing the need to adapt strategies to local conditions (Hadi et al., 2017).

Dissatisfaction with construction project outcomes in Sarawak is prevalent, driven by delays, cost overruns, and subpar quality. These issues point to underlying problems in project management and execution, necessitating systemic changes. Improving project delivery processes and quality control is essential to meet stakeholder expectations (Zainordin, 2016).

Construction projects in Sarawak face land blockages, utility conflicts, and delays in obtaining approvals. These hurdles impede project progress and increase costs. Coordinated efforts among stakeholders are necessary to streamline execution and minimize disruptions (Ting et al., 2021).

Resource scarcity and remote suppliers elevate construction expenses in Sarawak, particularly transportation costs. Efficient resource management is crucial to mitigate delays and budget overruns. Innovative solutions are needed to manage resources

effectively and reduce financial burdens associated with logistical constraints (Hadi et al., 2017).

1.4 Research Questions

In order to accomplish the study's objectives, the research questions for this study were associated with:

1. What are the factors influencing construction readiness, whether the construction project is ready or not ready for construction?
2. What are the key factors of readiness in the implementation of building project?
3. What are the categories of the critical construction readiness factors?

1.5 Research Objectives

The objectives of this study are:

1. To determine the factors influencing the readiness for implementation of construction project.
2. To rank the critical factors of readiness in the implementation of building project in Sarawak.
3. To categorise the critical construction readiness factors for building project in Sarawak

1.6 Scope of Study

Using a questionnaire survey covering Construction Readiness Factor (CRF), this study concentrated on the clients, consultants, and contractors with building project experience to get feedback and ideas based on the recommendations from the pilot study and the literature review.

The primary focus is on engaging key stakeholders involved in building projects through a meticulously designed questionnaire, which incorporates insights gleaned from

both the pilot study and an extensive literature review, the research targets three pivotal groups: clients, consultants, and contractors. These stakeholders possess valuable on-the-ground experience and are crucial sources of feedback and ideas.

1.7 Significance of Research

The project is delay when the contractor not able to complete on the schedule finish date. There are numerous serious consequences if the project fails to be completed within the stipulated time, money, and quality. Additional causes could be added to speed up the postponed project.

The scope of the readiness research can be expanded to include the construction sector. This expansion would involve increasing awareness among participants within the industry. In order to help an organisation, this study contribute in identifying the readiness factors for building construction projects is to provide an assessment tool that helps organizations evaluate their readiness level before starting a project.

According to Sa'adi & Zainordin (2019), the construction industry in Sarawak is a key economic sector that contributes to the overall economic development. Sarawak, recognized as a vital centre for construction and infrastructure development within Malaysia, has experienced these disruptions in a particularly pronounced manner.

Thus, emphasising the building construction project, the current study differs from earlier studies. This study aims to fill the gap left by an inadequate number of studies examining the building readiness factor. It is imperative to look into CRF for building projects due to their importance and inadequate published studies discussing this subject.

Adequately assessing construction readiness as well as performing suitable preconstruction activities could prevent premature starts in constructions. Based on a previous study, the top three impacts from premature starts are schedule slippage, cost overruns, and unplanned work (Griego & Leite, 2017).

The research's significance is in establishing the CRF specifically for building construction projects and providing important CRF to evaluate the project's readiness. This study will help the project perform better, and it is also crucial for policymakers to

implement the proper steps to lessen and prevent construction project delays. Additionally, study results provide industry professionals and researchers with a list of crucial readiness factors to determine the project's readiness.

As recommended by Mohd Radzi (2021), significant literature studies and expert advice used to develop the CRF and identify ways to improve it. A pilot study will further validate these initiatives. As a result, the construction readiness study for the building construction project happens to be carried out. Understanding the opposing side of construction planning thoroughly is vital, especially for the building project in Sarawak. It could be unique compared to other countries or even locations.

1.8 Organisation of the thesis

Chapter one describes the general context of the research, including the introduction, problem, questions, and aims, is shown in this chapter. This chapter has shown the extent and importance of the research.

Chapter two presents an overview of the literature on construction readiness. The definition, advantages, and context of construction readiness are covered in this chapter. The literature review of the critical elements of construction readiness in the execution of building projects is also covered in this chapter.

Chapter three covers the research methods used for the study, including data analysis, research design, and research instrumentation. This chapter provided a detailed explanation of how the research problem was used to determine the choice of study design, instrument, and data processing methodologies.

Chapter four presents the analysis of the research. The first step is determining the variables affecting the readiness for evaluating a building project. The crucial elements were then identified. Lastly, an analysis is conducted on the critical factor categories.

Chapter five presents a summary of the investigations' and the literature review's research findings as provided in the thesis, along with recommendations for the research's industry and limitations.

1.9 Summary

This chapter discusses about how important it is for construction projects in Malaysia to be well-prepared. It explains that being ready can help prevent delays in extra costs and protect the reputation of the people involved. It also sets goals for research to improve building projects in Sarawak by finding important readiness factors.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Construction projects aim to build places that offer specific services while staying on time and within budget. However, many projects face problems that make it hard to finish on time and within the planned cost. It's becoming common to see construction projects not meeting their goals within the set budgets and schedules. Ensuring construction projects are successful and sticking to the estimated costs and timelines depends on how well the construction sector works. This chapter examines numerous studies about construction readiness, seeking to identify the factors that influence the readiness of building projects. It has three main parts. First, the chapter reviews different studies about construction readiness and related issues. Then, it discusses important ideas by exploring construction readiness and its significance. Finally, the chapter discusses crucial factors contributing to the readiness of a construction project.

2.2 Problems in Construction Industry

Construction projects are becoming more complex. The study on project management has been extensively investigated in terms of project complexity, and several definitions have been put forth, concentrating on certain characteristics (Qazi et al., 2016). According to (Nichols, 2018), the construction industry is there and expanding. Some challenges in construction should be aware of.

2.2.1 Safety Concerns

The construction industry's inherent risk factors necessitate a continual focus on safety, as underscored by Nichols (2018). Safety concerns within construction projects pose direct threats to workers and have broader repercussions for project timelines, labour availability, legal compliance, and financial stability.

Nichols (2018) highlights the critical link between safety and the overall well-being of workers, emphasizing the potential for accidents and injuries to disrupt construction operations. The consequences range from minor setbacks to severe disruptions that impede workers' ability to carry out tasks, resulting in labour shortages and operational inefficiencies. Moreover, the legal and financial ramifications of accidents and injuries can pose significant challenges, with potential legal penalties and financial burdens on the contractor.

Jones (2018) contributes to this discourse by emphasizing the preventive aspect of safety practices. When construction companies actively reduce safety risk and rigorously enforce safe work practices, they create an environment where accidents are less likely to occur. Jones (2018) argues that businesses with robust safety programs ensure their workforce's well-being and experience heightened productivity. Additionally, he emphasizes the top-down nature of safety implementation, asserting that a company's commitment to worker welfare, starting from leadership, not only fosters a secure working environment but also attracts top talent and enhances the company's overall reputation.

This review consolidates the perspectives of Nichols (2018) and Jones (2018), underlining the multidimensional impact of safety in construction. It reinforces the idea that safety is not just a regulatory requirement but a strategic imperative influencing productivity, workforce attraction, and overall organizational reputation. The synthesis of these viewpoints calls for a holistic approach to safety in the construction industry, integrating preventive measures and a commitment to worker well-being at all levels of leadership.

2.2.2 Labour Productivity and Shortages

Poor labour productivity can influence the contractor’s overall performance in the project, which might cause lower actual progress than the plan progress. Contractors should ensure they hire a qualified contractor or provide training for the workers to improve their skills.

Reduced productivity is also a result of the labour shortage. This also includes businesses attempting to accomplish more work with fewer employees or lacking the necessary knowledge or experience. The industry's fragmentation due to siloed activity is another significant factor in the lack of annual productivity growth (Jones, 2018).

Poor labor productivity significantly impacts a contractor's project performance by often resulting in actual progress falling short of planned progress. Effective management practices and continuous worker training are crucial for enhancing labor productivity in construction projects (Hanna & Sullivan, 2004). Extended overtime has been identified as a factor that can negatively affect construction labor productivity, underscoring the importance of balanced labor scheduling to mitigate productivity declines.

The skill level of the workforce plays a critical role in productivity outcomes. Research by Jarkas & Bitar (2012) highlights that labor skill levels, supervision quality, and project management practices significantly influence construction labor productivity. Investing in the recruitment of skilled personnel and providing ongoing training programs are essential strategies for bolstering workforce competence and project efficiency.

Labor shortages exacerbate productivity challenges in construction. Aiyetan et al. (2012) emphasize that inadequate availability of skilled labor contributes to project delays and reduced productivity levels. Strategies such as competitive compensation packages and robust career development opportunities are advocated to attract and retain skilled workers in the construction sector.

2.2.3 Technological Adoption

Historically, the construction sector has been slow to accept new technologies. The difficulty is in incorporating the latest innovations into traditional construction techniques, such as automation, drones, and building information modelling (BIM). There are several reasons why construction projects take longer than expected, including technology issues and poor management.

Technology will soon reach the point where it is necessary for every construction job. Early adopters will have a clear advantage over their rivals when they incorporate new technologies into their processes and workspaces. Companies that refuse to embrace technology's benefits or who underinvest in it will lack the competitive edge necessary to succeed in this quickly evolving world (Jones, 2018).

In conclusion, while challenges persist in incorporating new technologies into traditional construction practices, the potential advantages for firms that navigate these challenges effectively are substantial. By embracing technological innovations, construction companies can not only enhance operational efficiency and project outcomes but also gain a strategic advantage in a competitive marketplace increasingly driven by technological capabilities (Chen et al., 2022; Oteng et al., 2018).

2.2.4 Environmental Sustainability

Integrating sustainability goals and environmentally friendly practices within the construction industry poses a considerable challenge, particularly when confronted with conventional construction methods and materials that may not align with emerging green building standards. Zainordin (2016) emphasises the importance of introducing the concept of sustainability into the construction sector.

The aim is to achieve a careful balance between promoting development prosperity and environmental conservation. This viewpoint is consistent with the general consensus that the construction industry needs to shift to sustainable practices in order to lessen its ecological footprint, as it is a major contributor to environmental impact.

The challenge lies in the alignment of traditional construction practices with the evolving ethos of sustainability. Green building standards necessitate a departure from conventional methods, requiring the industry to adopt innovative approaches and materials that prioritize environmental responsibility.

On environmental sustainability, a product should be appropriately located to reduce biodiversity losses; it should be sited to maximize low-energy transportation choices and other environmental protection features (Adabre & Chan, 2019). It

underscores the necessity for a paradigm shift within the construction industry, emphasizing the integration of sustainability as a fundamental guiding principle rather than an optional addendum. As the construction sector navigates this transition, it becomes apparent that embracing sustainability is not merely a way to meet regulatory requirements but a proactive step towards harmonizing development with ecological preservation.

2.2.5 Supply Chain Disruptions

The vulnerability of construction projects to disruptions in the supply chain is a well-established concern, particularly when influenced by global events, geopolitical factors, or natural disasters. The repercussions often manifest in material shortages and project delays. In addressing this challenge, Reddy & Rao (2022) delve into the intricate dynamics of supply chain coordination, emphasizing its critical role in mitigating the impact of disruptions.

The complex nature of on-site communications in supply chains, particularly in situations that are subject to disruptions. Especially, they highlight differences in the volume and quality of on-site communications. The propensity of successful production managers for informal ties while exchanging and gathering data is an important discovery. This strategic decision emphasises the importance of being adaptive and flexible when handling supply chain communications in challenging and complex construction situations.

Construction industry needs greater attention to its supply chain of materials and labor to improve project timelines. Enhancing performance in these areas is crucial for timely project completion, which will benefit the entire industry. Addressing these supply chain issues can lead to more efficient construction processes and better overall outcomes, ensuring that projects are completed within their designated time frames and contributing to the sector's growth and stability (Alrasheed et al., 2023).

2.2.6 Risk Management

Identifying and mitigating project risks effectively is an ongoing challenge. Unexpected risks can affect the budget, schedule, and general success of a project. One of the most crucial steps in project management is risk management, which involves a structured process of controlling risk events in order to act immediately to produce effective outcomes and make informed decisions (Tagod et al., 2021).

The research highlights the dynamic nature of risk occurrences in project settings, emphasizing the need for a structured and adaptive approach to risk management. The term "effective results" implies not just risk mitigation but attaining project goals despite uncertainties. The study encourages project managers to view risk management as a continuous process that evolves in response to the changing landscape of potential threats.

This emphasizing the critical role of risk management in project success. It underscores the proactive nature of effective risk management, positioning it as an integral component of project management strategies. As projects become increasingly complex, the formalized approach advocated by the research becomes a cornerstone for project managers aiming to navigate uncertainties and deliver successful outcomes.

With all these problems, construction readiness should be done to avoid delay. The construction industry should improve its technology and methods and adopt a sustainable building approach (Musa et al., 2016). Readiness is the most important aspect of daily life, which means we have always been ready for not being ready.

Addressing these challenges often requires a combination of improved project management practices, technological adoption, industry collaboration, and a commitment to continuous improvement. As the construction industry evolves, finding innovative solutions to these problems is crucial for sustained growth and success.

2.3 Project Construction Delay

The universality of delays in construction projects, regardless of scale or economic development, is a recognized and pervasive challenge, as articulated by (Tariq

& Gardezi, 2023). Delays, defined as exceeding the specified agreed-upon date by project parties, are not confined to specific project sizes or economic contexts; they manifest as a common issue across the construction spectrum.

Tafesse (2021) adds another layer to understanding delays by associating them with projects or construction works that fail to meet the stipulated completion time. This perspective underscores the tangible impact of delays on project owners, emphasizing that timely completion is a critical metric of success.

Okpala & Roslan (2019) contribute to this discussion by highlighting the role of project management knowledge in averting delays. They revealed that in the lack of appropriate project management expertise, delays can arise in nearly all construction projects emphasises how crucial competent project management is to the construction sector.

Project delays affect all involved parties because the project's success depends on everyone working together. It is a collective responsibility to underscore the importance of collaboration among all parties, ensuring the project runs smoothly and that problems are solved together. The key is to understand that the project's success relies on everyone pitching in and working collectively.

When a construction project exceeds the expected completion time, it is referred to as a project construction delay. Such delays are frequent and can result from a number of different circumstances. These delays can affect the project's timeframe and could incur additional costs. Construction delays can occur at any stage of the project, ranging from planning and design to execution and completion.

Project delays in construction are a pervasive challenge encountered on a global scale. A comprehensive survey conducted by Scopus, encompassing over 1000 studies worldwide, sheds light on the multifaceted nature of this problem. The findings underline that various factors contribute to delays, spanning from uncontrollable elements like weather conditions and unforeseen site issues to more nuanced aspects such as changes in project scope and challenges within the supply chain.

What stands out in the research conducted by (Alrasheed et al., 2023) is the differentiation in the causes of delays between developing and developed countries. In developing nations, economic, contractual, and technical factors emerge as pivotal influencers, shaping the timeline setbacks in construction projects. Conversely, in developed countries, the emphasis shifts to project characteristics, indicating different challenges that impact timely project completion.

This review encapsulates the global nature of the problem, emphasizing the significance of understanding regional variations in the factors contributing to construction project delays. The thorough examination of studies worldwide provides valuable insights into the complexities inherent in the construction industry, paving the way for informed strategies and solutions to mitigate delays in diverse contexts.

The challenge often stems from inaccurate cost estimates, highlighting the vulnerability of initial budgeting practices in accurately forecasting the financial requirements of a project. Additionally, changes in project scope contribute to the deviation from planned costs, as the dynamic nature of construction projects can introduce unforeseen complexities and alterations.

The significance of the problem becomes apparent when considering its potential to disrupt the economy at large. When a construction project surpasses its budgeted or planned cost, it not only affects the project stakeholders directly but also has ripple effects on the economic landscape. These effects can include financial strain, resource misallocation, and a cascading impact on related industries and sectors.

2.3.1 Weather Conditions

Reddy & Rao (2022) shed light on the significant influence of adverse weather conditions on construction projects, particularly those conducted outdoors. The research underscores the impact of heavy rain, snow, or extreme temperatures on delays in construction activities. The connection between weather and material supply is highlighted, emphasizing how weather conditions can impede the process of receiving materials from manufacturing units and transporting them to the project site.

The study delves into the specific challenge of rain causing delays in the supply of materials to construction sites, highlighting the vulnerability of construction schedules to unpredictable weather patterns. The observation that materials imported from overseas manufacturers often rely on raw materials collected from other nations adds another layer of complexity to the supply chain dynamics in the construction industry.

Bad weather shared responsibility among involved parties. The study found that inclement weather, particularly heavy rains and resulting floods, was the top cause of cost escalation. This highlights the significant impact of weather on project budgets, underscoring the need for better planning and risk management to mitigate these effects. By addressing weather-related challenges, parties can better control costs and improve project outcomes despite adverse conditions (Kaliba et al., 2009).

2.3.2 Unforeseen Site Conditions

Kamaruddeen et al. (2019) delve into the complexities of construction projects, specifically addressing the challenges posed by unexpected conditions at the construction site. The study emphasizes that discovering issues like poor soil quality or concealed structures necessitate adjustments to the project plan, potentially leading to delays in the construction timeline.

The location of a building, particularly if it lacks easy accessibility to the site, emerges as a significant factor influencing construction duration. Beyond accessibility, site conditions, including topography, site size, and ground conditions, play a crucial role in determining the construction timeline. The researchers highlight how variations in site conditions might require different machinery for tasks like backfills or excavations, contributing to the overall project duration.

Unforeseen condition is any physical condition that the contractor and owner could not have foreseen reasonably given the nature of the site and information readily available to the parties. Whereas it is often easy to agree that certain dimensions have changed, it is much more difficult to agree on whether or not unexpected geologic conditions warrant a contract modification. Therefore, changes and claims over

unforeseen conditions are often difficult and time-consuming to resolve (Halligan et al., 1987).

2.3.3 Design Changes

Azmi et al. (2018) highlight a critical aspect of construction project changes in project design after construction commencement. The research underscores the disruptive impact of such changes on the construction process, necessitating revisions to plans and posing a potential risk of project delays.

A notable insight from the study is the identification of the most prevalent reason for construction claims, which is the introduction of design changes at the post-tender stage. This finding speaks to the significant role that alterations in project design play in the construction industry's challenges and potential conflicts.

