

**An Investigation of Risk Factors Impacting on Government Infrastructure
Projects' Schedules in Lesotho**

By

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DECLARATION

This dissertation is submitted to the Central University of Technology for the award of MPhil Research. This work or any part thereof has not been partially or fully submitted to any other university. The content of the dissertation is the result of my efforts, and the ideas taken from other people are identified by reference.

Signature

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DEDICATION

I dedicate this work to God Almighty for His protection, guidance and knowledge He gave me when carrying out this study. I also dedicate it to my caring husband, daughters (Eugenia, Bernice and Gertrude) and my family for their support through difficult times spent on my studies.

ABSTRACT

In the pursuit of infrastructural development, Lesotho has made substantial investments, with a particular emphasis on road construction. However, to optimise the returns on these investments, it is imperative to mitigate the prevalent issue of schedule overruns in infrastructure projects. This study is primarily aimed at scrutinising the risk factors that exert influence on the schedules of infrastructure projects and at proposing efficacious strategies and control measures to alleviate the detrimental effects of these risks.

The research methodology employed in this study is a mixed-method design, specifically an explanatory sequential design. The data collection process was multifaceted, encompassing questionnaires that collected the viewpoints of seventy-five respondents, semi-structured interviews, and an exhaustive review of relevant literature. On the other hand, the viewpoints about risk mitigation strategies were collected from five interviewees comprising quantity surveyors, project manager, an architect and structural engineer. The analysis of the quantitative data was conducted using regression with mediation, while the qualitative data derived from the interviews was subjected to thematic analysis. To ensure the reliability and validity of the quantitative data, several measures were taken, including the application of Cronbach's Alpha and Confirmatory factor analysis for construct validity.

The results derived from the quantitative data analysis revealed that certain factors, such as financial considerations, design aspects, ownership issues, and government-related risks, do not have a significant direct impact on the schedules of government infrastructure projects. However, insights gleaned from the literature review suggested that the successful completion of these projects could be facilitated through the deployment of skilled construction professionals, the implementation of effective planning and scheduling strategies, and the formation of knowledgeable project teams, among other factors. In conclusion, the study puts forth several risk mitigation strategies and practices, which were informed by the insights provided by experienced construction professionals. These strategies include joint risk assessment, the use of insurance premiums, leveraging the experience of contractors, and promoting effective communication among all stakeholders.

KEY WORDS: Risk factors, government infrastructure projects, schedule overrun, project schedule

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LIST OF ACRONYMS AND ABBREVIATIONS

CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CPM	Critical Path Method
CTB	Central Tender Board
DF	Design Risk Factors
FF	Finance Risk Factors
GDP	Gross Domestic Product
GF	Government Risk Factors
IPS	Infrastructure Projects Schedules
NSDP II	National Strategic Development Plan II
OF	Owners Risk Factors
PERT	Project Evaluation and Review Technique
PS	Project Scheduling
RMSEA	Root Mean Square of Approximation
SACU	Southern African Customs Union
SDGs	Sustainable Development Goals
SRS	Simple Random Sampling
TLI	Tucker-Lewis Index
TOC	Theory of Constraints
WBS	Work Breakdown Structure

CHAPTER 1: STUDY ORIENTATION

1.1 INTRODUCTION

The construction of infrastructure projects is significant for the financial development of a country (Girardi et al., 2018) as infrastructure has a direct effect on investment, on effectiveness of production sectors, and on social development. For instance, transport infrastructure plays a major role in connecting production places and markets, facilitating trade with other countries, as well as attracting foreign investment.

Nonetheless, the phenomenon of schedule and cost overrun in infrastructure projects is a global concern which affects the construction industry as a whole. Due to involvement of several stakeholders and technological advancements, construction projects experience a lot of risks such as scope and design changes, unavailability of funds, weather and climatic conditions and many more (Iqbal et al., 2015). These risks impede the success of a project in terms of cost, time and quality, hence implementation of effective risk management techniques to manage these risks is essential for successful delivery of a project.

Notwithstanding some enhancements in the last decade, Lesotho infrastructure (transportation and electricity) remains the most underdeveloped in the Southern African Customs Union (SACU) region. This country's infrastructure has declined and its contribution to Gross Domestic Product (GDP) has dropped since 2014, from 14.4% to 12.9% in 2016 (Nseera, 2018) because of the long overdue construction projects. The government is dealing with a huge public investment of many public projects and among these are infrastructure projects which go beyond their planned duration, consequently forestalling the creation of monetary space for new projects. Some infrastructure projects that were planned to take two years end up taking six years thus disappointing the public which was promised those development projects as some of them never materialise (Motsoeli, 2020). Just like other countries worldwide, infrastructure projects in Lesotho are experiencing a number of risks due to their nature and complexity which results in projects failing to be completed within the planned cost and duration. Therefore, it is

important to investigate specific potential risks which result in cost overrun and delay in infrastructure projects in Lesotho.

For these reasons it is crucial for project stakeholders to carry out risk management process through proper risk identification, risk assessment, risk response and risk monitoring, as risk management has a positive impact on projects being completed within their contracted duration and planned budget (Mtshali, 2018). Lesotho, through the National Strategic Development Plan II (NSDP II) goals 2018/19-2022/23, aims at construction of roads, improvement of communication, water supply and energy throughout the country. As a result, provision of infrastructure to the private sector promotes sustainable economic growth and private sector-led job creation (Letooane, 2018). The findings of this study will help project planners and managers in the study area to successfully implement infrastructure projects. Through this study, Lesotho could achieve its NSDP II goals of employment creation, combating poverty and inequality and affordable and clean energy through building enabling infrastructures. The following Sustainable Development Goals (SDGs) will be achieved through successful building of infrastructure within their planned schedule: SDG 1; No Poverty, SDG 8; Decent work and economic growth.

1.2 BACKGROUND

Construction development is a good contributor to the economies of many countries and has a great impact on the society as it offers significant job opportunities for many people thus decreasing unemployment. Renault et al. (2016) support this by stating that the outcome of construction projects in a country is infrastructure development and creation of jobs. Due to the project complexity and uncertainty in the construction industry, this sector experiences many risks such as technical, political and commercial which prevent the success of this industry in developing countries (Alhassan, 2016).

In Lesotho, infrastructure development, and roads transport specifically, is capable of enhancing the connection of supply chain networks to production centres. Nseera (2018) indicates that among all the Lesotho sectors, the construction sector has experienced decline in the contribution of the Gross Domestic Product. It is over a decade that Lesotho

construction projects have been performing poorly and are failing to achieve the intended results due to the risks that these projects face. As result, Lesotho's insufficient infrastructure has greatly affected the nation's economy as the country fails to address the challenges faced by this sector hence failure to complete of many projects. Contemporary risk management practices in the construction sectors are found to be lacking to address all these risks (Nketekete, 2016).

1.3 PROBLEM STATEMENT

Infrastructure projects play a vital role in society by improving its economic needs and also changing their quality of life (Onyango et al., 2017). However, many infrastructure projects worldwide are plagued with numerous risks such as frequent design changes, incompetent subcontractors, inadequate planning and scheduling and many more due to uncertainties (Ismail, 2014). These result in schedule and cost overrun (Kudumela, 2015) thus failing to achieve project objectives.

Infrastructure projects in Lesotho fail to be completed within their scheduled duration due to construction risks that occur during projects implementation, because these projects are characterized by high risks and uncertainty (Nketekete, 2016). A total of 19 government projects, some dating back from 2011 have been stagnant while others showed little progress (Senoko, 2020). The unfinished projects have been expensive since the government has paid out M2, 8 billion, which is more than what they were budgeted for, as they have taken longer than expected (Motsoeli, 2020). For instance, the Lesotho Royal Palace which was planned to be completed in three years at a cost of M160 million, took more than eight years and exceeded the budget to M450 million (Ramolibeli, 2018).

Therefore, the purpose of this study is to investigate risk factors impacting on government infrastructure projects' schedules so that relevant risk management strategies can be employed to reduce these risks and achieve the planned schedules and budgeted costs.

1.4 RESEARCH AIM AND OBJECTIVES

1.4.1 Aim

The main aim of this study is to investigate risk factors impacting on government infrastructure projects' schedules and propose key strategies and control measures that could be employed to alleviate unfavourable impacts of these risks, and to provide policy makers with relevant information that will guide them to avoid late completion of projects hence cost overruns.

1.4.2 Objectives

The objectives of this study are as follows:

- To identify the risk factors impacting on government infrastructure projects' schedules.
- To determine the prevalence of different risk factor categories on government infrastructure projects in Lesotho.
- To recommend various risk mitigation strategies and practices that could be used by stakeholders to reduce the adverse effects of the identified risk factors.

1.5 LIMITATIONS OF THE STUDY

The study aimed to collect data from various construction professionals such as consultants and contractors, and the researcher was keen to get appropriate and experienced professionals to collect the targeted data. However, the survey collected views of a limited number of consultants and contractors, as most of the construction companies closed down due to COVID-19. During the researcher's visits for data collection, certain companies were not in operation due to suspension of projects. Some consulting and contractors' companies were hit by several lockdowns in 2021 resulting from the COVID-19 pandemic. As a result, resuming work was a critical challenge for these professionals. Also, prices of construction material escalated so much that other companies were compelled to shut down. Consequently, to gain access to the expected construction professionals was a challenge.

1.6 SUMMARY

Chapter one discussed the purpose of this research by showing that infrastructure projects in the study area fail to be completed within their schedules. Therefore, there is a need to identify the risk factors that hinder successful implementation of these projects, and recommend relevant risk mitigations in order to save the government's funds overspend on delayed projects. The chapter also presented the aim and objectives of the study.

1.7 CHAPTER LAYOUT

Table 1.1: Chapter layout

Chapter 1	Chapter one presents the introduction to the research. It introduces the whole research by discussing the problem statement, aims and objectives of the study, as well as its purpose of the study.
Chapter 2	This chapter reviews prior relevant literature on the phenomenon under investigation. The chapter presented the theoretical work underpinning the study, conceptual framework and research hypothesis. It further discusses in detail the previous studies on risk factors impacting on infrastructure projects' schedules, the prevalence of risk factors on government infrastructure projects, scheduling strategies and risk mitigations.
Chapter 3	Chapter three presents the methodology used for investigating the research problem. This includes the discussion of the philosophy underpinning this study. The chapter further discusses the choice of research methods, sampling techniques including the justifications for various choices made by the researcher. This research was undertaken based on the explanatory sequential method where quantitative data was collected in the first phase, and qualitative data in the second phase. Data collection

	instruments for both phases are also explained as well as data analysis methods.
Chapter 4	This chapter presents and analyses the findings of the study. It also links the findings to the literature review to find out how similar and different the study is to previous studies.
Chapter 5	Lastly, chapter five presents the conclusion of the research, summarizing the main findings of the study, together with the recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents the theoretical framework guiding the study, research hypothesis, as well as conceptual framework. It also discusses a review of the literature related to the problem being investigated. It is categorised according to the specific objectives of the study to ensure relevance to the whole research which is on the identification and assessment of risk factors impacting on infrastructure projects' schedules overrun, the prevalence of risk factor categories on government infrastructure projects, as well as the responses and practices used to manage the identified risks.

2.2 THEORETICAL FRAMEWORK

This section discusses the theoretical lens that underpin this study. It tries to show how the theory fits into the research topic and provides justification for its adoption. The study uses The Theory of Constraints to identify various project risks found in infrastructure projects in Lesotho. Like other public construction projects, the Lesotho infrastructure projects experience several risks that hinder the successful completion of these projects, as a result, this theory shows the necessary steps to undertake in improving these projects.

This study is guided by The Theory of Constraints (TOC) developed by Elihayu Goldratt in the 1980s, who states that every system must have at least one constraint restricting it from achieving its best performance. If these constraints are not addressed, the system will fail to achieve its goals (Landau, 2018). In Goldratt's view, a constraint is anything that prevents the system, organisation or business to accomplish its goals, (Pannizolo, 2016). Constraints can either be internal or external to the system. Internal constraints are usually inside the system and easy to deal with, while external constraints are outside and not easy to control but their effects can be reduced. Mishra (2020) further indicates that these constraints are the most prohibiting factors that restrict the overall performance of organisations. It is further pointed out that the five basis steps of TOC to remove

constraints are: identifying the constraint, exploiting the constraint, subordinating to exploitation, elevating the system performance and repeating the process.

The Theory of Constraints recognises that there are constraints within the construction industry called risk factors which impact on projects' schedules, cost and quality. These projects' goals can be affected by risk factors such as design, finance and many more. The success of projects lies on the capability of the project team to identify and manage these risks.

2.3 RESEARCH HYPOTHESES

H₁ Financial risk factors have significant impact on infrastructure projects' schedules in Lesotho.

H₂ Design risk factors affect government infrastructure projects' schedules in the aforementioned study area.

H₃ Owner risk factors have significant impact on infrastructure projects' schedule performance in Lesotho.

H₄ Government risk factors have a significant impact on projects' schedules in Lesotho.

2.4 CONCEPTUAL FRAMEWORK

Figure 1 below demonstrates a visual illustration of the risk factors that affect infrastructure projects' schedules. As presented, the three categories: finance, design, and owner risk factors form the basis for the identification of risk factors impacting on the abovementioned projects' completion date, with government risk factors as a mediating variable. After the review of the study results, the conceptual framework was developed to show the relationship between the independent variables and the dependent variable. These three risk categories in the framework represent the independent variables, while infrastructure projects' schedules are the dependent variable. The relationships are shown by the arrows drawn from each category towards the projects' schedules which indicate a direct and indirect impact. Finance, design and owner risk factors are hypothesized to have an impact on infrastructure projects' schedules. This figure attempts to represent the potential impact of the independent variables (IVs) both directly and indirectly on infrastructure projects' schedules (IPS).

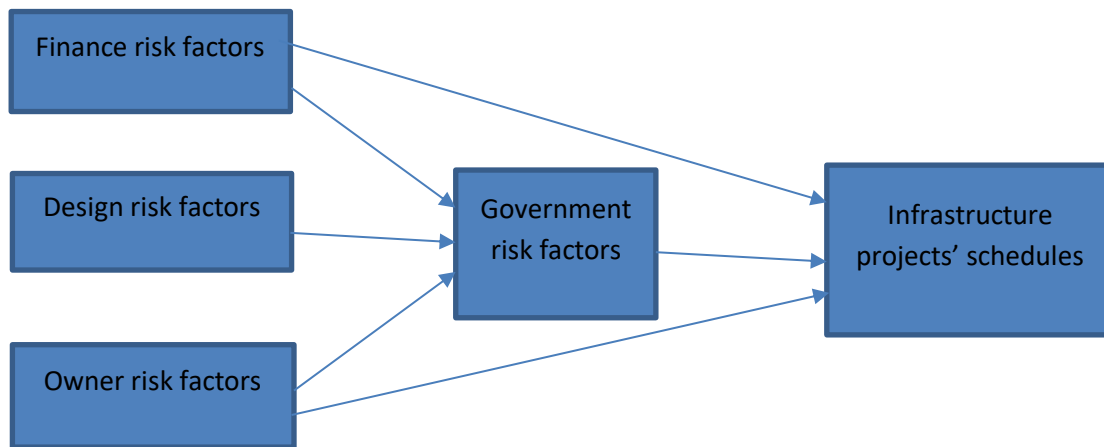


Figure 2.1: Conceptual Framework

2.5 DEFINITION OF RISK

There are several ways in which different authors define the term risk in project management, however these definitions are similar in the aspect of uncertainty and unexpected event. Risk is an unexpected event that is associated with project work and has a positive or negative impact on the project objectives such as scope, schedule, cost or quality (Larson and Gray, 2018). This indicates that risk is a probability that project activities will not occur as planned or that unplanned events will occur that could have either a positive or negative impact on the project.

2.6 INFRASTRUCTURE PROJECTS' RISKS

Large infrastructure projects suffer from significant under management of risks throughout the life cycle of the project. The development of these projects is one of the most important activities in different countries as it improves the business sector. However, the success of these projects is challenging due to uncertain events that are experienced either internally or externally (Khodeir and Nawaby, 2019). Igbal et al. (2015) have defined risk in relation to infrastructure projects as a variable in the life cycle of a project whose variation results in uncertainty on the duration, cost or quality of the project. Due to the complexity of these projects, a number of risks are experienced and these also change from one project to another (Junior, 2017).

2.7 PROJECT RISK MANAGEMENT IN INFRASTRUCTURE PROJECTS

Project risk management is the identification, analysis, assessment, managing and avoidance, elimination or reduction of unacceptable risks. It is further defined as a process of taking actions against uncertainties (Aminu, 2013). According to Larson and Gray (2018), project risk management is concerned with identification of risk events, reducing their effects and providing contingency funds over those risks. Watt (2016) indicates that risk management leads to successful delivery of projects in that it is able to recognise and manage project risks that may occur during project execution.

