STRATEGIES TO MINIMIZE THE RISK OF COST OVERRUN IN CONSTRUCTION BUILDING PROJECT DURING PRE-CONTRACT STAGE

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KUALA LUMPUR

2024

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RESEARCH PROJECT
SUBMITTED TO THE FACULTY OF BUILT ENVIRONMENT UNIVERSITI MALAYA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PROJECT MANAGEMENT

2024

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UNIVERSITY OF MALAYA

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Matric No: S2193670

Name of Master: Master of Project Management

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Field of Study: Cost Overrun

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STRATEGIES TO MINIMIZE THE RISK OF COST OVERRUN IN CONSTRUCTION BUILDING PROJECT DURING PRE-CONTRACT STAGE

ABSTRACT

Construction projects are prone to cost overruns, which can significantly impact project success and profitability. This study aims to establish a reference of workable strategies for stakeholders such as client, project sponsor, contractor, quantity surveyors, etc., during pre-contract stage to minimize the risk of cost overrun in construction building projects in Selangor, Malaysia. Although cost overruns can occur at any stage of a construction project, the pre-contract stage is critical as it sets the foundation for the entire project. As the saying goes, prevention is better than cure. It is crucial to identify the potential cost overrun before it becomes an uncontrolled situation. This paper aims to identify the factors during pre-contract stage that impacted cost overrun in construction building projects and evaluate their impacts. This paper also evaluates the impact of the strategies during the pre-contract stage to reduce the likelihood of cost overrun in construction building projects. The study involves a literature review of academic and draws on data from experienced practitioners, including developers, contractors and quantity surveyors, on previous construction building projects and utilizes quantitative research method. The top five factors related to pre-contract stage are Inflation, Inaccurate Estimation, Wrong Planning and Scheduling, Insufficient Contractor Experience and Inappropriate Managerial Skills. While the top three strategies to be used during pre-contract stage are Selection of contractors takes account of expertise, Pre-contract cost control, and Proper project activities planning. Ultimately, the findings of this research paper could benefit the construction industry by helping to improve project success and profitability through the prevention of cost overruns during the pre-contract stage.

Keywords: cost overrun, pre-contract stage, risk, construction building project

STRATEGI UNTUK MENGURANGI RISIKO PENINGKATAN KOS DALAM PROJEK PEMBINAAN BANGUNAN SEMASA PERINGKAT PRAKONTRAK

ABSTRAK

Projek pembinaan cenderung mengalami kenaikan kos, yang boleh memberi impak yang ketara terhadap kejayaan dan keuntungan projek. Kajian ini bertujuan untuk menetapkan rujukan strategi berkesan bagi pihak berkepentingan seperti pelanggan, penaja projek, kontraktor, juruukur kos, dll., semasa peringkat pra-kontrak untuk mengurangkan risiko kenaikan kos dalam projek pembinaan di Selangor, Malaysia. Walaupun kenaikan kos boleh berlaku pada bila-bila peringkat projek pembinaan, peringkat pra-kontrak adalah kritikal kerana ia membentuk asas projek. Kertas ini bertujuan mengenal pasti faktor-faktor dengan peringkat pra-kontrak menyebabkan kenaikan kos dalam projek pembinaan yang berkaitan dan menilai impaknya. Kertas ini juga menilai kesan strategi semasa peringkat pra-kontrak untuk mengurangkan kemungkinan kenaikan kos dalam projek pembinaan. Kajian melibatkan tinjauan literatur akademik dan data dari pengamal berpengalaman, termasuk pembangun, kontraktor, dan juruukur kos, pada projek pembinaan sebelum ini dan menggunakan kaedah penyelidikan kuantitatif. Lima faktor utama yang berkaitan dengan peringkat pra-kontrak adalah Inflasi, Anggaran yang Tidak Tepat, Perancangan dan Jadual yang Salah, Pengalaman Kontraktor yang Tidak Memadai, dan Kemahiran Pengurusan yang Tidak Sesuai. Sementara itu, tiga strategi teratas yang perlu digunakan semasa peringkat pra-kontrak adalah Pemilihan kontraktor dengan mengambil kira kepakaran, Kawalan kos pra-kontrak, dan Perancangan aktiviti projek yang betul. Kesimpulannya, hasil kajian ini dapat memberi manfaat kepada industri pembinaan dengan membantu meningkatkan kejayaan projek dan keuntungan melalui pencegahan kenaikan kos semasa peringkat pra-kontrak.

Kata Kunci: peningkatan kos, peningkat prakontrak, risiko, projek pembinaan bangunan

ACKNOWLEDGEMENT

I would like to thank everyone who contributed to the successful completion of this project. I would like to express my gratitude to my research supervisor, Associate Professor Sr Dr Faizul Azli Mohd Rahim for his invaluable advice, guidance, and his enormous patience throughout the development of the research. In addition, I would also like to express my gratitude to my beloved family members, moderator, lecturers, and friends who had assisted and given me encouragement.

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α	level of significance
df	degree of freedom
e	margin of error
E	expected frequencies
N	population size
O	observed frequencies
p	sample proportion
p-value	significance value
X2	chi-square
z	z-score

APA	American Psychological Association
BQ	Bills of Quantities
BQSM	Board of Quantity Surveyor Malaysia
CIDB	Construction Industry Development Board
GDP	Gross Domestic Product
PAM	Malaysian Institute of Architects
QS	Quantity Surveyor
REHDA	Housing Developers' Association of Malaysia
SPSS	Statistical Package for Social Science

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CHAPTER 1: INTRODUCTION

1.1 General Introduction

This chapter introduces the research background, problem statement, the objectives of research, scope of study, research methodology, significance of study and structure of thesis. This chapter aims to give a general overview of the whole research.

1.2 Research Background

The construction industry plays a vital role in society, contributing to the local and national economy in Malaysia. According to the data published by Statista Research Department Malaysia (2022) and Department of Statistic (2022), the number of people employed in the construction industry in 2021 was approximately 1.38 million, contributing to 8.6 % of the working population in Malaysia as of September 2022. Gross Domestic Product (GDP) from the Malaysian construction industry soared from RM 12,929,000,000 in the second quarter of 2022 to RM 13,621,000,000 in the third quarter of 2022 (Department of Statistics Malaysia, 2022). This indicates the construction industry provides greater economic opportunities and greater resources available, such as wages, profits, goods and services, to the people.

Atkinson (1999) claimed that the project iron triangle determines the project success according to some measurable criteria which inclusive of time, cost and quality. Cost is referred to as the financial constraint of a project. Every project owner or the project sponsor wants to complete the project within the agreed budget. However, one of the most serious concerns in construction projects is cost overrun. Cost overrun can be described as a cost growth, cost rise or budget growth. Hinze et al. (1992) also mentioned that cost overrun is the ratio of difference in the original contract sum to the original contract awarded sum.

The cost of the project is estimated at the time of awarding the contractor, but the project gradually incurs cost overrun because of several reasons. Project to be completed on time and budget is an efficiency indicator, but the uncertainties are unavoidable in the construction process (Beaty et al., 2016). Therefore, it is difficult for construction projects to be accomplished within the initially allocated budget. Eventually, project cost overrun has become a nationwide issue (Sepasgozar et al., 2022).

In Ethiopia, Kassa (2020) mentioned that 80% of road construction projects and 100% of railroad construction projects ran over budget. According to Nikkei (2023), China and Indonesia have agreed the first high-speed railway project in the Southeast Asian country has been overbudgeted for US$1.2 billion. In Ghana, 72 % of public construction projects encountered cost overrun (Asiedu & Alfen, 2016, as cited in Asiedu & Adaku, 2020). In Nigeria, 84 % of 8,000 construction projects were completed out of the given budget, time and quality in 1994 (Amen et al., 2010, as cited in Kamaruddeen, 2020). In the context of worldwide issues, Hesna et al., (2021) claimed that the outbreak of COVID-19 brought a huge impact to the construction industry, the performance of the project cost was strongly influenced by the cost variance between the market value and planning cost.

Specifically in Malaysia, a developing country, Kamaruddeen et al. (2020) claimed that most of the construction projects experienced 5 % to 10 % cost overrun of the total contract sum. Rahim, Ibrahim and Nelson (2022) reported an over RM 100 million cost overrun to upgrade and repair works on the Parliament building in Malaysia. Along with above mentioned examples of cost overrun projects, eventually, cost overrun lead to significant loss to the project stakeholders.

The pre-contract stage and the post-contract stage are the two phases of contractual practice. Pre-contract stage typically involves inception, feasibility study, proposal outlining, preparation of scheme design and detail design, tendering and pre-contract planning. Meanwhile, construction on the job site, completion, and feedback are often included in the post-contract stage. For projects' success, this research seeks to establish strategies for stakeholders during pre-contract to minimize the risk of cost overrun in construction building projects because prevention is better than cure.

1.3 Problem Statement

Cost overrun is the worldwide issue faced by the construction industry, while there is no exception in Malaysia. Cost overrun is defined as the phenomenon when the practical cost exceeds the budgeted amount (Jackson, 2002). Therefore, it could be said that cost overrun is usually noticed only when the project starts executing and spending, people notice cost overrun when the actual spend exceeds the anticipated budget.

It is crucial to identify the potential cost overrun before it becomes an uncontrolled situation. Based on the previous research, the critical factors causing cost overruns are poor contract management, inaccurate estimates, frequent design change, poor planning strategies, poor communication and coordination, poor tendering documentation, global inflation, political interference and so on (Ahady et al., 2017; Aljohani et al., 2017; Durdyev, 2020). Kawmudi, et al. (2021) and Famiyeh, et al. (2017) also reported cost overrun occurs due to the limited place for new generation ideas, lack of innovative thinking, poor financial management and major change order by clients during construction phase, etc.

Certainly, here are some examples of cost overruns in residential and non-residential building projects in Malaysia. Cost overruns are a typical issue in the non-residential sector, according to a survey by the Malaysian Institute of Architects (PAM). In one instance, unanticipated site conditions, design revisions, and permission delays led to a 33% cost overrun on a government building project in Kuala Lumpur (Mamat & Zainal Abidin, 2018). Furthermore, Rahim (2020) claims that a Selangor low-cost housing project in 2020 experienced a 30% cost overrun. The project had a RM15 million starting budget, but due to modifications in design and scope, price variations for materials, and construction delays, the project's overall cost ended up being higher than RM19.5 million. The main causes of the cost overrun, according to the project's developer, were a lack of experienced labourers and expensive building supplies.

Even though there are plenty of studies analyzing the causes of cost overrun, there are limited studies highlighting the strategies to mitigate cost overrun in construction projects. The recent study of Mahmud et al. (2021), still emphasized the issue of cost overrun and the need for in-depth investigation. If the cost overrun issue gets out of hand, it would become difficult or impossible for the project stakeholders to control. As the saying goes, prevention is better than cure, limited studies dedicated to the cost overrun factors specifically related to pre-contract stage and the strategies during pre-contract stage to minimize the risk of occurrence of cost overrun. People understand why cost overrun happens, but do not know the exact actions, precautions and/or prevention actions could be taken to minimize the risk of cost overrun in construction projects.

Therefore, to fill this gap, there is a need to study the factors of cost overrun particularly related to pre-contract stage and the strategies during pre-contract stage to minimize the risk of cost overrun in Malaysian construction industry. According to World

Bank Group and Economic Planning Unit of Malaysia (2021), the average cost overrun in the industry is estimated to be around 20% to 30%. Thus, this research is referring to a 20% cost overrun as the magnitude of the issue. This research is focused on the perspective of construction project developers, contractors and quantity surveying consultants. Once the unclear factors become clear, the project team could implement best practices and keep cost overruns at a minimum occurrence.

1.4 Research Questions

The research questions and the associated research objectives are shown in Table 1.1.

Table 1.1: Research Questions (Source: Author Derived)

Research Objectives	Research Questions
RO1: To identify the factors during pre-contract stage that impacted cost overrun in construction building projects.	• What are the factors of cost overrun in construction building projects? • What are the factors of cost overrun directly related, partially related or not related to the pre-contract stage?
RO2: To evaluate the impact of the factors during pre-contract stage that impacted cost overrun in construction building projects.	• How are the factors causing the project cost overruns? • What is the impact of the factors of cost overrun?
RO3: To assess the impact of the strategies during pre-contract stage to minimize the risk of cost overrun in construction building projects.	• What are the strategies during the pre-contract stage to minimize the risk of cost overrun in construction building projects? • How are the strategies during the pre-contract stage to minimize the risk of cost overrun in construction building projects? • What is the impact of strategies to secure successful cost control? • How do the strategies secure project success?

1.5 Research Aim

This exploratory research aims to establish a reference of workable strategies for stakeholders such as client, project sponsor, contractor, quantity surveyors, etc., during pre-contract stage to minimize the risk of cost overrun in construction building projects.

1.6 Research Objectives

The aim is achievable by the following objectives:

a) To identify the factors during pre-contract stage that impacted cost overrun in construction building projects.

b) To evaluate the impact of the factors during pre-contract stage that impacted cost overrun in construction building projects.

c) To assess the impact of the strategies during the pre-contract stage to minimize the risk of cost overrun in construction building projects.

1.7 Research Methodology

This research is designed to be exploratory research with the aim to establish the strategies for stakeholder during pre-contract stage to minimize the risk of cost overrun in Malaysian construction building projects with a quantitative research methodology. The research is kicked off with a comprehensive literature review to identify the research gap from previous studies regarding cost overrun. The research is then designed with three key processes including determining the factors particularly related to pre-contract stage that impacted cost overrun, evaluating the impact of the factors, and evaluating the strategies during pre-contract stage to minimize the risk of cost overrun in Malaysian construction building projects.

This study implements the technique of questionnaire survey to collect data. Questions for questionnaire surveys will be designed based on the available cost overrun issues related to pre-contract stage from literature reviews in the format of structured closed-format questions. A pilot study will be done to validate the questions before the questionnaire is distributed. Descriptive statistics, inferential statistics, and reliability analysis will be used to examine the acquired data. Descriptive statistics include central tendency and frequency analysis; inferential statistics include correlation test, chi-square test and Kruskal-Wallis test; and the reliability of data will be indicated by using the Cronbach's Alpha coefficient.