This research review emphasizes the practical implications of Azmi et al. (2018)'s work. Acknowledging design changes as a prominent factor in construction claims underscores the importance of robust project design and management processes. It underscores the need for careful consideration and thorough planning during the initial stages of a construction project to minimize the likelihood of design changes that can disrupt the construction process and lead to delays. Overall, the study provides valuable insights for industry professionals to navigate potential challenges associated with project design modifications during construction.

2.3.4 Material Shortages

The research by Alsharif & Karatas (2016) and Aziz & Abdel-Hakam (2016) brings attention to a significant factor influencing delays in construction projects issues related to construction materials. The findings underscore the critical role of timely and sufficient material delivery in the smooth progression of building activities.

A noteworthy insight is identifying specific material-related issues that contribute to delays. These include shortages of materials, delays in material delivery, fluctuations in material prices, and deviations from the agreed-upon materials specifications outlined in the contract.

The research review emphasizes the practical implications of these findings. Delays caused by material issues highlight the importance of robust supply chain management, accurate inventory forecasting, and clear contractual agreements. Industry professionals can use these insights to proactively address and mitigate potential delays arising from material-related challenges. The study contributes valuable knowledge for enhancing project planning and execution in the construction sector, promoting more effective measures to ensure a steady and reliable supply of materials throughout the construction process.

2.3.5 Contractor Issues

Wirahadikusumah & Ario (2015) delve into the complexities surrounding contractors, subcontractors, and suppliers in construction projects. The study underscores those problems within these relationships, such as financial issues, disputes, or breaches of contract, can significantly contribute to project delays.

A notable observation from the research is the gradual implementation of principles by contractors in construction projects. This suggests an evolving landscape where industry stakeholders adapt to principles that aim to enhance project efficiency and collaboration.

The study also touches upon the crucial factor of trust between contractors and project owners. The commitment of contractors to working progress is intricately tied to the trust placed in them by the owner for the project's future construction phases.

Additionally, Duat (2014) adds another layer by highlighting the influence of a contractor's reputation on their potential to secure new tenders from the same company. This underscores the long-term impact a contractor's performance and reputation can have on their business opportunities within the industry.

This research review emphasizes the multifaceted nature of relationships within the construction sector, particularly the dynamics involving contractors. The gradual adoption of principles, the significance of trust in owner-contractor relationships, and the lasting impact of reputation on future opportunities provide valuable insights for industry

professionals. These insights can inform strategies for fostering collaborative and trustworthy partnerships, ultimately contributing to the prevention of delays in construction projects.

2.3.6 Equipment Breakdowns

Aziz & Abdel-Hakam (2016) research highlights a critical aspect of construction projects the susceptibility to delays caused by mechanical failures or breakdowns of construction equipment. The study emphasizes that interruptions due to equipment malfunctions can significantly impede progress and contribute to project delays.

A crucial insight the research provides is the importance of equipment quality and adherence to the equipment approval procedure. The findings suggest that equipment failure can have direct implications for project timelines, underscoring the need for rigorous quality control measures in the construction industry.

Additionally, the study draws attention to the significance of managing equipment shortages. Addressing the equipment shortage is a key factor in avoiding delays, emphasizing the need for proactive measures to ensure an adequate and reliable supply of construction equipment.

This research review underscores the practical implications of Aziz & Abdel-Hakam (2016) work. It emphasizes the need for construction professionals to prioritize equipment quality, adhere to approval procedures, and implement effective strategies to manage equipment shortages. By addressing these aspects, stakeholders can enhance the resilience of construction projects against delays caused by mechanical failures or equipment-related challenges.

2.3.7 Technology Adoption Challenges

Nichols (2018) highlights a significant challenge in the construction industry in introducing new technologies without proper planning or training. The research suggests this can lead to inefficiencies and delays as teams navigate the adjustments required to incorporate these technological changes. Construct Connect notes a delay in the construction industry's adaptation of technologies that could enhance productivity and

profitability, including BIM, telematics, software applications, robots, the IoT, and 3D printing.

Jones (2018) contributes insights into the positive impact of employing design-build and lean construction techniques. These methodologies, emphasizing close coordination and communication among all project participants, have been demonstrated to enhance project productivity and efficiency. Jones further highlights the role of technology, such as project management software and building information modelling (BIM), as tools that contracting firms can leverage to increase efficiency.

This research review underscores the dual nature of technology in construction; while its implementation without proper planning or training can lead to delays, strategic adoption and integration of technologies, along with effective methodologies, can significantly enhance project productivity and efficiency. The insights provided by Nichols and Jones offer practical considerations for construction industry professionals aiming to navigate the challenges and opportunities presented by evolving technologies.

2.4 Causes of Delay

However, most of studies reported that the primary reasons for the delay are the less experienced workers (Aftab Hameed et al., 2011; Sambasivan and Soon, 2007; Fong, Wong and Wong, 2006; Aziz and Abdel-Hakam, 2016; Odeh and Battaineh, 2001) which had led to poor site coordination and management, ineffective planning and scheduling (Aftab Hameed et al., 2011; Marzouk and El-Rasas, 2014; Sambasivan and Soon, 2007; Doloi et al., 2012; Alsharif and Karatas, 2016; Fong, Wong and Wong, 2006) . In addition, contractors selected was also financially instable, has conflict with subcontractors and even has the workload staff issues (Aftab Hameed et al., 2011; Marzouk and El-Rasas, 2014; Fong, Wong and Wong, 2006; Hamzah et al., 2011).

Another cause of delay was client-related causes such as the owner interference in construction regarding the clarity of the project scope and scope change which caused the variation orders (Marzouk and El-Rasas, 2014; Doloi et al., 2012; Alsharif and Karatas, 2016; Hamzah et al., 2011; Odeh and Battaineh, 2001). Not only contractors have the financial issues, inadequate client's financial and payments also one of the

causes of delay with also some other issue regarding the late in giving document approval and slow decision making (Sambasivan and Soon, 2007; Fong, Wong and Wong, 2006; Hamzah et al., 2011; Aziz and Abdel-Hakam, 2016).

Nevertheless, the other top five reasons for delays noted by earlier researchers include the nature of the project's award and bidding, the impact of subsurface conditions, and (Marzouk and El-Rasas, 2014), design error (Alsharif and Karatas, 2016), inclement weather (Hamzah et al., 2011) and consultant contract management (Odeh and Battaineh, 2001). Table 2.1 summarizes the papers.

Table 2.1 Previous Study on Causes of Construction Delay

Title	Researchers	Causes of Delay
Delays In Construction Projects: The Case of Jordan	(Sweis et al., 2008)	• Shortage of manpower • Presence of unskilled labor • Shortage of materials • Delay in material delivery • Material price fluctuations
Time Overrun in Construction Projects from the Perspective of Project Management Consultant (PMC)	(Memon et al., 2011)	• Cash flow and financial difficulties faced by contractors • Contractor's poor site management • Inadequate contractor experience • Shortage of site workers • Ineffective planning and scheduling by Contractors
Analysing Delay Cause in Egyptian Construction	(Marzouk & El-Rasas, 2014)	• Ineffective planning and scheduling • Financing project by contractor • Variation orders • Type of project bidding and award • Effects of subsurface conditions

Table 2.1 Continued

Title	Researchers	**Causes of Delay**
Cause and Effects of Delays in Malaysian Construction	(Sambasivan & Soon, 2007)	• Contractor's improper planning • Contractor's poor site management • Inadequate contractor experience • Inadequate client's finance and payments • Problems with subcontractors
Analysing Factors Affecting Delays in Indian Construction Project	(Doloi et al., 2012)	• Lack of commitment • Inefficient management • Poor site coordination • Improper planning • Lack of clarity in project scope
A Framework for Identifying Causal Factors of Delay in Nuclear Power Plant Projects	(Alsharif & Karatas, 2016)	• Missing schedules update • Design Error/ECRs (Engineering Change Request) • Scope change • Inadequate contractor performance • Materials specification
Fire Service Installation Related Contributors of Construction Delays	(Fong et al., 2006)	• Improper site coordination and management • Lack of timely decision making • Workload of project staff • Procedures for equipment approval • Working experience
Cause of Construction Delay – Theoretical Framework	(Hamzah et al., 2011)	• Variation orders • Late documents approval • Inclement weather • Financing project by contractor • Conflict with subcontractors

Table 2.1 Continued

Title	Researchers	**Causes of Delay**
Exploring Delay Causes of Road Construction in Egypt	(Aziz & Abdel-Hakam, 2016)	• Owner financial problems • Equipment shortage • Inadequate contractor experience • Construction material shortage • Equipment failure
Causes of Construction Delay: Traditional Contracts	(Odeh & Battaineh, 2001)	• Owner interference • Inadequate contractor experience • Consultant contract management • Shortage in material • Labor productivity

Source: Romzi & Doh (2017)

Moreover, when construction projects face delays, it causes a bunch of problems like more money being spent, contracts getting cancelled, less money coming in, and less work getting done. This can also lead to arguments between the people doing the work and those who own the property. Hence, it is imperative to thoroughly investigate the causes of these delays to prevent such problems. This way, we can avoid these issues and ensure projects finish well without causing more trouble (Kumar & Raj, 2015).

2.5 Construction Readiness in Construction

2.5.1 Concept of Construction Readiness

The concept of construction readiness refers to the state of readiness or fitness that a construction project or organization must achieve before initiating or undergoing a specific phase or activity. It involves ensuring that all necessary conditions, resources, and plans are in place to facilitate a smooth and successful execution of the construction process. Construction readiness is crucial for minimizing risks, avoiding delays, and ensuring the overall efficiency of a construction project.

Adequate planning is a fundamental aspect of construction readiness. This includes developing comprehensive project plans, schedules, and budgets. Kaufmann &

Kock (2022) contends that the positive effect of project management effort on project profitability increases with project complexity. A project's complexity is often the result of multiple issues that require additional management and coordinating labour. As complexity rises, the project team must plan and handle more design elements.

Ensuring that the project has access to and is properly allocated the resources it needs, including money, labour, supplies, and equipment. The construction readiness of a project could be assessed as early as the start-up stage. If the preparedness is not adequately evaluated, there may be a work stoppage, inefficient work, rework, and shortages of workers, supplies, or equipment. Therefore, it is crucial to ensure that the readiness factors used are appropriate for the project to avoid delays (Radzi et al., 2021).

The concept of construction readiness recognizes that successful project outcomes are contingent on thorough preparation and proactive management of various factors. It is a holistic approach that considers the interplay of technical, managerial, and organizational elements to create an environment conducive to successful construction project completion.

In construction, there is no exception to not being ready and prepared from the beginning of the project until the project is complete. Even if the advantages and possibilities of construction are widely known, proper strategic planning is needed for both the implementation and the implementation process. As part of strategic planning, readiness factors must be defined. An organization's or its members' readiness to deliver effectively depends on several factors (Musa et al., 2016).

2.5.2 Definition of Construction Readiness

Readiness is to measure how ready a country and be ready to gain benefit in their own economy. Harvard University Centre for International Development defines readiness as how ready a community is to participate or be involved in any sector anywhere in the world and capable of gaining benefits from network connectivity. Key elements of construction readiness include thorough project planning, allocation of resources, compliance with regulatory requirements, risk management, stakeholder

communication, technological readiness, health and safety readiness, and various other factors depending on the nature and scope of the construction project.

It involves ensuring that all necessary conditions, resources, and plans are in place to facilitate a smooth and successful execution of the construction process. Construction readiness is crucial for minimizing risks, avoiding delays, and ensuring the overall efficiency of a construction project. Readiness assessment refers to a management assessment tool to assess the level of readiness of an organisation before assets, capital, human resources, and investment. The readiness assessment is to identify the organisation's potential compared to the level of a target that it aims to achieve (Musa et al., 2016).

Construction readiness is the set of actions that, in order to continue operations, must be completed, or completed in major part, before construction commences. Construction-ready projects often have a 22% reduction in schedule, a 29% improvement in productivity, a 20% cost savings, 7% less rework, and 21% fewer adjustments in comparison to construction-not-ready projects (Mohd Radzi, 2021).

The state of being ready to begin implementing any development project is another definition of readiness (Donkor et al., 2020). In essence, construction readiness reflects a project's readiness to move forward confidently and effectively, addressing potential challenges and uncertainties that may arise during the construction process. It encompasses the strategic, logistical, regulatory, and operational aspects necessary for successful project initiation, progression, and completion.

Construction readiness means being ready before starting a construction project by planning in order to avoid some problems that may occur during the project. This is important to ensure the project is performing well, yet delays are still under budget, cost overruns, less productivity, and safety exposure. Construction readiness may help avoid the wrong track, expensive, and project rework.

2.5.3 Importance of Construction Readiness

Sam Rayburn quotes that readiness is an opportunity to create success. This quote means that we should be ready for an opportunity that might bring us success. An opportunity usually comes surprisingly, but not for readiness. Readiness has to be a plan in order to achieve what we want.

Adequately performing suitable preconstruction activities and assessing the construction readiness could prevent premature starts of the project. The three primary consequences of early starts are unexpected work, slippage, and cost overruns. As a result, adverse effects might be minimised, and delays could be avoided (Mohd Radzi, 2021).

As the Construction Readiness Factor is reviewed by the project team to achieve the desired level of readiness, they can ensure a productive start to the construction. This is also important to industry players as they can differentiate between a ready project and one that is not ready to start construction.

2.5.4 Key Factors on Construction Readiness

The construction readiness factors refers to a group of particular requirements, specifications, and guidelines that must be fulfilled to guarantee that a construction project is suitably ready for each phase. The following elements are typically included in the factor, though they may differ based on the nature, scope, and complexity of the building project:

2.5.4.1 Project Planning

Project planning in construction is the process of defining the objectives, scope, schedule, budget, and resources required for a construction project. It involves creating a comprehensive plan as a roadmap for the entire project, guiding all activities from initiation to completion. Effective project planning in construction is crucial for ensuring that the project is completed on time, within budget, and to stakeholders' satisfaction.

They also have to prepare a proper project plan and schedule (Ahmad Hisham & Yahya, 2016) with a detailed site investigation done and data provided by the designer (Halim & Zin, 2016). Project planning is an iterative process that involves continuous monitoring and adjustment as the project progresses. It provides a structured framework for decision-making, risk management, and communication, ultimately contributing to the successful completion of the construction project.

2.5.4.2 Resource Allocation

The procedure of allocating and managing resources, such as labour, supplies, machinery, and money, to various duties and tasks within a construction project is known as resource allocation in the industry. Effective resource management minimises costs and guarantees quality, essential for a construction project to be completed successfully and on schedule.

There are some readiness factors mentioned by other researchers, such as experienced and capable contractors should be selected as mostly the project performance depends on the contractor's experience and capability for the project (Aravindhan et al., 2021; Ahmad Hisham & Yahya, 2016; Halim & Zin, 2016).

Effective resource allocation requires careful planning and ongoing monitoring to adapt to changes and challenges throughout the construction project. Utilizing project management tools, software, and techniques can aid in optimizing resource allocation and improving overall project efficiency.

2.5.4.3 Regulatory Compliance

Regulatory compliance in construction refers to the adherence to laws, regulations, codes, standards, and other legal requirements governing the construction industry. Meeting regulatory compliance is crucial for construction projects to ensure the safety of workers, the public, and the environment and maintain the quality and integrity of the structures being built. Here are some key aspects of regulatory compliance in construction.

In order to be ready to proceed with the construction project, the project scope must be finalised, the project fund must be approved, and the project supervision and inspection team must be organized (Ahmad Hisham & Yahya, 2016). Other construction factors are before the construction starts, make sure the client has approved the drawing as it might be changes requested (Assaf & Al-Hejji, 2006) and the expected project outcome has been established Zainordin (2016) with sufficient time given during planning and design stages (Halim & Zin, 2016) (Mohd Radzi, 2021).

Mohd Radzi (2021) mentioned that a few things should be settled to be ready to start, such as land acquisition, utility relocation issues, engagement with stakeholders, approved work programme by the consultant, and approved building plan by the Local Authority.

Failure to comply with regulatory requirements can lead to legal consequences, project delays, and reputational damage. Therefore, construction project managers, contractors, and stakeholders must stay informed about and actively manage compliance with relevant regulations throughout the project lifecycle.

2.5.4.4 Financial

In the construction industry, financial readiness refers to the ability to efficiently manage the financial parts of a project by having the necessary tools and preparation. This encompasses planning, budgeting, resource allocation, and implementing financial controls to ensure the project remains within budget, achieves its financial objectives, and maintains financial sustainability.

Contractors also have to be ready in terms of financial funding for the projects acquired (Ahmad Hisham & Yahya, 2016; Reddy & Rao, 2022; Mohd Radzi, 2021). Financial readiness in construction is critical for the success of a project, as it helps mitigate financial risks, ensures the availability of funds when needed, and contributes to the overall financial health and sustainability of the construction endeavour.

These factors collectively contribute to the construction readiness of a project, ensuring that it is well-prepared, organized, and equipped to move forward successfully.

It's essential for project managers and stakeholders to regularly assess and update these factors throughout the project lifecycle to adapt to changing conditions and maintain readiness.

Construction readiness methodology and construction readiness elements for every research differed depending on their objective and scope of work. The construction Readiness Factor is important as the project team will review the readiness of a project where some action must be taken to be ready to start. Therefore, professionals in the field might aim to evaluate the project before initiating work and ascertain whether the building project is prepared for construction to commence. Table 2.2 summarizes the previous study on sixteen Construction Readiness Factors.

2.6 Construction Delay in Sarawak

Table 2.2 Previous Study on Construction Readiness

Researcher	Construction Readiness Factor	Location
(Aravindhan et al., 2021;Ahmad Hisham & Yahya, 2016)	Experienced and capable contractor have been selected	India and Malaysia
(Ahmad Hisham & Yahya, 2016)	Project scope have been finalised Project fund have been approved Project supervision and inspection team have been organized	Malaysia
(Assaf & Al- Hejji, 2006)	Drawing have been approved	Saudi Arabia
(Zainordin, 2016)	Expected project outcome have been established	Sibu, Sarawak (Malaysia)
(Halim & Zin, 2016; Mohd Radzi, 2021)	Sufficient time have been given during planning and design stages	Malaysia
(Halim & Zin, 2016)	Complete project data have been provided to designers Detailed site investigation has been done	Malaysia

Table 2.2 Continued

Researcher	Construction Readiness Factor	Location
(Mohd Radzi, 2021)	Land acquisition has been settled Utility Relocation issues has been settled Engagement between stakeholders have been held Work programme has been approved by consultant Building plan have been approved by Local Authority	Malaysia
(Ahmad Hisham & Yahya, 2016; Mohd Radzi, 2021; Reddy & Rao, 2022)	Contractors to make sure funding for the projects has been acquired	Malaysia and India
(Ahmad Hisham & Yahya, 2016)	Proper project plan and schedule have been prepared	Malaysia

The global tendency of big projects being completed later than originally scheduled in contract agreements is not unique to Sarawak's construction industry. The building industry's contribution to the economy, society, and environment has fluctuated and declined significantly despite its significance in attaining sustainable growth in Sarawak Zainordin (2016).