In the context of construction projects, Madushanka and Tulakasiri (2020) define project risk management as the process of identifying, analysing and responding to risks so as to accomplish project objectives. Due to the complex nature of infrastructure projects, it is difficult for project managers to understand and respond on time to the risks that might occur (Boateng et al, 2020). For this reason, Serpella et al. (2014) explore the idea that it is important to employ risk management so as to reduce the likelihood of unsatisfactory consequences to infrastructure projects at different phases.

The construction industry is seriously facing high levels of risks especially in developing countries compared to the developed countries (Elijah, 2017). This is due to lack of formal project risk management strategies which are not widely adopted. As a result, these projects experience time and cost overrun (Kudumela, 2015). Studies reveal that the major reason for not employing risk management in the construction industry is due to inadequate knowledge of risk management framework. It is crucial to apply this framework in the initial stage of the project because awareness of the origin of the risk will help stakeholders to deal with them effectively (Sharma and Gupta, 2019).

For infrastructure projects to be implemented successfully, risks should be identified, assessed and responded to and based on the knowledge available at that stage (Alsaadi and Norhayatizakuan, 2021). Musta (2018) is of the same opinion with Alsaadi and Norhayatizakuan that risk management is a significant aspect of effective project control within the construction industry. Therefore, the three phases of risk management to be carried out in infrastructure projects are risk identification, risk assessment and risk

monitoring and control. As a result, Kang et al. (2015) stipulate that many construction companies should implement risk management in their projects in order to increase productivity as well as to improve the overall performance.

Alsaadi and Norhayatizakuan (2021) investigated the impact of project risk management practices on the performance of construction projects in Oman. The results demonstrated that adopting these practices improves the performance of those projects. They further show that this becomes successful if qualified project managers who have adequate knowledge in risk management activities are hired. In the same context, Kang et al. (2015) conducted a study about the practice of risk management in the Malaysian construction industry. However, the findings of the study reveal that risk management is not effectively implemented as a project management function, as a result that hampers project performance. This is due to the fact that response to project risks is in the form of contingency rather than a comprehensive identification and analysis of risks. Larson and Gray (2018) oppose this practice and state that risk management is a proactive rather than reactive approach. It is a process used to reduce unexpected events on time in order to achieve project objectives.

The results of the study conducted by Dosumu (2018) in Nigeria also indicate that the construction stakeholders are aware of risk management techniques, but the problem lies at the stage at which risk management should be implemented. The correct risk management process is as follows: risk identification, risk analysis, risk response and risk control. However, with projects participants in Nigeria, the process is thus: risk response, risk assessment and risk identification respectively. Therefore, the study revealed that the most important stage, which is risk identification, is neglected, and the focus is greatly on risk response and assessment. As a result, it is difficult to achieve project objectives without proper implementation of risk management.

Research shows that proper implementation of risk management accounts for project success. For instance, in Finland, Rahman et al. (2018) indicate that the Rantatunneli project which was faced with many high risks due to its complexity was successfully completed six months before its scheduled date, and the actual outturn cost was less than the initial estimations. With the use of risk management process, the project team

identified potential risks before project execution and planned for the mitigation strategies to be employed. It is further stated that with the involvement of different stakeholders during identification of risks, several opinions such as identifying method of risk, risk mitigations, risk responsibilities and ownership were solicited.

2.8 RISK IDENTIFICATION TOOLS AND TECHNIQUES

The first step in the project risk management process is risk identification, which involves the identification of the major potential sources of risks associated with the project objectives. Renault et al. (2016) assert that effectiveness of risk identification depends on the availability of the important project documents such as the Project Charter, scope statement, project management plan and the Work Breakdown Structure (WBS), which help to generate a large number of potential risks. Furthermore, they indicate that in this step, sources, features, causes and effects of risks on projects are established.

A risk cannot be managed unless it is identified. Therefore, risk identification is the major step in the risk management process as it identifies the source and type of risk. In that case, risk identification should be performed as early as possible because uncertainty is high in the beginning of the project, and responses taken early are cheaper than the late ones (Larson and Gray, 2018). Risk identification can be described in relation to the sources of risk which are variables that can yield a positive or negative outcome. Madushanka and Tilakasiri (2020) state that proper risk identification is essential and needs to be performed so that projects can be completed within their duration, with expected quality as well as within the estimated cost.

As infrastructure projects are full of complexity and uncertainty, it is essential that identification of risks is performed throughout the project life-cycle so as to come up with new risks that were not identifiable in the initial stage (Sharma and Gupta, 2019.) This step is helpful to project managers since they will identify the areas where projects are exposed to risk (Hayford and Ahmed, 2013). According to Dosumu (2018), risk identification entails identification and application of procedures to be used to identify opportunities and losses of risks. Furthermore, these procedures entail how and why risks

arise in a project. Therefore, it is indicated that risks with high likelihood and impact should be prevented before they occur.

There are different risk identification tools and techniques that are used to capture potential risk factors affecting infrastructure projects. These include brainstorming, workshops interview, checklist analysis, Delphi technique, risk register and others (Kang et al, 2015). Sharma and Gupta (2019) studied risk identification and management in construction projects and they used literature review to gather data. Their study identified risk identification techniques used in construction projects. The study shows that the most commonly used techniques are questionnaire survey, literature review, brainstorming and Delphi technique.

2.8.1 Brainstorming

Brainstorming is a favoured technique which is used to generate ideas used for risk identification (Tharanga,2020). According to Ootobo (2016), brainstorming involves bringing together the project team as well as set of experts to generate potential risks that might affect the project. Sources of overall project risks are also identified. In order to achieve effectiveness of this technique, these experts must be experienced in risk management. This technique is regarded as a well-organised technique because it involves open discussion by project teams and other project participants. Its purpose is to generate a large quantity of risks that might affect the project (Renault et al. 2016).

Tadayon et al. (2012) indicate that in brainstorming sessions, project stakeholders come together to identify and prioritise risks in a project. This technique is essential for projects which involve new or unusual risks. For this reason, it is suitable for construction projects due to their complexity. This is supported by Petrovic (2017) in a study carried out in Sweden which aimed to explore and evaluate the practical adoption of risk management. The results revealed that the usage of brainstorming was common in Sweden construction companies where meetings are arranged and attended by project teams, site managers, supervisors, construction managers and project managers. The aim of these meetings is to identify and discuss risks that might affect their projects, and also to share experiences from the previous projects. Larson and Gray (2018) emphasise the

importance of involving different stakeholders in the process of risk identification process and indicate that the involvement of other stakeholders in this process instil the spirit of commitment in the project success. This idea of Larson and Gray was shared among the construction stakeholders in Sweden.

Madushanka and Tilakasiri (2020) conducted a study which aimed to identify significant risks impacting on the Sri Lankan construction industry and to evaluate the practical responses employed by local contractors to manage those risks. The study used mixed-method of questionnaires and interviews to investigate the risks and the trend of risk management implementation. It was found out that the most common risk identification tool used by the local contractors was brainstorming which highly depends on the subjective experiences of the people involved.

2.8.2 The Delphi Technique

According to Youssef (2017), Delphi technique is a risk identification method which employs subjective discussion in order to get objective findings. In this technique, the risk manager gives the project team questionnaires to fill. The responses are discussed and altered until a consensus is reached by all members. Using this method is beneficial because everyone's input is considered, and no members are allowed to dominate the discussion. However, the repeated rounds may be time-consuming.

The Delphi technique is also used in the risk identification process where a group of qualified experts are consulted and asked to identify risks, and provide their estimates in relation to the risks' impact and probability (Sourani and Sohail, 2014). The advantage of this technique is that anonymity of experts provides them with freedom to express their opinions (Otobo, 2016). Kiral et al. (2014) conducted a study whose main objective was to assess the appropriateness of Delphi technique in the identification of construction risks. From their findings through literature review, it is concluded that the Delphi method is an appropriate tool specifically in the identification of financial risks in infrastructure projects. This is due to the fact that these projects are characterised by complexity as there are a number of parties involved. As a result, gathering different ideas from financial experts is easy with the use of the Delphi technique. For this reason, using this technique

saves both time and money, and employing the Delphi technique is appropriate for construction projects which are prone to high political risks with complex financial structures (Alaloul et al. 2015).

Delphi technique is helpful in soliciting judgements from different experienced experts on complex matters where the precise information is lacking. Furthermore, the benefit of using this method is that it is suitable where no or very limited data is available (Rahman et al, 2018). Rahman et al (2018) used this method in his study undertaken in Iraq to assess various causes of time and cost overrun throughout the construction life cycle. In this study, data was successfully collected using the Delphi method in two rounds with selected respondents who were managing construction projects. In this study, it was concluded that Delphi studies provide rich data because of their multiple iterations and their response revision due to feedback. However, according to Rostami (2016) in a study in United Kingdom construction projects, group-based techniques like brainstorming and Delphi techniques are the least practised due to inadequate level of knowledge and resources.

2.8.3 Checklist Analysis

Risk checklist is a risk management identification tool that is used in the early stages of the risk identification process to learn from past projects and past team members. These checklists are developed based on the experience from the past projects. In this process, the project team and experts in the industry evaluate the likelihood that potential risks might occur in the project (Watt, 2016).

The construction industry experiences more risks than other industries due to its distinctive features which include complexity and uncertainty, as well as complicated project activities (Dosumu, 2018). If these risks are not well identified on time, they result in cost and time overrun, as well as poor project quality. Petrovic (2017) undertook a study in Sweden to explore and evaluate project risk management within the Swedish construction industry. Among the different risk identification techniques, the most commonly used technique is checklist. The findings show that responsible teams make regular visits to the construction sites so as to identify new risks and document them on

the checklist. The site visits are described as proactive rather than reactive as risks are identified early enough before they harm the project.

Risk identification plays a major role in managing risks successfully, and failure to identify construction risks affects the achievement of organisational objectives. Checklist analysis is another technique used to identify and assess project risks. Construction companies usually benefit from risk checklists and risk breakdown structures for identification of risks as the checklist of the risks found in the previous projects and the control measures against those risks provides a starting point in the identification of risks (Masengesho et al. 2021). In this process, a list of potential risks that might affect the project during implementation is created. The project manager and the project management team are responsible for the checklist in order to eliminate the risks with the lowest impact. Normally the final checklist includes a response plan that might be used during the development (Musta, 2018). Rostami (2016) studied and identified tools and techniques used within Small and Medium Enterprises (SMEs) in the UK construction projects. A questionnaire survey was designed for this study where the results showed that these SMEs face challenges in undertaking risk identification. The results further reveal that the most common techniques used among the 453 organisations are documentation review, expert judgement, checklist analysis and information gathering.

2.8.4 Interviewing / Expert Opinion

According to Watt (2016), expert opinion as a risk identification technique is whereby experts who have done a similar work before, are brought together to get their opinion about possible risks in a project. Renault et al. (2016) state that individual project risks and their sources are identified by interviewing experts or experienced project participants. This is done to avoid solving similar problems repeatedly. Otobo (2016) suggests that interviews can best be employed as a follow-up to brainstorming and the Delphi technique. In this technique, experts with relevant knowledge on certain risk issues are interviewed to evaluate risk parameters and identify appropriate mitigation strategies. Youssef (2017) asserts that respondents in an interview answer prepared questions which is followed by discussions. Normally questions are presented either structured or unstructured, and the latter provides the respondents with ample choice to answer as

they choose. The responsibility to develop questions and conduct the interviews lies with the project or risk manager who in most cases must be knowledgeable and experienced in this process.

2.9 IDENTIFICATION OF RISK FACTORS IN INFRASTRUCTURE PROJECTS

For infrastructure projects to be successful mainly in being completed within their schedule and on budgeted cost, all stakeholders in the projects need to clearly understand risk so that they would employ a risk management process which begins with identification of risks. This section discusses the identification and assessment of risk factors impacting on construction projects' schedules in different countries.

2.9.1 Financial risks impacting on project schedule performance

Financial risks impacting on project schedule performance internationally

In order for infrastructure projects to be successful and achieve the planned objectives in terms of time, schedule and quality, there must be financial stability from the client as well as the contractor. Owners are the crucial stakeholders in the success of construction projects as they fund these projects until they are completed within cost and schedule (Chigangacha, 2016). The factors responsible for schedule overrun in construction projects differ according to the regions where projects are carried out as well as the different rules and regulations of countries (Esperance and Sung-Hoon, 2019).

Several risks have a direct impact on the projects' schedule due to their high frequency. In Malaysian construction, (Cheng and Abdul-Rahman et al. 2013) state that financial risks are identified as major risks which largely impact negatively on the duration of projects. These financial risks are a result of frequent late payments, cash flow problems, inflation and others. Due to the interdependence of risks, financial risks also trigger the occurrence of other risks thus preventing projects' completion within their planned duration. Therefore, different risk responses should be employed to manage these risks effectively

Financial risk factors prohibit construction projects to be completed within the planned schedule. In a study conducted in Qatar by Yousef (2017), the top four overall critical risk

factors identified under all the seven categories were sanctions, departure of key staff during the project, financial failure of the owner and delayed payments to the contractor. Furthermore, ten financial risk factors that delay completion of construction projects in Qatar were also identified and ranked in order of severity on projects schedules. It was found that delayed payments force contractors to frequently stop construction activities until payment is made by the owner, and this causes delay in completion of the projects. This is supported by a study conducted by Ramachandra (2013) on payment problems in the New Zealand construction industries. The study results confirmed that payment problems are still common in that country. The study further revealed that the main causes of this problem were cash flow difficulties which result from delays and non-payments experienced in projects. As a result, these have considerable impact in terms of schedule, cost and quality.

Hosaimi and Singla (2019) in their research identified significant risk factors that cause delays in construction projects in Afghanistan. The top four risks listed were inefficient planning and scheduling of a project by a contractor, delay in progress payments by client, poor site management and supervision of contractors by client and financial difficulties. It is stated that the lengthy procedure of payments by the Ministry of Finance causes delay during the project execution, therefore the contractors stop some work as they are not paid on time. Adnan (2017) added that these financial issues caused by prolonged payments do not only delay projects, but also lead to total abandonment, late delivery of one to three years, as well as increased project costs.

Construction works entail high daily expenses due to the nature of work, and this cannot be met by the contractors if clients delay progress payments. This kind of work is largely affected by late payments since they require huge funds (Dziadosz et al. 2015). Mahamid (2013) identified and assessed common risks affecting time overrun in road construction projects in Palestine. A quantitative approach, using questionnaire survey, was employed to evaluate 45 risk factors in terms of severity and frequency. The results of the study showed that financial group was a key category that causes projects to be completed beyond their contracted duration. The main factors in this group are financial status of the contractors and payment delays by the owner. According to this study findings, project

bids are awarded to the lowest bidders who in most cases are not financially capable and lack resources, consequently leading to poor performance and schedule overrun.

Kazaz et al. (2012) in their research on investigating the causes of time extensions in the Turkish construction industry, found that critical factors that affect projects' duration are design and material changes, delayed payments, cash flow problems, contractor's financial problems and poor labour productivity. These top five risk factors are dominated by financial problems. Cash flow problems of an owner is a serious threat to the success of construction projects since they cause late monthly progress payments to the main contractor which directly affects the contractor's financial strengths. However, in the case of Kuwait, cost estimation accuracy under finance category was ranked as the critical risk that threatens construction projects schedule, (Altoryman, 2014).

Madushanka and Tilakasiri (2021) stated that the construction stage of projects experiences the highest number of risks in Sri Lankan projects life cycle. Moreover, the study results indicate that financial risks are frequent in these projects due to regular late payments by the client which affect performance of contractors. These risks have a great impact on project time, cost and quality. This is supported by Al-Emad et al. (2017) whose research findings show that the contractor's difficulties in financing the project are critical factors that delay construction projects in Makkah's construction industry in Malaysia. Using a structured questionnaire survey, the results further reveal that contractors in the study area are expected to begin the construction work even before the payment from the client can be disbursed. As a result, it becomes difficult to carry out further activities thus leading to late completion of projects.

Financial risks impacting on project schedule performance in African countries

Projects cannot be successfully implemented without adequate the funds required. Esperance and Sung-Hoon (2019) presented 40 causes of delays influencing the performance of building construction projects in Rwanda. The significant factors that led to unexpected delays and additional costs were ranked as cash flow constraints, delay in approving design documents, confidentiality of physical plan, price fluctuations and change orders. Cash flow constraints were found to have a high probability and significant

impact in delaying these projects. The findings show that this is due to regular instability in the country's economy. Finance is a significant factor that determines the success of a project; any problem linked to finance leads to a project failure (Eja and Ramedegwa, 2019).