1.8 Scope of Research

This research will focus on construction firms in Selangor as Selangor is one of the most concentrated construction activities areas in Malaysia. Selangor recorded the highest value of construction work done at RM 6.9 billion as of quarter three of year 2022 (Department of Statistics Malaysia, 2022). This research is limited to construction building projects as building construction contributes to the highest value of construction work done at total 55.5 % as of third quarter of 2022, 37.7 % of non-residential buildings and 17.8 % of residential buildings respectively (Department of Statistics Malaysia, 2022). In addition, this project is open to developers, contractors and quantity surveyors. Developers are chosen because they are the paymaster, in charge of the overall project, and they are the landowner. Contractors are important as they are the ones entering into the contract with the developer and are responsible for oversighting the project. Quantity surveyors are playing a vital role in cost matters which are highly related to the cost overrun issue.

1.9 Significance of Research

Cost overrun in construction building projects was a result of various causes from different aspects. The analysis of factors directly related to pre-contract stage calls attention to preventing such causes from cost overrun happening. The study of the strategies to be taken during the pre-contract stage to minimize the risk of cost overrun is crucial to all construction players because prevention is better than cure. Construction practitioners should take precautions before the project cost overruns to secure the organization's profitability, growth opportunities and stakeholders' benefits. In addition, minimization of the risk of cost overrun ensures project execution within a budgeted amount, and eventually contributes to projects' success in terms of meeting business requirements, project deliverables, client satisfaction and expectation on the return on investment.

1.10 Structure of Thesis

(a) ***Chapter 1***

The research background and the problem statement will be presented at the beginning of this chapter. The research questions, aim and objectives for solving the problem statement are also covered in this chapter. This chapter will also provide an overview of the research methodology, scope of research and research's significance.

(b) ***Chapter 2***

This chapter provides an overview of the literature review for the topic. This analysis covers the general causes of cost overrun in construction building projects, its effects, and the strategies employed to reduce the risk of cost overrun. The information for this chapter will be gathered from secondary data sources, including books, journals, theses, articles, reports, and others.

(c) ***Chapter 3***

The research methodology that will be used for data collecting and analysis is described in this chapter. By distributing the questionnaire survey form to the chosen respondents, quantitative research will be used. For the quantitative investigations, the sample of respondents will be chosen using the probability sampling method. After that, the data gathering will be analyzed using the SPSS program.

(d) ***Chapter 4***

This chapter presents the data analysis. This chapter examined the information gathered through the distribution of questionnaire survey forms, secondary data sources, and a quantitative technique. After the data analysis is finished, the knowledge between the primary and secondary data will be sorted out.

(e) ***Chapter 5***

This chapter presents the research findings. The core of research is explored, and interesting discoveries are shared and analyzed through a thorough investigation. These findings will be explained in the context of construction project management, understanding what they mean.

(f) ***Chapter 6***

This chapter serves as the conclusion of the study and also the last chapter in this dissertation. The entire purpose of the study is summarized in this chapter, along with factors of cost overrun that are directly related to the pre-contract stage, as well as strategies that can be used during pre-contract stage to reduce the risk of cost overrun in construction building projects.

1.11 Summary of the Chapter

In short, this chapter provides a general description about the whole research. The problem background and problem statement for conducting the study has been discussed. The objectives of the study and scope of study have been explained clearly. The aim of this study is to establish a reference of workable strategies during the pre-contract stage to minimize the risk of cost overrun in construction building projects.

CHAPTER 2: LITERATURE REVIEW

2.1 General Introduction

This chapter has reviewed different articles, research and journals corresponding to the cost overrun issue in the construction industry. This chapter clearly explains the definition of cost overrun, construction building project, and pre-contract. The activities carried out in the pre-contract stage are discussed as well. The factors of cost overrun in construction building projects in general, along with the impact of cost overrun and the strategies used to minimize the risk of cost overrun, are reviewed.

2.2 Definition of Cost Overrun

Cost overrun is defined as the discrepancy between actual and budgeted costs, or as the difference between the revised contract amount and the initial contract value (Lee, 2022). Bentil (2017) claims that this computation might be changed to a percentage for simpler comparison. The proportion of cost overrun was calculated as follows:

$$\frac{\text{Final Contract Amount} - \text{Original Contract Amount}}{\text{Original Contract Amount}} \times 100\% = \text{Cost Overrun in \%}$$

2.3 Definition of Construction Building Projects

In Malaysia, the construction industry is often broken down into four (4) wide categories: non-residential buildings, residential buildings, civil engineering activities and special trades' activities (Department of Statistics Malaysia, 2022). Construction building projects are inclusive of non-residential buildings and residential buildings. Commercial, industrial, health, and institutional buildings are examples of non-residential buildings; while residential buildings are the ground-oriented house such as detached, semi-detached, terraced house, etc., and other than ground-oriented house such as condominium and apartment (United Nations, 1997, as cited in OECD, 2002).

2.4 Definition of Pre-Contract

The process of building has become more complex over the years. Each phase—from conception to completion, design, contracting, and construction—has grown more time- and money-intensive. Hence, process optimization is vital. Pre-contract is the preparation stage before the contract awarding (Ashworth, 2002). A good job at this preparation stage could help to prevent mistakes throughout the project life.

2.4.1 Pre-Contract Activities

The pre-contract stage, according to Hackett and Robinson (2003), begins with the initial brief and continues through procurement, detail design, programming, design team meetings, the creation of drawings, specifications, and bills of quantities (BQ), the involvement of specialized subcontractors and suppliers, quality assurance, and, finally, the request for tenders.

The initial brief should include the feasibility study, sketch scheme, and initial cost estimate (Hackett & Robinson, 2003). The framework for how a construction is created, acquired, or gained is known as the construction procurement (Sharif & Morledge, 1996, as cited in Morledge et al., 2021). There are typically three (3) types of building procurement systems, which are separated and co-operative procurement systems, integrated procurement systems and management-oriented procurement systems (Perry, 1985, as cited in Masterman, 2013). Every procurement has different time, cost and quality priorities due to their different procurement route (Hackett & Robinson, 2003). Pre-contract programmes can be finalized only after the procurement method is identified.

When the sketch scheme is transformed into a practicable solution, detail design is generated (Hackett & Robinson, 2003). The design team is in charge of coming up with

a sound solution to satisfy the client's requirements and the expected lifespan of the building, take consideration of the end-user if not aligned from the client, coordinate structural and architectural considerations into one complete design, etc.

The design team can review the initial program overview and make any necessary modifications after the final design proposals have been submitted, while the procurement method and any financing conditions imposed (Hackett & Robinson, 2003). The programming activity aids in laying out the numerous pre-contract processes in a fair and logical order.

It is necessary to hold design team meetings to examine the updated and new project information, the detailed design, the integration of the structural and architectural aspects, the expert design input, the health and safety guidelines, and the program's progress. In short, regular design team meetings could ensure the production of efficient and coherent design.

Drawings and specifications are necessary to convey the fundamental information for building, without the clear and detailed drawings and specification, inaccurate estimates could occur (Hatamleh et al., 2018). Meanwhile, one of the more common ways to provide the specifications chosen by the client and design team and to offer a standard basis for pricing is to produce bills of quantities.

Furthermore, the normal practice of the design team is to approach specialist subcontractors or suppliers for the provision and quotations for the work. Also, quality assurance is a management process to ensure the quality of product or service is at an acceptable level (Hackett & Robinson, 2003). Last but not least, tendering is carried out

at the final step of the pre-contract stage. Table 2.1 below summaries the pre-contract activities.

Table 2.1: Summary of Pre-Contract Activities (Source: Author Derived)

Pre-contract Activities	Description
Initial Brief	• Feasibility Study • Sketch Scheme • Initial Cost Estimate
Procurement	• Integrated Procurement Systems • Separated and Co-operative Procurement Systems • Management-Oriented Procurement Systems
Detail Design	Workable solution of sketch scheme.
Programming	Programme outlining including but not limited to (Hackett & Robinson, 2003): • Design team meetings to discuss progress • Coordinated production information prepared • Statutory approvals obtained • Completion of legal agreements for access arrangements, party wall awards and similar matters • Negotiating with the service providers • Receiving and incorporating specialized design components • Receiving quotes from subcontractor and supplier • Finalizing information for the pre-tender health and safety plan • Preparing pricing documents for the tender • Preparing a pre-tender estimate and updated cash flow prediction • Providing tender documents • Administration of contract documents • Briefing site inspectorate • Nominating/naming subcontractors and suppliers.
Design Team Meetings	Review of project information.
Drawings and Specifications	Provide fundamental information for building.
Bills of Quantities	Provide information on the project and provide a basis for pricing.
Specialist Subcontractors and Suppliers	Provision and quotations for the work.
Quality Assurance	Ensure acceptable quality of product or service.
Obtaining Tenders	Obtaining tenders for buildings

2.5 Factors of Cost Overrun in Construction Projects

Lee (2008, as cited in Ariyawansha & Francis, 2022) mentioned the initial cost figure represents the determined and planned budget during the project initiation, while the final cost figure represents the total expenditure at the project completion stage. Project cost overruns in construction are generally caused by the impact of financial risk. However, the factors causing cost overruns are not only the financial issues, but also more complex particularly in construction projects. Table 2.2 depicts the cost overrun factors along with the frequency count of previous research.

Table 2.2: Cost Overrun Factors (Source: Author Derived)

Factors	Sources	Frequency
Client's Financial Difficulty	Lee et al. (2022); Kuware (2021); Durdyev (2020)	3
Contractors' Financial Difficulties	Ahady et al. (2017); Aljohani et al. (2017); Lee et al. (2022); Durdyev (2020); Niazi & Painting (2017)	5
Contractor's Poor Site Management and Supervision	Ahady et al. (2017); Adam et al. (2017); Amini et al. (2022); Lee et al. (2022); Gaurang (2020)	5
Corruption	Babalola et al. (2022); Niazi & Painting (2017)	2
Delayed Payment to Contractors or Consultants	Adam et al. (2017); Aljohani et al. (2017); Niazi & Painting (2017)	3
Frequent Design Change or Frequent Change Order	Adam et al. (2017); Amini et al. (2022); Aljohani et al. (2017); Babalola et al. (2022); Durdyev (2020); Niazi & Painting (2017)	6
Ground or Soil Conditions	Adam et al. (2017); Kuware (2021); Durdyev (2020)	3
Inaccurate Estimation	Amini et al. (2022); Aljohani et al. (2017); Babalola et al. (2022); Durdyev (2020)	4
Inflation	Ahady et al. (2017); Adam et al. (2017); Amini et al. (2022); Kuware (2021); Durdyev (2020); Niazi & Painting (2017)	6
Insufficient Contractor Experience	Ahady et al. (2017); Amini et al. (2022); Aljohani et al. (2017); Lee et al. (2022); Durdyev (2020)	5
Inappropriate Managerial Skills	Adam et al. (2017); Aljohani et al. (2017)	2

Table 2.2: Cost Overrun Factors, continued (Source: Author Derived)

Factors	Sources	Frequency
Wrong Planning and Scheduling	Ahady et al. (2017); Adam et al. (2017); Amini et al. (2022); Lee et al. (2022); Gaurang (2020); Durdyev (2020)	6
Information and Communication Barriers	Ahady et al. (2017); Adam et al. (2017); Amini et al. (2022); Kuware (2021); Gaurang (2020); Durdyev (2020)	6
Poor Monitoring and Control	Adam et al. (2017)	1
Poor Tendering Documents	Aljohani et al. (2017); Durdyev (2020); Niazi & Painting (2017)	3
Process Inefficiency	Adam et al. (2017); Gaurang (2020)	2
Incorrect Project Duration	Adam et al. (2017); Babalola et al. (2022)	2
Rework	Adam et al. (2017); Amini et al. (2022); Lee et al. (2022); Kuware (2021)	4
Shortage of Equipment	Adam et al. (2017); Kuware (2021)	2
Weather	Adam et al. (2017); Babalola et al. (2022); Durdyev (2020)	3

Table 2.2 summarizes the common cost overrun factors in construction projects from the findings of the literature with the frequencies out of ten (10) references. According to the findings, four (4) factors (frequent design change or change order, inflation, incorrect planning and scheduling, and information and communication barriers) are ranked as the top simultaneously among twenty (20) factors that were carried out with the previous studies.

Moreover, contractors are playing a crucial role from the submission of tender to the project handover. However, half of the studies mentioned cost overruns in construction projects can be caused by a variety of circumstances, including contractors' financial issues, poor site management and oversight, and insufficient contractor expertise. These three (3) factors are ranked as the second place among all twenty (20) factors. In addition, four (4) out of ten (10) studies indicate the cost overrun is critically caused by inaccurate estimates and rework due to mistakes during construction. These two (2) factors are ranked as the third among all factors.

2.5.1 Impacts of Cost Overruns Occur in Construction Industry

There are obvious impacts towards the construction industry and the project stakeholders from the issue of cost overrun. According to Asiedu and Ameyaw (2020), cost overrun could lead to project abandonment and declining work done in construction activities. To the client, cost overruns represent fewer returns on investment, or probably financial loss. To the contractor, non-completion of projects could earn a bad reputation for his company, and eventually affect his chances of winning future jobs. To the professionals such as architects, quantity surveyors, engineers, etc., cost overruns represent their inability to deliver trustable services for project implementation. This could result in the client's loss of the confidence to repose in them.

2.6 Strategies Used to Minimize the Risk of Cost Overruns in Construction Projects

Table 2.3: Strategies to Minimize the Risk of Cost Overruns (Source: Author Derived)

	Ikechukwu et al. (2017)	Abusafiya & Suliman (2017)	Durdyev et al. (2017)	Aljohani et al. (2017)	Ahady et al. (2017)	Ullah et al. (2018)	Al-Keim (2017)	Sánchez et al. (2022)
Adopt suitable project management scheduling tool	/						/	
Staying within the project planned scope	/							
Proper project activities planning before project execution	/		/			/	/	
Selection of contractors takes account of expertise, financial capability and experience.	/					/		
Effective communication	/			/		/		
Risk Assessment during project estimating		/				/		
Pre-contract cost control		/						
Use mainly local construction material during selection of the construction methodology and materials			/			/		
Effective resources management system (human, technical, material)			/	/				
Keep updating of material prices and labour rates					/			
Quality Monitoring by consultant and quality professionals					/			
BIM adoption							/	/
Managing and Completing Design Stage before construction							/	

Table 2.3 summarizes the strategies to minimize the risk of cost overrun in construction projects. There are thirteen (13) strategies reported by eight (8) references. Proper planning before project execution was the most mentioned strategy among all strategies. Furthermore, effective communication was reported in three (3) out of eight (8) references, ranked in the second place among all strategies. In addition, adoption of suitable techniques and tools such as scheduling tools, risk assessment, resources management system and BIM adoption were mentioned twice among all references. On the other hand, two (2) references also indicated one of the tactics to reduce the risk of cost overruns in building projects is the selection of qualified contractors, construction methods, and materials. In short, the most mentioned cost control strategies are on project planning, followed by the adoption of tools and techniques, and the management of people.