Aside from that, the sustainability tagline mostly expresses dissatisfaction with the results of construction and the careless acts of all levels of practitioners in the Malaysian construction sector, namely in the state of Sarawak (Zainordin, 2016). Therefore, additional initiatives are required to raise public knowledge of environmental issues and responsibilities in order to promote sustainable building practices in the future.

Table 2.3 illustrates the number of project delays in Sarawak. Sarawak has 21 critical projects compared to 92 projects for all of the states in Malaysia which has contributed 22.8% of the critical projects during the pandemic. The data show that there is a need for the study and a readiness for a similar situation in the future (Gara et al.,

2022). The management of these projects falls under Sarawak Public Work Department, which is administered by the State of Sarawak, which has different law and organization from the Federal Ministry of Public Works in Peninsular Malaysia.

Table 2.3 Number of Critical Project in Sarawak

Programme	Under Construction	Delay Project	Critical Project
Building	131	40	7
Road	46	24	8
Bridges & Wharves	15	9	4
Rural Development	18	4	2
Total	210	77	21

*Total critical project in Malaysia = 92 projects

Source: Gara et. al. (2022)

2.6.1 Internal Issues

Another major factor considered when awarding contractors, the EoT is internal problems. A few elements combined under the heading of internal issues are variation orders, site possession, design changes, and contractor selection techniques. It is apparent that the location of these projects impacts them, particularly those that have a 100% delay because of it (Ting et al. 2021).

Variation means including or omitting part of the work. Also, issuing variation after the completion of that part of the work, it might cause the contractor to demolish the existing work and reconstruct. The completion date will have to be extended due to the variation order, and the additional cost will result in cost overrun of the project (Kamaruddeen et al., 2020).

Contractors' perspectives on variation orders vary, influenced by factors such as contractual arrangements and project-specific conditions. Research emphasizes the need for proactive management strategies to anticipate and mitigate the impacts of variations, thereby enhancing project performance and minimizing disputes (Lim & Loo, 2018; Azhar et al., 2008).

Regional studies provide insights into the diverse challenges faced in construction projects. Factors such as political instability (Azhar et al., 2008) and regulatory frameworks (Choudhry & Ali, 2016) contribute significantly to project delays and variations. Understanding these regional dynamics is crucial for developing tailored strategies that address local challenges and optimize project outcomes (Choudhry & Ali, 2016).

2.6.2 Environmental and Unpredictable Reasons

Other factors include environmental conditions (Kamaruddeen et al., 2019b). One of the primary criteria that will be considered when awarding the Extension of Time to contractors is environmental and unforeseeable reasons. Unexpected causes, air quality, flooding incidents, and other variables have all been grouped under environmental and unpredictable reasons (Ting et al., 2021).

Environmental and unpredictable reasons are pivotal factors influencing construction project delays. Kamaruddeen et al. (2019b) highlight the critical role of environmental conditions in determining the Extension of Time (EoT) granted to contractors. They emphasize the need for comprehensive assessment and management of these factors to mitigate their impact on project schedules effectively. Similarly, Li et al. (2020) discuss how climate variability and extreme weather events contribute to unpredictability in construction timelines, underscoring the importance of adaptive strategies in project planning.

In addition to environmental conditions, Ting et al. (2021) identify various unexpected causes such as air quality deterioration and flooding incidents as significant contributors to project delays categorized under environmental and unpredictable reasons. They emphasize the complexity of managing these variables and stress the necessity of integrating advanced risk assessment tools and mitigation measures to enhance project resilience. Furthermore, Xu et al. (2020) argue that geological hazards, including landslides and ground subsidence, pose substantial challenges to construction timelines, requiring proactive monitoring and contingency planning to minimize disruptions.

Moreover, technological advancements play a crucial role in addressing environmental and unpredictable reasons in construction projects. Wang et al. (2020) discuss the application of Building Information Modeling (BIM) and Geographic Information Systems (GIS) in environmental risk management, enabling real-time monitoring and predictive modeling of potential disruptions. They advocate for the integration of these technologies into project management frameworks to improve decision-making and mitigate risks effectively.

Furthermore, regulatory frameworks and contractual obligations also influence how environmental and unpredictable reasons are managed in construction projects. Zhao et al. (2021) examine the legal implications of project delays attributed to environmental factors, highlighting the importance of clear contractual provisions and dispute resolution mechanisms. They emphasize the role of regulatory compliance and environmental impact assessments in mitigating legal risks associated with unforeseen events.

2.6.3 Third-party Obstruction

One of the primary factors considered when awarding contractors access to the Extension of Time is third-party obstruction. Third-party obstacles have been defined as a number of things, such as land blockage, existing utilities, authority inspection and approval (Gara et al., 2022), and delays by SESCO. Building, road construction, riverine terminal, earthwork, bridge construction, water work, and farm sub-station projects are among these projects. This indicates that no cost pattern will cause the third-party obstruction to have an impact on the EOT, either high or low (Ting et al. 2021).

One critical determinant influencing the allocation of Extension of Time (EOT) to contractors pertains to third-party obstructions. Defined broadly, these obstructions encompass various factors such as land blockages, existing utilities, authority inspections, and approvals (Gara et al., 2022). Such hindrances significantly impact diverse construction projects ranging from building and road construction to riverine terminals and bridge constructions (Smith & Brown, 2023). These complexities underscore the non-uniformity in cost implications attributable to third-party

obstructions, suggesting a nuanced approach is required in assessing their EOT effects (Ting & Patel, 2021).

The assessment of delays arising from third-party obstructions reveals notable insights into their implications for project scheduling. Johnson and Patel (2023) emphasize the quantification of these delays within infrastructure projects, highlighting the need for precise management strategies to mitigate their impact. Legal frameworks also play a crucial role in governing the resolution of disputes arising from third-party obstructions in construction contracts (Lee & Park, 2022). Understanding these frameworks is vital for establishing effective contractual safeguards and ensuring timely project completion (Garcia & Nguyen, 2021).

Moreover, proactive mitigation strategies are essential to address the complexities posed by third-party obstructions. Wang and Zhang (2020) advocate for probabilistic approaches to assess the potential impact of such obstructions on project costs and schedules. Their research underscores the significance of adopting robust risk management techniques to enhance project resilience against unforeseen delays.

2.7 Construction Readiness in Sarawak

The thoroughness and effectiveness of project planning, including defining project scope, setting realistic timelines, and developing comprehensive project management strategies, are pivotal for successful building projects. Zainordin (2016) emphasizes the need for sustainable issues to be incorporated during the conceptual and design stages, highlighting the importance of proactive planning.

Among other factors influencing building costs in Sarawak is the limited availability of suppliers, as mentioned by Hadi et al. (2017). This scarcity results in increased transportation expenses, particularly in remote areas where factories are situated far away. Additionally, the need for pricey cranes due to large and heavy components further impacts construction costs.

Despite efforts to promote Building Information Modeling (BIM) by CIDB (Zaini et al. 2020). Sarawak's building industry still lags behind. However, aligning with

Sarawak's vision to become a developed state by 2030, initiatives like the digital transformation outlined in the Sarawak Digital Economy blueprint aim to propel the industry forward (Ashari & Farouk, 2023).

Efficient planning for transportation and delivery, as well as coordination of construction activities, is crucial, especially in rural areas where access might be limited to rivers, as highlighted by Hadi et al. (2017). This underscores the interconnectedness between logistical planning and cost management in construction projects.

The state of infrastructure in Sarawak, being behind other regions, poses challenges, particularly in transporting materials and machinery, as discussed by Hadi et al. (2017). Upgrading roads and improving river access are imperative to mitigate delays and additional costs, emphasizing the need for synchronized efforts in infrastructure development.

Ensuring safety and quality in construction projects in Sarawak is paramount, as highlighted by comprehensive checklists that encompass various stages of construction (SBCECA). This meticulous approach underscores the interconnectedness between regulatory compliance, safety standards, and quality assurance in building projects.

Monitoring mechanisms, as advocated by CIDB, play a pivotal role in ensuring project efficiency and compliance (CIDB). By utilizing technological solutions and regular inspections, stakeholders can detect deviations early, emphasizing the importance of continuous oversight in project management.

Enforcement mechanisms, as underscored by the Sarawak Ministry of Urban Development and Natural Resources, are crucial for upholding regulatory standards and promoting accountability (Sarawak Ministry of Urban Development and Natural Resources). Collaboration between regulatory agencies and industry stakeholders is essential for effective enforcement and sustainable growth in the construction sector.

In conclusion, the seamless integration of planning, sustainability, logistics, safety, monitoring, and enforcement is essential for the successful realization of building

projects in Sarawak, reflecting the interconnected nature of various facets within the construction industry.

2.8 Summary

Construction projects face various challenges, including delays, cost overruns, safety hazards, and labour shortages, and they demand innovative solutions. Factors contributing to delays range from weather and site conditions to design changes and material shortages. Addressing these issues requires proactive measures such as improved planning and coordination. Construction readiness ensures preparedness for project initiation through thorough planning, resource allocation, and regulatory compliance. In Sarawak, construction delays align with global trends, impacting economic and environmental aspects. Solutions involve enhancing project planning, resource availability, technology adoption, and logistical planning. Utilizing tools like literature reviews and surveys aids in understanding and mitigating delay factors, fostering project success.

Figure 2.1 shows the conceptual framework for this study. By achieving the objectives, which are to identify the factors influencing the construction project's readiness for implementation, to rank the critical readiness factors for the project's implementation in Sarawak, and to categorise the critical construction readiness factors for building project in Sarawak, building project's readiness can be adequately assessed before starting the construction. Consequently, it can ensure successful project completion.

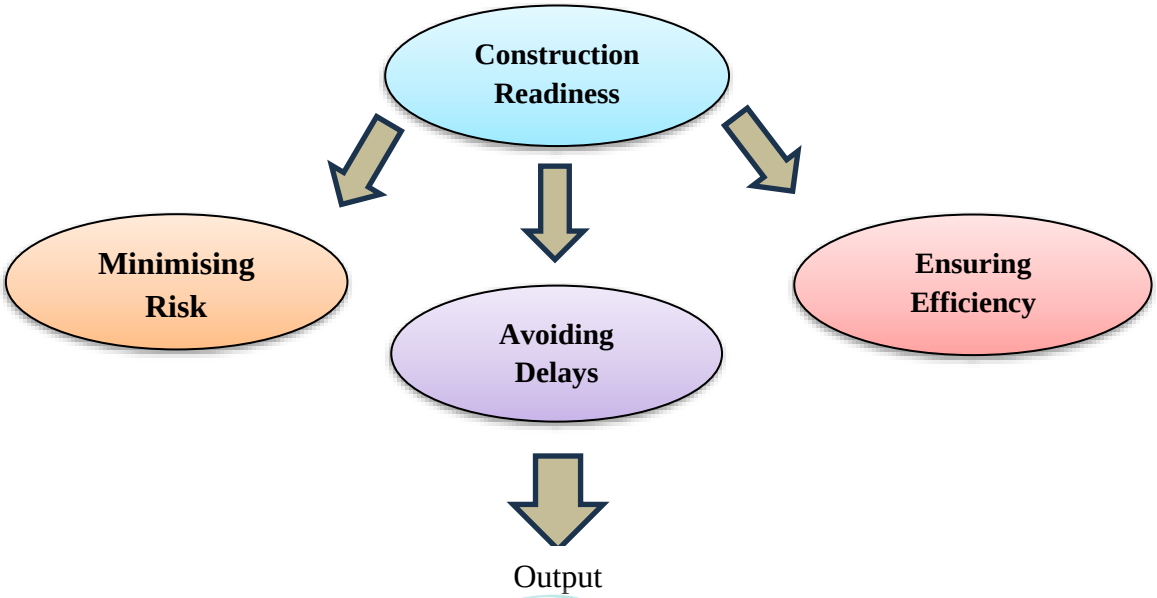

Figure 2. 1 Conceptual Framework for Construction Readiness

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter provides information on the methodology adopted in the study. The methods and steps used are explained, including the process of selecting samples for the study. The research goals can be achieved by following the outlined methodology. To understand the basics of the Construction Readiness Factor, existing studies were reviewed and grouped into three stages to achieve three research goals. First, a qualitative approach was employed to identify factors influencing the readiness of a construction project, using questionnaires and expert opinions. Next, to rank these factors, a quantitative approach was used, involving data collection, validation, and analysis. Finally, the critical factors were categorized into groups through data analysis, also utilizing a quantitative approach.

3.2 Research Design

According to Al-Btoush (2022), the research design guides researchers during the collection, analysis, and interpretation of their data. It also typically enables them to draw conclusions and establish causal relationships between the variables they are studying. Creating a research study involves developing a plan or strategy to direct the data gathering and analysis. The research design refers to the scientific research plan or organisation. Additionally, it directs the researcher in designing and carrying out a study in a manner most likely to accomplish the desired outcome. The framework for research design comprises methods and techniques that specify the instruments and processes that must be employed in data collection and data analysis. This study is divided into three stages.

The first stage consists of an extended review of the literature. This was carried out to provide the research background as well as the basis for the research inquiry. The review enabled the gathering of knowledge related to readiness factors in construction projects.

Information gathered during this stage has subsequently enabled the question to be designed and ready for data collection. This became the basis for accomplishing the tasks specified in the research objectives. The tasks involved in this phase include questionnaire design, pilot study, sampling, and questionnaire establishment.

The second stage consists of data collection and analysis, which relates to studying the first objectives. It focuses on the questionnaire survey adopted as a data collection method. According to the study objectives, the data collected from this phase was subjected to specific analysis types. The collected data is analyzed using the Statistical Package for Social Sciences (SPSS) software version 27 to perform reliability tests for analyses of Cronbach Alpha and mathematical analyses to evaluate the Relative Importance Index (RII).

Finally, the third stage is to categorize the critical factor of construction readiness by using Factor Analysis, which is important in sorting things into categories because it helps find hidden patterns, makes the data simpler by focusing on key factors, picks out the most useful information, makes it easier to understand, and makes the categorization process work better.

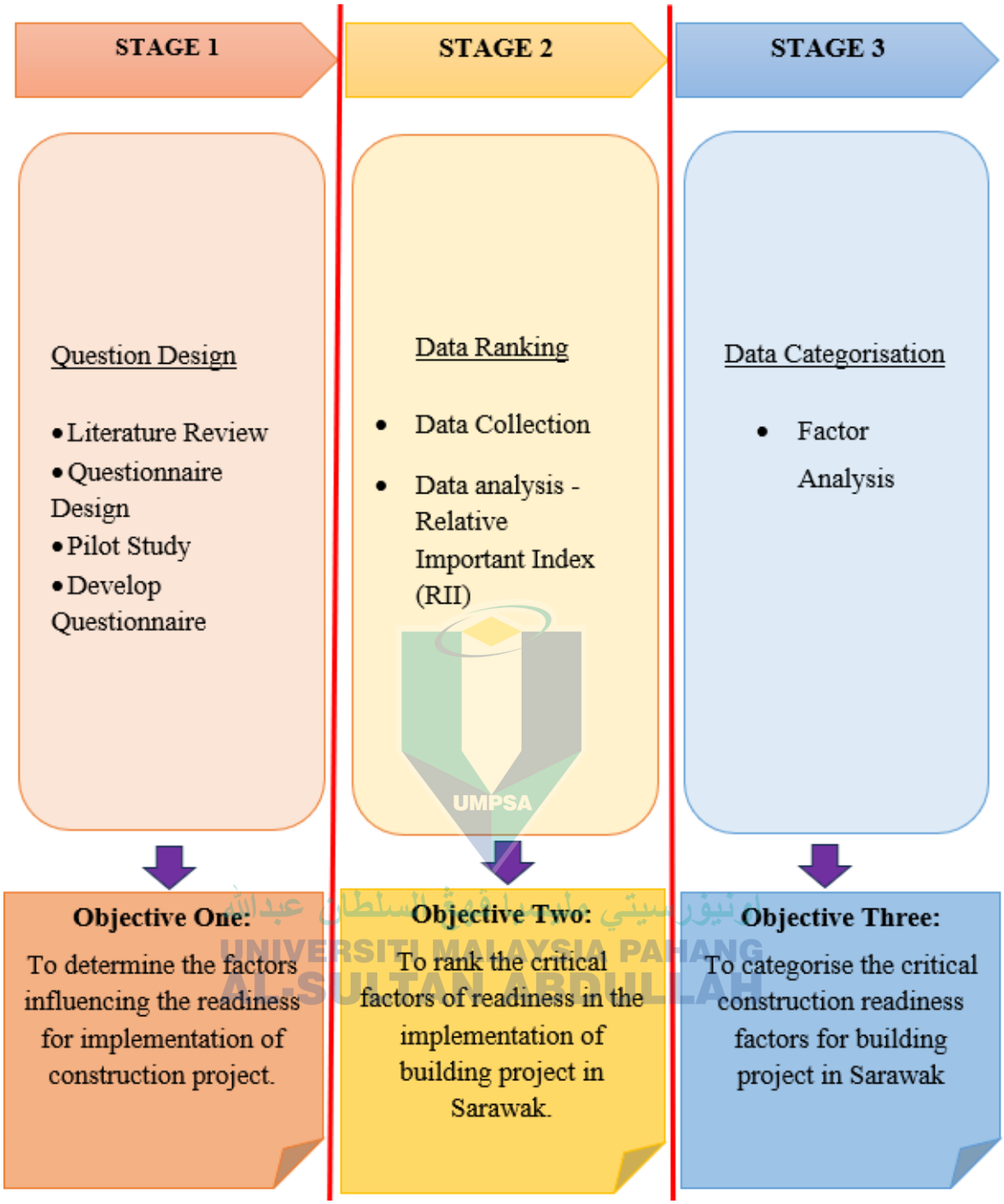

Figure 3. 1 Research Design

A study conducted Ramabhadran (2018) employed the same approach to look into the many aspects impacting cost overruns in the building sector in the United Arab Emirates and the corrective measures. Also, the study conducted in Malaysia by Mohd Radzi (2021) used the same methodology to identify the readiness factors of highway construction projects and evaluate the relationship between key decision factors. On the other hand, another study (Al-Btoush, 2022), which studies effective strategies dealing with construction cost overruns in Jordan, agreed with the current study in using the pilot study to validate the question design for data collection, which was used as a basis of the research design.