Schedule overrun is one of the most critical issues for construction projects that leads to huge losses in both developing and industrialised countries. As such, these projects are exposed to financial risks due to the nature of this industry and high uncertainty. The regular types of financial risks in this industry include inadequate project funding by the owner, fluctuation of inflation rate, cash flow constraints, change in price of materials in the market, and many more (Kolhatcar and Dutta, 2013). Indeed, financial risks are considered to be the most critical factors that hinder successful delivery of construction projects in Sudan. Mohamed (2015) conducted a study employing a questionnaire survey to find out the main causes of delay in building construction projects in Sudan. He found out that the main reason for project delay was fluctuation of prices of construction materials in the market. This affects the cost estimation of the project, and construction projects with weak financial capabilities delay the projects' activities, hence exerting pressure on the contractor to meet the project objectives.

The projects in this industry need funds within their planned duration, and failure to secure adequate funds leads to delay in payments hence late project completion (Shiri, 2015). This is also supported by Tadele (2018) who undertook research in Ethiopia where the aim of the study was to identify the causes and impacts of delay in roads projects. It was discovered that delay in contractor payment by the client lengthens projects' duration, consequently leading to contractors' budget deficit because of extra costs related to schedule extension. Eja and Ramegowda (2019) attribute construction project schedule overrun to five main factors; poor financial capacity, inaccurate costing and corruption, incompetence and lack of knowledge, poor planning and estimation, and poor communication. The first two factors are linked to finance. Their research results in Nigeria indicate that poor financial capacity is not only a problem to the government but contractors who are involved in government projects also contribute to late project completion.

The findings of Philemon and Msomba (2018) confirm Mahamid's assertion in Palestine that the critical factor delaying Tanzanian infrastructure projects is inadequate projects funding by the client. The study which employed questionnaire survey to identify crucial risk factors in infrastructure projects in Tanzania shows that it is common for government-financed construction projects to start without proper funding plans. This results in projects being stopped or progressing slowly because contractors and consultants are only paid upon availability of funds. Therefore, delayed payments by the government hinder progress on projects.

Projects funding is a key factor in construction projects, and as such it should be guaranteed so that projects will be completed within their contractual duration. This is manifested in the study of identification of risk factors influencing completion of construction projects in Nairobi, Kenya where 98 % of the respondents revealed that project financing and supervision influence completion of construction projects (Munyoki, 2014). For instance, in Kenya, contractors often leave projects full of financial problems and focus on other business opportunities. Financial risk factors identified in this country were timely release of funds, stability of local currency, cash flow, change in price of materials, and access to credit from lending institutions.

Financial constraints are often regarded as the main causes of project failure globally. Most of the construction projects in developing countries are left before completion due to lack of projects funding, either by the client or the contractor (Damoah, 2015). The same problem exists in Nigerian construction projects where it was found out that financial predicament impact on projects' schedule (Emeka, 2016). The same applies in Morocco, where delay of progress payment is the top critical cause of schedule delay in these projects. Semi-structured interviews were employed to collect data from Moroccan experts, public and private contractors, and consultants. The study identified 49 causes which were grouped into 9 categories. The study results showed that Moroccan contractors and sub-contractors encounter financial difficulties whereby their payments periods exceed 90 days. This restrains project progress especially for the companies that lack financial strength and, as a result, predefined contract duration is regularly exceeded (Bajjou and Chafi, 2018).

Financial risks impacting on project schedule performance in Southern African countries

Adugna (2015) studied causes of delay and cost overrun in office construction projects in eThekweni municipal area in South Africa. The outcome of the research shows that the major reasons for this delay are related to contractors' cash flow problems, delay in progress payment by the client, poor site supervision and management by contractor and contractors' difficulties in financing the project. These risk factors have a negative impact on projects, completion date.

In Zimbabwe, the majority of construction projects had faced a serious problem of being completed beyond their duration, resulting in cost overrun and project suspension. Shiri (2015) investigated the causes and effects of construction delays in Zimbabwean construction projects. A questionnaire survey and semi-structured interviews were used to collect data, whereby four cases of construction projects were analysed. In this study, 22 main causes of construction delays were identified, and the top five were financial difficulties of the owner, variations, contractors' financial difficulties, late payment and wrong estimation. The study shows that the major causes are dominated by the finance category. This is due to the financial predicament that Zimbabwe faced. As a result, a large number of investors failed to secure enough funds for construction projects. Therefore, many construction projects were delayed because of financial difficulties.

Botswana is not an exception from the problem of delays in the construction projects. In a related study, Adeyimi and Masalila (2016) found that the leading causes of delays in Gaborone City Council construction projects are improper planning, contractors' poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work. This implies that without financial payments to the contractor, delay problems cannot be resolved, thereby causing projects to exceed their schedule.

Project funding is one of the factors that contribute to the successful completion of construction projects within their scheduled period. For this reason, the delayed payment to the contractors results in disputes between the owner and the contractor, which also

lead to slow down of progress of work, claims for time extensions and sometimes termination of contract. Aigbavboa et al. (2014) point out that delay in progress payment and financial difficulties of the contractor leads to late completion of construction projects in Zambia.

2.9.2 Design risks impacting on project schedule performance

In construction projects, design risks refer to design deviances in relation to the requirements of the projects. These changes are also caused by regular additions, omissions and adjustments to the original project design and, as result, these alterations affect both time and cost performance (Hui et al. 2017).

Rwanda

Risks factors impacting on construction projects' schedule differ in countries globally due to the characteristics of the construction industry where projects are implemented. (Esperance and Sung-Hoon, 2019). A list of 40 risk factors grouped into seven categories was formulated from the literature review and tested in building construction projects in Rwanda. The authors' main focus was on the identification of critical risk factors responsible for delays in Rwanda building construction projects so that appropriate strategies could be used to minimize these delays. A questionnaire was used as a survey tool to collect data from clients, contractors and consultants. The results revealed that the second critical risk factor was delay in approving design documents. It was found that the delay in approving design documents was caused by lack of attention and enough time during designing, as well as inadequate management during design.

United Arab Emirates (UAE)

Under the design category, Harthi (2015) identified four risk factors that cause delay in the completion of construction projects based on the perceptions of clients, consultants and contractors in UAE. Analysed in the order of severity, frequent changes of designs, defective designs and the late issue of drawings and documents are the top three critical risk factors. These defective designs have several mistakes which make it impossible to construct thus delaying project work and affecting the planned schedule. Furthermore,

changes by the designer during the construction of the project affect project schedules as those changes interrupt the duration of work activities.

A similar study by Johnson and Babu (2018) identified and ranked key risk factors that cause time and cost overrun in the UAE construction projects. A concurrent mixed-methods approach employing a questionnaire and an interview with construction stakeholders was used to collect data. The main aim of this study was to investigate, evaluate and analyse the causes of construction projects' time and cost overrun in the UAE construction projects. Thirty risk factors were identified with the top five risks ranked as design variation from client and consultants, unrealistic schedules and completion dates projected by the clients, delay in obtaining government permits and approvals, inaccurate time estimates by the consultants, and change orders from clients. The interviews used also indicated that scope changes and design variations from the client delay projects. This incomplete and variations in design occurs because the timeline for design approval was not included in time estimates in the initial stage of the project.

Ethiopia

When design is flawed, inefficient or interrupted by the owner in construction projects, chances of delay are inevitable. Asmeron (2021) observed that changes requested by the owner in Ethiopian building projects are common, and affect project performance in terms of duration. According to this study, which employed explanatory quantitative research design, the three top factors that lead to design change was the change requested by the owner, poor communication between contracting parties, and errors and omission. Alharbi (2021) supports the study results by indicating that the issue of changes in design requested by the owner is frequently observed in project scope modifications during the project execution phase. This tends to hinder the progress of project activities due to rework on the project to satisfy the requirements of the owner. It is further indicated that design changes effected by the owner during the lifecycle of the project result in late completion of the construction projects. In addition, delay in issuance of designs and working drawings, as well as design errors and complexity of designs are found to be among the top influential risks that cause delay in public building construction projects in Ethiopia (Kuhil and Seifu, 2019). The authors observed that these two risks are

consultant-related, which is found to be the second category that leads to schedule overrun in Ethiopia.

Uganda

A similar study identified the same problem in Ugandan construction projects. With regard to road construction projects, the main challenges were related to designs due to project complexity. Contractors' and consultants' view was that design challenges are a result of lack of time to review and amend them for construction work (Muhwezi, 2014). For this reason, when design errors are during project implementation, project activities are suspended for correction of those errors thus delaying project schedule.

Kuwait and Barhain

Altoryman (2014) conducted a study in Kuwait and Barhain to identify and assess risk factors affecting construction projects' cost and duration. Design risk category was found to be the second category that has a higher impact on the projects' schedule. Nine risk factors were identified, and the most significant risks under this category were design team experience, complexity of project design and confusing requirements. Detailed and efficient planning is an essential contributing factor to the success of construction projects.

South Africa

In a study conducted by Londiwe (2017) in South Africa, 77.9% of the respondents stipulated that design changes during the execution phase is a major factor that leads to projects' cost and time overrun. The results showed that the critical risk factors that influence project cost and time overrun are design changes, lack of contractor management, poor procurement planning, scope creep and inaccurate estimation.

Pakistan

Every construction project has a unique set of needs to be completed successfully, therefore project stakeholders should take this into consideration. Hayat (2020) points out that delays in Pakistan construction projects are due to non-availability of drawings and

designs on time. The study results show that as a result of these, projects' completion is affected. Design risk factors include among others lack of design coordination between the disciplines, drawings and specifications, lack of consistency between bill of quantities, and others. It is therefore important for contractors to pay attention to design deficiency so as to avoid the blame for project delay (Hui, 2017).

Cambodia

Design error poses a significant risk in construction projects. Tahmasebinia and Song (2022) indicate that project design is central to construction projects' outcome in terms of duration. Nonetheless, design errors found in construction projects lead to wrong project estimations which result in re-design as well as more time to rework. Therefore, project duration and budget are affected negatively due to additional work. Asmerom (2021) asserts that design errors or omission is commonly caused by the failure of design professionals to construct complete and accurate design results. It is further indicated that the well-known design errors that lead to design change are the omission of details on structural drawings and wrong description in specifications of architectural drawings. All these result in demolition and rework which lead to project delay and increase in project cost.

Kenya

Oyieho et al. (2020) investigated the influence of construction time overrun related risks on completion of public private partnership projects in Kenya. A questionnaire survey and interviews used targeted the management of Sondu-Miriu Power project to collect data. The study found that the design process exceeded its schedule, eventually affecting the time scheduled for construction projects' completion. Different stakeholders point out that the prolonged design period leads to projects being completed later than it was planned for.

Lengthy delay in construction projects is caused by variations in design. This is in line with the study by Shiri (2015) who found out that variations during construction phase was ranked as the second risk factor affecting projects duration in Zimbabwe. The results revealed that these variations are due to high technological environment, together with

clients who change the scope during project execution. These change orders call for time extensions to accommodate the variations, thus delaying the project completion time.

A survey conducted by Belay et al. (2021) studied analysis of cost overrun and schedule delays of infrastructure projects in low-income countries, Ethiopia being a case study. Causes of time overrun in these projects were identified and ranked. These risk factors were categorised into nine groups, namely, Owner, Consultant, Contractor, Contract Administration, Project and Market conditions risks. The results pointed out that the most significant risk factors affecting projects duration are variations (design changes) which lead to rework, economic conditions, escalation of material prices, shortage of construction materials, together with delay in payments.

2.9.3 Owner risks impacting on project schedule performance

The success of the project depends on cooperation among the concerned stakeholders in the implementation of projects. They must all abide by the schedule, budget, quality and scope of work, which have been stipulated in the contract before the implementation (Alharbi, 2021). There are several studies undertaken by different researchers in different countries which identified owner-activities as the main causes of construction project delay, although it differs in the extent of their involvement. Owner interference in different phases of the project such as planning and execution affects the contractors' and designers' activities thus leading to rework and late projects completion (Otobo, 2016).

Owner interference in the planning phase

Risk factors that impact on construction projects' schedules differ according to the regions where projects are carried out, how advanced the technology used is, as well as the experience of the owner. Elawi et al (2016) conducted a study in Saudi Arabia where the focus was on owners' perspective of factors contributing to project delay in roads and bridges. The main aim of this study was to identify the causes of delay and the responsible parties for these delays. The top five delay factors were land acquisition, contractors' lack of expertise, re-designing, line services together with clashes with other ministries. Among the top five delay factors, four of them are owner-related. This therefore means that in Saudi Arabian construction projects, owners are responsible for projects' time

overrun. Land acquisition is the responsibility of the owner, as they have to prepare the site before the execution of the project. Re-designing is also blamed on the owner because design specifications are given to the contractor before the project starts, however, during the execution phase the owner brings changes which affect the schedule of the entire project. The findings state that owners are responsible for 53% of project delays in Saudi Arabia.

The findings of Alotaibi (2018) in a study undertaken in Saudi Arabia, confirm Elawi et al. (2016) in that the owner in the same country is the most responsible stakeholder for schedule overrun in construction projects. The author schedule overrun in this country is due to five main factors: slowness in decision-making, assigning contractors to lowest bidder system, change orders, planning and scheduling of project, and difficulties in financing the project. Slowness in decision-making, together with change orders are directly linked to the owner. In this study, it was discovered that owners' slowness in decision-making influences delays. Major decisions that were supposed to be made by the owner were always late and, as a result, independent project activities were eventually delayed. This issue of decision-making was caused by the bureaucratic atmosphere of the government of Saudi Arabia where power is in the hands of few people who were also in charge of other government projects. Therefore, it was common that contractors or designers would spend around three weeks waiting for approval of key decisions.

A survey study into the assessment of delay causes of construction projects in Palestine from the contractors' and consultants' point of view indicates that these projects fail due to technical issues caused by the owner. This study results show that in this Palestine, projects fail due to owner's administrative and technical causes, owner's financial matters and owner's human resources (Albatsh, 2015). Owner's administration has a high impact on the duration of the project since projects' bids are awarded to the lowest price contractors who do not have enough resources to execute projects effectively and achieve contracted duration. Furthermore, there are some weaknesses in communication and coordination between the owner and other parties in the initial stage hence the owner's demands are not understood by the consultants. This implies that without proper communication, projects will be unsuccessful eventually leading to total failure.

Owner interference in the execution phase

Successful delivery of construction projects depends on the joint efforts of all stakeholders, nonetheless, these parties contribute differently in project delays (Elawi et al. 2016). Larson and Gray (2018) state that before the project starts, the project manager and the owner agree on the project objectives, deliverables, technical requirements and other factors. Therefore, if the project scope changes during construction, it is difficult to attain contracted duration. According to Tahmasebinia and Song (2021) the owners' change of scope during construction is the third important risk factor that delays projects in Cambodia. The change of scope by the owner extends the project activities which had different lengths of time to be completed. This change of scope by the owner results in rework by the designer and contractor, as well as additional activities which were not included in the initial scope, hence schedule overrun of the project.

Harthi (2015) states that owners' risk factors normally originate within the projects where there are delays of payment to contractors by the client. Furthermore, owner risk factors identified by Harthi in a study undertaken in the United Arab Emirates (UAE), which affect construction projects' schedule and cost are: improper intervention of the owner during construction, disputes of contract with contractors, failure to define the scope and delayed payments to contractors. It is found that delay in payment to contractors by the owner affects projects completion date as the contractor stops the work in the middle of construction due to lack of funds to execute project work. This results in completing projects later than was planned. Fernando (2017) is of the view that if financial issues are not addressed on time, contractors will end up refusing to correct defects, asking for extra payments, and most importantly, falling behind the schedule.

Alavir and Motamedi (2014) found that the most significant critical risk factors affecting construction projects' duration as perceived by contractors and consultants in Iran are owner risks. Late revision and approval of design documents by the owner, delay in progress payments, suspension of work and change orders by the owner during construction, are assessed as the most critical risk factors affecting construction projects' schedules. Lessing et al. (2017) conducted research using a questionnaire survey and face-to-face interviews to study the main factors causing delays on large infrastructure

projects in Auckland, New Zealand. The study results indicated that continuous design changes by the client affect quality and projects' schedules. These changes which are requested during the construction phase hamper project progress as they sometimes include material that take a long time to be ordered and delivered. Therefore, designers' time schedules for project completion are delayed.

Design change at construction phase leads to project failure (Bassa et al. 2019). This is supported by the study of factors affecting time and cost performance of building construction projects in Rwanda (Tuyishime, 2020). The study concluded that variations and design change requirements during project execution by the client results in late completion of the projects. In the study, it was found that the significant factors that lead to project delay were rooted in the owner. Schedule estimates are based on the design and resources available at that particular time. Therefore, changes in design by the owner during project execution affect project duration as consultants are bound to rework on the design (Alharbi, 2021). Furthermore, the owner is also blamed for the untimely decisions in the Rwandan building projects. This delay in making decisions make it impossible for contractors to complete projects within the contracted duration and, as a result, contractors demand extra time to recover lost time.