2.7 Summary of the Chapter

The definition of cost overrun, construction building projects and pre-contract are explained in this chapter. This chapter presents a literature review on the cost overrun in the construction industry context. This chapter concludes the factors of cost overrun, impacts, and strategies in reducing the risk of cost overrun in construction projects.

CHAPTER 3: METHODOLOGIES

3.1 General Introduction

This chapter outlines several data collection and analysis approaches that will be applied to the research's data. The research design, sampling design, data collection methods, and data analysis strategies will all be part of the methodologies.

3.2 Research Design

According to Wong (2015), research design is defined as a systematic outline of how the research problem to be addressed effectively. Research design involves the procedures for collecting, analyzing, interpreting, and reporting data (Creswell, 2007). The three primary categories of research designs are mixed, qualitative, and quantitative.

Utilizing data and statistics to support the pertinent conclusions, a quantitative research strategy is used to examine the interaction between the factors (Creswell, 2009). Large sample sizes are necessary for quantitative research, which places more emphasis on the quantity of replies than on gaining deeper psychological understanding of the targeted subject. Qualitative research is interpreted as empirical research in which the data is in the form of words (Wong, 2015). Wong (2015) further claimed that qualitative research tends to be more subjective, and the responses collected may induce bias.

The best type of research approach will depend on the goal of the study and the information that is available. A quantitative research design is used in this study. The quantitative research design method ensures that each respondent receives an identical question, allowing for an equal evaluation of the full data sample. Since the data from the survey is presented in numerical form, it is possible to interpret it quantitatively by utilizing statistical techniques (Leinhardt & Leinhardt, 1980). A series of survey

questions is created to learn more about the cost overrun issues specifically related to the pre-contract stage and the methods to reduce the risk of cost overrun in building projects.

Open-ended and close-ended questions are the two types of questionnaires that can be created. The closed question tends to be answered more easily and rapidly. The opened question required respondents to answer with full sentences and the responses are more difficult to analyze. Thus, more close-ended questions will be set in this research questionnaire.

3.3 Research Process

The five crucial phases of this research are depicted in Figure 3.1 and include the preparatory study, selection of the study region and sampling design, data collecting, data analysis, and conclusion. The stages have been set up to encompass a wide spectrum of study from beginning to completion.

Figure 3.1: Research Process (Source: Author Derived)

3.4 Preliminary Study

Conducting a preliminary study is the first step in the research process to collect secondary data from earlier scholarly works and literature reviews. The preliminary study included an overview of the proper approach that has been used in many studies during the early stages of the research. The preliminary study provides information for future topical research. Preliminary research aims to increase public awareness of the body of existing information (Naoum, 2007). Also, preliminary study has found out the

knowledge gaps, reduced the methodological risks, and enhanced the researcher's theoretical sensitivity. The knowledge of published articles and journals has improved the sensitivity of data recognition. In this research, the definition of cost overrun, construction building projects and pre-contract are studied. The activities involved during the pre-contract stage are explained in detail. Also, the overall cost overrun factors and strategies to minimize the occurrence of cost overrun in construction projects are studied according to the previous scholar studies, articles and reference books. The theoretical ideas from the preliminary literature could provide guidance for the primary data comparison.

3.5 Setting of Research Area and Sampling Design

Establishing the research area and target population is the second step in the research process. To concentrate the scope of the investigation, the research field must first be established. Following the selection of the research area, the target population is identified.

The act of picking a sample from a population is referred to as sampling. Probability sampling methods and non-probability sampling methods are the two primary categories of sampling techniques. According to McCombes (2021), probability sampling involves systematic sampling and random sampling, which allows researchers to make strong statistical inferences on the overall group. While non-probability sampling involves judgement sampling, convenience sampling and quota sampling, which are based on the basis of personal judgement or convenience (Hee et al., 2014).

In this research, the random sampling is applied as each respondent in the population has an equal chance of being picked as the sample for this research and the respondents are chosen in arbitrary manner without any purpose (Kendra, 2019). The amount of target

samples is calculated using a sample size formula, while the confidence level is set at 95% and the margin of error is allowed for 5%.

3.5.1 Research Area

The research area of this study is on the cost overruns in construction building projects. The cost overrun factors and the strategies to minimize the risk of cost overrun in construction projects are discussed in this research. The research scope is to study the cost overrun factors directly related to pre-contract stage and the strategies could be taken during pre-contract stage to minimize the risk of cost overrun in construction building projects from project stakeholders' perspectives.

3.5.2 Sampling Design

Selangor is the chosen state in this research as Selangor is reported having the highest work done in the construction sector at RM 6.1 billion as of Q3 2022 (Department of Statistics Malaysia, 2022). The scope of projects is limited to the construction building projects which includes non-residential buildings and residential buildings. This is due to building projects reported having the highest work done as of Q3 2022 at 55.5 % (Department of Statistics Malaysia, 2022). Figure 3.2 and Figure 3.3 illustrate the above information.

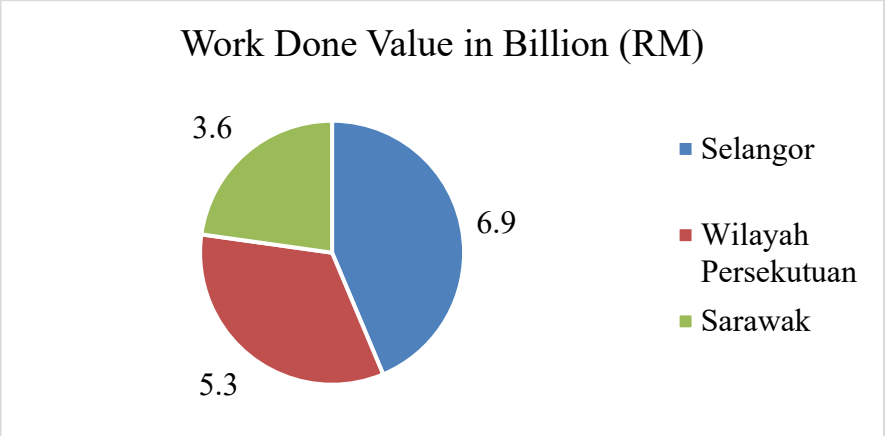

Figure 3.2: Three Main States with Highest Value of Work Done as of Q3 2022 (Source: Adapted from Department of Statistics Malaysia, 2022)

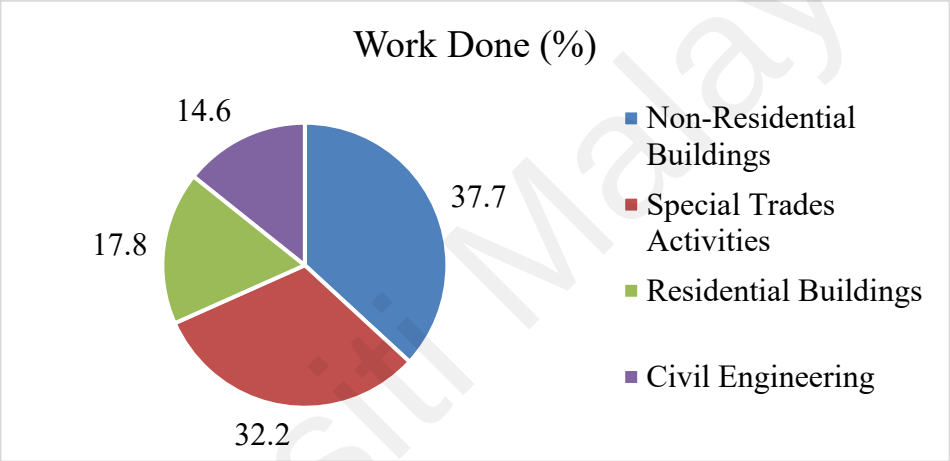

Figure 3.3: Work Done for Construction Activities as of Q3 2022 (Source: Adapted from Department of Statistics Malaysia, 2022)

This research focuses on the project stakeholders in the construction industry, and is limited to the specific developers, contractors, and quantity surveying firms in Selangor. The different groups of respondents are targeted as they occupy different responsibilities, and therefore their opinions are sought for this study. Developers represent the owners, paymaster and users; contractors are representing the builders; and quantity surveyors are representing the cost consultant.

The scope of this research is confined to the 3,084 Construction Industry Development Board (CIDB) recognized G7 building contractors in Selangor. This is because G7

contractor is the highest CIDB Contractor grade which could involve in any size, and any of unlimited value building construction projects in Malaysia. Since there is no tendering capacity, G7 contractors typically will have more extensive experience and expertise in handling larger and more complex projects compared to G1 to G6 contractors. Furthermore, this research is limited to the 147 quantity surveying consulting companies located in Selangor that are currently in the list of the Board of Quantity Surveyor (BQSM) and 310 developers located in Selangor that are registered with the Real Estate and Housing Developers' Association of Malaysia (REHDA). The organizations mentioned above will be the population of this research. Table 3.1 demonstrates the population frame for this research.

Table 3.1: Population Frame (Source: Author Derived)

Project Stakeholder	Source	Number of Registered Organizations
Developer Firms	REHDA	310
G7 Contractor Firms	CIDB	3,084
Quantity Surveying Firms	BQSM	147
	TOTAL	3,541

The targeted samples for this research are the developer firms, G7 contractor firms and quantity surveying consultancy firms in Selangor. The population comprised a total of 3,541 registered firms. The list of samples was obtained from REHDA, CIDB and BQSM official websites. The sample size calculation is obtained in accordance with Equation 3.1 and Figure 3.4.

$$\textbf{\textit{Sample size}} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \frac{(z^2 \times p\,(1-p)}{e^2 N}} \qquad \textbf{(3.1)}$$

where
N = Population Size
e = Margin of error (percentage in decimal form)
z = z-score
p = Sample proportion

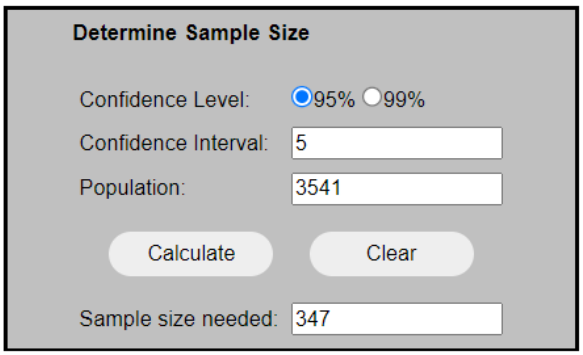

Figure 3.4: Sample Size Calculator (Source: Sample size calculator – Creative Research Systems, 2012)

Table 3.2: Suggested Sample Size for Project Stakeholder

Project Stakeholder	Population	Percentage (%)	Sample Size Needed
Developer Firms	310	9	30
G7 Contractor Firms	3,084	87	302
Quantity Surveying Firms	147	4	15
Total	**3,541**	**100**	**347**

Following the calculation of the sample size, the suggested sample size for this study is 347, with a 95% confidence level and a 5% margin of error. A total of 500 questionnaires will be distributed via email and WhatsApp and 347 responses are expected. In addition, sample size suggested for each stakeholder group is shown in Table 3.2, to avoid bias.

Furthermore, this research restricted one response per company to justify the occurrence of cost overrun by the construction companies. Also, not all working QSs are registered under BQSM, thus the calculation of population merely based on the numbers of registered QS are not accurate. Also, the project cost-related matters are normally reviewed by the company's director or the management level. Through this method, the respondents are representing their company to answer the questionnaire, thus a more reliable and convincing result can be achieved regarding the concerns on the cost overrun factors and strategies to minimize the risk of cost overrun.

3.6 Data Collection

The third stage is the primary data collection. This study's findings are compiled using a quantitative approach. Only closed-ended questions are included in the survey questionnaire to examine respondents' opinions under specific conditions. The survey questionnaire is separated into Sections A, B, and C to accomplish the goal of the research. Section A is to find out the respondents' background; Section B is designed to identify the cost overrun factors directly related to pre-contract stage; Section C is designed to identify the strategies could be done during pre-contract stage to minimize the risk of cost overrun in construction building projects.

The primary data collection is obtained through three practical approaches, including survey method, case study method and problem-solving method. The survey method is adopted to achieve the research's objectives. The tool utilized to collect the data is a questionnaire. The decision to use a questionnaire is made because it is a fast and economical method for carrying out the survey. Questionnaire also provides high validity results, and it is appropriate for wide geographical area surveys.

First and foremost, the list of registered firms in Malaysia is obtained from CIDB, REHDA and BQSM websites respectively, and the companies' addresses, email addresses and phone numbers are obtained as well. Subsequently, the questionnaires are distributed to the respective firms in the Selangor area through email and WhatsApp only. The online questionnaires, Google Forms, are used to save time and cost, while Google Forms are expected to have a higher rate of return. Table 3.3 summarizes the data collection techniques to achieve the research objectives.

Table 3.3: Summary of Data Collection Technique (Source: Author Derived)

Research Objectives	Data Collection Technique
RO1: To identify the factors during pre-contract stage that impacted cost overrun in construction building projects.	- Literature Review - Questionnaire Survey
RO2: To evaluate the impact of the factors during pre-contract stage that impacted cost overrun in construction building projects.	- Literature Review - Questionnaire Survey
RO3: To assess the impact of the strategies during pre-contract stage to minimize the risk of cost overrun in construction building projects.	- Literature Review - Questionnaire Survey

3.6.1 Pilot Study

Pilot study is a process of testing on a small scale of respondents before the proper questionnaires are distributed to the targeted respondents. In (2017) mentioned that a pilot study offers essential information for the sample size estimation, minimizing the unnecessary effort and also helps to evaluate the other aspects of the study. There are ten (10) sets of questionnaires distributed randomly for the industry practitioners to execute the pilot study as they understand the real conditions of the industry. In this research, the data collected from pilot study is only used to evaluate the efficacy of research. The data collected is not included in the data analysis as it might not be accurate due to limited sample and due to time constraint.

3.7 Data Analysis

The fourth stage is data analysis. The descriptive statistical methods are employed, including central tendency, frequency and reliability, and the inferential methods are used as well including correlation analysis, chi-square test, Kruskal-Wallis test and Friedman test, to study the cost overrun factors directly related to the pre-contract stage and the strategies during pre-contract stage to minimize the risk of cost overrun in construction building projects. Statistical reports by CIDB, Department of Statistics Malaysia and

several books and studies regarding cost overrun issues are referred in discussion with APA referencing style.