3.3 Stage 1: To determine the factors influencing the readiness for implementation of the construction project

In the first stage, CRF from any construction category is gathered based on previous studies, which is the objective of this study. At this stage, experts' opinions obtained regarding the CRF through a pilot study. Then, those comments and recommendations captured were used to develop a questionnaire, which will be used for data collection in the second stage.

3.3.1 Literature Review

The literature review aims to explore and analyse existing research on the factors influencing construction readiness. Understanding these factors is critical for effective project planning and execution in the construction industry. This section provides a context for the review by outlining the importance of construction readiness in project success.

Factors for selecting relevant literature are established, ensuring a focused review. Inclusion factors involve studies published in the last decade, peer-reviewed articles, and empirical research. Exclusion factors include outdated or non-peer-reviewed sources. A systematic search is conducted using academic databases such as Science direct and Scopus. Keywords include "construction readiness," "construction project," and "readiness factors" to capture a broad spectrum of literature.

Initial screening involves reviewing titles and abstracts to exclude irrelevant articles. Selected articles undergo a full-text review to assess their relevance to the research objectives. Articles meeting the inclusion factor are subject to a detailed analysis. The emphasis is on extracting information regarding factors influencing construction readiness, methodologies used, and findings.

A concise summary of key findings is presented, highlighting the factors that influence construction readiness. Potential literature review limitations, such as publication bias or geographical focus, are acknowledged. This ensures transparency in the interpretation of findings.

3.3.2 Question Design

The questionnaire aims to validate identified factors influencing construction readiness by soliciting feedback from stakeholders in the construction industry. Capture diverse perspectives from stakeholders, including project managers, engineers, contractors, and regulatory authorities, to gain a comprehensive understanding of their experiences and opinions.

Previous research has stated that most of the construction industry encounters delays in the delivery of the project, which suggests evaluating the project's readiness before the project's kick-off. Therefore, the questionnaire is designed based on the identified Construction Readiness Factor from previous studies to determine a list of CRFs from any type of construction in addition to the strategies to reduce delay.

The questions in the questionnaire were organized by assigning the Likert Scale, which is widely used in questionnaires to measure the level of agreement. It is used for scaling responses in survey research. Respondents can easily convey their opinions by answering questions on a five-point Likert scale from 1 to 5, utilised in numerous studies (Haslinda et al., 2018: Sohu et al., 2018).

Each responder in the current study was given the option to identify the variables they believed were likely causing the cost overruns as well as the measures that reduce them

through the questionnaire by answering on a five-point Likert scale ranging from 1 to 5. The points fall into the following categories: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree (Al-Btoush, 2022). This scale quantifies the degree of influence of each variable in the current study.

3.3.3 Pilot Study

Conduct a pilot test with a small sample of stakeholders to refine question-wording, assess clarity, and identify any ambiguities or biases in the questionnaire. A trial run test on the process is important for establishing a questionnaire survey (Al-Btoush, 2022). Therefore, the drafted questions will be asked in a pilot study to validate the designed questions and test the understanding among the respondents.

This will also help ensure the questions' reliability before being distributed to targeted respondents. On the other hand, (Hussain et al. 2013) suggested using a pilot study on a small group of survey respondents to ensure the validity of the tools used and the reliability of what was collected.

Include specific questions asking stakeholders to validate or challenge findings from the literature review. This provides an opportunity to corroborate theoretical insights with practical experiences. The pilot study included one lecturer from a university in Malaysia, and the other four are project manager, construction manager, technical Executive HSSE, and Persara Penguasa Kanan, JKR on construction projects in Malaysia; all of them hold a master's of science in construction project management.

Every pilot respondent had completed their higher degree and worked in construction for more than five years. Most of them were working on construction projects involving buildings. The five expert backgrounds are summarized in Table 3.1 as follows:

Table 3.1 Background of the experts

Competence	Qualification	Research Field	Years of Experience	Current Position
Civil Engineer	PhD	Construction Management	6	Senior Lecturer
Civil Engineer	M.Sc	Construction Management	36	Retired JKR Senior Officer
Civil Engineer	M.Sc	Construction Management	10	Technical Executive HSSE
Civil Engineer	M.Sc	Construction Management	10	Project Manager
Civil Engineer	M.Sc	Construction Management	10	Construction Manager

The questionnaire was sent to experts for their review, and they provided some comments and recommendations on the draft questionnaire that the researcher should consider to improve. The draft questionnaire was revised as follows:

Table 3.2 The CRF before and after modification

No.	The Factors Before Modification	The Factors After Modification
1.	Expected project outcome have been established	Expected project output have been established
2.	Sufficient time have been given for planning and design stages	Sufficient time have been given for planning stages
3.	Complete project data have been provided to designers	Complete project data/information have been provided to designers at design stage
4.	Land acquisition has been settled	Land acquisition has been settled and site free from encumbrances (squatters)
5.	Utility relocation issues has been settled	Utility relocation issues has been resolved
6.	Engagement between stakeholders have been held	Engagement between stakeholders have been conducted
7.	Detailed site investigation has been done	Detailed site investigation has been carried out
8.	Work programme has been approved by consultant	Removed
9.	Proper project plan and schedule have been prepared	Removed

Other CRF were added to the questionnaire, which are:

Table 3.3 The CRF added for modification

No.	Construction Readiness Factor
1.	Building Information Modelling has been adapted.
2.	Contingency plans due to unprecedented events have been prepared (eg: Covid19/ natural disaster/economic factor/political influences).
3.	Project Management Plan, PMP (inclusive of risk management and quality management plan) has been established.
4.	Letter of award from the client has been received.
5.	Local Authority has approved the project.
6.	Construction duration has been verified.
7.	The official commencement date has been verified.
8.	Traffic around the construction site has been verified.
9.	Process for responding to delay has been verified.
10.	Process for reporting RFI (Request for Inspection) has been verified.
11.	Adequate workforce has been acquired.
12.	The site location and site condition have been verified as same to the contract.
13.	Schedule for design deliverables compatible with the sequence of construction have been verified.
14.	Project team includes a representative from the procurement team.
15.	Clear procurement process and supporting systems in place for storage have been verified.
16.	System to align construction with commissioning and operations has been verified.
17.	Nearest material supplier to the construction site has been verified.
18.	Parking space for machinery at the construction site has been verified.
19.	The necessary insurance has been obtained for the project.
20.	Safety signboards have been placed at the construction site.
21.	Project workplan has been approved by the client.
22.	Discrepancies between construction drawings and tender drawings have been verified.
23.	Complete IFC (issued-for-construction) drawings have been issued.
24.	Equipment for the project has been acquired.
25.	Utilities on the construction site are ready (e.g. electricity, water, wifi, etc.).
26.	The site office is ready.
27.	CCTV has been installed at the construction site.

After making all necessary changes, the researcher created the questionnaire's final draught. The final version of the questionnaire has 41 CRF that are relevant to Sarawak, based on the findings of the pilot study.

3.3.4 Development of Questionnaire Form

A questionnaire form is developed based on recommendations and comments from experts who consider the suitability of the questionnaire for use as CRF for building projects in Sarawak. As commented and recommended by experts, the CRF became forty-one for building projects in Sarawak.

This method is used to gather researchers' opinions regarding factors or mitigation to avoid delay based on the literature review. A draft questionnaire survey and a list of prospective Construction Readiness Factor are created. It consists of a set of inquiries used to elicit data from participants. They are designed to do statistical analyses of the answers.

A draft of the questionnaire is designed with 4 sections. The first section is Section A, which gathered respondents' background information such as age, education, organisation type, and experience in construction. Collect basic demographic data such as job role, experience level, and project type to categorize responses effectively.

The next section, Section B, is to obtain the respondent's opinion regarding the current performance of government projects and the most critical construction stages that require readiness. List and address factors obtained from the literature review. Questions associated with each factor should explore the perception, importance, and effectiveness of that particular factor.

Section C in this draft questionnaire is for the respondents to rank the fourty-one CRF listed from the literature review based on previous studies, and the last section, Section D, asks if there is any suggestion for respondents to add to or comment on the questionnaire.

Utilize Likert scale questions to quantify respondents' opinions on the importance and effectiveness of each identified factor. This allows for statistical analysis and

comparison. Incorporate open-ended questions to encourage stakeholders to provide detailed insights, examples, or suggestions for each readiness factor.

The primary method of conducting the population survey was the questionnaire, which offers an effective way to ask a wide range of questions to large sample populations. The literature review results, along with their established research methodology and questionnaire design, served as the foundation for the questionnaire's creation. After the final version of the questionnaire was completed, Google Forms was used to create the survey. The intended sample population received the questionnaire via email. The email also contained a cover letter that explained the study's objectives.

3.4 Stage 2: To rank the critical factors of readiness in the implementation of building project in Sarawak

In stage 2, the method chosen is to determine critical CRF for building projects, which is objective two of this study, involving data collection, data validation, and data analysis.

3.4.1 Data Collection

The Likert scale are obtained from contractors, consultants, and clients who have completed and returned the questionnaire. The information is evaluated to facilitate discussion of the questionnaire's results and conclusion, followed by suggestions that could aid in solving the issue.

Data is collected through a questionnaire that develops in stage 1. The finalised questionnaire survey was distributed to 175 industry practitioners using the online platform. This study used convenience sampling techniques to collect data to investigate the critical Construction Readiness Factor for building construction projects in Sarawak. A 5-point Likert scale was used in the survey as adopted in previous studies to obtain respondent opinions on the Construction Readiness Factor (Yap et al. 2021).

3.4.1.1 Research Population and Sample Size

A research population can be defined as all elements (personal objects and events) that meet the sample factor included in the study and also defined the target population as a whole group of persons, events, or objects with common observable characteristics (Al-Btoush, 2022). This research studies the issue of construction readiness for building projects in Sarawak. As a result, the target population was the graduate engineers working on construction projects within the three main categories, namely clients, contractors, and consultants in Sarawak.

To prevent systematic errors such as calculating an over or under-sample size for a questionnaire survey, it is crucial to consider the sample size. Generally, it is suggested that 32 or more responses are adequate, and a sample size should be at least 30 items (Al-Btoush, 2022). A minimum of 30 sample size is necessary for statistical analysis to produce a significant summary (Mohd Radzi, 2021).

Figure 3. 2 Number of Graduate Engineer in Sarawak
Source: Board of Engineers Malaysia (2021)

In the present study, the sample size of the population was determined based on the following formula as provided by Tayeh et al. (2018):

$$nf = \frac{n_s}{1 + \frac{n_s}{N}} \quad 3.1$$

Where:

N: Total number of populations

nf: Sample size from finite population

n: Sample size from infinite population

$$n_s = \frac{t^2 \times p \times q}{e^2} \quad 3.2$$

P and q is the estimate of the variance, suggest p = q = 0.5

t = t Value (e.g. 1.96 for 95% confidence interval)

e = Maximum error of estimation (0.074)

The sample size was calculated using the formula provided by Tayeh et al. (2018), equivalent to 172 items.

3.4.1.2 Selection of Location

Sarawak, one of Malaysia's largest states, is expected to make further development contributions in the future (Sa'adi & Zainordin, 2019). Sarawak, the largest of Malaysia's thirteen states, is situated in the northwest corner of Borneo. The State's GDP, which

accounted for 9.50% of Malaysia's GDP in 2020, is the third largest in the country (Ashari & Farouk, 2023).

Sarawak situated northwest of Borneo Island and shares borders with Brunei and Indonesia. In terms of immigration and land issues, Sarawak is independent. The government's authority over the flow of people, products, and services into and out of the nation may affect the importation of building supplies and the employment of foreign labourers in Sarawak (Kamaruddeen et al., 2020). Construction duration can be impacted by immigration policy, which also indirectly affects construction costs by approving work permits for foreign nationals.

The South China Sea divides the state from Peninsular Malaysia by a distance of 600 km. Sarawak is separated into three regions: a large expanse of undulating hills measuring 300 metres; the mountain highlands stretch to the border with Kalimantan; and the coastal lowlands, which include peat swamp as well as narrow deltaic and alluvial plains. Due to its geographic location, Sarawak receives most of its construction and building materials by sea (Kamaruddeen et al., 2020). The construction projects in Sarawak State may be impacted by the logistics of importing building supplies into the state.

While numerous prior studies have been conducted in Malaysia concerning the building industry, only one appears to have been carried out in Sarawak, specifically in Sibu. Only contractors and stakeholders participated in the focus group for this study. The study discovered that for this notion to be completely understood, applied in the construction industry, and well-aware, it must be built on initiatives and receive full support from relevant bodies and organisations Zainordin (2016).

Delays had diverse reasons in different countries, particularly because developing countries have different critical causes than developed ones (Alrasheed et al., 2023). Thus, research on the variables affecting building construction projects' readiness in Malaysia's Sarawak State is necessary.

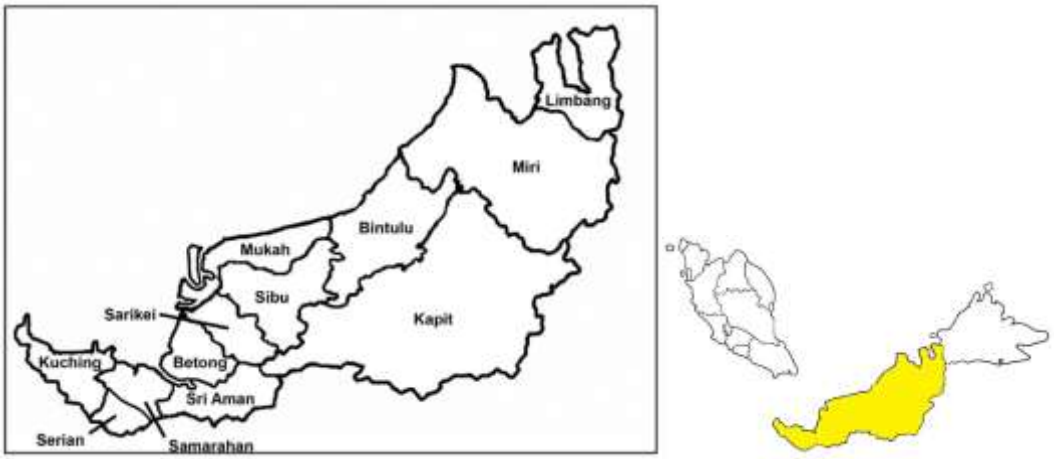

Figure 3. 3 Map of Sarawak
Source: Dow (2021)

3.4.1.3 Sampling Method

Since there was no sampling frame for this investigation, a nonprobability sample was the sampling strategy employed (Zhao et al. 2015). Using the nonprobability sampling technique, a representative sample can be obtained (Mohd Radzi, 2021).

Accordingly, to attain a proper and effective overall sample size, a convenience sampling method is used. (Sa'adi & Zainordin, 2019) refers to the convenience sampling method, which is a technique where respondents who met the requirements of being able to answer the questions and having the time to do so were chosen. Convenience sampling is the method of choice since it is easily accessible and depends on gathering data from study participants who are conveniently available to the study.

Convenience sampling is a nonprobability sampling technique in which researchers select individuals or elements for a study based on their accessibility and ease of inclusion in the sample. In other words, participants are chosen because they are readily available and convenient to reach, rather than through a random selection process. This method is often used when researchers face limitations in time, resources, or access to the entire population of interest.

When using convenience sampling, the first primary data source that becomes available is used for the study without any further conditions. As stated differently, finding participants for this sampling usually involves going to places convenient for them. No inclusion factor was found in convenience sampling before the subjects were chosen (Romzi & Doh, 2017).

3.4.2 Validation of Data Collected

3.4.2.1 Missing Data

Before analysing the data, it is important to screen it to ensure it is entered accurately, without missing values and outliers. Accurate first data screening is essential for an appropriate study's effectiveness and performance (Abdulwahab et al., 2011).

The value of the data not recorded in the observation variable of interest is referred to as missing data (Kang, 2013). Investigating missing data is important for many researchers, particularly when dealing with large sample sizes available for analysis. In virtually all research, the issue of missing data is relatively common and can substantially impact the conclusion drawn from the data. Consequently, it could affect the generalization of the study outcome (Abdulwahab et al., 2011). In the previous research, the researcher employed preliminary descriptive statistics to determine the frequency of missing data once the data was gathered in Excel.

3.4.2.2 Reliability Test

An acceptable reliability measure of the collected data is Cronbach's alpha coefficient, which approximates the internal consistency of responses to various scale items (Al-Btoush, 2022). The study employed a reliability test to evaluate the dependability and internal consistency of the data obtained via the questionnaire. However, this type of analysis was employed in the current study to verify if every item in the questionnaire accurately measures the structure meant to be measured.

In order to verify the authenticity of the data, a reliability test by Cronbach Alpha will be performed using the statistical analysis programme SPSS. It is frequently used to

estimate a psychometric test's reliability for sample examinees (Sambasivan & Soon, 2007). The SPSS uses the reliability analysis to measure the alpha coefficient of Cronbach, where the alpha value ranges from 0 to 1. The basic principle for reliability analysis is that any value of 0.7 or higher is considered good data reliability (Oyedele, 2013).

Table 3.4 Internal consistency of Cronbach Alpha

Cronbach Alpha, α	Internal Consistency
$0.9 \leq \alpha$	Excellent (High Stakes Testing)
$0.7 \leq \alpha < 0.9$	Good (Low Stakes Testing)
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Source: Ahmad Hisham & Yahya (2016)

3.4.3 Data Analysis

Figures and tables are among the approaches employed in the study to provide easy-to-understand results.

3.4.3.1 Quantitative Analysis

Statistical analysis, which includes mathematical equations and statistical analysis software (SPSS), is used to analyse quantitative data. Factor analysis and reliability tests are conducted using the SPSS in data analysis. Descriptive analysis, factor analysis, reliability, and the Relative Importance Index were all part of the analysis process.

3.4.3.2 Descriptive Analysis

Descriptive analysis was used to explain and describe the data collected through the questionnaire. The analysis of the data collected in this study is prepared for factors influencing the implementation of the building project in Sarawak using statistical analysis

software (SPSS). For all variables in the questionnaire, the mean, median, standard deviation, and frequency are calculated for other analyses in the current study.