Scope change has a detrimental effect on the project duration. This is more evident in construction projects which demand high technological innovation in their implementation. In most construction projects, alterations by the owners are made before projects start to avoid changes during the execution phase (Damoah, 2015). However, Alharbi (2021) indicates that client interference results in changes in projects specifications. The study adopted mixed methods where respondents comprised clients, consultants and contractors in the Saudi Arabian construction industry. The participants agreed that change orders which affect projects' schedule are the main delay factors associated with the client. The findings of the study show that the key factors contributing to schedule overrun are change orders, involvement of the client in the construction process, shortage in the construction experience, delays by the client in issuing modification orders, and slow payments to the contractor. This implies that owner interference of change orders affects the contractors' work hence project delay. In

addition, client interference causes disputes with subcontractors and this also delays the project.

In a study to determine how client interference affects construction projects in South Africa, a survey of construction contracting companies was done. Using a questionnaire survey to collect data from contractors, consultants and client, Booyens et al. (2015) found that negative interference of the client leads to failure of the projects in terms of time, cost and quality. The client causes inconvenience to contractors and consultants. The study identifies four factors where the client interferes negatively. These include changes in design or scope, breaking lines of communication, use of authority over other professional members and alteration of payments. Change of design or scope by the client automatically leads to extra costs and unforeseen delays in the overall project. This is confirmed by Alharbi (2021) that frequent change orders by the owner during project execution indicate negative involvement of the owner in the contractor's work. This therefore contributes to project delay.

Impediment in prompt decision-making process due to lack of judgement by the owner is also a leading risk factor in late completion of construction projects in Ethiopia. This causes delay in projects as contractors have to re-design the projects requirements, reschedule other activities as well as changes in material procurement. Contractors wait for a longer time for arrival of material thus hampering the flow of project activities (Yadeta, 2019). In the same country (Ethiopia), a study was conducted by Hussein (2018) where the results indicated that the top five risks that lead to late completion of Private Real Estate construction projects are: owner interference, frequent change orders, long waiting time for approval of tests and inspection, and mistakes in design documents. According to the perspectives of the contractors, consultants and clients, owner interference is the most significant factor causing delay. This interference normally results in design change and material change which greatly influences the completion of these projects.

2.9.4 Government risks impacting on project schedule performance

The planning stage is a very critical period as it is where most of the activities are planned by the different stakeholders. There should be cooperation among the concerned teams so that all plans will be fulfilled. Some of the risk factors that result in late completion of construction projects are planning and design at the beginning of the project. Londiwe (2017) found that during the design stage, consultants failed to deliver the detailed design before the commencement of the project due to delays in the environmental laws and land acquisition approvals by some of the government ministries.

In all countries, the responsibility to provide infrastructure lies in the hands of the government, and as such, the political activities of governments normally affect the success of construction projects in terms of duration, cost and quality. Political risk factors are the risks which emanate from governmental actions or activities which involve changes in policies or regulations (Damoah, 2015).

Government activities' impact on project schedule performance in developing countries

In Ghana, the five most significant risk factors that cause delays in construction projects are found to be monitoring, corruption, political interference, change in government and bureaucracy Damoah (2015). The study revealed that most of the Ghanaian construction projects experience delays because of corruption which is caused by high level of paper work and bureaucratic processes. Therefore, contractors and consultants engage in corrupt practices of paying bribery to government officials in order for their work to be approved. The effect of this is that several design errors are noticed during project implementation, and the time taken to correct the errors delays the project as a whole. The majority of respondents state that many Ghanaian government projects are not awarded on merit. Corruption is seen as an obstacle that is commonly found in construction projects. According to several studies, there are high levels of corruption in developing countries, especially African countries. A common practice is found whereby companies are involved in paying bribery so as to win construction projects (Otobo, 2016).

Bribery and corruption are not only found in Ghana. Dosumu (2017) also pointed out that bribery and corruption are common in the Nigerian construction industry where the stakeholders, especially the consultants allow poor quality work to pass to the next stage of construction only because the contractors have paid bribery. Consequently, these corrupt practices have led to building collapse, defects, disputes, cost and time overrun as rework is done regularly. The study further stipulates that corruption is also observed at the bidding stage of the project where large sums of money are given to politicians and high-level executives who are involved in the bribery group to award the construction projects to unqualified contractors. In this study, questionnaire survey was employed to collect data from building contractors and consultants.

Okafor (2016) supports this by indicating that corruption is a significant delay factor found in Nigerian construction. In a study undertaken by Okafor, 74% of respondents agreed that corruption, which is in the form of favouritism, leads to project delay. From the questionnaire survey distributed to contractors, project managers and quantity surveyors, the author identified communication barriers, high level of corruption within the government and construction industry in Nigeria, poor contract management, changes in site condition, as well as shortage of materials as significant factors that impact on project schedule.

An analysis of delay on construction projects also revealed corruption as the number one key factor that leads to delay in construction projects (Gebrehiwet and Luo, 2017). This research which used Ethiopia as a case study identified the top key factors to be corruption, unavailability of utilities at site, price increases in materials, lack of quality materials, and late design and design documents. The study indicates that these projects experiences delays throughout the project life-cycle. This is seen where the pre-construction stage experience risks such as corruption, ineffective planning and scheduling and price increases in materials. However, Dosumu (2017) argues that risk issues are better solved as early as during the bidding and procurement phase than during the construction phase. Eja and Ramegowda (2019) asserts that corruption is also seen during projects' implementation. These lead to time overrun and, as result, it becomes costly to finish these projects due to the lengthy time taken. This further causes

massive failures, stalling of projects, delays and even abandonments of infrastructure projects, consequently leading to project scope creeps, disputes between client and contractors and others.

Another source of project delay discovered by Damoah (2015) in Ghana was political interference. According to contractors, political interference is ranked number one. The study found out that most of the government projects are awarded on the basis of political party patronage. Moreover, the study found that sometimes political parties establish construction companies. These companies are illegally awarded construction work but fail to execute these projects due to lack of technical expertise and knowledge to implement such projects. In this case project delays are unavoidable. The author further states that change in government during projects execution leads to halting and abandoning of projects in Ghana. The interview results showed that it has been a norm that governments support projects within their political parties. This is evident where after elections, projects are stopped because politicians want to re-award those projects to their party members, hence project delay.

Political risks such as clash of interests, changes in tax and other laws are associated with change of government and pressure from opposition parties. These risks have a high probability of occurring and prevent successful delivery of construction projects in terms of schedule (Aminu, 2013). Furthermore, Kudumela (2015), in his study about risks and mitigations associated with infrastructure development projects in South Africa, found that political risk factors prevent infrastructure projects to be completed within the planned schedule. He further indicates that these political risks are caused by government decisions, social unrest, war and many more. According to Alhassan, (2016), political risk factors that affect construction projects' schedule include change of government, change of government policy and new governmental acts. In his study, Alhassan found that the political risk factors assessed by the contractors are all ranked as the highest risk factors in Ghana.

Middle-East related studies

According to Harthi (2015), delays in granting government approvals, threat of war, political instability, changes in laws and regulations, and strikes and disputes contribute to delays in construction projects. For instance, the UAE government passed a law which required construction companies to stop work between 1 and 3pm throughout summer. As a result, time that is lost due to this law was not recoverable thereby failing to keep up with the projects schedule. Furthermore, consultants and contractors argued that corruption and bribery are also common in this country. Competent and qualified contractors are not granted tenders due to bribery paid by incompetent contractors who lack resources and fail to deliver projects within the expected duration. As a result, political and government risks contribute a lot in delaying the completion of these projects

A study by Gardezi et al. (2013) on the extensions factors in construction industry in Palestine shows that the political culture of this country affects public infrastructure projects to a large extent. According to the views of contractors, consultants and clients, they are unable to withstand the political influence where there is lack of law and order. This eventually leads to time extensions in order to complete these projects. The top five risk factors the authors identified were law and order situation, design changes, unavailability of funds from the client, war and terrorism, as well as poor site management. In a related study Mahamid, (2013) found that one of the leading causes of delays in Palestine is the political situation and segmentation of the West Bank. There was no stability in this country due to the conflicts between Palestine and Israel. As a result, the West Bank is subdivided into many areas that prohibit free movement of project resources such as people and goods, consequently leading to time overruns.

Government is one of the important stakeholders that contributes to the success of infrastructure projects. For this reason, relevant government ministries must cooperate and act decisively. Problems such as delays by municipalities in issuing permits and changes in legal regulation in Turkey affect completion of these projects because the structure and dynamics of the construction industry are more dependent on local regulations in urban areas (Aydin and Mihlayanlar, 2018).

There are many studies carried out in the Middle East countries on risk factors that lead to project schedule overrun in the construction industry. In Iran, Bekr (2015) identified 53 delay factors on projects' schedules. The results pointed out that the critical delay factors were security measures, government change of regulations and bureaucracy, official and non-official holidays, low performance of the lowest bidder contractors in the government tendering system, and the design changes by the owner. The participants indicated that not only do these projects suffer delays but they were also temporarily or permanently abandoned during the years 2003-2014. These delays result in time and cost overrun, disputes, arbitration and total abandonment. Alavir and Motamedi (2014) also attribute the root causes of delays in construction projects in Iran to delay in obtaining permits from the municipality, late revision and approval of design documents by the owner, poor communication and coordination by the owner and other parties, and legal disputes between various sectors.

2.10 SCHEDULING STRATEGIES AND TECHNIQUES

Successful project delivery depends on project planning and scheduling. Scheduling is defined by Ssempebwa (2013) as the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. According to Kawa (2020), project planning and scheduling are essential in deciding project activities, duration, costs, resources and the relationship of different activities in order to finish the project. When scheduling projects, all necessary activities required to finish the project are established together with their earliest start, therefore the project schedule has to reflect all the work related to delivering the project on time (Ssempebwa, 2013).

There are different strategies for scheduling construction projects such as Work Breakdown Structure (WBS), Project Evaluation and Review Technique (PERT), Gantt Chart, Critical Path Method (CPM) and many more. These strategies are employed for work schedules (Alotaibi, 2018). When selecting which strategy to be used, project managers and other stakeholders take into account the goal of the project together with project requirements (Kawa, 2020). These sections below will focus on the above-mentioned common project scheduling approaches.

2.10.1 Work Breakdown Structure (WBS)

The perceptions of stakeholders show that poor planning and scheduling are the contributing factors to project schedule overrun. Ssempebwa (2013) states that in project management, scheduling is the initial step in carrying out projects such as construction projects. In construction projects, project managers are responsible for collecting all information to be used throughout the project life cycle so as to make estimations and plan efficiently before the project is executed. Scheduling and cost estimation are significant tasks that need to be performed successfully in construction projects. After the identification of project milestones, activities and deliverables, the project team must determine their durations, as well as the resources needed to complete them (Larson and Gray, 2018).

The WBS is a fundamental document used in projects for planning and managing project schedules, costs, resources and changes. It is a full description of the total project scope as it contains all deliverables. Project managers together with the project team have to develop a good WBS so that all stakeholders will understand what work should be done to complete the whole project. The benefit of using this structure is that it assists the project team to identify where integration between several work packages will be required (Heagney, 2012).

Larson and Gray (2018) indicate that after the development of the project scope, a Work Breakdown Structure (WBS) is developed. The WBS sets out all the elements of the project in a hierarchical framework and establishes their relationships to the project end item. WBS is essential when creating a project schedule as it provides the client with accurate and detailed information, as well as cost estimates (Sidney, 2018). Ssempebwa (2013) supports this by indicating that the first step of project scheduling is to define the work through the WBS. During project scheduling, work activities are defined and arranged hierarchically as WBS is a starting point of project schedule where project work is displayed in terms of deliverables. Despite the importance of WBS, Sawalhi and Enshassi (2012) found that contractors and consultants do not employ it due to unawareness of its benefits and lack of knowledge to apply it. Larson and Gray (2018) further stipulate that WBS defines the project scope and subdivides it into major

deliverables, sub-deliverables and smaller pieces which are work packages. The advantage of WBS is that managers of work packages ensure that the package is finished on schedule, within the budget and according to specifications.

This breakdown categorises work packages by the type of work within a deliverable and allows assignment of responsibility to organisational units.

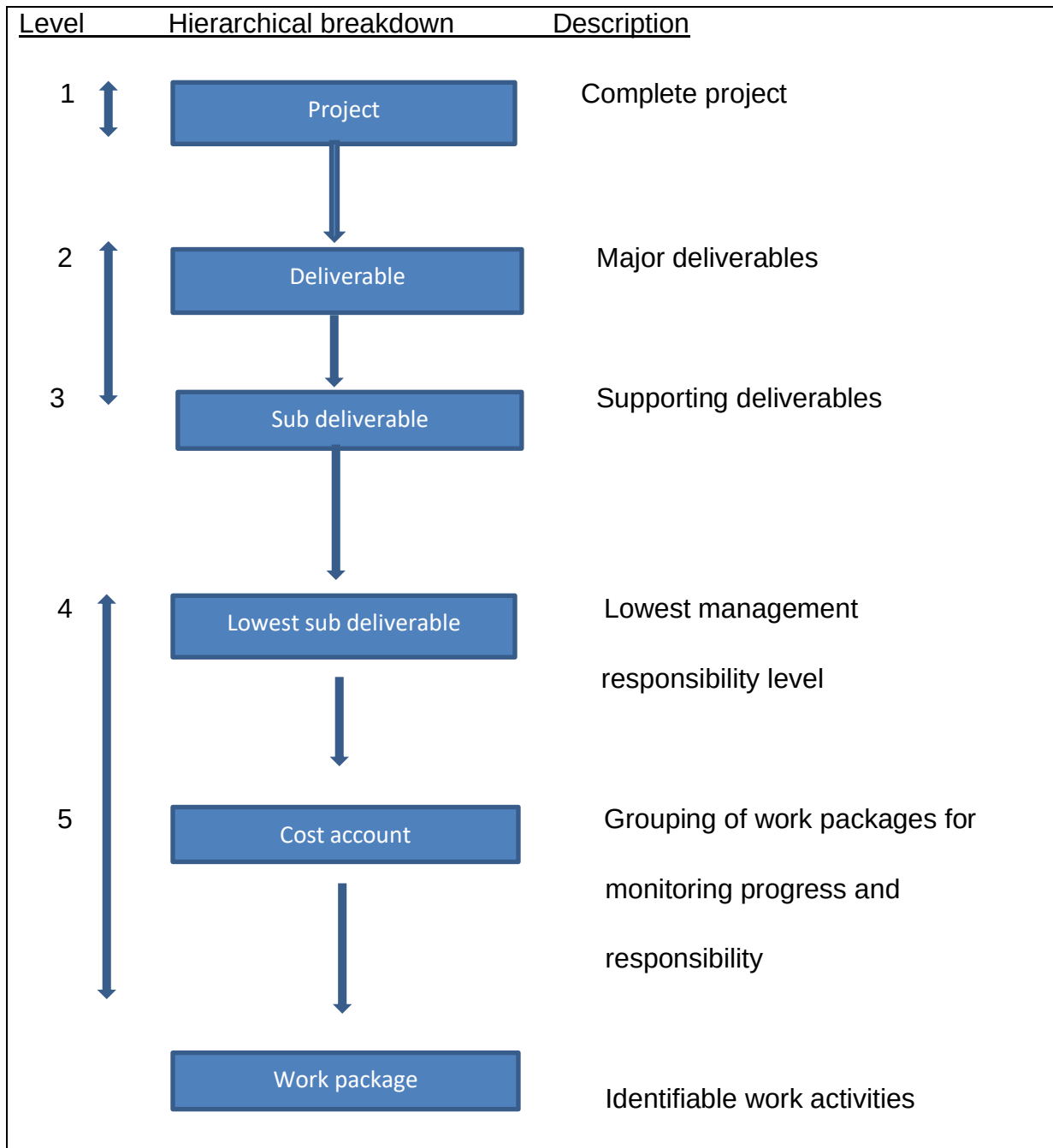


Figure 2.2: Hierarchical Breakdown of WBS (Larson and Gray, 2018)

2.10.2 Critical Path Method (CPM)

The main aim for scheduling a project is to ensure that the project deadline can be met. CPM is another scheduling technique which was developed for the purpose of breaking down projects into individual activities and estimating the duration of those activities as each task takes a different amount of time and resources (Kawa, 2020). The significance

of this method is that activity sequences are displayed graphically. Project scheduling requires the project team to establish the logical relationship between activities. The four types of standard dependency relationships are Finish-to-Start, Start-to-Start, Finish-to-Finish and Start-to-Finish. The CPM uses the predefined duration of activities as well as their relationship in order to determine the critical path (Larson and Gray, 2018).