MS Excel and the Statistical Package for Social Science (SPSS) are used to calculate quantitative data. To ensure that the data is accurate and dependable, SPSS software supports data evaluation. To create charts and arrive at certain analytical conclusions, MS Excel is employed as a sophisticated tool.

3.7.1 Descriptive Statistics

Descriptive statistics are adopted to analyze the collected data. The reason for employing a descriptive statistic approach is because descriptive statistics is the simplest way to examine data and get an overview of the outcomes. Naoum (2007) mentioned the general descriptive statistic will analyze data either in the forms of percentages or numeric format. Loeb, et al. (2017) claimed that the basic methods of descriptive statistical approach are conducted in frequency distribution, measurement of central tendency and measurement of dispersion. The methodologies are chosen based on the type of data to be analyzed, while the data analyzed in this research are ordinal, nominal and interval.

3.7.1.1 Central Tendency

According to Bujols (2012), the mean, mode, and median are part of the central tendency. The mathematical procedure known as "mean" calculates the arithmetic average of a group of scores (Rugg, 2007). The sum of all values is divided by the total number of values in the data set to produce the mean. The next most common choice, or the one that received the most votes from all responders, is mode. The median, which is less affected by outliers and skewed data, is the middle value for a data collection that has been organized by order of magnitude (Seo, 2006).

This approach is used to evaluate the Likert scale questions. The indication from "slightly related" to "strongly related", or "strongly disagree" to "strongly agree" range from 1 to 5. All the questionnaires' raw data is tabulated, extracted, and analyzed by using the mean method. Mean method is preferable as it indicates the arithmetic average of a set of scores (Coolidge, 2020). The mean score obtained is used to identify the cost overrun factors directly related to pre-contract stage and to assess the impact of the strategies during pre-contract stage to minimize the risk of cost overrun in construction building projects. Equation 3.2 shows the mean score calculation, which is used to analyze Sections B and C of the questionnaire.

$$\boldsymbol{Mean\ Value} = \frac{\boldsymbol{X_1 f_1 + X_2 f_2 + X_3 f_3 + + \ \ldots + X_n f_n}}{\boldsymbol{N}} = \frac{\boldsymbol{\sum fX}}{\boldsymbol{N}} \qquad \textbf{(3.2)}$$

where
X = Variable
f = Frequency
$\sum fX$ = Sum of the scores
N = Total number of observations

The mean values are then used to identify their respective mean range, the mean ranges of Likert Scale are shown in Table 3.4. There are two types of mean range for Section B and C.

Table 3.4: Mean Range Interpretation for Questionnaire Section B and C (Source: Author Derived)

Section	Description	Category	Mean Range
B	Factors related to the pre-contract stage that impacted cost overrun.	Not related	1.00 – 1.79
		Slightly related	1.80 – 2.59
		Partially related	2.60 – 3.39
		Highly related	3.40 – 4.19
		Definitely related	4.20 – 5.00
C	Strategies could be done during pre-contract to minimize the risk of cost overrun in construction building projects	Strongly disagree	1.00 – 1.79
		Disagree	1.80 – 2.59
		Agree	2.60 – 3.39
		Highly agree	3.40 – 4.19
		Strongly agree	4.20 – 5.00

3.7.1.2 Frequency

A descriptive statistical technique called frequency analysis shows the overall frequency of each response that respondents chose. It can be represented in table form or charts, such as pie charts, bar charts or graphs, to show the responses' portion. The most preferred answers for each question are shown through the highest frequency or percentage. The frequency or percentage calculation is obtained in accordance with Equation 3.3. This frequency analysis is used to analyze the demographic data in Section A, such as the working experience in construction industry, involvement in construction building projects, organization type, experience in project cost overrun, involvement in pre-contract stage, etc.

$$\boldsymbol{Percentage} = \frac{\boldsymbol{Frequency\ of\ Selected\ Answer}}{\boldsymbol{Total\ Respondents}} \times \mathbf{100}\,\% \qquad \textbf{(3.3)}$$

3.7.2 Inferential Statistic

Additionally, this study uses inferential statistics to extrapolate sample results to the total population (Allua & Thompson, 2009). The link between the two variables is examined in this study using the inferential analysis techniques of Spearman correlation, chi-square test and Kruskal-Wallis test. Due to the use of the nominal and ordinal levels of measurement in both procedures, which prevent the variables from having a normal distribution, they are both non-parametric tests (Adeyemi, 2009; Allua & Thompson, 2009).

3.7.2.1 Chi-Square Test

The association between two data sets is examined using the chi-square test, and it is suitable for nominal data. According to Adeyemi (2009), this nonparametric test is useful

for data in the form of frequency. The formula for chi-square calculation is shown in Equation 3.4.

$$X^2 = \sum \frac{(O-E)^2}{E} \qquad (3.4)$$

Where
X^2 = Chi-square
O = Observed frequencies
E = Expected frequencies

The common levels of significance which are represented by *alpha*, or α are 0.1 %, 1 % and 5 %. A p-value will be given in a chi-square test. The p-value or also known as significance value is compared to α to determine the association between two variables.

H_0 = 0; H_0 = There is no significant relationship between pre-contract stage involvement and the organization type.

$H_1 \neq 0$; H_1 = There is a significant relationship between pre-contract stage involvement and the organization type.

In this research, the chi-square test will be used to test the relationship between the pre-contract stage involvement and the organization type, these two variables are the nominal data. The α was set at 5 %, which represents the percentage of rejecting the null hypothesis. If the p-value is smaller than α, an alternate hypothesis will be accepted, which means the result will be statistically significant.

3.7.2.2 Correlation Analysis

Correlation coefficient is adopted to evaluate the two variables linearly linked. There are two different correlation analyses which are Pearson and Spearman. The Pearson correlation will be evaluating the linear relationship between two variables. The linear relationship means if one variable changes, it will establish a proportional change in the other variable (Minitab, 2019). Spearman correlation is used to analyze the monotonic

relationship between two ordinal variables. Unlike Pearson correlation, one variable changes in Spearman correlation, the other variable will change also but unnecessarily to change at a constant rate (de Winter et al., 2016; Minitab, 2019).

If the data is ordinal, a Spearman's rank correlation is appropriate and regarded as accurate (Minitab, 2019). Spearman correlation is more appropriate in this research as this research involves ordinal variables such as degree of relation and degree of agreement, and it is based on the variables' ranked values rather than the raw data.

The nature of the relationship is indicated by the positive (+) sign and negative (-) sign of correlation. As shown in Figure 3.5, the coefficient value lies between -1 and +1. The indications are on a similar path if the relationship exhibits a positive sign. There is no linear relationship between the two variables when the coefficient value is null. For example, the relationship between the respondents' working experience in the construction industry and the agreement level of the strategy used during pre-contract stage to mitigate the risk of cost overrun in construction building project is analyzed in this research. The correlation of these two variables is analyzed based on

Table 3.5.

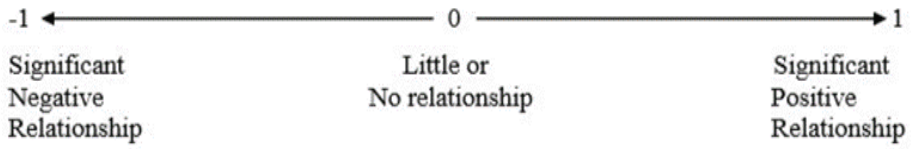

Figure 3.5: Relationship Descriptor for Spearman's Correlation Coefficient (Source: Adapted from Schober et al., 2018)

Table 3.5: Spearman Correlation's Interpretation Table (Source: Adapted from Leclezio et al., 2015)

Spearman	Correlation
≥ 0.70	Very strong relationship
0.40 – 0.69	Strong relationship
0.30 – 0.39	Moderate relationship
0.20 – 0.29	Weak relationship
0.01 – 0.19	No or negligible relationship

Remarks: This descriptor is applicable to both negative and positive relationships.

3.7.2.3 Kruskal–Wallis Test

The Kruskal-Wallis test is a non-parametric statistical test used to determine whether there are any statistically significant differences between the medians of three or more independent groups. It is an extension of the Mann-Whitney U test, which is used for comparing two independent groups. The Mann-Whitney U test is a non-parametric test used to compare two groups of sample means drawn from the same population. This test is typically used to determine whether the means from two samples are equal. According to LaMorte (2017), this test is adopted when there is ordinal data, or the t-test's assumptions are not achieved. The Kruskal-Wallis test is a suitable test for analyzing ordinal data. Ordinal data involves categories with a clear order but where the intervals between the categories may not be uniform or meaningful. Examples of ordinal data include Likert scale ratings.

In this research, the Kruskal-Wallis test is adopted to compare three groups of samples, which are developers, contractors and quantity surveyors in respect to their experiences and perspectives. This is because these groups of respondents might have different working environments; hence their responses need to be further determined to check whether there is significant difference. The research hypothesis is formed as follows:

$H_0 = 0$; H_0 = There are no statistically significant differences in the medians of developers, contractors and quantity surveyors.

$H_1 \neq 0$; H_1 = There are statistically significant difference in the medians of developers, contractors and quantity surveyors.

The α was set at 5 % in the Kruskal-Wallis test, which represents the percentage of rejecting the null hypothesis. If the p-value is more than 5 %, null hypothesis will be accepted and thus there is no significant difference between the groups.

3.7.3 Reliability Analysis

The reliability and the internal consistency of the data is indicated by using Cronbach's Alpha coefficient. Cronbach's Alpha Coefficient is to investigate whether the respondents will give the same responses under the same condition; or their responses will have huge differences among each other (Taber, 2017). Sekaran and Bougie (2020) claimed greater reliability will be obtained when the coefficient is closer to 1.0. The reliability test is interpreted according to the range of coefficients: *'≤ 0.5 = Poor; ≤ 0.7 = acceptable; ≤ 0.8 = Good; > 0.8 = Very Good; > 0.9 = Excellent'*. This test is used for Section B and C to determine the consistency of the cost overrun factors directly related to pre-contract stage and the strategies during pre-contract stage to minimize the risk of cost overrun in construction building projects.

3.7.4 Summary of Data Analysis

Table 3.6 summarizes the test that can be used to examine the information gathered from the questionnaires in the relevant parts.

Table 3.6: Summary of Analysis Techniques Used to Analyze the Data Collected from Questionnaire Sets (Source: Author Derived)

Section	Description	Test
A	Analysis on the respondents' background	- Frequency - Central tendency - Chi-square test - Spearman correlation
B	RO1: To identify the factors during pre-contract stage that impacted cost overrun in construction building projects. RO2: To evaluate the impact of the factors during pre-contract stage that impacted cost overrun in construction building projects.	- Reliability test - Central tendency - Kruskal-Wallis test
C	RO3: To assess the impact of the strategies during pre-contract stage to minimize the risk of cost overrun in construction building projects.	- Reliability test - Central tendency - Kruskal-Wallis test

3.7.5 Conclusion of Research

The study's fifth stage is its conclusion. The study's findings and analysis come to a definitive conclusion. After summarizing the findings, the researcher emphasizes the study's limitations and suggests directions for future research to enhance future studies with a comparable scope.

3.8 Summary of the Chapter

This chapter gave a thorough explanation of the research's overall methodology. This research process outlines the overall research strategies from the formation of problem to the validation of problem including all the parameters. The data types, methods of data collection and methods of data analysis are studied. All the data collected through questionnaires were analyzed, which eventually helped in the achievement of research objectives. The proper methodology is conducted to enhance the result's reliability and validity. The research methodology flow is shown as per Figure 3.6.

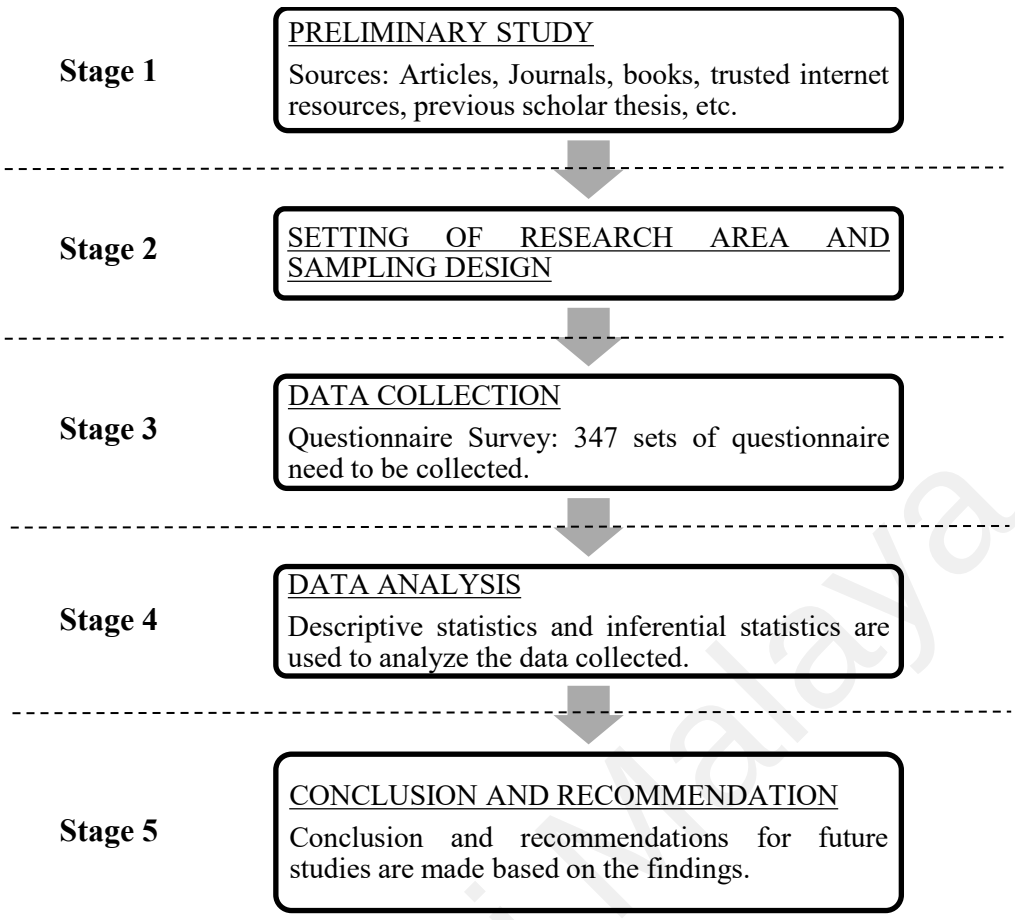

Figure 3.6: Flow Chart of Research Methodology (Source: Author Derived)

CHAPTER 4: RESULTS

4.1 General Introduction

This chapter will disclose the practical outcomes of the study, where the collected and analyzed data will be showcased. Following the groundwork laid in earlier chapters, where research questions were defined, the methodology was explained, and the theoretical framework was established, this chapter is where theory and reality are brought together. The main objective here is to present the results in a clear, systematic manner that can be easily understood. Each research question will be closely examined to provide a detailed understanding of the investigated aspects.