3.4.3.3 Relative Importance Index (RII)

Following data confirmation and verification, the data will be analysed using Microsoft Excel's Relative Importance Index. The Relative Importance Index (RII) will be used to assess the validity of the collected data. One index analysis technique used to rank the significance of components is the Relative Importance Index (RII). Their study (Mahmud et al. 2020) reviewed the literature and revealed that the (RII) is the most widely used indicator analysis method.

In the current study, it was used to rank the importance of construction readiness factors by applying the 5-point Likert Scale (1= strongly disagreed, 2= disagreed, 3= neutral, 4=agreed, 5=strongly agreed). The RII was used in order to identify the highest-ranked Construction Readiness Factor. The importance of the Construction Readiness Factor increased with RII value. The RII value is determined based on the following equation (Megha D & Rajiv B, 2013):

$$RII = \frac{\sum W}{A \times N} \quad 3.3$$

Where:

W = Weighting given to each factor by the respondents and ranges from 1 to 5
A = Highest weight (i.e., 5 in this case)
N = Total number of respondents

The Construction Readiness Factor was more significant when the RII value was higher, ranging from 0 to 1. (Ahmad Hisham & Yahya, 2016). The various reasons were ranked using the RII. The RII classification table 3.5 is then used to classify the RII, as shown in Table. The classification of the RII as the most desirable building readiness criterion will be discussed.

Table 3.5 Classification of RII

Scale	Level of Preferences	RII
1.	Not preferred at all	$0.0 \leq RII \leq 0.2$
2.	Slightly preferred	$0.2 < RII \leq 0.4$
3.	Moderately preferred	$0.4 < RII \leq 0.6$
4.	Preferred	$0.6 < RII \leq 0.8$
5.	Most preferred	$0.8 < RII \leq 1.0$

Source: Ahmad Hisham & Yahya (2016)

3.5 Stage 3: To categorise the critical construction readiness factors for building project in Sarawak

3.5.1 Factor Analysis

The third goal of this work was to categorise the key CRFs using factor analysis (FA). In order to assess the clustering impacts, FA was utilised to decrease the feature (Doloi et al., 2012). Using a data reduction approach such as FA, numerous connected variables can be gathered and reduced to a more manageable and pertinent collection of factors or components (Mohd Radzi, 2021).

FA is considered a method that reduces a large number of variables into a small number of component variables (Wanjari & Dobariya, 2016), which is used to group the variables into several components. It is used to define the interrelationships between a large number of variables to determine which of the variables might quantify aspects of the same phenomenon that were known to lead to construction readiness (Asiedu & Adaku, 2019). In the field of construction studies, this type of analysis is frequently employed. The most crucial elements of construction readiness in building construction projects are grouped using FA in the current study.

The two primary categories of analysis techniques are confirmatory factor analysis (CFA) and exploratory factor analysis (EFA). CFA seeks to validate hypotheses and depict variables and components using their method of analysis patterns, whereas EFA searches for

complex patterns by studying the dataset and testing predictions (Yong & Pearce, 2013). An exploratory factor analysis was performed to explore the components of CRFs.

Before starting the analysis, two important tests should be performed: Kaiser-Meyer-Olkin (KMO), which measures sampling adequacy. A KMO value of more than 0.5 means the sample is suitable for factor analysis (Lu et al., 2015). The second is the Bartlett sphericity test, which examines the data's applicability; the value is expected to be highly significantly less than 0.05 (Al-Btoush, 2022).

For factor extraction, retained variables have eigenvalues greater than one, which indicates how much of a contribution each variable makes to the major components. The Varimax rotation was then applied to the CRFs to look for underlying components. In summary, factor loadings of more than 0.5 are considered significant and contribute to component interpretation, while loadings less than 0.5 are considered insignificant (Mohd Radzi, 2021).

3.6 Summary

The chosen research methodology is addressed in this chapter. In stage 1, a list of possible Construction Readiness Factor was listed and prepared for the pilot study. In stage 2, there was a pilot study process with modifications based on comments and suggestions from experts and data collection online, data validation using Cronbach Alpha, and data analysis using the Relative Importance Index (RII). In stage 3, categorise all the critical factors using factor analysis. Overall, the technique to achieve the output was mentioned in this chapter, and the output will be presented in the next chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The data collection methods employed in this study were questionnaires in accordance with the research methodology described in Chapter Three. Each objective's data analysis and explanation are provided separately to show how each goal influences the final result. To accomplish the study's second goal, this chapter concentrates on assessing and debating the data obtained from the surveys. This goal is to identify the crucial readiness factor for the Sarawak building construction project.

This chapter also includes a discussion of the reliability test, the profile of participants in the study, and the analysis of questionnaire responses. Data was extracted from the questionnaire and analysed using SPSS. The final output of this chapter presents the categories of critical readiness factors in Sarawak to achieve the third objective of this study.

4.2 Result of Questionnaire Survey

A questionnaire is used to collect responses from various respondents to identify and analyse the critical building Construction Readiness Factor, CRF, to reduce project delay in Sarawak. The data gathered from the questionnaire has been examined in this section. Herein, the respondents' profiles and the responses to the questionnaire are addressed.

4.2.1 Valid Questionnaires

A total of 175 questionnaire sets were distributed, while the number of questionnaires received was 105. The results revealed 14 questionnaires with missing data, which occurred because respondents did not answer one or more questions on the questionnaire. Hence, they were excluded from the analysis. Therefore, only 91 questionnaires are valid for the analysis. Furthermore, the responding rate is 60.00%, and the percentage of the questionnaires valid for analysis is 86.67%, as summarized in Table 4.1.

Table 4.1 Valid Questionnaires

Parameters	Values
Number of questionnaires distributed	175
Number of questionnaires received	105
Number of incomplete questionnaires (invalid)	14
Number of valid questionnaires for analysis	91
Percentage of questionnaires received (%)	60.00
Percentage of questionnaires valid for analysis (%)	86.67

4.2.2 Reliability Test

According to Owolabi et al. (2020), reliability analysis is a statistical process that assesses the validity of the Likert scale assessment utilised for the construct under evaluation in the questionnaire. The reliability of the items is investigated by measuring the Cα for each group using the statistical programme SPSS. Based on the findings presented in Table 4.2, the Cronbach's α coefficient for every item in the present investigation is 0.981, suggesting a robust internal consistency among the components employed in this investigation. Additionally, Cronbach's alpha coefficient values exceed 0.7, indicating that the gathered data is both requested and accepted at a high degree of reliability (Akram et al., 2017).

Table 4.2 Reliability test results

Component	No. of Items	Cronbach's Alpha	Result
Construction Readiness Factor	41	0.981	Excellent

4.2.3 Demographic Description

The respondents targeted in this study are project team members working in Sarawak with work experience in construction management. During the questionnaire, the researcher asked about six key topics specific to the respondents, which can be used when analysing the results to compare their responses. These topics include age, education level, type of organization, type of building project, experience in building projects, and number of building projects of the respondent.

4.2.3.1 Education Level

The education level of the respondents was identified in this research, with the highest respondents having a bachelor's degree at 58.2%, followed by a diploma degree at 24/7%, a master's degree of 8.8%, certificate of 7.7%, and PhD degree of 1.1% as shown in Figure 4.1.

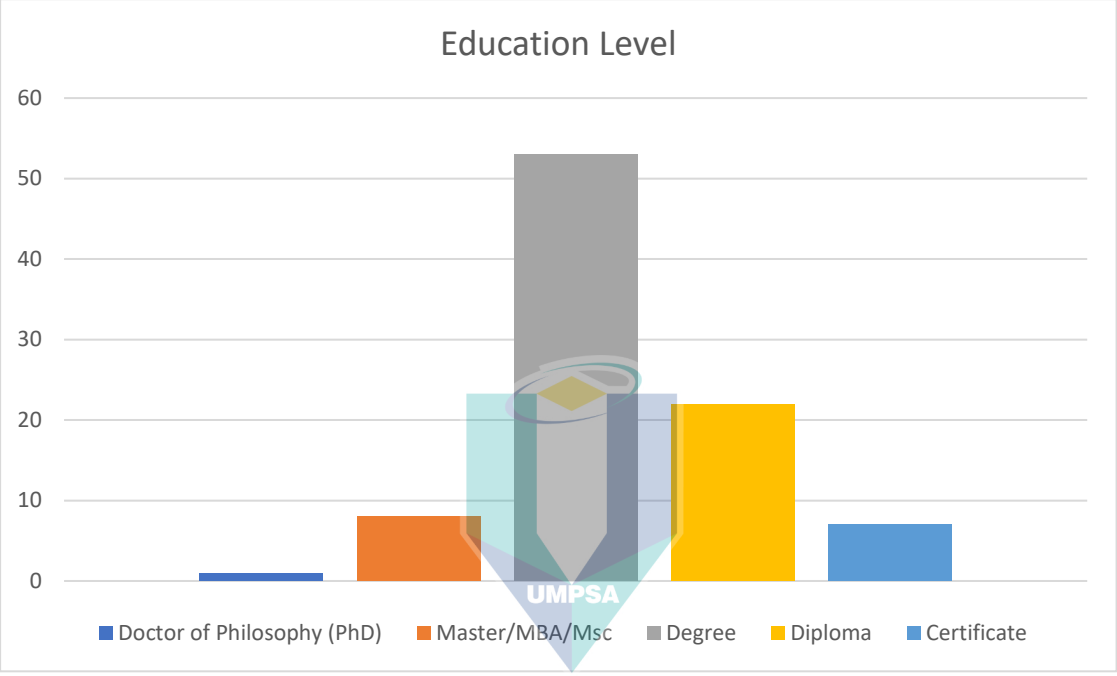

Figure 4. 1 Level of Education

4.2.3.2 Type of Organization

Construction projects in Sarawak involve clients, project proponents, consultants, and contractors. Another study by (Fagbenle et al., 2018) covered these three types of organizations. The questionnaire finding results the most from consultants at 35.2%, followed by the same percentage of 29.7% from owners and contractors, and others at 5.5%, as shown in Figure 4.2.

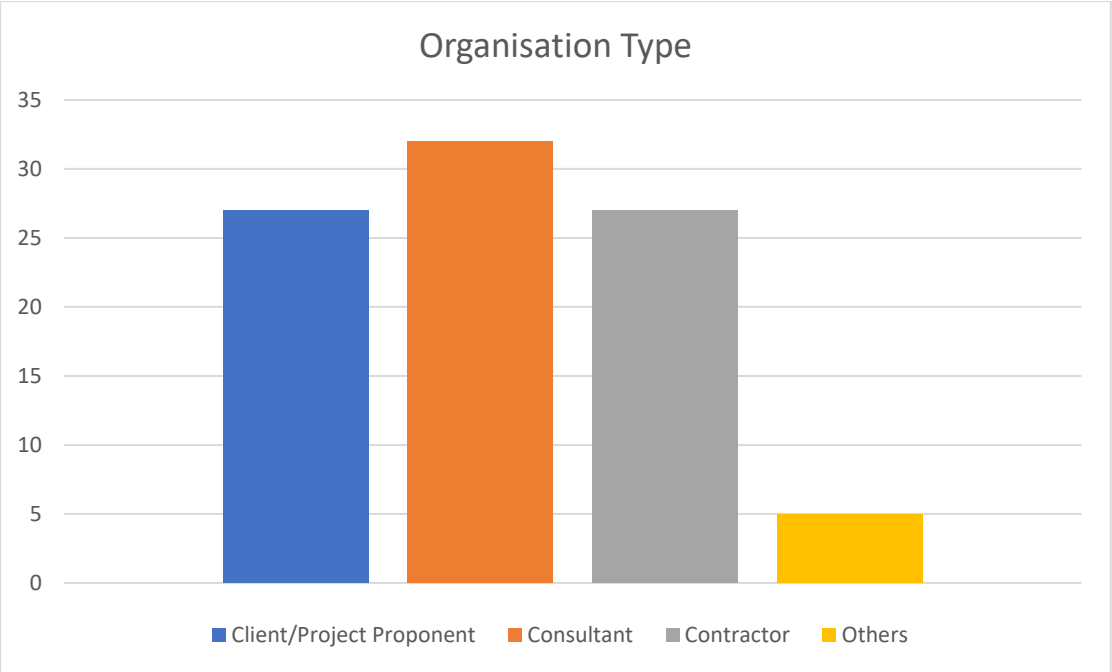

Figure 4. 2 Organization Type in Construction

4.2.3.3 Type of Building Project

The common type of building project identified from this questionnaire is the most respondents involved in commercial at 33%, followed by Low-rise residence at 31.9%, High-rise residential at 22%, and others at 13.2%, as shown in Figure 4.3.

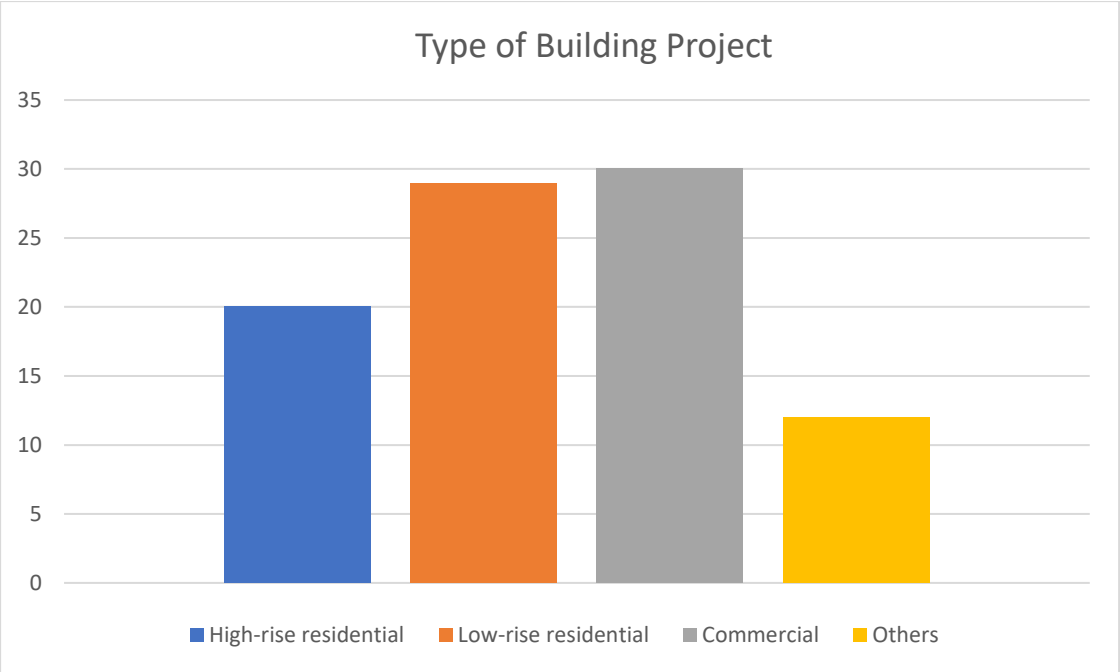

Figure 4. 3 Most Common Type of Building Project Involved

4.2.3.4 Experience in Building Project

There are various building project experiences of respondents in this research, which mostly experienced 2-5 years 44%, followed by more than 9 years' experience 36.2% and 6-9-years' experience 19.8% as shown in Figure 4.4. Different experiences give different data with broad knowledge, and this variety of categories of respondents' experience was also mentioned by (Amusan et al., 2018). Identifying respondents' experiences gives a variety of data in proportion to the different experiences. This diversity of experiences indicates that the participants have a broad knowledge reflected in their answers (Al-Btoush, 2022).

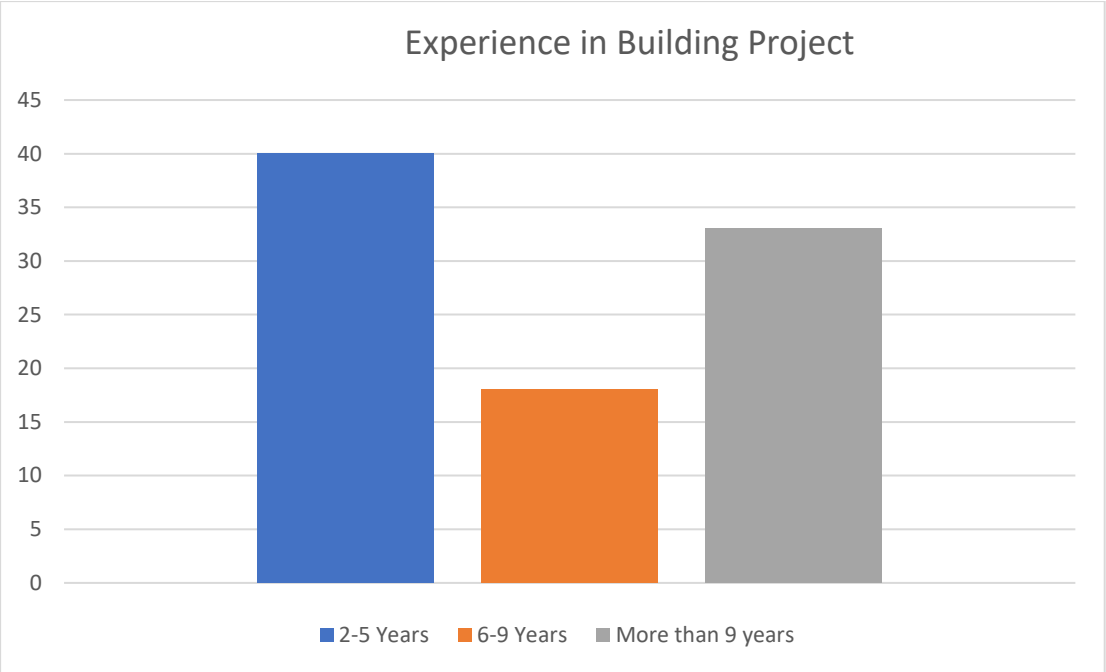

Figure 4. 4 Years of Experience in Building Construction Projects

4.2.3.5 Number of Building Project

The number of building projects involved by respondents showed that mostly involved more than 9 projects at 48.4%, followed by 2-5 projects at 20.9%, and with the same percentage of 15.4%, which involved 6-5 projects and less than 2 projects as shown in Figure 4.5.