Behnam et al. (2016) point out that in CPM, project activities are represented by an arrow, and when the arrows are linked, they clearly show the order in which the activities are to be performed. As a result, the activities in the project network identify the critical path; this is the longest sequence of activities which determines the duration of the project. The project network determines the set of activities that connect a projects' start and end. When using CPM in projects, the project manager requires all activities needed to complete the entire project, the durations for each activity to be completed, the interrelationship between the activities, as well as logical end points such as deliverables. Furthermore, the CPM calculates the critical path and the early start and finish together with the late start and late finish of activities without affecting the duration of the project, (Ssempebwa, 2013).

The advantage of using the CPM is that project managers are able to tell if the duration of the project can be achieved, and also when several tasks will be completed in order to meet the deadline. This technique determines the critical path which is the longest series of activities and maximum duration that determine the completion date of the project. Therefore, the critical path gives direction of how the project should be managed. In a study conducted by Orumie (2020) in Nigeria, the finding revealed that the use of PERT and CPM in the scheduling of house construction projects were effective and efficient since they were completed within their duration.

The critical path method helps the project manager to make decisions on how the project can be completed earlier than it was scheduled. For instance, the project manager can add more resources on the critical path not anywhere else (Watt, 2016). Employing CPM in projects is beneficial as it allows continuous monitoring of the schedule. The project manager is also able to track critical activities and become aware of where non-critical activities can be delayed beyond their total float and a new critical path can be created

thus delaying project completion, (Ssempebwa, 2013). Adugna (2015) states that in construction projects, if the estimates of the duration of each activity are well detailed, then the project duration will be accurate. Consultants and contractors are both advised to bring their own CPM so that they will be correlated. Furthermore, it is stated that CPM assists project managers to plot project dependencies using a network diagram. This will provide a better idea of which activities cannot run parallel, allowing the project manager to schedule accordingly. CPM is one of the common tools used in scheduling projects, however, it is criticized for its focus on time-constrained output in terms of times for starting and finishing activities. It ignores other important aspects such as resources used in the project.

2.10.3 Program Evaluation and Review Technique (PERT)

Program Evaluation and Review Technique (PERT) is a method of network analysis used in projects where duration times cannot be estimated with certainty due to inherent characteristics of those projects. It is difficult to determine the exact duration of project activities hence this technique adopts a statistical weighted average time estimate based on three-time estimates which are optimistic (O), which is the shortest time in which the activity can be completed, pessimistic (P) that is the longest time an activity can be completed, and most likely (M) which is the highest probability that a project will be finished (Kawa, 2019).

Orumie (2020) indicates that when using PERT, it is possible to calculate the probability that an activity will be completed by a certain time. PERT was developed to schedule and cover uncertainty in projects. It is a probabilistic network which uses three time estimates to model the uncertainty associated with the estimation of task duration (AlNasseri and Aulin, 2015)). Therefore, PERT helps project managers to assess the risks associated with time estimates, and for that reason, it can assist in developing more realistic schedules to reduce cost and time requirements.

2.10.4 Gantt Chart

A Gantt chart is a type of bar chart developed by Henry Gantt to display a project schedule. It is the first tool that a project manager uses for rough time estimates to

complete the main tasks. The main stages of the project and their duration are shown in sequence as a bar chart. Project managers should play a leading role in their teams in creating realistic schedules for their projects and also monitor and control them during project implementation. Larson and Gray (2018) states that project schedules are commonly displayed in the form of a Gantt chart. These charts display project schedule information by listing tasks, and when they start and finish. It is beneficial to use them as they show when activities will be started and ended relative to one another.

Gantt charts are used in project management during planning, resource scheduling and status reporting. They are commonly used in projects because they are easy to understand and they present a clear picture on a time-scaled horizon where activities are displayed against time. Activities are listed on the left side of the chart and a suitable timescale along the top. Each activity is displayed by a bar, and the position and length of the bar shows the start date, duration and end date of the activity (Kawa, 2020). Sidney (2018) further states that Gantt charts provide a graphical display of project activities using a two-dimensional representation of the project schedule with project activities on the *y-axis* plotted against time on the *x-axis*. However, with the use of computers and project management software, Gantt charts can be updated and show the progress of work.

Heagney (2012) finds Gantt chart simple to construct and read, therefore this is the greatest tool to use for communication among the team members about what to do within given time frames. However, when using Gantt chart, the challenge arises when the projects have many dependency lines (Larson and Gray, 2018). Behnam et al. (2016) state that the time execution for every activity is shown as a bar on the time graph corresponding to the planned times of occurrence. Parallel to the planned times, the actual period of accomplishment is plotted.

In a study conducted by AlNasseri and Aulin (2015) on assessing practitioners' perceptions of planning and scheduling on Oman construction projects, it was revealed that the main issue in planning and scheduling is the ineffectiveness of the traditional scheduling strategies when dealing with complex projects. Gantt chart, CPM and PERT are found to be the commonly used methods in the construction projects although they

are criticized as traditional approaches. Respondents revealed that project managers found CPM and Gantt chart to be problematic since these tools are formulated on linear programming, and this poses some problems when changes take place in minor activities not in line with the critical path.

Alotaibi (2018) investigated critical factors causing delays in public construction projects in the Kingdom of Saudi Arabia. The study further aimed to identify project time planning tools and techniques used. The findings revealed that these techniques are not widely used in planning construction projects in this country hence delays in executing these projects. In addition, Gantt chart, WBS, PERT and Milestone technique were found not to be employed in the planning of public construction projects. Among the respondents, 67.85% indicated that WBS is rarely or never used. Furthermore, PERT was found to be ignored in the implementation of these projects. However, the results showed that the commonly used method was CPM.

Sawalhi and Enshass (2012) conducted a study by means of a questionnaire survey, with the aim of investigating the level of applying project management tools and techniques to the construction industry in the Gaza Strip. The survey results indicated that project management tools and techniques are not widely employed by the contractors and clients due to lack of knowledge about the significance of these tools. According to the results, the most commonly used tool is the Gantt chart because it is easy to apply in all phases of the project. The findings further show that WBS is not used, and 44% of the respondents had never used it as they were unaware of its importance in successful implementation of projects. The study shows that local contractors use linked bar charts more frequently when scheduling construction activities. AlNasseri and Aulin (2015) indicate that even though the abovementioned tools are easily applicable and dominant in construction projects, there is still a strong need to be aware of other advanced tools that can help defeat the complexity and uncertainty found in these projects.

2.11 PREVALENCE OF RISK FACTOR CATEGORIES ON INFRASTRUCTURE PROJECTS

Several studies were conducted by different researchers to analyse the prevalence of risk factors on infrastructure projects basing on the opinions of the main stakeholders; mainly the clients, consultants and contractors. There are several important factors that have a positive impact in the successful delivery of these projects, therefore these stakeholders must take them into consideration. On the other hand, some risk factors that hinder the progress and completion of projects within their schedule must be identified, analysed and appropriate mitigations applied to avoid schedule and cost overrun.

Damoah (2015) asserts that lack of communication among project stakeholders leads to conflicts and ultimately project failure. This is supported by Booyens et al. (2015) in their study where respondents stated that ineffective communication lines among the client, consultants and contractors were recognised to have a negative impact on the project duration. In order for the project to be successful, all stakeholders must be aware of project changes and incorporate them. From the study results, it is clear that negative interference of client affects construction projects due to the large amount of time taken beyond project schedule.

2.11.1 Consultants' perceptions on the prevalence of risk factors on infrastructure projects

Qualified and skilled professionals play a crucial role in the success of a project regardless of its size or complexity. Project managers, project team, contractors and consultants must be experienced. Experienced professionals are able to avoid the challenges on time and deliver according to expectations. Therefore, contractors should appoint qualified and experienced sub-contractors as their capabilities are crucial in the successful implementation of construction projects (Bitamba, 2020).

From the perspective of consultants and contractors, risk factors that lead to schedule overrun in the housing development project office in Addis Ababa are ranked as inadequate experience and skills of contractors, inappropriate construction methods by

contractors, insufficient funding by clients, poor site management by contractors, as well as impractical allocation of resources. Contractors and consultants point out that inadequate experience and skills of contractors is a key factor in the delay of these projects. Contractors who lack appropriate skills and experience are unable to plan and manage projects efficiently. They fail to apply the usual construction methods, best practices and tools, as a result, errors occur leading to rework, therefore, delays are inevitable (Zewdu, 2018).

Planning is a fundamental part which determines successful implementation of construction projects because clear outlines of deliverables as well as milestones are stated clearly. Inputs of consultants indicate that “unsuitable construction program planning” lead to late completion of projects. This mostly emanate from inadequate program scheduling, innovative design and inexperienced contractors who fail to plan construction programs (Zou et al. 2014).

Lack of efficient communication among the stakeholders in construction projects hinders project success which ultimately leads to total failure. Communication barrier is found to be one of the delay factors in the construction industry. Okafor (2016) points out that currently construction projects are complex and risky due to the advanced technology used, therefore, active participation of stakeholders is essential. Poor communication among stakeholders as well as failure to determine communication channels lead to delays and failure in construction projects. Co-operation and coordination of activities through interpersonal methods and communication between different groups are essential in ensuring that a project is completed as contracted. Due to different stakeholders involved in the construction of projects, communication among these groups is essential for project success. Failure to communicate properly leads to errors and rework; as a result, projects experience delay. Consultants and contractors suggest that, in order to achieve the contracted duration, proper channels of communication should be established (Al-Emad et al. 2017).

Knowledgeable project teams are the champions. They surpass the clients’ expectations and complete projects ahead of schedule and under budget (Larson and Gray, 2018). A

study by Hadgu(2019), whose main aim was to investigate the critical success factors of building construction projects in Mekelle City, states that competent project team members contribute to the project success because they apply the skills and experience they had from the previous projects, as a result they are able to avoid delays in projects. Therefore, it is essential to establish a knowledgeable project team on time so that they are assigned to particular activities according to skills and experience.

The success of an entire project is also determined by the positive involvement of the client. Booyens et al. (2015) assert that the clients' participation in the briefing process contribute to the project success. The study revealed that a client who fulfils this provides relevant information on time, as well as the design requirements needed. Makabate (2016) supports this by showing that the client plays a crucial role in determining the success of construction projects. Delays in these projects are avoided where clients are able to determine the scope of the project, provides financial support, and are active in the project process especially in project decision-making which is essential for the smooth running of project activities.

2.11.2 Contractors' perceptions on the prevalence of risk factors in infrastructure projects

In the construction industry, effective planning and scheduling are crucial and contribute to the success of the project, especially if this is done before project execution. The findings of a study conducted by Al-Emad (2017) in Saudi Arabia point out that improper planning and scheduling of a project is a significant factor that results in projects schedule overrun. In this study, the consultants and contractors are of the view that this problem can be avoided by employing planning and scheduling software packages for managing projects.

According to studies on the reasons for construction projects' failure in developing countries, poor planning is a key cause. If proper planning has not been developed before the execution of the project, the project is likely to face risks and other challenges that were not anticipated, hence late project delivery (Eja and Ramegowda, 2019). According to Okafor (2016), most of the construction projects in Nigeria fail due to improper planning where contractors lack management strategies, and also make poor estimates. As a

result, shortage of materials is experienced and this delays projects while waiting for material to arrive. It is further stated that in Nigeria, contractors' activities such as wrong planning and management techniques delay construction projects.

Construction projects in Australia are completed beyond their schedule due to several risks related to owner, designers, contractors, government bodies as well as the external environment. The survey results of a study undertaken by Zou et al (2014) in Australia show the owner as the key stakeholder that contributes to projects delay. Contractors point out that the owner imposes a tight project schedule which the contractors fail to achieve. In the contractors' opinion, owners must formulate an appropriate and practical schedule in the conceptual phase. This will allow design and construction activities to be carried out without pressure thus avoiding errors and rework. Furthermore, the contractors assign "inadequate program scheduling" as another risk that affects construction project schedule. This is mostly experienced in projects with tight schedules where some of the programs need to be reduced in order to achieve a project timeline. However, contractors recommend that choosing experienced designers will help to reduce the time difference between the proposed and practical schedules. Harthi (2015) supports this by indicating that owners have a tendency to impose unreasonably tight project duration in order to save money, however, this results in a poorly defined scope as well as project delay.

An investigation into the causes and effects of project failure from consultants and contractors' view point revealed that there is poor planning in Ghanaian construction projects. This is mostly caused by government-appointed officials who coordinate governments projects. Research shows that these government leaders fail to plan properly due to lack of funds to undertake such planning. These projects are implemented without proper planning of how the government will allocate funds, as a result, this account for delays in these projects (Damoah, 2015).

The majority of the consultants and contractors in Palestine believe that poor communication among construction parties results in project delays due to misunderstandings that arise during project implementation. For that reason, they

suggest that there is a need for raising awareness among the contracting parties to ensure teamwork in order to achieve desired project results (Mahamid (2013). One of the critical success factors in construction projects is effective communication among the projects' stakeholders since communication is an essential aspect of every construction project. Kania et al. (2020) emphasise that the success of a project is highly dependent on the flow of information among the concerned stakeholders. According to the majority of contractors, communication is vital throughout all phases of construction projects as it is central to distribution of information among all project participants. Booyens (2015) further indicates that clear and effective communication lead to successful implementation of a project because its goals and objectives are communicated. Problems encountered during project implementation are quickly shared and solved by the project teams through communication, and as such, projects are delivered within their schedules.

Poor implementation of risk management due to lack of knowledge by project managers and their teams has devastating impact on projects. Majority of the studies shown that effective application of risk management in the construction industry contributes to the success of projects (Harthi, 2015). Nonetheless, construction projects in Lesotho have taken longer than they were planned for. According to Nketekete et al. (2016), most of the public construction projects in this country are not successful in terms of time, cost, integration, quality and procurement management. It is indicated that stakeholders lack risk management knowledge and skills. As a result, these projects face time overruns at project completion stages. Furthermore, the participants in Nketekete et al's stated that employers are reluctant to promote a risk management culture. Besides risk management, the other factor that causes project delays is inadequate project specifications during the design stage, consequently leading to random variation orders.

2.11.3 Client's perceptions on the prevalence of risk factors on infrastructure projects

The clients' architects and quantity surveyors argue that sometimes the client does not allow enough time for project activities to be performed as planned. As a result, errors which are made, especially in the designs, increase the cost, lengthen the project and

affect project quality (Otobo, 2016). The author further states that contractors fail to plan early enough to avoid late delivery of materials to project site. As a result of unavailability of material on the site, some project activities are suspended until the material arrives. For this reason, the duration of the project is affected.

Eja and Ramegowda (2019) conducted a study which aimed at investigating the causes, effects and consequences of government projects failure in Nigeria. One of the causes revealed by the study was poor communication among different stakeholders such as the government and private stakeholders. This factor also affects the implementation of the project in Nigeria consequently leading to abandonment and total failure.

Ineffective planning and scheduling are some of the risk factors that lead to delay in construction projects. For instance, a study undertaken by Alotaibi (2018) in the Kingdom of Saudi Arabia (KSA) stated that poor planning and scheduling by contractors contributes to delays in public construction projects in KSA. The majority of the respondents who constitutes consultants, contractors and clients, stated that this factor is related to contractors who are unqualified, and lack skills and experience. Improper planning is also experienced in construction projects in Sudan, where this problem results in inaccurate time estimation, hence projects are delayed (Mohammed, 2015). The author further indicates that when project participants fail to plan for the project efficiently, project schedule is affected and time overrun will occur. (Mohamed, 2015).

There are serious consequences which result from lack of proper planning in the construction industry. Risks in projects can be avoidable and minimized if effective planning is established. Good planning in projects allows the project team to identify and analyse potential risks to the projects, so as to develop relevant mitigation strategies. As such, successful delivery is achieved (Philemon and Msomba, 2018). Furthermore, the same problem exists in the construction projects in Afghanistan (Hosaini and Singla, 2019). The country has experienced war for a long time consequently depriving people of proper education needed in construction industry. Most of the contractors lack knowledge in planning and scheduling, therefore it is difficult for them to manage project activities hence late project delivery.

One of the main assets in a construction project is the competence of the consultant team. The capabilities of this team in designing the projects help to avoid unnecessary schedule overrun. Therefore, consultant teams with relevant level of experience, capabilities in design works, project management skills and commitment towards the project are essential (Hadgu, 2019). In a study conducted by Booyens et al. (2015), the researchers examined how client interference in South African construction projects affects the overall outcome and success of the project. It was found that positive client interference has led to reduction of project schedule and cost. This is due to flow of information among the relevant stakeholders. Therefore, clients are provided with updates on the project progress so that the client will plan ahead and late payment issues will not arise. Furthermore, if the client uses his authority to promote cooperation amongst all the parties involved, the project will have a greater chance to be completed within schedule.