4.2 Questionnaires Response Rate

A total of 3,541 sets of questionnaires were distributed to the registered firms in Selangor through Google Form via email and WhatsApp. This research accepted one response from one firm only. There were 180 responses collected, representing 5.1% of the total distributed questionnaire. All the responses collected were analysed using SPSS and used as the basis of the study. Table 4.1 depicts the response rate of this study.

Table 4.1: Summary of Research Response Rate

	Quantity	**Percentage (%)**
Responses Collected	180	5.1
Non-responded Questionnaires	3,361	94.9
Total	**3,541**	**100.0**

4.3 Reliability Test

Table 4.2 presents the reliability test conducted in Section B and C. In Section B, there is a question asked to indicate the relatedness of cost overrun factors to pre-contract stage. In Section C, respondents were asked to rate their agreement level towards the strategies

that could be applied during the pre-contract stage to mitigate the risk of cost overrun in construction building projects.

Table 4.2: Results of Reliability Test

Section	Topic	Cronbach's Alpha	N of Items
B	Factors Related to Pre-Contract Stage Causing Cost Overrun	0.791	20
C	Strategies during Pre-Contract Stage to Mitigate the Risk of Cost Overrun	0.602	13

4.4 Demographic Data

Section A of the survey form is dedicated to gathering crucial information about the respondents, specifically their personal details. This section comprises six questions that aim to capture key demographic data, providing a comprehensive overview of the characteristics of the individuals participating in the survey. Table 4.3 tabulated the demographic data. This table serves as a structured representation of the demographic information, offering a clear and concise summary for easy reference and analysis.

Table 4.3: Summary of Respondents' Demographic Data (N=180)

	Characteristic	Frequency	Percentage (%)
Organization Type	Contractor	114	63.3
	Developer	34	18.9
	QS Consultant	32	17.8
Year of Working Experience	1 to 5 years	92	51.1
	5 to 10 years	45	25
	Over 10 years	43	23.9
Position	Project Manager	59	32.8
	Quantity Surveyor	46	25.6
	Project Executive	75	41.7
Total Building Project Involved		1,108	
Total Number of Project Experienced at least 20% Cost Overrun		660	
Pre-Contract Involvement	Yes	125	69.4
	No	55	30.6

In statistics, a commonly applied guideline, grounded in the Central Limit Theorem (CLT), suggests that irrespective of the population distribution, the sample means will exhibit an approximately normal distribution when the sample size is adequately large (Van Belle, 2011). The threshold of 30 is frequently used in accordance with this principle. In this study, adherence to the rule of thumb is ensured, as each sample group comprises a minimum of 30 respondents. There are a total of 114 respondents associated with contracting, 34 respondents associated with development, and 32 respondents associated with quantity surveying. Hence, the data gathered in the current study is deemed to be satisfactory and meets acceptable standards.

4.4.1 Chi-Square Test

The Chi-square test was adopted in this research to determine if there is a significant association between organization type and pre-contract involvement. Table 4.4 organizes and displays the distribution of the joint counts of observations of the combination of two variables, organization type and pre-contract involvement. Table 4.5 further exhibits the result of chi-square test, the p-value is 0.00, which is lesser than the significant value 0.05.

Table 4.4: Organization Type and Pre-Contract Involvement Crosstabulation

			Pre-Contract Involvement		
			No	Yes	Total
Organization Type	Contractor	Count	37	77	114
		Expected Count	34.8	79.2	114.0
	Developer	Count	18	16	34
		Expected Count	10.4	23.6	34.0
	QS Consultant	Count	0	32	32
		Expected Count	9.8	22.2	32.0
Total		Count	55	125	180
		Expected Count	55.0	125.0	180.0

Table 4.5: Chi-Square Tests between Organization Type and Pre-Contract Involvement

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.304[a]	2	0.000
Likelihood Ratio	30.864	2	0.000
N of Valid Cases	180		

4.5 Factors Related to Pre-Contract Stage Impacted Cost Overrun in Construction Building Project

This segment provides the outcomes of both descriptive and inferential tests conducted on the gathered responses regarding the relatedness of factors of cost overruns related to the pre-contract stage.

4.5.1 Descriptive Test

Table 4.6 showcases the findings regarding the relatedness of factors contributing to cost overruns in construction building projects during the pre-contract stage in Selangor, Malaysia. The factors are listed in descending order, with the inflation factor securing the top rank. Subsequently, inaccurate estimations, erroneous planning and scheduling, and inadequate contractor experience followed suit in descending order of significance. Among the twenty (20) factors examined, these four (4) were unequivocally identified as having a substantial correlation with the pre-contract stage. In the ranking, inappropriate managerial skills and inadequate tendering documents were positioned in the fifth and sixth places, respectively. Their mean scores indicate a high level of relatedness with the pre-contract stage. Information and Communication Barriers, Ground or Soil Conditions, Process Inefficiency, Contractors' Financial Difficulties, Incorrect Project Duration, Corruption, Contractors' Poor Site Management and Supervision, and Shortage of Equipment, are recognized as being partially related with the pre-contract stage.

Table 4.6: Factors Impacted Cost Overrun in Building Projects during Pre-Contract Stage

Factors	Mean	Rank	Level of Relatedness
Inflation	4.9800	1	Definitely related
Inaccurate Estimation	4.9600	2	Definitely related
Wrong Planning and Scheduling	4.7400	3	Definitely related
Insufficient Contractor Experience	4.3400	4	Definitely related
Inappropriate Managerial Skills	4.0100	5	Highly related
Poor Tendering Documents	3.5200	6	Highly related
Information and Communication Barriers	3.1900	7	Partially related
Ground or Soil Conditions	2.9900	8	Partially related
Process Inefficiency	2.9900	8	Partially related
Contractors Financial Difficulties	2.8200	10	Partially related
Incorrect Project Duration	2.7700	11	Partially related
Corruption	2.7600	12	Partially related
Contractors Poor Site Management and Supervision	2.7500	13	Partially related
Shortage of Equipment	2.7200	14	Partially related
Clients Financial Difficulty	2.5800	15	Slightly related
Weather	2.5100	16	Slightly related
Poor Monitoring and Control	1.9700	17	Slightly related
Frequent Design Change or Frequent Change Order	1.9600	18	Slightly related
Delayed Payment to Contractors or Consultants	1.8300	19	Slightly related
Rework	1.6100	20	Not related

4.5.2 Inferential Test

In this section, the conducted inferential test was Kruskal-Wallis test.

4.5.2.1 Kruskal-Wallis Test

The Kruskal-Wallis Test was adopted in this study to test whether there is significant difference between the different sample groups, developer, contractor and QS consultant on the relatedness of cost overrun factors to pre-contract stage. Table 4.7 shows the results of hypothesis test along with the decision. In short, results show that only the factors of frequent design change or frequent change order, ground or soil condition, and inaccurate estimation retain the null hypothesis. Other seventeen (17) factors rejected the null hypothesis.

Table 4.7: Hypothesis Test Summary for Cost Overrun Factors Related to Pre-Contract Stage

Null Hypothesis	Sig.	Decision
The distribution of clients' financial difficulty is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of contractors' financial difficulties is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of contractors poor site management and supervision is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of corruption is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of delayed payment to contractors or consultants is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of frequent design change or frequent change order is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of ground or soil condition is the same across categories of organization type.	**0.638**	**Retain the null hypothesis**
The distribution of inaccurate estimation is the same across categories of organization type.	**0.445**	**Retain the null hypothesis**
The distribution of inflation is the same across categories of organization type.	**0.555**	**Retain the null hypothesis**
The distribution of insufficient contractor experience is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of inappropriate managerial skills is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of wrong planning and scheduling is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of information and communication barriers is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of poor monitoring and control is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of poor tendering documents is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of project inefficiency is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of incorrect project duration is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of rework is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of shortage of equipment is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of weather is the same across categories of organization type.	0.000	Reject the null hypothesis

In summary, the null hypothesis is rejected for the majority of factors, indicating significant variations in their distribution across different organization types, developer, contractor and QS consultant. This implies that the type of organization plays a substantial role in influencing these factors related to cost overruns during the pre-contract stage in construction projects. However, for ground or soil conditions, inaccurate estimation, and inflation, the null hypothesis is retained, suggesting that the distribution of these factors may not differ significantly across various organization types.

4.6 Strategies Used during Pre-Contract Stage to Minimize the Risk of Cost Overruns in Construction Building Projects

This section displays the findings from both descriptive and inferential tests regarding the agreement level on strategies that could be employed during the pre-contract stage to mitigate the risk of cost overruns in construction building projects.

4.6.1 Descriptive Test

Table 4.8 outlines the outcomes concerning strategies implemented during the pre-contract stage to minimize the risk of cost overruns in construction building projects. Among the thirteen strategies assessed, "Selection of contractors, taking into account expertise, financial capability, and experience," secured the top rank. Following closely were "pre-contract cost control," "proper planning before project execution," and "risk assessment during project estimating." These four strategies garnered strong agreement as crucial practices during the pre-contract stage to minimize the risk of cost overrun. The adoption of BIM was ranked next, succeeded by the adoption of suitable project management scheduling tools, effective resource management systems, regular updates of material prices and labour rates, adherence to the project's planned scope, and fostering effective communication, all endorsed by respondents in descending order of agreement.

Next followed by “managing and completing design stage before construction” and “quality monitoring”. Lastly, one strategy, which involves predominantly employing local construction materials, received an average feedback score of 2.3833. The mean responses indicated disagreement regarding the feasibility of implementing this strategy during the pre-contract stage to mitigate the risk of cost overrun in construction building projects.

Table 4.8: Strategies during Pre-Contract Stage to Minimize the Risk of Cost Overrun in Construction Building Projects

Strategies	Mean	Rank	Level of Agreement
Selection of contractors takes account of expertise, financial capability and experience.	4.8167	1	Strongly agree
Pre-contract cost control	4.7444	2	Strongly agree
Proper project activities planning before project execution	4.7000	3	Strongly agree
Risk Assessment during project estimating	4.6889	4	Strongly agree
BIM adoption	4.0500	5	Highly agree
Adopt suitable project management scheduling tool	3.9778	6	Highly agree
Effective resources management system	3.9111	7	Highly agree
Keep updating of material prices and labour rates	3.8778	8	Highly agree
Staying within the project planned scope	3.7833	9	Highly agree
Effective communication	3.4500	10	Highly agree
Managing and Completing Design Stage before construction	3.3389	11	Agree
Quality Monitoring	2.6778	12	Agree
Use mainly local construction material	2.3833	13	Disagree

4.6.2 Inferential Test

The inferential tests conducted in this section were Spearman’s Correlation Analysis and Kruskal-Wallis Test.

4.6.2.1 Correlation Analysis

A Spearman's correlation analysis was performed to examine the correlation between the number of years of professional experience among respondents and the degree of agreement regarding strategies employed during the pre-contract stage to mitigate the risk of cost overrun. Table 4.9 exhibits the correlation coefficient which represents the degree of association between the two variables. The positive coefficients (exceeding 0) suggest a positive correlation, which are staying within the project planned scope, effective communication, use mainly local construction material, keep updating of material prices and labour rates, and quality monitoring. A positive correlation coefficient indicates that as respondents' working experience increases, their agreement level with the strategies also tends to increase.

Table 4.9: Correlations between Year of Working Experience and Strategies during Pre-Contract Stage to Mitigate the Risk of Cost Overrun

		Year of Working Experience
Adopt suitable project management scheduling tool	Correlation Coefficient	-0.153
	Sig. (1-tailed)	0.020
	N	180.000
Staying within the project planned scope	Correlation Coefficient	**0.689**
	Sig. (1-tailed)	0.000
	N	180.000
Proper project activities planning before project execution	Correlation Coefficient	-0.641
	Sig. (1-tailed)	0.000
	N	180.000
Selection of contractors	Correlation Coefficient	-0.275
	Sig. (1-tailed)	0.000
	N	180.000
Effective communication	Correlation Coefficient	**0.509**
	Sig. (1-tailed)	0.000
	N	180.000
Risk Assessment during project estimating	Correlation Coefficient	-0.300
	Sig. (1-tailed)	0.000
	N	180.000
Pre contract cost control	Correlation Coefficient	-0.579
	Sig. (1-tailed)	0.000
	N	180.000

Table 4.9: Correlations between Year of Working Experience and Strategies during Pre-Contract Stage to Mitigate the Risk of Cost Overrun, continued

		Year of Working Experience
Use mainly local construction material	Correlation Coefficient	**0.397**
	Sig. (1-tailed)	0.000
	N	180.000
Effective resources management system	Correlation Coefficient	-0.316
	Sig. (1-tailed)	0.000
	N	180.000
Keep updating of material prices and labour rates	Correlation Coefficient	**0.546**
	Sig. (1-tailed)	0.000
	N	180.000
Quality Monitoring	Correlation Coefficient	**0.558**
	Sig. (1-tailed)	0.000
	N	180.000
BIM adoption	Correlation Coefficient	-0.738
	Sig. (1-tailed)	0.000
	N	180.000
Managing and Completing Design Stage before construction	Correlation Coefficient	-0.003
	Sig. (1-tailed)	0.486
	N	180.000

These explanations help to understand how the number of years of working experience relates to different strategies used during pre-contract stage. However, just because there is a connection does not mean one thing causes the other. Other factors could be affecting these connections. Also, how strong the connection is depending on the situation.

4.6.2.2 Kruskal-Wallis Test

Table 4.10 exhibits the result from Kruskal-Wallis Test on the agreement level of strategies used during pre-contract stage to mitigate the risk of cost overrun in construction building projects. Result shows that only the strategy of using effective resources management system retain the null hypothesis. Other twelve (12) factors rejected the null hypothesis.