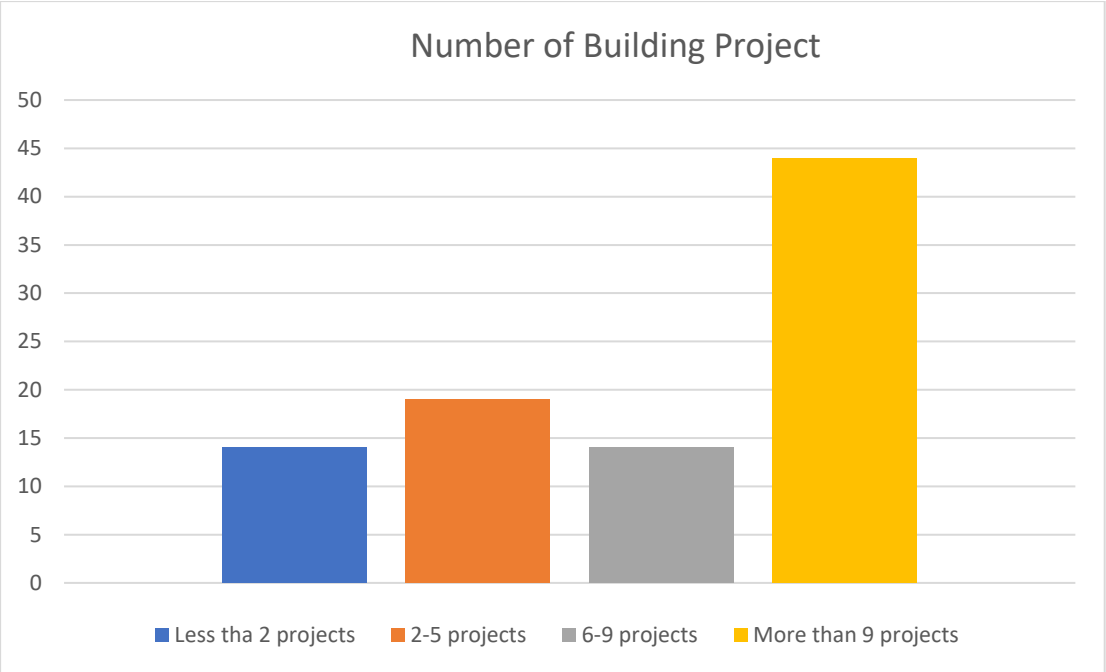

Figure 4. 5 Total Number of Building Projects Involved

4.2.4 Respondent's Background

The sample size of this study (91 replies) may seem small to some, but experts generally concur that a sample size of at least 30 is necessary for statistical data analysis and generating significant results (Mohd Radzi, 2021). Furthermore, the goal of this study was not to provide the opinions of the entire population regarding the variables; rather, it was to emphasise the varying degrees of significance among the choice factors. This goal is comparable to other published research, such as identifying crucial success factors for international public-private partnerships with 45 responses (Osei-Kyei et al. 2017) and identifying crucial impediments to affordable housing with 51 responses (Adabre et al. 2020). For this reason, the study believes the sample size is enough for further research.

Section A of the questionnaire was regarding the respondent's background. Respondents were asked about age, education level, type of organization, type of building project involved, number of building projects involved, and experience in building projects. Table 4.3 shows the respondents' background information. Consultants have the highest proportion at 35.2% and the proportion of contractors and clients at 29.7%. However, the majority of respondents (48.4%) have worked on more than nine building projects, and 44%

have two to five years of experience working on building projects. A basic overview of the respondent's participation is provided in Table 4.3.

Table 4.3 General information about the participation of respondent

Scale	Categories	Frequency	Percentage (%)
Education	Doctor of Philosophy (PhD)	1	1.1
	Master/MBA/MSc	8	8.8
	Degree	53	58.2
	Diploma	22	24.2
	Certificate	7	7.7
Type of Organization	Client/Project proponent	27	29.7
	Consultant	32	35.2
	Contractor	27	29.7
	Others	5	5.5
Type of Building Project	High-rise residential	20	22.0
	Low-rise residential	29	31.9
	Commercial	30	33.0
	Others	12	13.2
Experience in Building Projects	2-5 years	40	44
	6-9 years	18	19.8
	More than 9 years	33	36.2
Number of Building Projects	Less than 2 projects	14	15.4
	2-5 projects	19	20.9
	6-9 projects	14	15.4
	More than 9 projects	44	48.4

4.3 Objective 1: To determine the factors influencing the readiness for implementation of construction project

4.3.1 Literature Review

The questionnaire survey employed in this study was developed based on previous studies. The researcher looked at published research on construction readiness that had been done in different countries. Verifying the validity of the initial questionnaire form is crucial throughout the study's initial phase. As a result, the researcher sent it to several Sarawakian experts before adopting it, as detailed in the following section. As indicated by Table 4.4, a literature review was the foundation for many investigations to identify the components required to create the study questionnaire.

Table 4.4 Summary of Construction Readiness Factors

Construction Readiness Factor	Researchers
Experienced and capable contractor have been selected	(Aravindhan et al., 2021), (Ahmad Hisham & Yahya, 2016), (Kamaruddeen et al., 2019)
Project scope have been finalised	(Ahmad Hisham & Yahya, 2016), (Kamaruddeen et al., 2020), (Kamaruddeen et al., 2019)
Project fund have been approved	(Ahmad Hisham & Yahya, 2016), (Tang, 2016), (Kamaruddeen et al., 2019)
Project supervision and inspection team have been organized	(Ahmad Hisham & Yahya, 2016), (Tang, 2016)
Drawing have been approved	(Assaf & Al-Hejji, 2006), (Kamaruddeen et al., 2019)
Expected project outcome have been established	(Zainordin, 2016)
Sufficient time have been given during planning and design stages	(Halim & Zin, 2016), (Mohd Radzi, 2021), (Kamaruddeen et al., 2019)
Complete project data have been provided to designers	(Halim & Zin, 2016)
Detailed site investigation has been done	(Halim & Zin, 2016), (Tang, 2016)
Land acquisition has been settled	(Mohd Radzi, 2021)
Utility Relocation issues has been settled	(Mohd Radzi, 2021), (Tang, 2016)

Table 4.4 Continued

Construction Readiness Factor	Researchers
Engagement between stakeholders have been held	(Mohd Radzi, 2021), (Tang, 2016)
Work programme has been approved by consultant	(Mohd Radzi, 2021)
Building plan have been approved by Local Authority	(Mohd Radzi, 2021)
Contractors to make sure funding for the projects has been acquired	(Ahmad Hisham & Yahya, 2016), (Mohd Radzi, 2021), (Reddy & Rao, 2022)
Proper project plan and schedule have been prepared	(Ahmad Hisham & Yahya, 2016)

4.4 Objective 2: To rank the critical factors of readiness in the implementation of building project in Sarawak

The second objective of this research is to ascertain the critical CRF in Sarawak Building construction projects and to achieve the objective by adopting a questionnaire survey based on the opinions of construction project organizations such as clients, consultants, and contractors in Sarawak. It helps in creating a solid foundation for the construction phase and ensures that the project progresses smoothly from initiation to completion.

A questionnaire survey on a 5-Likert scale was used to rate the importance of CRF for building projects. Likert scales are user-friendly for respondents. They are intuitive and easy to understand, allowing individuals to express their opinions without requiring extensive cognitive effort. The 5-Likert scale allows the generation of a range of responses, including neutral responses, and does not force a decision (Mashwama et al., 2016).

There were 41 Construction Readiness Factors in the study. Version 27 of the Statistical Package for Social Sciences (SPSS) was used to evaluate the supplied data. The technique known as the Relative Importance Index (RII) is used to rank the acquired CRFs. The Relative Importance Index (RII) is a statistical technique used in survey research to assess and rank the importance of various factors or items based on respondents' perceptions.

It was extensively employed by numerous studies in construction research (Rahman et al., 2012: Niazi & Painting, 2017: Tejale et al., 2015).

The Relative Importance Index (RII) values range from 0 to 1. The importance of the factor increases when the value of RII closes at 1 (Naoum, 2012). In this study, the highest RII value (0.9275) is CRF18, whereas the lowest RII value (0.7033) is CRF41, as shown in Table 4.5. On top of that, Table 4.5 also shows the mean values and ranks of CRF. It is noticeable that the mean values range from 3.52 to 4.64.

Table 4.5 Mean, RII, and Rank values for the CRF

CRF	Readiness factor	Mean	RII	Rank
18	Letter of award from the client has been received	4.6400	0.9275	1
4	Drawing have been approved by client	4.6300	0.9253	2
3	Project fund have been approved	4.5900	0.9231	3
19	Local Authority have approved the project	4.5800	0.9165	4
33	The necessary insurance has been obtained for the project	4.5700	0.9143	5
36	Discrepancies between construction drawings and tender drawings have been verified	4.5300	0.9055	6
34	Safety signboards have been placed at the construction site	4.5300	0.9055	6
35	Project workplan has been approved by the client	4.5100	0.9011	7
20	Construction duration has been verified	4.4900	0.8989	8
11	Detailed site investigation has been carried out	4.4700	0.8945	9
26	The site location and site condition has been verified as same to the contract	4.4700	0.8945	9
12	Building plan have been approved by Local Authority	4.4700	0.8945	9
21	The official commencement date has been verified	4.4700	0.8945	9
14	Contractors to make sure funding for the projects has been acquired	4.4500	0.8901	10
37	Complete IFC (issued-for-construction) drawings have been issued	4.4400	0.8879	11

Table 4.5 Continued

CRF	Readiness factor	Mean	RII	Rank
8	Land acquisition has been settled and site free from encumbrances (squatters)	4.4300	0.8857	12
25	Adequate workforce has been acquired	4.4200	0.8835	13
2	Project scope have been finalised	4.4100	0.8813	14
13	Project supervision and inspection team have been organised	4.4000	0.8791	15
6	Sufficient time have been given for planning stages	4.3800	0.8769	16
7	Complete project data/information have been provided to designers at design stage	4.3700	0.8747	17
5	Expected project output have been established	4.3600	0.8725	18
24	Process for reporting RFI (Request for Inspection) has been verified	4.3500	0.8703	19
9	Utility relocation issues has been resolved	4.3500	0.8703	19
38	Equipment for the project have been acquired	4.3200	0.8637	20
22	Traffic around the construction site has been verified	4.3100	0.8615	21
28	Project team include representative from the procurement team	4.3000	0.8593	22
23	Process for responding to delay has been verified	4.3000	0.8593	22
27	Schedule for design deliverables compatible with the sequence of construction have been verified	4.2900	0.8571	23
30	System to align construction with commissioning and operations have been verified	4.2900	0.8571	23
17	Project Management Plan, PMP (inclusive of risk management and quality management plan) has been established	4.2600	0.8527	24
1	Experienced and capable contractor have been selected	4.2500	0.8505	25
39	Utilities on construction site are ready (e.g. electricity, water, WIFI, etc.)	4.2500	0.8505	25

Table 4.5 Continued

CRF	Readiness factor	Mean	RII	Rank
10	Engagement between stakeholders have been conducted	4.2400	0.8484	26
29	Clear procurement process and supporting system in place for storage have been verified	4.2300	0.8462	27
31	Nearest material supplier to the construction site has been verified	4.1300	0.8264	28
32	Parking space for machinery at the construction site have been verified	4.1300	0.8264	28
40	The site office is ready	4.0400	0.7988	29
16	Contingency plan due to unprecedented event have been prepared (e.g. Covid19/natural disaster/economic factor/political influences)	4.0200	0.7944	30
15	Building Information Modelling has been adapted	3.8700	0.7736	31
41	CCTV has been installed at the construction site	3.5200	0.7033	32

According to Table 4.5, there are thirty-seven (37) critical Construction Readiness as the RII value more than 0.8.

4.4.1 CRF18 Letter of award from the client has been received

The client notifies the contractor in writing that the contractor has been selected for the project and will receive a letter of award. A written and signed contract stating that the owner had awarded the project to the contractor would prevent several issues that could arise in the absence of a letter of award. Without a contract, there would be no agreement, no safeguards for the contractor, and no assurance that they would get paid for their labour. Furthermore, failure to agree on the contract terms and conditions (Tavakoli et al. 2020).

The contractors might incur additional costs if they disagree with the terms and conditions before starting construction. As a result, excessive expenses may have an impact on the contractor's cash flow. As a result, employees may be reluctant to work if the contractor pays them late, which could stop construction activity and reduce productivity.

Thus, before beginning construction, the contractor must ensure that the letter of award has been received in order to avoid project delays (Mohd Radzi, 2021).

In summary, the Letter of Award is a key construction readiness factor as it signifies the formal commencement of the construction project, sets the terms of the contractual relationship, and provides the necessary authorization and financial commitment for the contractor to proceed with the work. This factor was also used based on the in-depth interview and literature (Radzi et al. 2021).

4.4.2 CRF4 Drawing have been approved by client

The approval of construction drawings by the client is indeed a crucial readiness factor in the construction process. These drawings serve as a communication tool between the client, architects, engineers, and the construction team." Drawing has been approved by the client" is also one of the critical factors ranked by respondents. As suggested by a previous study, to prevent delay, the designer should increase staff to provide drawings on time (Wanjari & Dobariya, 2016).

In conventional construction procurement method, construction drawings must comply with local building codes and regulations. Client approval often implies that the drawings have undergone necessary reviews and meet regulatory standards. Obtaining client approval of construction drawings is a significant milestone in the project timeline. It allows the construction team to proceed confidently, knowing the client is satisfied with the proposed plans.

4.4.3 CRF3 Project funds have been approved

With approved project funds, the project team and contractors are formally authorized to proceed with the construction work. This ensures sufficient funds are available to cover the costs associated with various project phases. The success of a project is significantly impacted by the availability of funds and the regularity of payments, as late payments can cause work to be interrupted or delayed. Furthermore, when the contractor is paid on time by the institution, the contractor pays workers and subcontractors on time as well, and the work proceeds according to schedule. In the event that payments are made beyond the due date, the opposite occurs (Tayeh et al., 2018).

In summary, the approval of project funds is a pivotal construction readiness factor as it provides the financial foundation necessary for the successful initiation, execution, and completion of the construction project. It sets the stage for the project team to confidently move forward, knowing that the financial resources needed to support the construction activities are in place. Since it relies on routine payments to cover project expenses, delays in such payments by the owner will adversely affect the contractor's financial position. Thus, at the beginning of a construction project, an acceptable amount of funding must be determined so that routine payments are made regularly before naming a contractor for the work performed (Al-Btoush, 2022).

4.4.4 CRF19 Local Authority have approved the project

Local authorities' approval is based on legal authorization, land use approval, building codes, zoning regulations, and other planning guidelines to ensure that construction projects adhere to safety, environmental, community, and infrastructure considerations.

Local authority approval typically includes the issuance of permits necessary for construction. Depending on local requirements, these permits may cover various aspects, such as building permits, environmental permits, and occupancy permits. When a construction project is approved, it means that the necessary authorities have granted approval for the development, ensuring that it complies with the criteria outlined in the building rules (Tavakoli et al., 2020).

4.4.5 CRF33 The necessary insurance has been obtained for the project

Risk Since risk avoidance won't cost the business any money, it is always the first risk treatment strategy that is considered. If there is no way to avoid the danger, the next best option is to reduce it. The organisation will still experience losses under this controlling strategy, but the harm will be lessened. When there is no means to resolve the troublesome issues, the next technique is risk transference, and the last one is risk acceptance (Sa'adi & Zainordin, 2019).

Obtaining necessary insurance for a construction project is a vital readiness factor that helps protect the project stakeholders, mitigate risks, and ensure financial security. Construction projects involve various risks, including accidents, property damage, and unforeseen events. Insurance provides a mechanism for managing and transferring these

risks, ensuring that the financial impact of unexpected events is mitigated. Purchasing insurance is a common method of transferring risk. When accidents happen, the insurance provider will cover compensation costs. As a result, the employer might not incur financial losses (Iqbal et al. 2015).

Insurance coverage contributes to project continuity by providing a financial safety net in the face of unexpected events. This can help prevent project delays and financial setbacks. The necessary insurance has been obtained for the project, as stated in a previous study (Radzi et al. 2021). In summary, ensuring that the necessary insurance has been obtained for a construction project is a critical readiness factor. It helps manage risks, comply with contractual and regulatory requirements, and provides financial protection for project stakeholders.

4.5 Objective 3: To categorise the critical construction readiness factors for building project in Sarawak

Bartlett's test of sphericity and the Kaiser-Meyer-Olkin test (KMO) are used to evaluate the appropriateness of the data. The KMO value of the CRF data is 0.906, indicating that the minimum required value of 0.50 is met, indicating an exceptional level of KMO value acceptance (Field, 2009). The correlation matrix is significant at $p < 0.05$, according to Bartlett's test of sphericity results of 4038.249 with a significance value of 0.000, meaning that the CRF data is appropriate for factor analysis (Mohd Radzi, 2021).

Table 4.6 KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.906
Bartlett's Test of Sphericity	Approx. Chi-Square	4038.249
	df	666
	Sig.	.000

The factor analysis results following the VARIMAX rotation are displayed in Table 4.5. Referring to Chan et al. (2017), only variables with eigenvalues greater than one should be retained. Four underlying components with Eigenvalues greater than one are identified

by the analysis as accounting for 74.010% of the variation overall. Only thirty-seven CRFs are successfully loaded in the four underlying components.

Two CRFs, 'Adequate workforce has been acquired'(RC25) and 'Project Management Plan, PMP (inclusive of risk management plan) has been established'(RC17), are excluded because their factor values are below 0.50. Factor loadings higher than 0.50 are regarded as significant and contribute to the interpretation of the components.

Based on the CRFs, the underlying components are named: Component 1: Preliminary Work and Authorities Approval, Component 2: Procurement and Execution, Component 3: Project Documentation and Verification, and Component 4: Capability and Project Scope. Each component is discussed in the subsequent subsections.