A close follow-up as well as controlling planned work leads to successful delivery of projects. Contractors' monitoring of project progress frequently, and coordinating all participants, helps to complete the projects on time. Melat (2017) investigated success factors for real estate development construction projects in Addis Ababa. This study brought to light the fact that control systems are employed in these construction projects to control planned against actual work in order to avoid delay, and projects be completed within planned cost and quality. The findings of Odhiambo's (2020) study revealed that project monitoring and coordination of project activities have a great influence on the timely completion of road projects in Kenya. It was concluded that effective project monitoring was one of the successful factors used against project time overrun.

Tekle (2019) also examined project management success determinants in the same country Kenya and assessment from the local construction companies as well as all concerned stakeholders revealed that there were 66 success factors found. Some of the most critical success factors associated with completion of projects on time included owners' involvement in the project. The outcome of the study states that owners need to precisely define the project scope and objectives. Furthermore, owners determine the success of the project by making decisions, and on time. The author further pointed out

that contractors and sub-contractors determine the successful delivery of these projects because they are responsible for site management and supervision of construction work. Makabate (2016) supports this by stating that positive owners' involvement in the projects is helpful because the owner ensures that the contractor and all participants involved acquire the resources on time and at all times. Moreover, the client ensures that there is a good relationship among all stakeholders.

According to Alotaibi (2018), consultant-related factors were ranked as the second most significant category contributing to delays in the Kingdom of Saudi Arabia's public construction projects. This is due to poor qualifications of the supervisory staff and the consultant engineers. Lack of sub-contractor skills also led to construction delays in Nigeria (Bitamba, 2020). Contractors face a major problem to get qualified staff, while some of these qualified staff leave the projects and it is not easy to retain the competent workers (Harthi, 2015).

2.12 RELATED RISK MITIGATION STRATEGIES AND PRACTICES IN CONSTRUCTION PROJECTS

Risk mitigations in Ghana

From the results obtained in a study conducted by Alhassan (2016) in Ghana, Ghanaian contractors manage risk factors by referring to the previous and ongoing projects for accurate program as the preventive method mostly used. In determining the probability and impact, they use the experience of the contractor from similar projects, and this is found to be subjective. The study also points out that due to the low levels of knowledge of risk management process, they rarely use quantitative risk analysis techniques and Primevera Monte Carlo Program. Furthermore, the frequently used mitigation method is close supervision of subordinates and working closely with sub-contractors, while the changing of the construction plan is the least used method. The results show lack of knowledge in the use of different risk analysis techniques.

Risk mitigation strategies in South Africa

Different mitigation strategies are implemented during the construction of infrastructure projects to manage the most significant risk factors in South Africa. According to

Kudumela (2015), inadequate skills capacity is managed by appointing service providers who can manage the junior staff, as well as outsourcing work to qualified organisations. In relation to lack of funding, reduction of project scope until funds are available is used. Alotaibi (2018) in a study conducted in Saudi Arabia, argued that the risk of inexperienced contractors' staff is effectively reduced in the mobilisation stage of a project. The contractors' first task is to identify the roles and responsibilities of the staff for the execution of the project through the use of WBS. This is achieved by establishing the experience and qualifications needed for those positions before recruiting them.

Risk mitigations in United Arab Emirates

Harthi (2015) states that there is little knowledge about risk management in United Arab Emirates construction projects, but more is needed to manage the risks in fast track construction projects. After the identification and the ranking of risk factors, the focus group proposed a framework that can be used to mitigate these risks. This was a Qualitative Risk Mitigation Framework which consists of six steps. The mitigation measures identified in this study were as follows:

- To undertake pre-project planning to avoid design errors and a thorough inspection before construction;
- The drawing design selection should be approved by an independent party
- Modification articles should be included in a contract.

Alotaibi (2018) further states that re-visiting the contractual agreement with the contractor during the mobilisation phase of a project, help to identify any issues that need re-negotiation in order to avoid any delays.

Risk mitigations in Qatar

Risk management is used in construction projects but to a less extent. This is supported by Yousef (2017) in a study conducted in Qatar. The aim of the study was to explore the effectiveness of both preventive and mitigation methods, as well as examining the usage of risk analysis techniques in construction projects in Qatar. The study results show that owners and contractors lack knowledge about ways to mitigate and prevent risks. The

most commonly used preventive method was based on subjective judgment of referring to previous and ongoing projects. Transferring or sharing the risks was the least used methods. The mitigation practices they relied on were: increasing supervision, increasing working hours, increasing equipment, while the changing of construction method was rarely used as a mitigation method. Yousef (2017) further indicates that risk analysis techniques such as scenario analysis, sensitivity analysis and simulation analysis were the least used because of lack of knowledge in employing them.

Malaysia

From the results of the study undertaken by Goh and Abdul-Rahman (2013) in Malaysia, formal risk management is not properly used as the construction stakeholders lack knowledge and exposure to risk management. As such, they fail to achieve the full benefits of risk management practices. The most preferred risk responses for financial risks in Malaysia are risk retention and risk control respectively.

Risk mitigation strategies in Tanzania

Completing construction projects within estimated costs and schedules requires appropriate strategies and practices. (Harthi, 2015) asserts that there are sound strategies that can be taken to minimize the causes and effects of schedule and cost overrun in these projects. Jongo et al. (2019) investigated mitigation measures in dealing with delay and cost overrun in public building projects in Dar-es-Salaam, Tanzania. The study results obtained from the questionnaires identified the top five mitigations as effective planning and scheduling, design change should be controlled, effective coordination and communication between parties, appoint competent site and project manager and comprehensive contract administration. It is indicated that there must be a good communication plan which would show the agreed hierarchy and channel.

Risk mitigations in Saudi Arabia

Proactive efforts to mitigate risks help to achieve a project's objectives. Alotaibi (2018) indicate that contractors should first identify the activities of the project before the execution. This could be achieved through the use of WBS where the experience and

qualifications needed are established. The findings of the study reveal that to minimize the construction projects' delays, contractors should encourage their skilled labour to help inexperienced workers to improve their performance and complete projects on time. The findings further suggest the involvement of all project parties through frequent communication and meetings.

2.13 SUMMARY

This chapter reviewed the related literature on identification and assessment of risk factors on infrastructure projects' schedules and costs. As a result, this literature contributed to the identification of risk factors that affect these project schedules. Although there are factors that were revealed by literature, their impact on infrastructure projects' schedule in Lesotho is not known. Therefore, this study aims to investigate the factors impacting on the above-mentioned projects' schedules so as to propose the main strategies to be employed to reduce their impact, since the risk factors are distinctive to certain geographical areas, socio-economic settings and certain industries. The theoretical framework (Theory of Constraints) which guides the study was also described here. The chapter further provided the conceptual framework that shows the relationship between the independent variables and the dependent variable.

The literature also reviewed the perceptions of the main stakeholders on the prevalence of risk factors on infrastructure projects. Risk identification tools and techniques were also discussed as they are capable of identifying project risks throughout the life-cycle of the project to avoid unexpected results. There is limited literature that has directly attempted to identify the risk factors that cause late completion of infrastructure projects in Lesotho. Through the literature review, it was found that the researchers identified the risk factors and their mitigations in their respective countries, therefore, there is a need for this investigation in the study area. Existing research on construction delays in Lesotho focused on risk management in the public sector construction projects. The issue of the most appropriate mitigation strategies that can be employed to address these schedule overruns are still being researched globally. However, the risk mitigations that are applicable in other countries might not be appropriate in the study area.

Literature found that inaccurate costing, frequent late payments to contractors, design errors by consultants, owners' slowness in decision-making, scope changes by the owner, bribery and corruption, change of government, and others affect construction projects' scheduling. It was further found that finance and owner risk factors are the most leading construction risk categories in terms of frequent occurrence and impact on the projects' schedules. Furthermore, the most leading risk factors are found to be delays of payment by the owner and scope modifications by the client. Finally, previous studies on construction delays have employed quantitative, qualitative and exploratory sequential mixed methods design to address this problem in isolation. However, this study will adopt explanatory sequential mixed methods design.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter discusses various research methods that were adopted in this study; details about research philosophy, methodology choice, sampling techniques and data collection instruments. These include the procedure followed for collecting data both in phase one and phase two, as well as the statistical methods used to analyse quantitative data, and methods for analysing qualitative data. Reliability and validity of data collected are also discussed and justification for the choice is provided. Lastly relevant ethical considerations were looked into. Methodology is the study of theoretical framing of methods or broader principles that underpin particular methods. Methodology guides the entire research project from data gathering, analysis to the final presentation (Crouch and Pearce, 2014).

3.2 RESEARCH PHILOSOPHY/PARADIGM

The idea of paradigm was first used by an American philosopher Thomas Kuhn in *The Structure of Scientific Revolutions* in 1962. In his view, a paradigm refers to a philosophical way of thinking. Kivunja and Kuyini (2017) state that a paradigm comprises a theoretical convictions and rules that shape how a researcher sees the world and how he interprets and acts within that world. According to du Plooy-Cilliers et al (2014), a paradigm refers to ‘a cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, how research should be done and how results should be interpreted’. The idea of the term paradigm is used in natural sciences while in social sciences paradigms are referred to as worldviews (du Plooy-Cilliers et al. 2014). Knowledge of paradigms helps the researcher to adopt a specific way of studying a phenomenon and it guides the researcher to decide on the research methods to be employed in a study and how data will be analysed. The two popular paradigms are positivism and interpretivism. As stated by Creswell and Creswell (2018), the four world views are post-positivism, constructivism, transformative and pragmatism.

Positivism is a research paradigm for scientific research. Positivists believe that in order to understand and explain natural phenomena, the facts should be objective, observable

and verifiable. Unlike positivists who focus on objectivism, Interpretivists view reality to be subjective as a researcher interacts with the phenomena being investigated. Interpretivists argue that people cannot be studied in a similar manner with objects, therefore, the human behaviour can be understood from the researcher's own standpoint (du Ploy-Ciliers et al. 2014). In a positivist paradigm, the researcher and the phenomena being studied are independent of each other, whereas in interpretivism, the researcher and the phenomena being studied interact and influence each another. Interpretivists state that in social science, researchers should study and describe meaningful social action while positivists aim to discover and explain the causal relationships of the phenomena being investigated. Interpretivism depends on the collection and analysis of qualitative data while positivism depends on collection and analysis of quantitative data (McNabb, 2015).

In contrast to positivism and interpretivism, pragmatism does not view the world as an absolute unity, what matters is the truth that works at the time, and it is not based on one philosophy and reality. In this worldview, the researcher is at liberty to choose the methods, techniques and procedures which are appropriate to address the research problem (Creswell, 2013).

Therefore, the pragmatic worldview is adopted in this study where the mixed-methods strategies were used. Acknowledging that other philosophies have limitations, the researcher adopted this worldview because there are no restrictions in selecting methods and procedures for investigating the phenomena. The advantage of using this approach in this study is that the weaknesses of quantitative research methods were neutralised by the strengths of qualitative research methods.

Pragmatists indicate that research occurs in social, historical, political and other contexts (Creswell and Creswell, 2018), therefore, pragmatism is appropriate in this study as it tries to find the perceptions of the contractors and consultants on the risk factors impacting on infrastructure projects' schedules which are influenced by social, historical, political and other contexts. Furthermore, pragmatic researchers look at what and how to research (Creswell, 2013) hence this worldview is the most appropriate for this study

since it investigates the risk factors which affect infrastructure projects' completion date in the study area.

3.2.1 Ontological and Epistemological position of pragmatism

Ontology deals with reality. The main question here is what reality is, and how we get know what is real because there are assumptions that are made about certain phenomena (du Plooy-Cilliers, 2014). The ontological position of pragmatism is that there is one reality and different perceptions of this reality in the mind of social researchers. In pragmatists view, the existence of reality depends on the context prevailing at that time. Therefore, different contexts result in multiple realities (Marouf, 2019).

According to du Ploy-Cilliers et al. (2014), epistemology deals with the nature of knowledge and the different ways of knowing. It deals with questions such as what is considered as knowledge, and what are the limits of knowledge. Pragmatism is defined from the epistemological position in the sense that knowledge can be seen as observable and unobservable, therefore the researcher accepts these two types of knowledge. This is due to the fact that knowledge in natural sciences is different from knowledge in the social sciences (Marouf, 2019).

3.3 RESEARCH APPROACH AND DESIGN

Schreiber and Asner-Self (2011) describe mixed-methods as an approach where the researcher collects data based on research questions which will contain both numbers and non-numbers using related methodologies categorised under quantitative and qualitative framework. According to Creswell (2014), mixed-methods is an approach to inquiry which incorporates the elements of both quantitative and qualitative approaches, and the two forms of data are blended. Furthermore, mixed-methods provide the researcher with additional insight beyond the information which would be provided by either quantitative or qualitative alone (Creswell and Clark, 2018).

This study has adopted a mixed-methods approach which helped the researcher to address the research problem in the best way, and, the two forms of data was integrated in the design analysis through explaining data. The mixed-methods approach was the

most appropriate approach in this study as Leedy and Ormrod (2015) state that the good reason for using this approach is that the research problem will be addressed successfully by collecting, analysing and interpreting both quantitative and qualitative data. Furthermore, the weaknesses of quantitative research will be neutralised by qualitative research. The rationale for using mixed-methods approach is that quantitative data and results were employed to identify the risk factors which impact of infrastructure projects' schedules as well as determining the risk perceptions of the main stakeholders in relation to infrastructure projects' risks. Furthermore, qualitative data analysis was used to recommend the mitigation strategies for the identified risk factors.

A research design is a procedural plan of how a research study is to be conducted by the researcher (Kumar, 2011). As the study has adopted the mixed-methods research, the three main mixed-methods research designs are the convergent design, the explanatory sequential design and the exploratory sequential design (Leedy and Ormrod, 2015). Explanatory sequential was used in this study to address the research objectives. This is a two-phase design where the researcher collects and analyses quantitative data in the first phase, and follows up with a qualitative phase on particular results that develop from the results of the quantitative phase, (Creswell, 2014). Dawadi et al. (2021) state that this design is appropriate for studies where the researcher requires qualitative results to explain significant, non-significant or remarkable quantitative results. Furthermore, this design was appropriate in this study as the research problem is more quantitatively oriented. Thus, it was appropriate to start the procedures with a quantitative phase. The advantage of using this design is that its structure is straightforward to implement. Here the researcher administered the two phases separately, starting by quantitative then followed by qualitative. As a result, it is a manageable design to use, (Creswell and Clark, 2018).

In this study, quantitative approach was first employed to identify risk factors impacting on government infrastructure projects' schedule as well as determining the risk perceptions of the main stakeholders. On the other hand, qualitative approach followed quantitative to recommend the risk mitigation strategies and practices used by the stakeholders in the aforementioned projects.

3.4 POPULATION & SAMPLING

Population refers to objects, subjects, phenomena, events or activities which have the same characteristics the researcher wishes to research (Brynard et al. 2014). In Lesotho, the Ministry of Public Works and Transport's mandate is to monitor and regulate the construction industry and to set standards and guidelines in order to ensure high quality services in the construction industry. To achieve this aim, the ministry has five departments: Administration, Building Design Services, Department of Civil Aviation, Department of Traffic and Transport, and Road Safety Department. All construction companies operating in Lesotho should be registered with the ministry. The ministry also incorporates registered consultants. The targeted population for the study thus included project managers, contracts managers, architects, quantity surveyors, and engineers of registered construction companies, all registered consultants, and government officials in the Department of Building Design Services, and from the Ministry of Development Planning. The entire population was 200 people as obtained from the Ministry of Public Works and Transport records, which comprised 65 engineers, 33 quantity surveyors, 27 government employees from the department of Building and Design, and from the Ministry of Development Planning, 20 project managers, 10 contracts and construction managers, and 35 architects (T'soeu, 2021).

Sampling method

Sampling is the process where the researcher chooses few respondents from the population to be studied to become the basis for the generalisations about the bigger group (Kumar, 2011). Different methodologies require different sampling techniques in research. The techniques for sampling are in two categories, namely probability and non-probability sampling. In probability sampling, respondents have equal chance of being selected in the sample, and the probability of being selected in the sample is known, (Creswell, 2014). However, in non-probability sampling, respondents in the population do not have equal chance of being selected in the sample, and sometimes they have no chance of being selected (Fox and Bayat, 2011).

The experience of the respondents in the infrastructure projects formed the basis for the selection of the sample. In the first phase of quantitative approach, probability sampling was used in order to make generalisations on the findings of the study. This study employed Simple Random Sampling (SRS) to obtain a sample that accurately represented the entire population. According to Kumar (2011), in (SRS), each element in the population is given equal chance of being chosen. Respondents with experience of five years and more were selected randomly.

In the second phase of qualitative approach, purposive sampling was adopted where the participants who provided data that addressed the research objectives were invited. Creswell (2013) states that in purposive sampling, the researcher's judgment is used to select people who according to the researcher have the required information needed in the study. Participants from this phase who understand the central phenomena, were selected from the population with the help of experts in the construction industry and those with risk management expertise. Due to time and costs constraints, the sample was drawn from Maseru as the majority of the construction companies and consultants are based in Maseru.