Table 4.10: Hypothesis Test Summary for Strategies Used during Pre-Contract Stage to Mitigate the Risk of Cost Overrun

Null Hypothesis	Sig.	Decision
The distribution of adopt suitable project management scheduling tool is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of staying within the project planned scope is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of proper project activities planning before project execution is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of selection of contractors is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of effective communication is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of risk assessment during project estimating is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of pre-contract cost control is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of use mainly local construction material is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of effective resources management system is the same across categories of organization type.	**0.210**	**Retain the null hypothesis**
The distribution of keep updating of material prices and labour rates is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of quality monitoring is the same across categories of organization type.	0.000	Reject the null hypothesis
The distribution of BIM adoption managing and completing design stage before construction is the same across categories of organization type.	0.029	Reject the null hypothesis
The distribution of managing and completing design stage before construction is the same across categories of organization type.	0.000	Reject the null hypothesis

In summary, most strategies exhibited significantly different distributions across various organization types, except for the effective resources management system, where the distribution similarity across organization types was not statistically significant. These findings suggest that organizational differences play a role in the adoption and implementation of specific strategies during the pre-contract stage in construction projects.

4.7 Summary of the Chapter

This chapter provides a thorough look at the research results. It starts with a general introduction and goes on to discuss how many people responded to the questionnaires, making sure the information is reliable through some tests. It also talks about the demographic data using Chi-Square tests. After that, it investigates the factors connected to the pre-contract stage causing cost overruns in construction building projects. Various tests, including the Kruskal-Wallis test, are used to understand this part. The chapter also explores the strategies used during the pre-contract stage to reduce the risk of cost overruns in construction building projects. Different tests, like correlation analysis and the Kruskal-Wallis test, are applied to learn more about these strategies. This chapter is crucial in the research, as it thoroughly examines important aspects, paving the way for a detailed discussion and understanding of the findings in the chapters that follow.

CHAPTER 5: FINDINGS AND DISCUSSION

5.1 General Introduction

In this new chapter, the core of research is explored, sharing and analyzing the interesting discoveries that came from thorough investigation. While going through the data details, interesting patterns and connections are observed. Not only are the numbers uncovered, but the reasons behind them are also explored. In the discussion, these findings will be explained in the context of construction project management, understanding what they mean and suggesting possible areas for more research.

5.2 Reliability Test

The reliability test provides an assessment of the internal consistency or reliability of a set of measurement items within a specific section or domain. The reliability coefficient, often expressed as Cronbach's alpha, ranges from 0 to 1, with higher values indicating greater internal consistency among the items. In this research, for Section B on the relatedness of cost overrun factors to pre-contract stage, the reliability coefficient is 0.791, and for Section C on strategies used during pre-contract stage to mitigate the risk of cost overrun, it is 0.603. These coefficients suggest the extent to which the items within each section consistently measure the same underlying construct.

For Section B, this relatively high coefficient of 0.791 indicates a strong level of internal consistency among the measurement items in Section B. Respondents answering questions in this section have provided responses that align well with each other, suggesting a reliable measurement of the construct or concept being assessed in Section B. While the coefficient for Section C is lower at 0.603, it still suggests a moderate level of internal consistency among the measurement items in this section. While not as high as Section B, this coefficient indicates a reasonable degree of reliability, meaning that the

items within Section C are measuring a consistent underlying construct, although there may be some variability.

It is essential to interpret these reliability coefficients in the context of your specific survey or measurement instrument. Generally, a reliability coefficient above 0.7 is considered acceptable, but the acceptable threshold may vary based on the field and purpose of the study. In your case, both sections show a level of reliability, with Section B demonstrating a higher degree of internal consistency compared to Section C. Considerations for improvement or further investigation may be warranted for Section C to enhance its reliability if necessary.

5.3 Organization Types and Pre-Contract Stage Involvement

The Chi-square tests conducted to explore the association between organization type and pre-contract involvement yielded statistically significant results, indicating a meaningful relationship between these variables. The Pearson Chi-Square value of 22.304 with 2 degrees of freedom and an asymptotic significance of 0.000, along with the Likelihood Ratio test yielding a value of 30.864 under the same degrees of freedom and significance level, both support the rejection of the null hypothesis. This implies that the observed differences in pre-contract involvement across various organization types are highly unlikely to have occurred by chance alone. With 180 valid cases considered in the analysis, these findings suggest that organizational characteristics play a role in determining the extent of pre-contract involvement in construction projects. This information is valuable for stakeholders and decision-makers in the construction industry, as it highlights the importance of considering organization type when assessing and planning for pre-contract activities to mitigate the risk of cost overruns.

5.4 Factors Related to Pre-Contract Stage Causing Cost Overrun in Construction Building Project

In examining the research's objectives, a detailed analysis was conducted to understand the factors that lead to increased costs in construction projects before the contract is finalized. Different elements directly related to this early stage were identified, revealing their significant impact on cost escalation. Following this identification, an assessment was made to understand how much each factor contributes to the overall increase in costs. This evaluation provides insights into why projects often end up costing more than initially planned. The goal is to present a clear and detailed understanding of the reasons behind cost increases before the contract is signed. This information is valuable not only for academic purposes but also for assisting project managers and other stakeholders in addressing cost-related challenges more effectively. Table 5.1 presents the categories of cost overrun factors with their respective relatedness to pre-contract stage according to the results. The following section discussed the results according to the respective category.

Table 5.1: Categories of Cost Overrun Factors with Respective Relatedness to Pre-Contract Stage

Categories	Factors	Mean	Rank	Level of Relatedness
Estimation and Planning	Inaccurate Estimation	4.96	2	Definitely related
	Wrong Planning and Scheduling	4.74	3	Definitely related
	Poor Tendering Documents	3.52	6	Highly related
	Incorrect Project Duration	2.77	11	Partially related
Experience and Skills	Insufficient Contractor Experience	4.34	4	Definitely related
	Inappropriate Managerial Skills	4.01	5	Highly related
	Contractors Poor Site Management and Supervision	2.75	13	Partially related
External and Environmental Factors	Inflation	4.98	1	Definitely related
	Ground or Soil Conditions	2.99	8	Partially related
	Weather	2.51	16	Slightly related

Table 5.1: Categories of Cost Overrun Factors with Respective Relatedness to Pre-Contract Stage, continued

Categories	Factors	Mean	Rank	Level of Relatedness
Financial Factors	Contractors Financial Difficulties	2.82	10	Partially related
	Clients Financial Difficulty	2.58	15	Slightly related
	Delayed Payment to Contractors or Consultants	1.83	19	Slightly related
Process and Design	Process Inefficiency	2.99	8	Partially related
	Frequent Design Change or Frequent Change Order	1.96	18	Slightly related
	Rework	1.61	20	Not related
Others	Information and Communication Barriers	3.19	7	Partially related
	Corruption	2.76	12	Partially related
	Shortage of Equipment	2.72	14	Partially related
	Poor Monitoring and Control	1.97	17	Slightly related

5.4.1 Estimation and Planning

Inaccurate estimation is a pervasive issue in construction projects. It often results from a lack of historical data analysis, inadequate understanding of project requirements, and unforeseen market fluctuations. Contractors may face challenges in predicting accurate costs for labour, materials, and equipment (Aljohani et al., 2017). This can lead to serious consequences, such as project delays, disputes over budget allocations, and strained relationships between project stakeholders (Amini et al., 2022). The definitely related level underscores the critical impact of inaccurate estimation on the pre-contract stage. Inaccurate estimates can lead to budget discrepancies, affecting the negotiation and agreement phases. Contractors may face challenges in providing realistic bids, and project owners may encounter difficulties in securing accurate funding (Amini et al., 2022). Enhancing the accuracy of estimation processes is crucial to laying a solid foundation for successful contract negotiations.

Wrong planning and scheduling are critical factors that can significantly impact the construction timeline and costs. Poorly sequenced activities, inadequate resource allocation, and failure to consider dependencies can result in cascading delays (Lee et al., 2022). This not only increases labour and equipment costs but also affects overall project efficiency. Implementing advanced project management methodologies, utilizing modern scheduling tools, and conducting regular risk assessments are essential to minimizing the impact of wrong planning and scheduling (Amini et al., 2022). Proactive identification and mitigation of potential bottlenecks are crucial to keeping projects on track. The definitely related level highlights the direct influence of wrong planning and scheduling on the pre-contract stage. During negotiations, project timelines and resource allocations are critical discussion points. Poor planning can introduce uncertainties and risks, affecting the terms and conditions of the contract (Durdyev, 2020). Addressing this factor is imperative to establish a realistic and achievable project plan during the pre-contract phase.

Poor tendering documents introduce a layer of uncertainty into the bidding process, potentially leading to inaccurate cost estimates and increased project risks. Incomplete or unclear project specifications can result in contractors underbidding or facing unexpected challenges during construction (Niazi & Painting, 2017). This factor highlights the importance of comprehensive and transparent communication during the pre-contract stage. Project owners must invest in creating detailed and unambiguous tendering documents, ensuring that all stakeholders have a clear understanding of project requirements. Improved transparency in the bidding process contributes to more accurate bids and reduced disputes. The highly related level emphasizes the importance of tendering documents in the pre-contract stage. Clear and comprehensive documents are essential for accurate bidding and contracting. Ambiguities in tendering documents can

lead to misunderstandings, disputes, and increased negotiation times (Durdyev, 2020). Improving the quality of tendering documents is critical to fostering a smooth pre-contract process.

While the incorrect project duration is less critical compared to other factors, it still plays a role in cost overruns. Underestimating the time required for certain project phases can lead to increased costs for labour, equipment, and other resources (Adam et al., 2017). The partially related level suggests that while incorrect project duration is a consideration in the pre-contract stage, its impact might not be as direct as other factors. Delays in project duration can influence contract negotiations, but they might not be as pronounced as issues related to estimation and planning. Nevertheless, ensuring realistic timelines is important for setting accurate expectations during the pre-contract phase.

In construction projects, it is crucial to carefully plan and estimate costs to avoid problems. If estimates are wrong, it can cause issues in the early stages, leading to budget problems and strained relationships among project partners. Improving estimate accuracy is vital for successful contract negotiations. Planning and scheduling mistakes also affect project efficiency, so it is important to identify and fix problems early on. Tendering documents, which are really important during the early project stages, need to be clear to avoid misunderstandings in the bidding process. Even though getting the project duration wrong is not as bad, it is still important to have realistic timelines to avoid surprises during the early planning stages. Overall, a careful and detailed approach to estimating and planning helps prevent issues and ensures successful construction projects.

5.4.2 Experience and Skills

Contractor experience is vital for successful project execution. The mean value and ranking highlight its substantial impact on the pre-contract stage. Insufficient experience may lead to inaccurate cost estimations, ineffective planning, and increased project risks (Ahady et al., 2017). It affects a contractor's ability to assess project complexities, potentially resulting in delays and budget overruns. The definite relatedness underscores the critical role of experience in the early stages, emphasizing the need for well-established contractors with a track record of successful projects to ensure a smooth pre-contract phase.

Managerial skills play a pivotal role in project success. The mean value and high rank indicate the substantial impact of inappropriate managerial skills on the pre-contract stage. Poor management can result in ineffective communication, delays, and increased project costs (Adam et al., 2017). Project managers must possess the skills to navigate complexities, make informed decisions, and mitigate risks. The highly related level emphasizes the direct influence of managerial skills on the early stages, emphasizing the need for competent leadership to ensure efficient pre-contract processes.

While site management and supervision are crucial, the lower mean value and ranking suggest a less critical impact compared to other factors. Poor site management can contribute to inefficiencies, safety issues, and delays (Gaurang, 2020). The partially related level indicates that while it plays a role in the pre-contract stage, its impact may not be as pronounced. Nevertheless, effective site management remains important for successful project execution, and addressing this factor is essential for minimizing risks during the early project phases.

In summary, the importance of experienced contractors is evident in the substantial impact it has on the early planning stages of construction projects, influencing aspects like cost estimation accuracy and effective planning. The definite relatedness underscores the critical role of well-established contractors with a successful track record, emphasizing their necessity for a smooth pre-contract phase. Similarly, the significance of managerial skills is highlighted by their substantial impact on early planning, with poor management potentially causing communication issues, delays, and increased costs. The high relatedness level emphasizes the need for competent leadership during the pre-contract stage. While site management and supervision are crucial, their lower mean value and ranking suggest a comparatively lesser impact, though still important for minimizing risks in the initial project phases. Overall, prioritizing experienced contractors, strong managerial skills, and effective site management is crucial for successful project execution.

5.4.3 External and Environmental Factors

Inflation emerges as a critical factor with the highest mean value and top rank among all twenty (20) factors. Its definitely related level underscores its profound impact on the pre-contract stage. Inflation can significantly affect material and labour costs, directly influencing project budgets and overall financial feasibility (Amini et al., 2022). Acknowledging and accounting for inflation during the early planning phases is imperative for accurate cost estimation and successful contract negotiations. For example, the global construction industry during times of economic uncertainty or crises, where inflationary pressures significantly impact project costs, causing delays and contract disputes (Kuware, 2021).

Ground or soil conditions, while moderately critical, can significantly impact construction projects during the pre-contract stage. Varying soil conditions, such as unstable ground or the presence of unexpected obstacles, can necessitate changes in construction methods and foundation designs (Durdyev, 2020). This can lead to increased costs and potential delays if not adequately addressed during the planning phase. A real-life example involves construction projects in regions with diverse geological conditions, where failure to conduct thorough site assessments can result in unexpected challenges, such as unstable soil requiring additional foundation support (Kuware, 2021).

Weather conditions, while rated at a slightly related level, still have implications for the pre-contract stage. Adverse weather, such as heavy rainfall, extreme temperatures, or storms, can lead to project delays and increased construction costs (Babalola et al., 2022). For instance, prolonged rainy seasons may hinder construction activities, affecting timelines and increasing labour costs due to decreased productivity. While the mean value and ranking suggest a lower impact compared to other factors, it remains crucial for project planners to consider and account for potential weather-related challenges. For example, the impact of hurricanes or typhoons on construction projects, where unexpected weather events can lead to delays, damage, and increased costs for recovery and adjustments.

In conclusion, inflation emerges as the most critical factor among the twenty considered, with a definite relatedness level emphasizing its profound impact on the pre-contract stage. Its ability to significantly influence material and labour costs underscores its importance in shaping project budgets and overall financial feasibility. Recognizing and accounting for inflation during early planning is imperative for accurate cost estimation and successful contract negotiations. Similarly, ground or soil conditions,

moderately critical, can impact projects significantly, requiring changes in construction methods and foundation designs. Weather conditions, rated slightly related, though lower in impact, demand proactive planning to mitigate delays and increased costs, as exemplified by the disruptive impact of hurricanes or typhoons on construction projects. Overall, strategic planning and risk management are crucial for navigating these external and environmental challenges in the pre-contract stage.