Table 4.7 Factor analysis after the VARIMAX rotation

Construction Readiness Factors		Components			
		1	2	3	4
Component 1:	Preliminary Work and Authorities Approval				
RF 11	Detailed site investigation has been carried out	0.783			
RF 7	Complete project data information has been provided to designer	0.756			
RF 8	Land acquisition has been settled and site free from encumbrance	0.730			
RF 9	Utility relocation issues has been resolved	0.721			
RF 13	Project supervision and inspection team have been organized	0.699			
RF 10	Engagement between stakeholders have been conducted	0.688			
RF 3	Project fund have been approved	0.659			

Table 4.7 Continued

Construction Readiness Factors		Components			
		1	2	3	4
Component 1:	Preliminary Work and Authorities Approval				
RF 14	Contractor to make sure funding for the project has been acquired	0.653			
RF 12	Building plan have been approved by Local Authority	0.649			
RF 6	Sufficient time have been given for planning stages	0.630			
RF 4	Drawing have been approved by client	0.617			
RF 5	Expected project output have been established	0.607			
RF 23	Process for responding to delay has been verified	0.592			
RF 22	Traffic around the construction site has been verified	0.547			
RF 17	Project Management Plan, PMP (inclusive of risk management and quality management plan) has been established	0.542			
Component 2:	Procurement and Execution				
RF 31	Nearest material supplier to the construction site has been verified		0.757		
RF 32	Parking space for machinery at the construction site have been verified		0.726		

Table 4.7 Continued

Construction Readiness Factors		Components			
		1	2	3	4
Component 2:	Procurement and Execution				
RF 30	System to align construction with commissioning and operations have been verified		0.723		
RF 28	Project team include representative from the procurement team		0.689		
RF 29	Clear procurement and supporting system in place for storage have been verified		0.682		
RF 27	Schedule for design deliverables compatible with the sequence of construction have been verified		0.615		
RF 38	Equipment for the project have been acquired		0.615		
RF 39	Utilities on construction site are ready (e.g. electricity, water, WIFI, etc)		0.595		
RF 34	Safety signboard have been placed at the construction site		0.540		
RF 24	Process for reporting RFI (Request for Inspection) has been verified		0.538		
RF 25	Adequate workforce has been acquired		0.533		

Table 4.7 Continued

Construction Readiness Factors		Components			
		1	2	3	4
Component 3:	Project Documentation and Verification				
RF 35	Project workplan has been approved by the client			0.726	
RF 21	The official commencement date has been verified			0.704	
RF 20	Construction duration has been verified			0.682	
RF 37	Complete IFC (issued-for-construction) drawing have been issued			0.655	
RF 19	Local Authority have approved the project			0.646	
RF 18	Letter of award from the client has been received			0.638	
RF 36	Discrepancies between construction drawings and tender drawings have been verified			0.630	
RF 33	The necessary insurance has been obtained for the project			0.624	
RF 26	The site location and site condition has been verified as same to the contract			0.566	

Table 4.7 Continued

Construction Readiness Factors		Components			
		1	2	3	4
Component 4:	Capability and Project Scope				
RF 1	Experienced and capable contractor have been selected				0.775
RF 2	Project scope have been finalised				0.591
Eigenvalue		23.292	1.748	1.283	1.061
Variance (%)		62.950	4.723	3.468	2.868
Cumulative variance (%)		62.950	67.673	71.141	74.010

Note:
Extraction method: Principal Component Analysis;
Rotation method: Varimax with Kaiser Normalization.

Figure 4.6 shows in percentage the contribution of each component to the overall CRF for assessing the construction readiness of building projects. Based on the result, "Component 1: preliminary work and authorities' approval" contributed 41% while, "Component 2: procurement and execution" contributed around 30%, respectively. On the other hand, "Component 3: Project Documentation and Verification" contributes 24%, and "Component 4: Capability and Project Scope", contributes 5% of the total CRF.

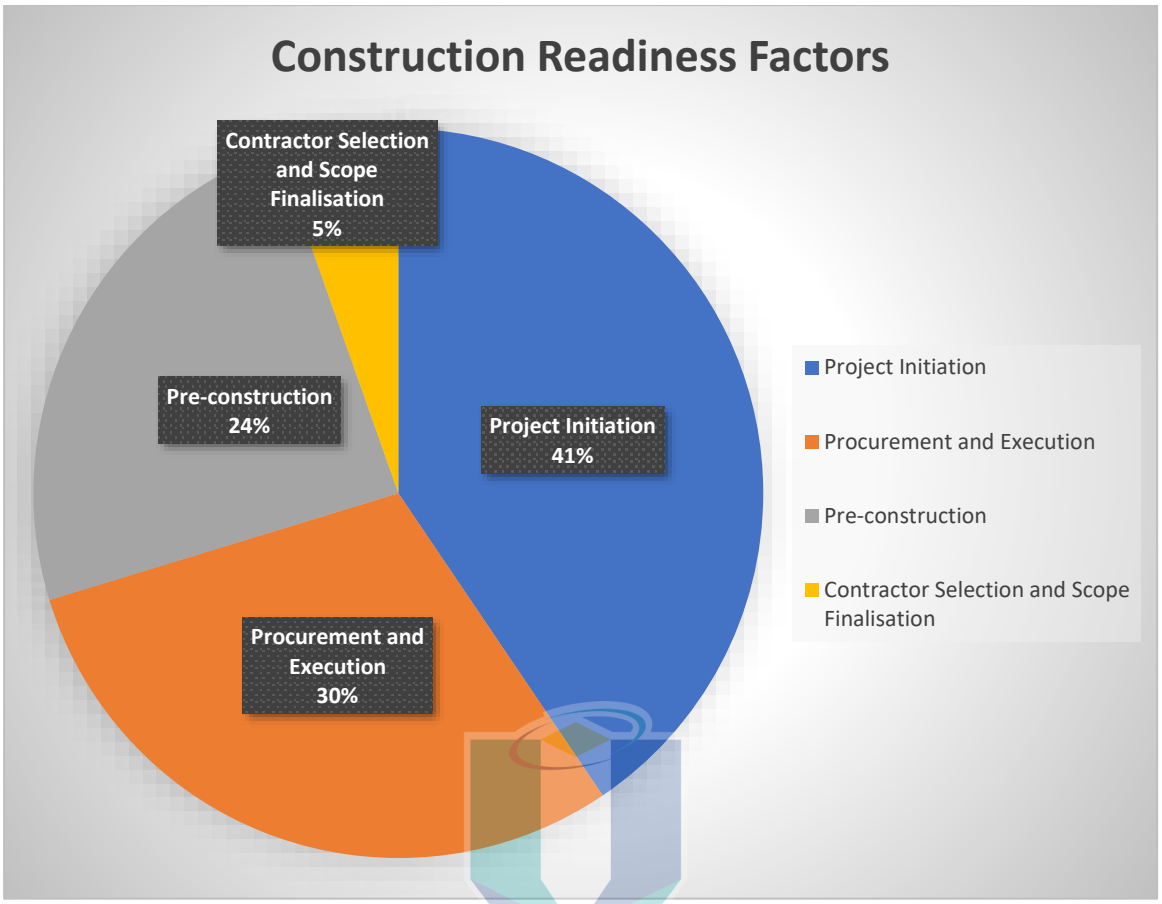

Figure 4. 6 Percentage of Each Component

4.5.1 Component 1: Preliminary Work and Authorities Approval

Preliminary Work and Authorities Approval is the first phase in the project life cycle, where a project is formally defined at a broad level. In this component, fifteen CRFs are involved. During this stage, the project's purpose, objectives, feasibility, and initial resources are determined. The primary goal of Preliminary Work and Authorities Approval is to provide a clear understanding of what the project aims to achieve and whether it is viable and worth pursuing.

CRF11 *Detailed site investigation has been carried out*. Performing a detailed site investigation is crucial in a building project as it aids in identifying potential hazards and constraints, facilitating informed decision-making throughout the construction process. This investigation helps understand the site's specific conditions, essential for designing and constructing a safe, stable structure that meets all regulatory requirements.

CRF7 *Complete project data/information have been provided to designers at design stage*. Ensuring comprehensive data accessibility facilitates accurate feasibility assessments, encompassing technical, operational, economic, legal, and scheduling aspects, ultimately guiding decisions on project viability and pursuit. Conducting a feasibility study to assess the project's technical, operational, economic, legal, and scheduling feasibility is essential. This helps determine whether the project is viable and worth pursuing.

CRF8 *Land acquisition has been settled and free from encumbrances (squatters).* Any legal or ownership disputes, especially those involving people occupying the land without proper authorization (squatters), have been resolved. Land acquisition can be complex, and addressing encumbrances is crucial to ensure clear and undisputed ownership. This is typically done through legal processes, negotiations, or other means to clear any claims or disputes over the land.

CRF9 *Utility relocation issues have been resolved*. Prior to starting a highway construction project, the contractor must ensure that the relocation of any utility lines that will be disrupted by the project won't interfere with the work being done. Utility lines that will be disrupted by the work must be moved, adjusted, or replaced. On highway projects, relocating utilities is a difficult pre-construction task that, if done poorly, frequently results in schedule and budget overruns (Mohd Radzi, 2021).

CRF 13 *Project supervision and inspection team have been organised*. Ensuring that qualified personnel are allocated to relevant tasks to uphold project quality and compliance standards. Establish clear communication channels and protocols within the project team to facilitate efficient coordination and address any issues that may arise during the project lifecycle. Identify and assemble the project team, define roles and responsibilities, and ensure that the team members understand the project's objectives and their roles within the project.

CRF10 *Engagement between stakeholder have been conducted.* Identify and list all the parties that have an impact on or can have an impact on the project. Recognise their expectations, interests, and possible effects on the project. In order to determine what has to be done to reach the target degree of readiness and guarantee a successful start to construction, the project team will examine the decision factor for construction readiness.

CRF3 *Project fund have been approved.* marking a significant milestone in securing the necessary resources for its execution. It is imperative for stakeholders to outline the project's purpose, goals, and objectives to ensure alignment with organizational strategies. By clearly defining these parameters, the project team can effectively steer the initiative towards success while minimizing potential risks and uncertainties.

CRF14 *Contractors to make sure funding for the project has been acquired*. Develop an initial estimate of the project budget. This includes estimating costs associated with resources, materials, equipment, and other project-related expenses. Cost estimates often allow the project's progress to be tracked and decisions taken with regard to project completion or termination. Therefore, initial cost estimates require special attention since many specifics and information are unknown or inaccessible at the project initiation stage (Al-Btoush, 2022).

CRF12 *Building plan have been approved by Local Authority*. Project initiation sets the foundation for the entire project and is a critical phase for ensuring that the project is well-defined, feasible, and has the necessary support to proceed to the planning and execution phases. It is the stage where decisions are made regarding whether to commit resources to the project or not.

CRF6 *Sufficient time have been given for planning stages*. Create a preliminary project schedule that outlines the important deadlines, tasks, and milestones. To provide efficient project monitoring and management, a suitable reporting and feedback procedure is necessary. Contractors' failure to meet project performance targets can be attributed to the lack of regular and efficient supervision and communication by consultants to pertinent project stakeholders, allowing for the timely implementation of corrective actions (Asiedu & Adaku, 2019).

CRF4 *Drawing have been approved by client*. To ensure comprehensive buy-in and support, it is essential to seek endorsement from key stakeholders and sponsors. Presenting them with a detailed overview, feasibility study, and other documentation facilitates informed decision-making and fosters alignment with project objectives. Their approval not only validates the project's viability but also strengthens collaboration and commitment moving forward.

CRF5 *Expected project output have been established.* This includes a detailed outline of the final deliverables upon completion of the project. The output likely encompasses specific goals, such as software features, research findings, or tangible products. Stakeholders and project team members should be aligned on these expected outputs to ensure clarity and success throughout the project lifecycle. Regular progress tracking and communication will be essential to ensure that the final output aligns with the initial expectations and requirements.

CRF23 *Process for responding to delay has been verified.* This verification likely involved reviewing and testing the established procedures for managing delays in project timelines or workflows. It ensures that the project team is equipped to handle unexpected setbacks efficiently and effectively. Verification may include simulations or real-world scenarios to assess the robustness of the delay response process. With this verification, stakeholders can have confidence in the project's ability to navigate challenges and meet its objectives on time.

CRF22 *Traffic around the construction site has been verified.* Verifying traffic conditions around a construction site is an important step in ensuring the safety of workers, pedestrians, and motorists, as well as in managing the logistical aspects of the construction project. By carefully verifying and managing traffic conditions around the construction site, you can enhance safety, minimize disruptions, and contribute to the overall success of the construction project.

4.5.2 Component 2: Procurement and Execution

The process of obtaining resources for consumption or building in exchange for money is known as procurement. The process of obtaining products, services, or labour from outside sources is referred to as procurement. It includes tasks including contract administration, purchasing, negotiating, and sourcing. From a wider angle, procurement can be defined as the process by which every company acquires the products and services it needs (Suresh & Arun Ram Nathan, 2020).

CRF31 *Nearest material supplier to the construction site has been verified.* Upon thorough analysis, it was found that proximity to the construction site significantly reduced transportation costs and minimized potential delays. This finding aligns with previous

studies indicating that efficient material procurement processes are crucial for mitigating both time and cost overruns in construction projects (Wanjari & Dobariya, 2016).

CRF32 *Parking space for machinery at the construction site have been verified.* Execution requires effective coordination of resources such as labour, materials, equipment, and time, with careful consideration given to optimizing workflow and minimizing potential bottlenecks to maintain project efficiency. Project managers and construction teams must ensure the right resources are available at the right time to keep the project on schedule.

CRF30 *System to align construction with commissioning and operations have been verified*. Execution in the context of a building construction project refers to the practical implementation and realization of the planned design and construction activities. It involves the on-site coordination, management, and supervision of various tasks to ensure that the project progresses according to the established plans and specifications.

CRF28 *Project team include representative from the procurement team.* Effective communication among project stakeholders, including architects, engineers, contractors, subcontractors, and procurement specialists, is crucial during the execution phase to streamline material sourcing, optimize costs, and ensure the timely delivery of supplies. Collaboration helps resolve issues, address changes, and keep everyone aligned with the project goals.

CRF29 *Clear procurement process and supporting system in place for storage have been verified.* Carry out the planned tasks and activities, ensuring that they align with the project schedule and budget. Regularly track and assess project performance against the project plan. This involves managing risks, addressing issues, and making adjustments as needed.

CRF27 *Schedule for design deliverables compatible with the sequence of construction have been verified.* Most of the design factors have a high impact on cost overrun and are ranked according to their importance. This outcome is acceptable since proper cooperation between designers and managers should have occurred prior to the bidding process, and any modifications to drawings and specifications made during construction and execution necessitate further time for resource adjustments (Ahady et al. 2017).

CRF38 *Equipment for the project have been acquired.* Maximize resource efficiency by procuring labour, materials, and equipment (Ahady et al. 2017). Efficient procurement practices not only involve acquiring the necessary equipment but also encompass strategic planning to ensure compatibility, reliability, and cost-effectiveness. By optimizing the procurement process, project managers can effectively allocate resources, minimize delays, and enhance overall project performance.

CRF39 *Utilities on construction site are ready (e.g. elctricity, water, wifi, etc.).* By thoroughly addressing these aspects during the pre-construction phase, project stakeholders can establish a solid foundation for a successful construction project, minimizing risks and ensuring that the project progresses smoothly. Adequate utility preparation also facilitates a conducive working environment, promoting productivity and enhancing overall project efficiency.

CRF34 *Safety signboards have been placed at the construction site.* These signboards help promote awareness of potential risks and encourage adherence to safety protocols, ultimately reducing the likelihood of accidents or injuries. Proper placement and clear signage contribute to a safer work environment, fostering a culture of safety among all personnel involved in the construction project. Regular inspection and maintenance of these signboards are essential to ensure their effectiveness throughout the duration of the project.

CRF24 *Process for reporting RFI (Request for Inspection) has been verified.* The process for reporting a Request for Inspection (RFI) typically involves several steps to ensure accuracy and efficiency. It includes the receipts of the RFI to the closure and archive of the RFI. It's essential to customize this process based on the specific requirements and protocols of your organization or industry. Regularly reviewing and updating the process will help ensure its effectiveness over time.

In summary, procurement and execution are interconnected aspects of project management, where procurement ensures the necessary resources are acquired, and execution involves implementing the project plan to achieve its objectives. Coordination and communication between these two processes are vital for project success.

4.5.3 Component 3: Project Documentation and Verification

Project Documentation and Verification involves planning, design, and preparation activities to set the foundation for a successful construction project. Premature starts can be avoided by adequate construction readiness assessment and performing appropriate preconstruction activities (Radzi et al., 2021). In this component, there are nine CRFs involved.

CRF35 Project workplan has been approved by the client. A larger building would need project and management teams with greater experience. The complexity of a project influences how long it takes to complete. The management and construction of the building will be simpler if its complexity is low. A market building, for instance, might take less time to build than a hospital facility, which needs specialisation (Kamaruddeen et al. 2019).

CRF21 The official commencement date has been verified. Perform proper preconstruction planning on tasks & resources, ensuring thorough consideration of factors such as scheduling, budgeting, and resource allocation. Short and demanding project schedules cause insufficient preconstruction planning, potentially leading to delays, cost overruns, and inefficiencies during project execution (Ramabhadran, 2018).

CRF20 Construction duration has been verified. Develop a detailed construction schedule, taking into account dependencies and critical path activities, which is essential for effective project management and timeline adherence. Allocate resources efficiently to meet project milestones, ensuring optimal utilization of manpower and equipment throughout the construction process.

CRF37 Complete IFC (issued-for-construction) drawings have been issued. According to Azhar (2011), the usage of BIM applications resulted in cost and time savings. The utilization of Building Information Modeling (BIM) applications has been widely acknowledged for its capacity to bring about significant cost and time savings in construction projects. BIM enables project stakeholders to collaborate more effectively by providing a digital representation of the physical and functional characteristics of a facility.

CRF19 Local Authority have approved the project. The scope of this research is the engineering, procurement, and construction (EPC) industry, with emphasis placed on the construction period and related preconstruction activities in vertical construction (Ibrahim et

al. 2021). Understanding local regulations and obtaining necessary approvals are critical in ensuring construction projects' smooth progression.

CRF18 Letter of award from the client has been received. Receiving the Letter of Award is a crucial milestone indicating that the project has transitioned to the construction phase. The receipt of the Letter of Award is a pivotal moment that triggers a series of actions and signals the beginning of the construction phase. Effective and prompt response to this milestone is crucial for ensuring a smooth transition and successful execution of the building project.

CRF36 Discrepancies between construction drawings and tender drawings have been verified. It is imperative to address these inconsistencies promptly to avoid potential delays and cost overruns during the construction phase. Working closely with architects and engineers to develop detailed construction plans ensures that the project progresses smoothly and according to specifications while obtaining necessary permits and approvals from local authorities facilitates compliance with regulations and legal requirements.

CRF33 The necessary insurance has been obtained for the project. Obtaining the necessary insurance for a project is a crucial step to mitigate risks and protect the stakeholders involved. This ensures that the necessary insurance coverage is in place to protect the project and its stakeholders from potential risks and liabilities. Keep in mind that the specifics of the process may vary based on the nature and scale of the project, as well as local regulations and industry standards.