The objective of sampling is to determine the representative of the study population in order to make inferences about the population. The researcher adopted the survey type of research in which a sample from the target population was used for the study. The study employed the Cochran's formula of determining sample size for a known population. Confidence level of 90% and 7.53% sampling error was considered. The formula is:

$$n = (Z^2 * p * q) / E^2 \dots\dots\dots \text{Equation 1}$$

Where:

- n = sample size
- Z = the standard normal distribution value corresponding to the desired confidence level (in this case, 1.645 for 90% confidence)
- p = the proportion of the response distribution (in this case, 50%)
- q = 1-p
- E = the margin of error (in this case, 7.53%)

The outcome of substituting the given values is as follows:

$$n = (1.645^2 * 0.5 * 0.5) / (0.0753^2) \quad n = 74.89$$

Rounding up leads to a sample size of 75 respondents.

This means that in order to achieve a 90% confidence level with a margin of error of 7.53%, 75 randomly selected individuals from a population of 200 would need to be surveyed, assuming that the response distribution is 50%.

Table 3.1: Calculation of sample size from each category or group.

Category/group	Frequency	% of total frequency [(frequency/200) *100]	Sample %*75
Architects	35	18	14
Construction Managers	10	5	3
Contracts Managers	10	5	3
Project Managers	20	8	6
Government Employees	27	14	11
Quantity Surveyors	33	17	13
Engineers	65	33	25
Total	200	100	75

3.5 DATA COLLECTION

Data can be categorised as primary and secondary data. Information obtained using observation, interviewing or questionnaire is primary data as it has been extracted from primary sources. Secondary sources that provide secondary data are those such as government publications, past researches, service records and others (Brynard et al. 2014). In this study, data was collected from the ongoing projects which had been delayed, the completed and the abandoned which suffered schedule overrun.

In explanatory sequential mixed methods, data is collected in two phases, the initial phase is quantitative data collection followed by the second phase; qualitative data collection.

Phase one: Quantitative Approach

Quantitative data collection was the first phase in explanatory sequential design. Descriptive survey design best suits this study; therefore, a questionnaire was the most appropriate technique to collect data. The study started with a literature review which was used to gain a better understanding of construction projects' risks. This formed the basis for the design of the questionnaire that was administered in this phase. This questionnaire focused on identifying risk factors impacting on government infrastructure projects' schedules. Firstly, after the design of the questionnaire, it was presented it to the supervisor and a few construction professionals for review. These chosen professionals had more than 10 years of experience, therefore, they provided relevant information.

A Likert scale is the most common scale used in the social sciences because it is easy to compile (Fox and Bayat, 2011). As a result, a five-point Likert scale was used in the questionnaire which consisted of closed-ended questions, where the respondents showed the degree to which they agreed or disagreed with the content. du Plooy-Cilliers (2014) points out that the advantage of using close-ended questions is that it is easy for the researcher to quantify the responses.

The questionnaire was then refined on the basis of the pilot survey feedback. The questionnaire was divided into two main sections, mainly the demographics of the respondents and identification of risk factors. These questionnaires were then delivered to the respondents through e-mail and hand delivery. The respondents were also requested to return them after completion within a specified time frame, and collection of the questionnaires was done by the researcher. The advantages of using questionnaires is that, they are less expensive as they save time and financial resources. They also offer greater anonymity as the researcher does not have face-to-face interaction with the respondents. Furthermore, they are easy to construct and administer (Kumar, 2011).

Phase two: Qualitative Approach

The adopted primary data collection technique in this phase was semi-structured interviews which were conducted through zoom meetings. These interviews consisted of open-ended questions. The advantage of using open-ended questions in interviews is that it is possible for the researcher to get in-depth information by probing (Kumar, 2011). These interviews were employed to establish the risk mitigation strategies and practices that are used to reduce the probability and effects of risks on infrastructure projects' schedules.

The content for the questions was derived from the literature review in the previous chapter, and some were constructed with the assistance of industry professionals who had a greater knowledge and experience of risks in infrastructure projects. In order to cover research questions satisfactorily, a variety of questions were asked in the context of the stakeholders' perspectives and experiences. Firstly, the researcher made self-visits, telephone calls and e-mails to the relevant companies and individuals seeking permission to conduct interviews. The interviewees comprised two quantity surveyors, one structural engineer, one project manager and one architect.

3.6 VALIDITY AND RELIABILITY ASSURANCE

Validity

The term validity means that the measurements are correct; the instrument measures what it is intended to measure, and that it measures it correctly. Also, a valid measure accurately represents the relationship between things (Fox and Bayat, 2011). Among all the types of validity, content and construct validity were established in this study.

Content Validity

This is the extent to which the items on the data collection instrument adequately covers all the content that they should cover with respect to the variable (Schreiber and Asner-Self, 2011). In order to check for the validity of the instrument, content validity was ensured by seeking input from the supervisor and experts in the relevant field. The risk factors that were included in the questionnaire were based on the literature review, and

were sent to experts in the field of infrastructure projects, as well as the university supervisor to examine the wording of the survey items, and to check if the survey questions were relevant to the phenomena under investigation. In order to determine the validity of the questionnaire, a pilot study was undertaken with the purpose of refining the questionnaire. It was administered to a sample group of six participants comprising two engineers, two quantity surveyors and two architects. Creswell (2014) argues that a pilot study should precede actual data collection so that the questions, format and scales may be improved. After the return of the piloted questionnaires, modifications were made so that all questions would be comprehended by participants.

Construct Validity

Construct validity is the extent to which the data collection instrument provides scores that can be used to make inferences about a construct (Schreiber and Asner-Self. 2011). du Plooy-Cilliers et al (2014) indicates that construct validity assesses the extent to which a measuring instrument accurately measures a theoretical construct. The objective of Confirmatory Factor Analysis (CFA) model is to test hypothesis, either about the number of the underlying factors or the variables that load on any single factor, the researcher can test the hypothesis by examining the factor loadings, (du Plooy-Cilliers et al. 2014). In this study, the CFA was used to test whether the data collected supported a hypothesized model.

Reliability

Quantitative reliability means that the scores received from the respondents are consistent and stable over time, (Creswell and Clark, 2018). Kumar (2011) indicates that reliability of a research instrument is the extent to which it is able to reproduce similar results, under a similar methodology when the constructs are measured under constant conditions. Earl (2008) also maintained that reliability of a measurement instrument is the extent to which it yields the same results each time when it is applied repeatedly to the same object. This implies that when a test is repeated more than once, and the results are similar, then the study results are reliable.

In order to check for the reliability of data collected, Cronbach's alpha (α) was employed to measure internal consistency of the measured concepts. According to Creswell and Creswell (2018), a scale's internal consistency is evaluated by Cronbach's alpha (α) coefficients that range between 0 and 1, and the acceptable internal consistency varies between 0.7 and 0.9, while a scale of 0 indicates no internal consistency, (Schreiber and Asner-Self, 2011).

Phase two: Qualitative Validity and Reliability

Qualitative researchers use the concept of "trustworthiness" to measure reliability and validity in qualitative studies (du Plooy-Cilliers, 2014). According to Kumar (2011), trustworthiness is determined by four dimensions, namely: credibility, dependability, confirmability and transferability.

Credibility, according to Kumar (2011), relies mainly on how believable or credible the results are from the perspectives of the respondents in the study. In order to determine the credibility of this study, the member checking strategy was used. Copies of the studied transcripts were sent to the participants in order to confirm or verify that the transcripts reflected their opinions and feelings accurately. All the participants' responses approved that the information provided was accurate. Creswell (2014) indicates that if the outcome from participants is high, then the validity of the study is also high.

Dependability

Another dimension for trustworthiness is dependability, and it is determined by whether the same results would be obtained if a similar phenomenon could be observed twice, (Nowell et al. 2017). In this study, a detailed record of the research process is provided and documentable so that the readers can attempt to replicate if desired.

Qualitative Reliability

In this study, reliability was enhanced by providing enough information on the process of the research study so that it becomes traceable and documentable to the reader. The researcher kept a detailed record of the process of integration of data collection methods and data analysis so that others would ascertain the level of dependability. Creswell and

Creswell (2018) have suggested several qualitative reliability procedures. Among them, the researcher reviewed transcripts to ensure that they contained no mistakes. In addition to that, coding procedures were checked to guarantee that there was no drift in the definition of codes. This was achieved by repeatedly comparing data with the codes.

3.7 DATA ANALYSIS

Quantitative data analysis

The study used mediation analysis to analyse quantitative data. Chen (2021) states that Statistical Mediation Analysis serves as a tool used to assess indirect effects within a causal sequence, and seeks to answer the questions of “why” and “how” observed results occur. Mediation analysis is employed to identify intermediate variables that transfer the effect of the Independent Variable (IV) on the outcome. It is further used to quantify the magnitude and test the importance of the indirect effect. The focus of mediation analysis is on three principal effects, that is, total effect, indirect effect and direct effect, (Miocevic, 2022). In order to determine which risk categories have a significant impact on the infrastructure projects’ schedule, the study used mediation analysis which, according to Saunders and Blume (2017), explores the extent to which independent variable’s effect on a dependent variable is diverted through a mediating variable.

In this study, a causal sequence was conducted in which the independent variables FF, OF and DF affects dependent variable IPS indirectly through the mediator variable GF. It is suggested that these independent variables affect GF and this effect then passes on causally to IPS. Furthermore, FF, OF and DF affect IPS directly without their influence on GF. Chen (2021) indicates that the coefficients are used to estimate the direct and indirect effects. Therefore, the outcome of mediation analysis determines the acceptance or rejection of pre-defined hypothesis (Gunzler et al. 2013).

Qualitative data analysis

This section discusses the procedure that was applied in the data analysis of semi-structured interviews after data was collected. Several steps were used to analyse the risk mitigation strategies used in IP. The procedure that was adopted in the analysis of data collected is discussed in detail in order to reveal how different themes were derived.

Despite several methods of qualitative data analysis, this study adopted thematic analysis. Nowell et al. (2017) indicate that thematic analysis is a useful method as it examines the views of the research participants by highlighting their similarities and differences. The following steps were followed in the data analysis process:

- Before analysing data, all the audio-recorded interviews from five participants were transcribed. According to Kumar (2011), transcribing data is the first step in analysing qualitative data where the researcher writes down notes taken during the interviews. Therefore, in this study, text from recorded audio was written down word by word so that no important information would be omitted, and each participant was labelled next to their transcribed data. This was followed by going through the responses from the respondents to each question line by line in order to get the general mitigation strategies for IP before analysing data.
- Coding the collected data is another step that follows transcription of interviews. This involves taking text data collected during interviews into categories with a term (Creswell, 2013). From the interview responses, the main themes were identified and categorised for each transcript. Identical themes were classified together, while the different ones were separated. Data was then classified based on the risk mitigation strategies from collected data, and codes were assigned to each of them using keywords. In the identification of emerging themes in the interview data, the coding label was taken from the exact words of the participants. All the mitigations provided by the respondents were listed based on financial, design, and owner risk factors. This coding was undertaken manually.
- The mitigations under each theme were analysed based on how frequent the respondents mentioned them.

3.8 ETHICAL CONSIDERATIONS

Research has to be conducted ethically within the relevant rules and ethical considerations, (Crouch and Pearce, 2012). Ethical aspects of this research were effectively addressed as proposed by Creswell (2013). Firstly, permission was sought from the Central University of Technology, companies, associations of respondents, government ministries, as well as individuals before involving the participants in the

research exercise. The participants in the research, both in the questionnaire survey and semi-structured interviews, were not subjected to coercion in any way. Their rights were respected and they took part voluntarily. Furthermore, the researcher maintained anonymity or privacy of participants by keeping collected data confidential so that they will not be identified by anyone reading the report. To ensure that anonymity was achieved, unique code numbers were assigned to participants. In obtaining informed consent, research participants were fully informed about the procedures and risks involved in participating in research before giving their free and unforced consent.

3.9 SUMMARY

The chapter discussed the research approach adopted in this study which is mixed-methods together with the rationale for choosing this method. This approach entails the combination of both quantitative and qualitative methods. The procedures for data collection using questionnaires and interviews were also presented, as well as the different strategies to ensure validity and reliability of data collected, such as Cronbach's alpha (α) and Confirmatory Factor Analysis in quantitative data, and trustworthiness in qualitative data. The chapter also provided the research population and sampling techniques used in this study. Moreover, different statistical procedures that analysed quantitative data such as Regression Analysis with mediation, were presented, as well as thematic analysis method for analysing qualitative data.

CHAPTER 4: DATA ANALYSIS

4.1 INTRODUCTION

This chapter presents the results from the questionnaire survey and semi-structured interviews based on the objectives of the study which are: (1) identification of risk factors affecting infrastructure projects' duration (2) determining the risk perceptions of the main stakeholders on the abovementioned projects, (3) to recommend risk mitigation strategies and practices that can be used by stakeholders to minimise the effects of the identified risks. Lastly, the discussion of the findings of this study is also presented.

4.2 PRELIMINARY DATA ANALYSIS

Results of the study revealed that out of 75 respondents, 58 were male while there were 17 females. The majority of the respondents were engineers (36%), followed by quantity surveyors (17.3%) and architects (16%). The Chi-squared test showed a significant association between profession and gender ($\chi^2 (6) = 22.084, p=0.001$). Further analysis revealed that the proportion of female respondents was significantly higher in the government officer profession than in any other profession ($p<0.05$). The present study's findings indicate that there is a significant relationship between profession and gender among respondents. The study also found that the government officer profession had a higher proportion of female respondents. This finding highlights the need to encourage more females to enter male-dominated professions such as engineering and construction management.

Table 4.1: Respondents' profession vs gender

PROFESSION	Gender (M/F)		Total
	MALE	FEMALE	
Architect	11	1	12
Construction Manager	2	0	2
Contracts Manager	1	0	1
Government officer	4	9	13
Project Manager	7	0	7
Quantity Surveyor	12	1	13
Engineer	21	6	27

Table 4.1: Respondents' profession vs gender

PROFESSION	Gender (M/F)		
	MALE	FEMALE	Total
Total	58	17	75

Table 4.2: Chi-Squared Tests: profession vs gender

	Value	df	P
X ²	22.084	6	0.001
N	75		

Table 4.3 shows that out of 75 respondents, few male respondents (6.9%), and female respondents (17.6%) possess experience between 6-10 years. Moreover, (50.6%) of the respondents had experience of more than 15 years, and this was dominated by the 31 male respondents, while 5 males and 5 females had the least experience which is between 1-5 years in the construction of infrastructure projects. Therefore, with this experience, it is expected that they attain planned projects' schedules as their experience helps them to identify and work on the risks identified. As can be seen by the frequencies tabulated in Table 4.4, there is a significant relationship between gender and experience, ($X^2(3) = 8.111, p = 0.044$), as the p -value is below the threshold for statistical significance which is 0.05. Therefore, the study results indicate that male construction professionals are more experienced than females.

Table 4.3: Participants' experience in infrastructure projects vs gender

EXPERIENCE	Gender (M/F)		
	MALE	FEMALE	Total
1-5	5	5	10
11-15	18	2	20
6-10	4	3	7
>15	31	7	38
Total	58	17	75

Table 4.3: Participants' experience in infrastructure projects vs gender

EXPERIENCE	Gender (M/F)		Total
	MALE	FEMALE	

Table 4.4: Chi-Squared Tests: experience vs gender

	Value	Df	P
χ^2	8.111	3	0.044
N	75		

Table 4.5 below was intended to extract information about work the experience that the respondents had in the implementation of infrastructure projects, as well as the number of projects they had worked on. This table shows that the majority of respondents (51%) had above 15 years of experience, while 23% had below 10 years of experience. Moreover, those with 11-15 years of experience made up (26 %) respondents out of the total sample of 75. It is apparent from these statistics that slightly more than half of the survey sample (51%) had over 15 years of experience in the construction industry. For that reason, they had a good knowledge of construction projects' risks that result in project schedule overrun. The other essential information demonstrated by this table is the number of projects worked on by the participants. This information indicates that only 12 respondents had worked on over above 20 projects which is a relatively small number as compared to 38 respondents who had been involved in 10 projects and below. Therefore, this might be a challenge in the successful implementation of these projects, although 51% had above 15 years of experience. At a significance level of 0.05, it is concluded from the Chi-Squared results of Table 4.6 that the association between the two categorical variables (number of projects the respondents had worked and the experience they had) is statistically non-significant, ($\chi^2 (9) = 15.283, p=0.083$).