5.4.4 Financial Factors

Contractors facing financial difficulties can have a moderate impact on construction projects, as indicated by the mean value and ranking. This factor is partially related to the pre-contract stage, suggesting that while it may influence project dynamics, its significance is not as pronounced. Financially strained contractors may struggle to allocate resources efficiently, potentially leading to delays and compromised project quality (Aljohani et al., 2017). While addressing contractors' financial stability is important, other factors may have a more direct impact on the early planning phases.

Clients experiencing financial difficulties are rated at a slightly related level, indicating a lower impact on the pre-contract stage. While client financial stability is important for project funding and progress (Lee et al., 2022), the mean value and ranking suggest that other factors have a more immediate influence during the early planning phases. However, clients' financial struggles can still pose risks, potentially affecting the availability of funds and project viability in the long run.

Delayed payments to contractors or consultants are rated as slightly related, indicating a relatively lower impact on the pre-contract stage. While delayed payments can cause financial strains on contractors and impact project cash flow (Adam et al., 2017), the

mean value and ranking suggest that its influence during the early planning phases is less significant compared to other factors. Nevertheless, timely payments are crucial for maintaining positive contractor relationships and ensuring the smooth progression of construction projects.

In conclusion, financial factors in construction projects, such as contractors' financial difficulties, clients' financial struggles, and delayed payments, play a role in the pre-contract stage, but their impact is generally considered moderate to slightly related. While financially strained contractors may face challenges in resource allocation, their influence on the early planning phases is not as pronounced compared to other factors. Client financial difficulties, while slightly related, may pose long-term risks to project viability. Similarly, delayed payments, rated as slightly related, are crucial for maintaining positive contractor relationships, though their impact during the early planning stages is relatively lower. Addressing these financial considerations remains important for risk mitigation and ensuring the smooth progression of construction projects.

5.4.5 Process and Design

Process inefficiency is identified as partially related, indicating a moderate impact on the pre-contract stage. Inefficient processes can lead to delays, increased costs, and hindered collaboration among project stakeholders (Adam et al., 2017). While not as critical as some other factors, addressing process inefficiencies is crucial for optimizing the planning and execution stages of construction projects. Streamlining processes can enhance project efficiency, reduce the risk of errors, and contribute to successful contract negotiations.

Frequent design changes or change orders are rated as slightly related, indicating a relatively lower impact on the pre-contract stage. While design changes can introduce complexities and potential delays (Niazi & Painting, 2017), the mean value and ranking suggest that their influence during the early planning phases is not as significant. However, managing and minimizing design changes is still important to maintain project timelines and budgets, ensuring that modifications do not disrupt the planning and pre-contract processes (Durdyev, 2020).

Rework is identified as not related to the pre-contract stage, suggesting that its impact during the early planning phases is minimal. While rework can lead to increased costs and delays during construction, the mean value and ranking imply that it is not a critical consideration in the initial stages. Nonetheless, minimizing rework remains crucial for project efficiency and cost-effectiveness during subsequent construction phases.

In summary, within the Process and Design category, process inefficiency is acknowledged as partially related, signifying a moderate impact on the pre-contract stage. While not as critical as some other factors, addressing inefficiencies is crucial for optimizing planning and execution, enhancing efficiency, and contributing to successful contract negotiations. Frequent design changes or change orders, rated slightly related, suggest a relatively lower impact during the early planning phases. Managing and minimizing design changes remains important for maintaining project timelines. Rework, identified as not related, implies minimal impact in the initial stages, emphasizing the need to focus on other critical considerations. Overall, streamlining processes and managing design changes are vital for effective project planning, with ongoing efforts to minimize rework crucial for subsequent construction phases.

5.4.6 Others

Information and communication barriers, rated as partially related, suggest a moderate impact on the pre-contract stage. Barriers such as inadequate communication channels or information silos can lead to misunderstandings, delays, and compromised decision-making (Durdyev, 2020). While not as critical as some other factors, addressing these barriers is essential for fostering effective collaboration among project stakeholders, ensuring accurate information flow, and minimizing risks associated with miscommunication.

Corruption is identified as partially related, indicating a moderate impact on the pre-contract stage. Corrupt practices can introduce biases, compromise fair procurement processes, and lead to inefficient resource allocation (Niazi & Painting, 2017). While not the most critical factor, addressing corruption is crucial for maintaining the integrity of the pre-contract phase, promoting fair competition, and ensuring that contracts are awarded based on merit rather than unethical considerations.

A shortage of equipment is rated as partially related, suggesting a moderate impact on the pre-contract stage. Insufficient equipment availability can lead to delays, increased costs, and hindered project progress (Kuware, 2021). While not among the most critical factors, addressing equipment shortages is vital for ensuring that construction projects can proceed efficiently and that contractors have the necessary tools for successful project execution.

Poor monitoring and control are rated as slightly related, indicating a relatively lower impact on the pre-contract stage. Inadequate monitoring can lead to oversight, increased risks, and compromised project quality (Adam et al., 2017). While not as critical as some

other factors, effective monitoring and control are essential for maintaining project timelines, ensuring compliance with specifications, and minimizing the potential for costly errors.

In summary, information and communication barriers, corruption, shortage of equipment, and poor monitoring and control are identified as partially or slightly related, indicating a moderate to relatively lower impact on the pre-contract stage. Addressing communication barriers is crucial for effective collaboration and risk reduction, even though it is not among the most critical factors. Similarly, mitigating corruption risks is essential for maintaining the integrity of the pre-contract phase and ensuring fair procurement. While shortages of equipment have a moderate impact on project efficiency, their importance lies in enabling smooth project execution. Effective monitoring and control, although rated slightly related, remain vital for maintaining project timelines and quality standards during the early planning phases. Overall, proactive measures to address these factors are essential for successful construction projects.

5.5 Strategies Used during Pre-Contract Stage to Minimize the Risk of Cost Overruns in Construction Building Projects

5.5.1 Selection of Contractors

The selection of contractors is a crucial aspect of the pre-contract stage in construction building projects, and it is encouraging to see that it has been ranked as the top strategy with a mean value of 4.8167. This indicates a strong consensus among stakeholders that this strategy is effective in minimizing the risk of cost overrun. The selection of contractors is a critical decision that directly impacts project outcomes. Choosing contractors based on expertise, financial capability, and experience ensures that the project is in the hands of capable and qualified professionals.

Contractors with the right expertise are more likely to understand the intricacies of the project, reducing the likelihood of errors and rework (Ikechukwu et al., 2017). Financially stable contractors are better equipped to handle unexpected costs and fluctuations in the market, reducing the risk of financial issues during the project (Ullah et al., 2018). Experienced contractors have a track record of successful project completion, indicating their ability to manage complexities and challenges effectively.

Proper contractor selection contributes to the overall quality of the construction project. Quality construction practices reduce the likelihood of defects and costly repairs, minimizing the risk of cost overrun (Ullah et al., 2018). Conduct a comprehensive risk assessment to identify potential challenges and uncertainties that may impact the project's cost (Ikechukwu et al., 2017). This includes analyzing environmental factors, regulatory requirements, and external influences. Understanding and quantifying risks early on enables proactive risk management strategies.

The success of a construction building project is significantly influenced by the strategies implemented during the pre-contract stage. A holistic approach that encompasses contractor selection, risk assessment, clear contracts, and effective project management can create a robust foundation for cost control and successful project delivery. Regular reviews and adjustments to these strategies throughout the project life cycle are also crucial for adapting to changing conditions and mitigating emerging risks.

5.5.2 Pre-contract Cost Control

The strategy of "Pre-contract cost control" has been identified as crucial for minimizing the risk of cost overrun in construction building projects, with a mean value of 4.7444 and a strong agreement level, as evidenced by its second-place rank.

First, pre-contract cost control emphasizes the importance of identifying and managing costs at an early stage of the project. This involves a detailed analysis of various cost components, including materials, labour, equipment, and overhead expenses (Abusafiya & Suliman, 2017). By implementing pre-contract cost control measures, project stakeholders can proactively identify and address potential risks that could lead to cost overruns. This includes understanding market dynamics, inflation, and other external factors that may impact project costs.

Furthermore, the strategy involves developing accurate and realistic budgets based on comprehensive cost estimates. This ensures that the project is financially feasible, and stakeholders have a clear understanding of the financial commitments required (Abusafiya & Suliman, 2017). Pre-contract cost control involves a meticulous breakdown of costs for different project elements. This clear allocation of costs helps in tracking and controlling expenditures in a more granular manner, reducing the likelihood of unexpected overruns. Including a contingency fund in the budget is part of the pre-contract cost control strategy. This fund acts as a safety net, providing financial flexibility to address unforeseen events or changes in project requirements without causing significant budget overruns.

The strong agreement and high ranking of the "Pre-contract cost control" strategy underscore its significance in minimizing the risk of cost overrun in construction building projects. By focusing on accurate budgeting, risk mitigation, clear contracts, and continuous monitoring, project stakeholders can establish a solid foundation for financial success throughout the project life cycle. This proactive approach contributes to the overall efficiency, transparency, and success of construction projects.

5.5.3 Proper Project Activities Planning before Project Execution

Proper project activities planning before project execution is a critical strategy in the pre-contract stage of construction projects. The high mean value of 4.7000 indicates strong agreement among stakeholders about the importance of this strategy. This level of agreement is supported by its third place ranking among the 13 strategies, highlighting its significance in the eyes of project participants.

The key components of project activities planning included comprehensive planning, risk identification, resource allocation, and timeline development (Ikechukwu et al., 2017). Comprehensive Planning emphasizes the need for a comprehensive and detailed project plan before the execution phase begins. It involves breaking down the project into specific activities, outlining timelines, and assigning resources. In addition, effective planning includes a thorough risk assessment to identify potential challenges and uncertainties. By recognizing risks early in the project, stakeholders can develop mitigation strategies, reducing the likelihood of cost overruns and delays. While proper resource allocation ensures that resources such as labour, materials, and equipment are allocated efficiently (Durdyev et al., 2017). This prevents bottlenecks, optimizes productivity, and contributes to cost control. Timeline Development is about the creation of realistic timelines, it is crucial for successful project execution (Ullah et al., 2018). Well-planned schedules help in avoiding delays and enable better coordination among various project activities.

In short, proper project activities planning before project execution is rightly recognized as a key strategy during the pre-contract stage. The high mean value and strong agreement among stakeholders underscore its importance in setting the groundwork for successful construction projects. By investing time and effort in thorough

planning, project teams can lay the foundation for effective cost control, risk management, and overall project success. Regular reviews and adaptability to changing conditions ensure that the initial plan remains aligned with project objectives throughout its lifecycle.

5.5.4 Risk Assessment During Project Estimating

The strategy of conducting risk assessment during project estimating emerges as a pivotal element in the pre-contract stage of construction projects, as indicated by its high mean value of 4.6889 and a strong consensus with a rank of 4 among the 13 strategies. Stakeholders strongly agree on the critical importance of integrating risk assessment seamlessly into the project estimating phase. This approach signifies a proactive stance toward identifying potential uncertainties that could lead to cost overruns, delays, or other complications during the project lifecycle (Abusafiya & Suliman, 2017). The high level of agreement underscores the recognition that risk assessment is not a standalone activity but an integral part of the estimating process. By systematically identifying and quantifying risks early in the project, stakeholders can develop effective mitigation strategies, allocate appropriate contingencies, and enhance overall project resilience (Ullah et al., 2018). This strategy, with its robust agreement and ranking, highlights the industry's understanding of the profound impact that thorough risk assessment during estimating can have on successful project outcomes. It underscores the importance of embracing uncertainty in the early stages of project planning to foster long-term project success.

5.5.5 BIM Adoption

With a mean value of 4.0500 and a rank of 5, BIM adoption is recognized as a highly significant strategy during the pre-contract stage of construction projects. The strong

agreement among stakeholders further emphasizes the acknowledged importance of BIM in the construction industry. BIM adoption involves the use of digital models to represent the physical and functional characteristics of a building or infrastructure throughout its lifecycle (Sánchez et al, 2022). The high level of agreement indicates a shared understanding that leveraging BIM technology can lead to improved project efficiency, collaboration, and cost-effectiveness. BIM enables stakeholders to visualize complex designs, identify clashes or conflicts before construction begins, and streamline the coordination of various project elements (Al-Keim, 2017). The technology's impact on reducing errors, improving communication, and enhancing overall project visualization contributes significantly to minimizing the risk of cost overruns. The fifth-place ranking suggests that while BIM adoption is highly valued, it may not be the top priority compared to certain other strategies. Nevertheless, its inclusion in the top strategies underscores its role as a transformative tool in modern construction practices, aligning with the industry's commitment to technological advancements for more successful and efficient project delivery.

5.5.6 Adopt Suitable Project Management Scheduling Tool

The strategy of adopting a suitable project management scheduling tool holds considerable significance during the pre-contract stage, evident from its mean value of 3.9778 and a rank of 6, coupled with a strong level of agreement. This strategy reflects the industry's acknowledgment of the pivotal role that effective scheduling plays in project success (Ikechukwu et al., 2017). While not the top-ranked strategy, the high level of agreement underscores the shared understanding among stakeholders regarding the importance of leveraging appropriate project management tools for scheduling purposes.

By adopting a suitable scheduling tool, project teams aim to enhance overall project control, coordination, and communication (Al-Keim, 2017). These tools enable the creation of detailed project timelines, facilitate resource allocation, and provide a platform for real-time collaboration among team members. The sixth-place ranking suggests that while stakeholders highly agree on the value of project management scheduling tools, they may prioritize other strategies slightly higher.

5.5.7 Effective Resources Management System

The strategy of implementing an effective resources management system emerges as a crucial aspect during the pre-contract stage of construction projects, with a mean value of 3.9111 and a rank of 7, accompanied by a strong level of agreement. This strategy reflects a shared understanding among stakeholders about the significance of optimizing the allocation and utilization of resources for project success.

The seventh-place ranking suggests that while stakeholders highly agree on the importance of an effective resources management system, it may not be the top priority compared to certain other strategies. However, its inclusion in the top strategies underscores its role in mitigating the risk of cost overruns by ensuring that resources such as labour, materials, and equipment are utilized efficiently (Aljohani et al., 2017). An effective resources management system involves careful planning, monitoring, and adjustment of resource allocation based on project requirements. This strategy contributes to maintaining project schedules, preventing bottlenecks, and optimizing productivity, thereby enhancing overall project performance (Durdyev et al., 2017).