CRF26 The site location and site condition has been verified as the same to the contract. Assess the site conditions, including topography, soil quality, environmental considerations, and access points, to inform the project planning process comprehensively. Conducting surveys to gather essential data for design and construction allows for informed decision-making and proactive mitigation of potential challenges throughout the project lifecycle.

4.5.4 Component 4: Capability and Project Scope

4.5.4.1 Contractor Capability

The contractor's experience in carrying out the work and his prior performance in the execution of the works in similar projects greatly affect the success of the projects and the

importance of the experience affecting the quality and the output of the project. (Reddy & Rao, 2022).

CRF1 *Experienced and capable contractor have been selected*. Insufficient experience of the contractor in the same role and scope of work has made it impossible to manage the project effectively. Experienced contractors may accomplish excellent quality and workmanship standards, have a high project success rate, and have a clean safety record. The inexperience of the site's management team is the true problem here. It appears that the contractor employs young, inexperienced workers there (Memon et al., 2011).

Selecting the right contractor is a crucial step in the success of a building construction project. The contractor is responsible for executing the project according to plans, meeting deadlines, and ensuring quality. By carefully evaluating qualifications, past performance, and other relevant factors, project owners can increase the likelihood of a successful construction project.

4.5.4.2 Scope Finalisation

The technical incompetence of the project team with regard to the clear understanding of the scope of works for effective controlling and monitoring over the project execution period is revealed by poor planning and supervision, which has also been identified as a critical failure factor of construction projects (Asiedu & Adaku, 2019).

CRF2 *Project scope have been finalised*. The construction business is frequently subject to a wide range of risks, including modifications to the scope of work, difficulties with finances and cash flow, unstable ground conditions, and shortages of workers and materials that can have an impact on costs and schedules. (Asiedu & Adaku, 2019). Careful consideration and management of these risks are essential for successful project execution and achievement of desired outcomes within budget and schedule constraints.

This is because it is challenging to construct a project without understanding its purpose, intended application, and points of view. The project's scope must be fully understood to prevent disagreements and conflicts, which could arise if not properly defined. This relates to a number of factors, including technical, financial, educational, and social difficulties (Tayeh et al., 2018).

4.6 Recommendation

A combination of quantitative and qualitative methods has been used to provide useful information about construction readiness in Sarawak building construction projects. This study confirmed that various construction readiness factors are needed during the project life cycle for the project to be completed within the planned cost and time limits.

By reviewing the literature, the current study found a lack of studies on construction readiness in building construction projects in Sarawak. Therefore, the researcher presents construction readiness factors according to the literature and questionnaire to give a comprehensive view of the construction readiness that helps reduce delays in construction projects. Additionally, this study provides a database for future research to create or improve other strategies. Besides, this study helps project managers develop effective plans to adopt acceptable strategies to reduce delays in the project life cycle. Additionally, the results of this study can aid construction practitioners in dealing with construction readiness issues.

The findings from this study revealed that the majority of the critical construction readiness factors are found in the early stages of the project life cycle. Therefore, this study suggests that good project planning should be undertaken during the initial stages, and sufficient time should be given to review the details of drawings and contract documents. Additionally, the owner must define the project's achievable objectives to conduct a comprehensive and integrated study of the project's initial stages.

The scope of this study is limited to Sarawak construction projects. For this reason, further studies are recommended to explore construction readiness factors in other countries' construction projects. In this case, different or similar construction readiness factors can be identified with this study and compared between them. In addition, this research can be useful for understanding and evaluating the development of the construction sector in different countries. This study recommends cooperation among all project stakeholders to improve the construction sector and keep it in line with recent developments, which will help to increase the efficiency of construction projects.

4.7 Summary

The chapter utilizes questionnaire-based data collection to analyse critical readiness factors for building projects in Sarawak. SPSS analysis of 105 valid responses shows strong

internal consistency (Cronbach's α = 0.981). Demographics indicate that the majority of consultants (35.2%) are involved in over nine projects (48.4%) and have 2-5 years of experience (44%). The study justifies its sample size (91 responses) and focuses on relative importance rather than capturing the entire population's perceptions. It employs Bartlett's test of sphericity and the Kaiser-Meyer-Olkin test to assess data reliability. Factor analysis identifies four components explaining 74.010% variation, aiding project management and reducing delays.

CHAPTER 5

CONCLUSION

5.1 Introduction

This chapter presents an overview of the work outlined in the study and highlights the conclusions drawn from the main research findings. The limitations to the research's findings and recommendations for further research are also mentioned.

5.2 Conclusion

This study on construction readiness in Sarawak holds significant implications for government supervision in the region's building construction sector. The findings highlight critical areas where governmental oversight can be strengthened, ensuring that projects are executed with higher efficiency and quality. By identifying specific readiness factors, the government can implement more targeted supervision protocols and policies, which will improve project outcomes and reduce delays and cost overruns. Enhanced government supervision, guided by the insights from this study, can lead to better enforcement of standards and more effective monitoring of construction activities.

The study identified 39 critical factors influencing construction readiness in Sarawak. Among these, key factors such as project planning, resource availability, stakeholder engagement, regulatory compliance, and workforce competency emerged as paramount. These findings underscore the importance of comprehensive project preparation and robust resource management. Additionally, the study revealed that effective communication and coordination among project stakeholders significantly contribute to construction readiness. By highlighting these factors, the research provides a detailed roadmap for ensuring that construction projects in Sarawak are well-prepared and effectively managed from the outset.

5.3 Research Contributions

The construction readiness factors identified in this study can be directly applied in the industry to improve project outcomes. Contractors and project managers can use these factors as a checklist to assess their preparedness before commencing construction activities. For instance, by ensuring that all critical resources are available and that project plans are meticulously detailed, contractors can minimize the risk of delays and cost overruns. Furthermore, the emphasis on stakeholder engagement and communication can lead to more cohesive project teams and smoother project execution. These practical applications can significantly enhance the efficiency and effectiveness of building construction projects in Sarawak. The detailed investigation into Sarawak's specific context ensures that the findings are highly relevant and actionable for local stakeholders. This contribution is crucial, given the unique challenges and opportunities in Sarawak's construction industry, and it sets a foundation for future research in this area.

Determining construction readiness factors can significantly assist consultants in evaluating contractors' preparedness before they begin construction activities. By using the identified success factors as benchmarks, consultants can perform thorough assessments and provide recommendations to improve readiness. This process ensures that only well-prepared contractors are engaged, reducing the likelihood of project disruptions. The factors are categorized into three main groups: industry, researchers, and government. For the industry, they provide a practical framework for readiness assessment. For researchers, they offer a basis for further studies and model development. For the government, they present a set of guidelines to enhance regulatory frameworks and supervision practices.

These CRFs can be grouped into four groups, which are, "preliminary work and authorities' approval", "procurement and execution", "project documentation and verification", and "capability and project scope". This finding suggests that, while evaluating the readiness of their construction projects, industry practitioners should concentrate exclusively on these thirty-seven CRFs because, in comparison to another factor, these CRFs are the most important. Practitioners may be reluctant to evaluate construction readiness because there are many considerations to consider. As a result,

practitioners can only evaluate the essential Construction Readiness Factor for their building projects' construction readiness evaluation by prioritizing these CRFs.

As a result of this research, there has been an increase in understanding of the Construction Readiness Factor for assessing the construction readiness of building projects. This study's contribution is based on several viewpoints. First, by offering a set of CRFs for evaluating building projects' construction readiness, this study closes a knowledge gap. Subsequently, these CRFs might be a useful resource for industry practitioners to evaluate the construction readiness of their projects. Additionally, these CRFs can assist planners in implementing the necessary measures to alleviate delays and avoid premature commencement. Researchers can also create decision support tools for evaluating construction readiness in building construction projects by utilising the identified CRFs and their relationships.

Construction readiness factors offer valuable contributions to policymakers, industry practitioners, and researchers by providing insights, guidance, and opportunities for improvement in various aspects of construction projects. Policymakers benefit from understanding construction readiness factors by making informed decisions when developing or revising policies related to infrastructure development, urban planning, and construction regulations.

Policymakers can design policies that facilitate smoother project implementation, reduce delays, enhance safety standards, and promote sustainable construction practices. Knowledge of construction readiness factors also assists in prioritizing resource allocation, such as funding for infrastructure projects, regulatory enforcement, and capacity-building initiatives. Additionally, identifying and addressing gaps in construction readiness can help policymakers mitigate risks associated with project delays, cost overruns, environmental impacts, and social conflicts.

For industry practitioners, understanding construction readiness factors allows for better planning and execution of construction projects. By anticipating challenges, allocating resources effectively, and mitigating risks, practitioners can improve project efficiency and reduce construction timelines. Addressing readiness factors such as permitting processes, availability of skilled labour, material sourcing, and infrastructure availability enhances project success. Moreover, knowledge of readiness factors related

to regulatory compliance, technical standards, and safety requirements enables practitioners to uphold quality standards and ensure project success. Addressing social and cultural readiness factors fosters positive community relationships, enhances stakeholder engagement, and promotes inclusivity in construction projects.

Researchers benefit from construction readiness factors by having a framework for collecting and analysing data on various aspects of construction projects. This facilitates empirical studies and evidence-based research, contributing to theory development in construction management, urban planning, policy analysis, and related fields. Research on construction readiness factors helps identify best practices, innovative solutions, and lessons learned from successful projects, guiding practitioners and policymakers in decision-making. Additionally, evaluating the effectiveness of policies and interventions in addressing construction readiness factors contributes to policy evaluation, performance measurement, and continuous improvement in construction governance.

In summary, understanding and addressing construction readiness factors empower policymakers, industry practitioners, and researchers to collaborate effectively, optimize project outcomes, and promote sustainable development in the construction sector.

5.4 Limitation of Study

The research has identified the CRFs for assessing a building project's construction readiness in order to reduce the risk of an early start to construction and boost performance. There are some constraints on this research, nevertheless. It is important to point out that the study's conclusions may not apply to other countries because they are based on the viewpoints of Malaysian practitioners in the building sector. This is due to the fact that building construction methods vary throughout nations. As such, it may have an impact on the relative importance of the determined decision factors. The study covers only for building construction which is the majority construction projects conducted in Malaysia. The characteristics of buildings require construction readiness at the first priority before the construction can be started. Furthermore, due to geographical and cultural differences, industry practitioners with varying backgrounds and experiences may impact this study's assessment results.

However, by adapting the knowledge and conclusions to their own national needs, other countries might use the information from this study to evaluate the construction readiness of their building projects.

5.5 Recommendation of Future Research

Scholars should take the ensuing suggestions and methods for research into consideration. First, the construction of buildings in Malaysia is the exclusive subject of this study. By examining various variables unique to local conditions in other parts of the world, future scholars will be able to provide even more significant insights. Second, using this study's information, future research might look at the decision-making model of the relationships between the CRFs and how those links affect the building time frame.

In the end, this approach could prevent early starts and delays by assisting industry practitioners in evaluating the construction readiness of their projects. Studies on construction readiness to address early construction starts are currently being carried out for building and industrial construction projects. Thus, by evaluating the project's construction readiness, a comparable research project may be carried out with other types of construction, such as infrastructures, to reduce the early start of other types of building projects. In addition, a study on the validation procedure may be done in the future. To sum up, future researchers ought to look into these topics in order to further improve and polish the research findings.

5.6 Summary

Chapter 5 summarizes the study's findings and contributions, highlighting the importance of evaluating construction readiness in building projects. It emphasizes the need to assess readiness from project initiation to execution, with top factors including client approval, drawing approval, project funding, local authority approval, and project insurance. The study contributes by providing a comprehensive set of readiness factors and recommends their use in evaluating project readiness and preventing delays.

However, limitations include the study's focus on Malaysian practitioners and building projects, which may not apply universally. Recommendations for future research include exploring global variations in readiness factors, analysing the relationships between factors, and validating the findings across different construction

types. Overall, the study aims to enhance understanding and improve practices in assessing construction readiness, benefiting industry practitioners and project stakeholders.

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APPENDICES

Appendix A: Survey Questionnaire

اونيۏرسيتي مليسيا ڤهڠ السلطان عبدالله
UNIVERSITI MALAYSIA PAHANG
AL-SULTAN ABDULLAH

Dear Sir/Madam,

I am Nurul Asyilah Binti Romzi, a postgraduate student at University Malaysia Pahang Al-Sultan Abdullah's Faculty of Technology. Under Dr. Doh Shu Ing, Associate Professor, I am conducting research on "Construction Readiness Review for Building Construction in Sarawak" As a result, I'm encouraging you to completely fill out this questionnaire if you would like to participate in this research project.

It will take five to ten minutes to complete the following questionnaire. There is no known risk associated with participating, nor is there any payment for answering. You may be confident that the information gathered will be kept private. Your choice to engage is entirely voluntary, and you are free to decline at any moment. If you consent to take part in this study, kindly respond to the questionnaire's questions.

I appreciate you taking the time to help me with my studies. The information gathered will be helpful in understanding construction projects in Malaysia. Your willingness to engage in this study will be indicated by your completion of the questionnaire. If you have any inquiries or require more information, please send me an email at the address mentioned below.

Sincerely,

Nurul Asyilah Binti Romzi
Student ID: MAP18002

SECTION A: RESPONDENT'S BACKGROUND

Please choose one.

Education

- Doctor of Philosophy (PhD)
- Master/MBA/MSc
- Degree
- Diploma
- Certificate

Other: please stated _____

Organisation Type in Construction

- Client/Project proponent
- Consultant
- Contractor

Other: please stated _____

Most common types of building project involved

- High-rise residential
- Low-rise residential
- Commercial

Other: please stated _____

Years of experience in building construction projects

- 2-5 years
- 6-9 years
- More than 9 years

Total number of building projects involved

- Less than 2 projects
- 2-5 projects
- 6-9 projects
- More than 9 project

SECTION B: RESPONDENT'S OPINION

Questions	Level Importance				
	1	2	3	4	5
Do project complete within agreed time	Not Important	Slightly Important	Moderately Important	Important	Very Important
Do project complete within agreed cost	Not Important	Slightly Important	Moderately Important	Important	Very Important
Do project complete within agreed quality	Not Important	Slightly Important	Moderately Important	Important	Very Important

Which is the most critical construction stages that may require readiness?

i. Pre-Construction
ii. During Construction
iii. Post Construction
iv. All stages

SECTION C: RANK MAJOR CONSTRUCTION READINESS

Questions	Level Importance				
	1	2	3	4	5
Experienced and capable contractor have been selected	Not Important	Slightly Important	Moderately Important	Important	Very Important
Project scope have been finalised	Not Important	Slightly Important	Moderately Important	Important	Very Important
Do government project complete within agreed quality	Not Important	Slightly Important	Moderately Important	Important	Very Important
Project fund have been approved	Not Important	Slightly Important	Moderately Important	Important	Very Important
Drawing have been approved by client	Not Important	Slightly Important	Moderately Important	Important	Very Important
Expected project output have been established	Not Important	Slightly Important	Moderately Important	Important	Very Important
Sufficient time have been given for planning stages	Not Important	Slightly Important	Moderately Important	Important	Very Important
Complete project data/information have been provided to designers at design stage	Not Important	Slightly Important	Moderately Important	Important	Very Important
Land acquisition has been settled and site free from encumbrances (squartters)	Not Important	Slightly Important	Moderately Important	Important	Very Important
Utility relocation issues has been resolved	Not Important	Slightly Important	Moderately Important	Important	Very Important
Engagement between stakeholders have been conducted	Not Important	Slightly Important	Moderately Important	Important	Very Important
Detailed site investigation has been carried out	Not Important	Slightly Important	Moderately Important	Important	Very Important
Building plan have been approved by Local Authority	Not Important	Slightly Important	Moderately Important	Important	Very Important
Project supervision and inspection team have been organised	Not Important	Slightly Important	Moderately Important	Important	Very Important
Contractors to make sure funding for the projects has been acquired	Not Important	Slightly Important	Moderately Important	Important	Very Important
Building Information Modelling has been adapted	Not Important	Slightly Important	Moderately Important	Important	Very Important

Contingency plan due to unprecented event have been prepared (e.g. Covid19/natural disaster/economic factor/political influences)	Not Important	Slightly Important	Moderately Important	Important	Very Important
Project Management Plan, PMP (inclusive of risk management and quality management plan) has been established	Not Important	Slightly Important	Moderately Important	Important	Very Important
Letter of award from the client has been received	Not Important	Slightly Important	Moderately Important	Important	Very Important
Local Authority have approved the project	Not Important	Slightly Important	Moderately Important	Important	Very Important
Construction duration has been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
The official commencement date has been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Traffic around the construction site has been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Process for responding to delay has been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Process for reporting RFI (Request for Inspection) has been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Adequate workforce has been acquired	Not Important	Slightly Important	Moderately Important	Important	Very Important
The site location and site condition has been verified as same to the contract	Not Important	Slightly Important	Moderately Important	Important	Very Important
Schedule for design deliverables compatible with the sequence of construction have been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Project team include representative from the procurement team	Not Important	Slightly Important	Moderately Important	Important	Very Important
Clear procurement process and supporting system in place for storage have been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
System to align construction with commissioning and operations have been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important

Nearest material supplier to the construction site has been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Parking space for machinery at the construction site have been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
The necessary insurance has been obtained for the project	Not Important	Slightly Important	Moderately Important	Important	Very Important
Safety signboards have been placed at the construction site	Not Important	Slightly Important	Moderately Important	Important	Very Important
Project workplan has been approved by the client	Not Important	Slightly Important	Moderately Important	Important	Very Important
Discrepancies between construction drawings and tender drawings have been verified	Not Important	Slightly Important	Moderately Important	Important	Very Important
Complete IFC (issued-for-construction) drawings have been issued	Not Important	Slightly Important	Moderately Important	Important	Very Important
Equipment for the project have been acquired	Not Important	Slightly Important	Moderately Important	Important	Very Important
Utilities on construction site are ready) e.g. electricity, water, wifi, etc.)	Not Important	Slightly Important	Moderately Important	Important	Very Important
The site office is ready	Not Important	Slightly Important	Moderately Important	Important	Very Important
CCTV has been installed at the construction site	Not Important	Slightly Important	Moderately Important	Important	Very Important

SECTION D: SUGGESTION

Do you have any suggestion to add? If yes please state.

_____

-Thank You-