5.5.8 Keep Updating of Material Prices and Labour Rates

The strategy of consistently updating material prices and labour rates during the pre-contract stage is of paramount importance in construction projects, as reflected by its mean value of 3.8778, a rank of 8, and a strong level of agreement. This strategy acknowledges the inherently dynamic nature of the construction industry, where material costs and labour rates can fluctuate significantly. The high level of agreement among stakeholders underscores the collective recognition that failing to account for these changes can lead to budget overruns and compromise project timelines. To implement this strategy effectively, project teams are advised to establish robust market monitoring mechanisms, fostering collaborative relationships with suppliers and subcontractors to gain timely insights (Ahady et al., 2017). The integration of technology for real-time updates, coupled with the incorporation of contingencies in the budget, ensures a proactive approach to managing uncertainties in material prices and labour rates. Clear communication within the project team and systematic documentation of changes further contribute to transparency and accountability. Overall, the commitment to keeping cost estimates current reflects a proactive stance in navigating market uncertainties and mitigating the risk of cost overruns, thereby contributing to the overall success of construction projects.

5.5.9 Staying Within the Project Planned Scope

The strategy of staying within the project planned scope is regarded with high significance during the pre-contract stage of construction projects, as evident from its mean value of 3.7833, a rank of 9, and a strong level of agreement among stakeholders. This strategy highlights the crucial emphasis placed on preventing scope creep, a phenomenon that can lead to unwarranted expansions of project deliverables, subsequently causing budget overruns and delays (Ikechukwu et al., 2017). The high level

of agreement underscores the collective understanding that maintaining a well-defined and clearly documented project scope is foundational for effective project management. To implement this strategy effectively, project teams are advised to invest time in thoroughly defining the project scope, establish robust change management protocols, foster open communication with stakeholders, and integrate risk assessment focused on scope changes (Ikechukwu et al., 2017). By adhering to the planned scope, project stakeholders can mitigate uncertainties, enhance project transparency, and contribute to the overall success of construction projects by ensuring alignment with the agreed-upon project objectives and minimizing the risk of cost overruns.

5.5.10 Effective Communication

Effective communication, although ranking 10th with a mean value of 3.4500 during the pre-contract stage of construction projects, is undeniably recognized as a crucial strategy among stakeholders, as evidenced by the strong level of agreement. This strategy underscores the industry's collective understanding of the pivotal role that clear and timely communication plays in project success. While it may not be the highest priority compared to other strategies, the high level of agreement suggests that stakeholders highly value the importance of communication in minimizing misunderstandings, preventing delays, and proactively addressing challenges. To implement this strategy effectively, project teams are encouraged to establish clear communication protocols, utilize technology tools for efficient information exchange, engage stakeholders in project discussions, and develop conflict resolution mechanisms (Ikechukwu et al., 2017). Despite its ranking, effective communication remains a fundamental aspect of successful project management, fostering transparency, collaboration, and trust among all project participants. As such, its implementation is essential for navigating the complexities of construction projects and contributing to positive project outcomes.

5.5.11 Managing and Completing Design Stage before construction

The strategy of managing and completing the design stage before construction is acknowledged as important during the pre-contract stage of construction projects, with a mean value of 3.3389, a rank of 11, and a generally agreeable consensus. This strategy highlights the industry's understanding of the significance of a well-structured and finalized design phase before commencing construction activities. Although it ranks 11th, the agreement among stakeholders emphasizes the importance of avoiding design changes during construction, which can lead to cost overruns and delays. To implement this strategy effectively, project teams are advised to focus on robust design management practices, ensuring that design activities are thoroughly completed and approved before entering the construction phase (Al-Keim, 2017). By minimizing design changes during construction, project stakeholders can enhance project efficiency, maintain project schedules, and contribute to successful project outcomes. Regular reviews and improvements in design management processes are recommended to ensure the seamless transition from the design to the construction phase, mitigating risks and optimizing project performance (Al-Keim, 2017).

5.5.12 Quality Monitoring

The strategy of quality monitoring, despite ranking 12th with a mean value of 2.6778 during the pre-contract stage of construction projects, is acknowledged as important with a consensus of agreement among stakeholders. Quality monitoring during the pre-contract stage of construction projects is closely related to ensuring that the initial design and planning phases align with established quality standards (Ahady et al., 2017). Although it may not be the top priority, the agreement among stakeholders suggests a shared understanding of the potential consequences of overlooking quality control. To implement this strategy effectively, project teams are encouraged to strengthen quality

monitoring processes, integrating regular checks and inspections into project milestones. By emphasizing adherence to quality standards, construction teams can mitigate the risk of rework, delays, and additional costs. Despite its ranking, the strategy of quality monitoring plays a crucial role in safeguarding the overall success of construction projects by ensuring that the final deliverables meet or exceed the expected standards of quality and durability. Continuous improvement in quality control processes is recommended to align with evolving industry standards and enhance project outcomes.

5.5.13 Use Mainly Local Construction Material

The strategy of using mainly local construction materials, with a mean value of 2.3833, a rank of 13, and a general disagreement among stakeholders, suggests that while it is presented as a strategy, there is a lack of consensus on its importance during the pre-contract stage of construction projects. The disagreement among stakeholders on this strategy indicates that, within the context of the pre-contract stage, potential reasons for this disagreement could include concerns about the availability, cost-effectiveness, or quality of local materials compared to alternative sources.

For example, stakeholders may question whether using local materials is truly more cost-effective when considering factors such as transportation, availability, and quality. Depending on the location and project requirements, certain materials may not be readily available locally, leading to the consideration of alternative sources. Also, concerns about the quality and consistency of local materials might be a significant factor in the disagreement, especially if there are doubts about meeting project standards.

When trying to prevent spending more money than planned before a construction project starts, some people might worry about using only materials from local. This shows

how it is crucial to carefully consider and plan where materials come from. Considerations need to be made regarding factors such as cost, quality, and accessibility of materials, contributing to the formulation of an intelligent cost control plan before the official commencement of the project.

5.6 Correlations between Year of Working Experience and Strategies during Pre-Contract Stage to Mitigate the Risk of Cost Overrun

Insights from the analysis reveal interesting connections between the length of professional experience and strategies used in the pre-contract stage to mitigate the risk of cost overruns in construction projects. The use of suitable project management scheduling tools shows a slight decrease as experience grows. In contrast, there is a strong increase in the tendency for more experienced professionals to stick to the planned scope of the project. The negative correlation with proper planning of project activities before execution suggests that those with more experience may be less likely to plan activities thoroughly beforehand. Moreover, negative correlations with contractor selection, risk assessment during project estimating, and pre-contract cost control hint at a reduced emphasis on these areas with increasing experience. Conversely, positive correlations with effective communication, using local construction materials, updating material prices and labour rates, quality monitoring, and adopting Building Information Modeling (BIM) highlight potential advantages of experience in these specific project management aspects. It is important to remember that correlation does not establish causation, and these findings should be considered within the broader context of construction projects. The only non-significant correlation involves managing and completing the design stage before construction, suggesting that experience may not significantly impact this particular project management aspect. Overall, these results offer valuable insights for

construction professionals and project managers looking to optimize their strategies based on their level of experience.

5.7 Summary of the Chapter

This chapter presents the discussions of the research results. It begins with a general introduction and proceeds to discuss the reliability test conducted. The chapter then explores the relationship between organization types and their involvement in the pre-contract stage. Moving forward, it delves into factors associated with cost overruns during the pre-contract stage in construction building projects. These factors include estimation and planning, experience and skills, external and environmental influences, financial considerations, process and design, and other miscellaneous factors. Additionally, the chapter examines strategies utilized during the pre-contract stage to minimize the risk of cost overruns. Lastly, the chapter explores correlations between years of working experience and the strategies employed during the pre-contract stage to mitigate the risk of cost overrun. These findings contribute to a comprehensive understanding of the factors and strategies in construction project management, paving the way for meaningful discussions and insights.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Summary of Study

The research aims to provide valuable insights and practical strategies for stakeholders involved in construction building projects to minimize the risk of cost overrun during the pre-contract stage. The objectives include identifying cost overrun factors related to the pre-contract stage, evaluating their impact, and assessing strategies during pre-contract stage to mitigate the risk. A total of 180 responses were collected from 3,541 distributed questionnaires, representing a 5.1% response rate.

The reliability test showed satisfactory results for both factors related to cost overrun and strategies, ensuring the credibility of the collected data. Demographic data revealed the diverse participation of contractors, developers, and quantity surveyors, with varying years of experience and project involvement.

The Chi-square test indicated a significant association between organization type and pre-contract involvement. Factors causing cost overrun during the pre-contract stage were explored, with inflation, inaccurate estimation, and wrong planning and scheduling identified as the most related. Inferential tests, including the Kruskal-Wallis test, revealed significant variations in the distribution of these factors across different organization types.

Strategies to minimize cost overruns were analyzed, with the selection of contractors, pre-contract cost control, proper project planning, and risk assessment being highly agreed upon. Spearman's correlation and Kruskal-Wallis tests further explored the correlation between the number of years of professional experience and the agreement level on strategies. While most strategies exhibited significant variations, the use of

effective resource management systems showed no statistically significant difference across organization types.

In conclusion, the study contributes valuable insights into the factors contributing to cost overruns and effective strategies during the pre-contract stage. The findings emphasize the importance of considering organizational differences in implementing strategies, providing a foundation for informed decision-making in construction project management.

6.1.1 Objective 1: To identify the factors during pre-contract stage that impacted cost overrun of construction building project.

Objective 1, aimed at identifying factors related to the pre-contract stage impacted cost overrun in construction building projects, was accomplished through a meticulous research design and data analysis approach. The study involved the distribution of 3,541 questionnaires to registered firms in Selangor, resulting in a 5.1% response rate with 180 firms participating. Rigorous data analysis techniques were employed, including reliability tests to ensure consistency in responses, Chi-square tests to examine the association between organization type and pre-contract involvement, and descriptive statistics such as mean scores and ranks to summarize the factors contributing to cost overruns in the pre-contract stage. The Kruskal-Wallis test was utilized for inferential analysis, revealing significant variations in the distribution of cost overrun factors across different organization types. Findings were presented systematically, detailing factors like inflation, inaccurate estimation, wrong planning, and insufficient contractor experience. The study's success in achieving Objective 1 provides valuable insights into the specific challenges contributing to cost overruns during the pre-contract stage, with implications discussed in the context of different organization types.

6.1.2 Objective 2: To evaluate the impact of the factors during pre-contract stage that impacted cost overrun in construction building project.

Objective 2, focusing on the evaluation of the impact of factors related to the pre-contract stage impacted cost overrun in construction building projects, was successfully achieved through a comprehensive analysis of collected data. The study employed various statistical methods, including descriptive tests, inferential tests such as the Kruskal-Wallis test. Descriptive statistics, represented through mean scores and ranks, provided a clear understanding of the perceived impact of different cost overrun factors during the pre-contract stage. The Kruskal-Wallis test, which compared the impact of these factors across different organization types, yielded valuable insights into variations in their significance. The findings highlighted factors like inflation, inaccurate estimation, and insufficient contractor experience, emphasizing their substantial impact on cost overruns. Through systematic presentation and interpretation of results, Objective 2 was successfully accomplished, providing a nuanced understanding of the varying impacts of identified cost overrun factors across diverse organizational contexts.

6.1.3 Objective 3: To assess the impact of the strategies during the pre-contract stage to minimize the risk of cost overrun in construction building projects.

Objective 3, which aimed to assess the impact of strategies implemented during the pre-contract stage to minimize the risk of cost overrun in construction building projects, was effectively accomplished through rigorous analysis and interpretation of the gathered data. The study employed a combination of descriptive and inferential statistical techniques to evaluate the perceived effectiveness of various strategies. Descriptive tests, including mean scores and ranking, offered a comprehensive overview of the agreement levels on different strategies. The Kruskal-Wallis test, assessing the impact of these strategies across diverse organization types, provided valuable insights into variations in

their effectiveness. Additionally, correlation analyses, particularly Spearman's correlation, examined the relationship between respondents' years of professional experience and their agreement levels on specific strategies. The findings shed light on strategies such as the selection of contractors, pre-contract cost control, and proper project planning, which were deemed highly effective in minimizing the risk of cost overruns during the pre-contract stage. Overall, through systematic analysis and interpretation of results, Objective 3 was successfully achieved, contributing to a nuanced understanding of the varying impacts of strategies in mitigating cost overruns across different organizational contexts.

6.2 Contribution of Study

The study makes a big contribution to how to manage construction projects. First, it helps to understand the problems that can make projects cost more than expected before they even start (Objective 1). By looking at different factors, the study talks more about the challenges in the early stages of projects.

Second, it looks at how these problems affect projects (Objective 2). It does not just say what the problems are; it also tells how much they matter. This helps people who make decisions on projects know where to focus to stop costs from going up.

Third, the study looks at how well different strategies work to stop costs from going up in the early stages of a project (Objective 3). It does not just mention what strategies are good; it looks at how well they work for different types of organizations. This is important because every project is different, and one size does not fit all.

The way the study was done, using surveys and tests, shows how can study these things in the future. The study looked at a lot of information about the people involved in projects, which helps to see how things change in different situations.

In summary, the study not only addresses problems and solutions but also provides a valuable approach for researching these aspects. This benefits everyone involved in projects, particularly construction stakeholders, by offering improved methods for decision-making and project analysis.

6.3 Limitation of Study

The study encompasses certain limitations that warrant consideration in the interpretation and application of its findings. Firstly, the study only looked at construction projects in Selangor, Malaysia. This means that the findings might not apply to projects in other places. Secondly, the people who answered the survey came from developer, G7 contractor, and QS consultant firms. This could limit the viewpoints represented, as other people involved in projects, like subcontractors or regulators, might see things differently. Lastly, the study had to work within a specific timeframe, which affected how much data could be collected and analyzed. These points mean that it should be careful when applying the study's results more broadly, and there is room for future research to explore these topics in more detail.

6.4 Recommendation for Future Research

For future research, consideration should be given to examining additional geographical locations beyond Selangor, Malaysia, in order to obtain a broader perspective on how construction projects address cost overruns. Furthermore, the inclusion of a more diverse range of participants, such as subcontractors and local

communities, could enhance the comprehensive understanding of challenges and potential solutions. Given the dynamic nature of the construction field, future research endeavors could investigate how emerging technologies and innovative approaches contribute to the prevention of cost overruns. Exploration of topics such as Building Information Modeling (BIM), advanced project tools, and sustainable building practices may offer valuable insights into evolving strategies within the construction industry.

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