Table 4.5: Number of infrastructure projects participants worked vs experience (years)

NUMBER OF PROJECTS	EXPERIENCE				Total
	1-5	11-15	6-10	>15	
1-10	9	10	4	15	38
11-20	1	9	3	12	25
21-30	0	0	0	5	5
>30	0	1	0	6	7
Total	10	20	7	38	75

Table 4.6: Chi-Squared Tests: number of projects vs experience

	Value	df	P
χ^2	15.283	9	0.083
N	75		

The different experience level of respondents up to above 15 years is presented in Table 4.7 below. The table shows that 60.7% of the respondents who are aged between 40-50 had an experience of 15 years and above, while all the 18 respondents who were above 50 years of age had also worked in this industry for more than 15 years. The majority of respondents (50.1) had an experience above 15 years. Therefore, this indicates that infrastructure projects are implemented by experienced professionals who have the ability to deliver these projects within the scheduled duration. On the other hand, a total of 17 participants had experience of 10 years and below. In Table 4.8 below, the p -value of 0.01 indicates a strong relationship between the age of respondents and their experience, ($\chi^2 (9) = 53.290, p=0.01$). It can be concluded that respondents who have more years of experience, also have more years of age, meaning that they have been in the construction industry for a long period of time.

Table 4.7: Participants' age vs experience in construction industry

AGE	EXPERIENCE (years)				Total
	1-5	11-15	6-10	>15	
20-30	5	1	2	0	8
31-40	4	11	3	3	21
40-50	1	8	2	17	28
> 50	0	0	0	18	18
Total	10	20	7	38	75

Table 4.8: Chi-Squared Tests: age vs experience

	Value	Df	P
X ²	53.290	9	< .001
N	75		

The participants were asked to indicate the number of construction projects they worked on. As shown in Table 4.9, the findings depict that 50.6% of the total respondents had been involved in 10 or fewer projects, 33.3% had undertaken 11-20 projects, 6.6% executed 21-30 projects while 9.3% had worked on more than 30 projects. The results show that the majority of participants had undertaken fewer projects as compared to other groups. This is an indication that a large number of construction professionals in Lesotho have carried out a few projects in the last five years, as a result they are unable to handle the challenges found in this industry. Moreover, 4% of respondents who aged from 41-50 carried out more than 30 projects. It can therefore be concluded that a large number of projects had been carried out by few but mature professionals. There is an association between the number of projects respondents had carried out and their age as presented by Table 4.10 below. The p-value indicates that these two variables are not independent of each other, and that there is a statistically significant relationship between them, (X² (9) = 17.351, $p=0.043$).

Table 4.9: Number of projects respondents worked vs age

NUMBER OF PROJECTS	AGE				Total
	20-30	31-40	41-50	> 50	
1-10	7	14	12	5	38
11-20	1	7	11	6	25
21-30	0	0	2	3	5
>30	0	0	3	4	7
Total	8	21	28	18	75

Table 4.10: Chi-Squared Tests: number of projects vs age

	Value	df	P
X ²	17.351	9	0.043
N	75		

The distribution of respondents based on their profession and number of projects they had carried out is represented in Table 4.11. This table clearly demonstrate respondents who were professionals and capable of providing the required information reflected by the number of projects they had executed. The table shows that the majority of the sample were engineers (36%) although only 11% of them had worked in over 20 infrastructure projects. This is followed by quantity surveyors (17%), while the fewest were contracts managers (1.3%) and construction managers (2.6%). This indicates that engineers were deeply involved in the survey and their opinions were obtained in higher numbers. The results further reveal that there are very few construction managers in the study area.

The table below (4.11) provides information regarding the number of infrastructure projects respondents had worked on over the past five years. The results tabled below indicate that the respondents who had executed 1-10 projects made up the largest proportion of 38 of the total responses, and this is found to be the lowest number of projects executed. Moreover, the least number of respondents (5) had worked in 21-30

projects, while 7 respondents had carried out more than 30 infrastructure projects. The profession of respondents seems not to be related to the number of projects respondents had worked on. The *p-value* of (0.849) signifies that the difference between the two proportions is statistically non-significant because ($X^2 (18) = 11.965$, $p=0.849$) as it is reflected in table 4.12.

Table 4.11: Respondents' professional position vs number of projects

PROFESSION	NUMBER OF PROJECTS				Total
	1-10	11-20	21-30	>30	
Architect	3	5	2	2	12
Construction Manager	1	1	0	0	2
Contracts Manager	0	1	0	0	1
Government officer	9	3	0	1	13
Project Manager	3	3	0	1	7
Quantity Surveyor	6	4	1	2	13
Engineer	16	8	2	1	27
Total	38	25	5	7	75

Table 4.12: Chi-Squared Tests: profession vs number of Projects

	Value	Df	p
X^2	11.965	18	0.849
N	75		

With regard to the experience that the participants had, 50.6% had worked for more than 15 years in the construction industry, while 26.6 % had been in the construction industry for 11-15 years as indicated in Table 4.13. Therefore, a larger number of the respondents had been in the industry long enough to have acquired enough experience needed to respond appropriately to construction projects' risks that impact on their schedules. This table further presents the respondents' profile in terms of their profession in the construction industry. The respondents comprised 27 engineers (36%), followed by an

equal number of 13 (17.3%) Quantity Surveyors and Government officers. According to this table, the Contracts Manager and the Construction Managers constituted the minority of respondents (1.3%) and (2.6%) respectively. Most importantly, engineers had developed a depth of experience since 59.2% of them had more than 15 years working in this industry as shown by Table 4.13. Out of 7 project managers, 5 of them had experience above 15 years. this means that the majority of project managers have sufficient experience hence understand issues related to risk factors affecting infrastructure projects' duration.

To identify the association between participants' profession and their experience in the construction industry, the Chi-Square test of independence was employed. The results presented in table 4.14 showed that there is no relationship between them, ($X^2 (18) = 24.644$, $p=0.135$), because the p -value is above 0.05; the significance value. Therefore, construction experience does not depend on the profession.

Table 4.13: Participants' profession vs construction experience (years)

PROFESSION	EXPERIENCE (years)				Total
	1-5	11-15	6-10	>15	
Architect	0	5	1	6	12
Construction Manager	1	0	0	1	2
Contracts Manager	0	0	0	1	1
Government officer	4	3	4	2	13
Project Manager	1	1	0	5	7
Quantity Surveyor	0	5	1	7	13
Engineer	4	6	1	16	27
Total	10	20	7	38	75

4.14 Chi-Squared Tests: profession vs experience

	Value	Df	P
X^2	24.644	18	0.135
N	75		

In Table 4.15, 37.3% (28) of respondents were in the 40-50 age category, followed by the 31-40 age category (28%), and 20-30 age group (10.6%). This table reveals that there was a high level of maturity among respondents in relation to construction projects issues as 61.3% of the respondents were above the age of 40. As shown in Table 4.15, the respondents surveyed seemed to have a higher number of males responsible for the activities of construction projects. This table further shows that 58 of the respondents were males, while females added up to 17 which is much lower than males. Therefore, it could be concluded that this is a male-dominated industry. Respondents' age and gender were examined to find out whether there is a relationship between participants' age and gender. It was found out that the *p-value* is far above the significance value, ($X^2 (3) = 1.346, p=0.178$). Therefore, there is no association between these two as shown in Table 4.16, this implies that the gender of respondents is not determined by their age.

Table 4.15: Respondents' age vs gender

AGE	Gender (M/F)		Total
	MALE	FEMALE	
20-30	7	1	8
31-40	15	6	21
40-50	21	7	28
> 50	15	3	18
Total	58	17	75

Table 4.16: Chi-Squared Tests: age vs gender

	Value	df	P
X^2	1.346	3	0.718
N	75		

Table 4.17 below shows the respondents' profession in relation to their age range. From the survey results, 37.3% of the respondents fall within the age range of 40-50, and the majority of them are engineers (46.4%). Among the respondents, 18 are aged above 50 years and only 5 of them are Project Managers. Apart from that, only 8 respondents were aged between 20-30. This shows that most of the construction companies had mature professionals who are capable of carrying out project work efficiently. According to these results, engineers are the key people in the construction industry as they are the dominant profession in this study. However, there are no project managers ranging between 40-50, and generally the results show that there is a shortage of project managers in Lesotho construction companies. This means that project management skills and techniques are not fully utilized due to lack of qualified project managers although they are strongly needed to ensure successful implementation of projects.

The association between respondents' profession and their age shows that the p -value of the Chi-Square test turned out to be 0.008, ($X^2(18) = 35.385, p=0.008$), this being far less than the significance level 0.05. This indicates that profession has a statistically significant relationship with age. Therefore, knowing the profession can determine the age of the participant.

Table 4.17: Respondents' profession vs age

PROFESSION	AGE				Total
	20-30	31-40	40-50	> 50	
Architect	0	6	3	3	12
Construction Manager	1	1	0	0	2
Contracts Manager	0	0	0	1	1
Government officer	1	7	3	2	13
Project Manager	1	1	0	5	7
Quantity Surveyor	1	0	9	3	13
Engineer	4	6	13	4	27
Total	8	21	28	18	75

Table 4.18: Chi-Squared Tests: profession Vs age

	Value	Df	p
χ^2	35.385	18	0.008
N	75		

4.3 CONFIRMATORY FACTOR ANALYSIS

As mentioned in the previous chapter, a scale is said to be reliable if Cronbach's coefficient Alpha of the scale is above the threshold value of 0.70. According to Creswell and Creswell (2018), the acceptable internal consistency varies between 0.7 and 0.9. In this study, the test results in Table 4.19 below show that Cronbach's α is 0.871. This indicates that the overall reliability of data is above the standard threshold which suggests that the data is highly consistent and reliable to use.

Furthermore, table 4.20 shows the item that could improve Cronbach's α if they were dropped. From the observation in table 4.20, the increase made when one of these items is removed is almost non-significant compared to the current α which is 0.871. Therefore, none of these items will be deleted because their deletion will not significantly improve the current α .

Table 4.19: Frequentist Scale Reliability Statistics

Estimate	Cronbach's α	mean	Sd
Point estimate	0.871	137.413	16.170
95% CI lower bound	0.824	133.754	13.932
95% CI upper bound	0.909	141.073	19.270

Table 4.20: Frequentist Individual Item Reliability Statistics

Item	If item dropped		
	Cronbach's α	Mean	Sd
B1	0.874	4.080	1.205
B2	0.869	3.973	1.162
B3	0.870	3.987	1.202
B4	0.868	3.147	1.322
B5	0.866	3.680	1.307
C1	0.867	4.720	0.708
C2	0.867	4.133	0.949
C3	0.866	3.400	0.986
C4	0.870	4.333	0.890
C5	0.869	4.387	0.804
D1	0.864	3.427	1.357
D2	0.866	3.240	1.303
D3	0.863	3.827	1.070
D4	0.867	3.440	1.093
D5	0.863	3.933	1.107
E1	0.865	4.200	0.959
E2	0.866	4.067	0.963
E3	0.865	3.973	0.915
E4	0.864	3.933	1.044
E5	0.866	4.093	0.989

The CFA model concerns the relations between measures of constructs, indicators, and the factors they were designed to measure (du Plooy-Cilliers, 2014). When the p -values of the manifest variables are less than 0.05, it means that the construct or factor is validated. From Table 4.21, the CFA indicates that all the manifest variables under the government risk factors belonged together. The p -values corresponding to those variables are far less than 0.05 significance level. Furthermore, this table was also meant to evaluate if the manifest variables under finance risk factors measure the factor they were intended to measure. Therefore, it was revealed that this construct was well-measured since the p -values of the variables are all below 0.05 which is the significance level. The table further shows that the design risk factors were validated since all the p -values of the variables are less than 0.05. From the analysis of Table 4.21, it is evident that all the indicators loaded under owner risk factors are associated to this factor as all

the p -values corresponding to those indicators are 0.001. Therefore, owner risk is validated because the manifest variables had measured what they were intended to measure.

Table 4.21: Factor loadings

Factor	Indicator	Symbol	Estimate	Std. Error	z-value	p	95% Confidence Interval	
							Lower	Upper
GOVERNMENT FACTORS	B1	λ_{11}	0.468	0.157	2.982	0.003	0.160	0.776
	B2	λ_{12}	0.490	0.151	3.252	0.001	0.194	0.785
	B3	λ_{13}	0.687	0.151	4.541	< .001	0.390	0.983
	B4	λ_{14}	0.854	0.165	5.187	< .001	0.531	1.176
	B5	λ_{15}	0.692	0.166	4.178	< .001	0.367	1.017
FINANCE FACTORS	C1	λ_{21}	0.286	0.087	3.281	0.001	0.115	0.458
	C2	λ_{22}	0.549	0.112	4.896	< .001	0.329	0.768
	C3	λ_{23}	0.654	0.114	5.732	< .001	0.431	0.878
	C4	λ_{24}	0.425	0.108	3.934	< .001	0.213	0.636
	C5	λ_{25}	0.275	0.100	2.744	0.006	0.079	0.472
DESIGN FACTORS	D1	λ_{31}	0.974	0.142	6.851	< .001	0.695	1.252
	D2	λ_{32}	0.914	0.138	6.642	< .001	0.644	1.183
	D3	λ_{33}	0.869	0.107	8.160	< .001	0.661	1.078
	D4	λ_{34}	0.565	0.124	4.549	< .001	0.322	0.809
	D5	λ_{35}	0.705	0.120	5.863	< .001	0.469	0.941
OWNER FACTORS	E1	λ_{41}	0.607	0.103	5.873	< .001	0.405	0.810
	E2	λ_{42}	0.504	0.108	4.675	< .001	0.293	0.716
	E3	λ_{43}	0.545	0.100	5.443	< .001	0.349	0.741
	E4	λ_{44}	0.724	0.110	6.585	< .001	0.509	0.940
	E5	λ_{45}	0.508	0.111	4.570	< .001	0.290	0.725

The results on table 4.22 below was meant to test relationship between different pairs of constructs. The relationship between the following pairs is existent and statistically significant as their p -values are less than 0.05 significance level: GF and FF ($p < 0.001 < 0.05$), GF and DF ($p < 0.003 < 0.05$), GF and OF ($p < 0.001 < 0.05$). The following

pairs of constructs are also statistically significant; FF and DF ($p < 0.001 < 0.05$), FF and OF ($p < 0.001 < 0.05$), DF and ORF ($p < 0.01 < 0.05$).

Table 4.22 Factor Covariances

						95% Confidence Interval	
		Estimate	Std. Error	z- value	p	Lower	Upper
GOVERNMENT FACTORS	↔ FINANCE FACTORS	0.688	0.128	5.370	< .001	0.437	0.939
GOVERNMENT FACTORS	↔ DESIGN FACTORS	0.401	0.137	2.927	0.003	0.132	0.670
GOVERNMENT FACTORS	↔ OWNER FACTORS	0.471	0.140	3.354	< .001	0.196	0.746
GOVERNMENT FACTORS	↔ PROJECT SCHEDULING	0.307	0.153	2.006	0.045	0.007	0.608
FINANCE FACTORS	↔ DESIGN FACTORS	0.728	0.101	7.205	< .001	0.530	0.926
FINANCE FACTORS	↔ OWNER FACTORS	0.729	0.111	6.543	< .001	0.511	0.948
FINANCE FACTORS	↔ PROJECT SCHEDULING	0.182	0.161	1.133	0.257	- 0.133	0.497
DESIGN FACTORS	↔ OWNER FACTORS	0.849	0.070	12.178	< .001	0.713	0.986
DESIGN FACTORS	↔ PROJECT SCHEDULING	0.133	0.144	0.924	0.356	- 0.149	0.415
OWNER FACTORS	↔ PROJECT SCHEDULING	0.328	0.143	2.299	0.022	0.048	0.608

The effect of each variable on each construct is presented in Table 4.23. All the variables under government risk factors have a significant impact on the GF as all the p values of the manifest variables which belong to this construct are 0.001 which is far less than the significance value of 0.05. However, B1 (corruption and bribes between government officials and other stakeholders' impact on projects' schedules) is considered to be the most important factor amongst other 5 variables, with the estimate value of (1.214). This is followed by B5; construction labourers' strikes and disputes make the projects to be completed beyond the contracted duration, (1.205). Finance risk factors' variables also

have an impact on this construct. All the p values corresponding to these variables are below the significance level of 0.05. Nevertheless, in this construct, the lowest estimate is observed in C1 (delay in payments to contractors is an obstacle to the successful completion of projects (0.413). The rest of the variables had estimates above 0.5.

The third factor is design risks which comprises five variables. All these variables have a significant impact on this factor since their p values are all less than 0.05 significance value. However, the estimated influence of the 4 variables under this construct are relatively high. Despite the high estimated influence of these variables, D3 (design errors and omissions delay project activities and delivery) has the lowest impact with the estimated influence of 0.374. Furthermore, the variables under factor 4 are all associated with owner risk factors as the p values corresponding to these variables are 0.01. Nevertheless, E5 (suspension of work by the owner during project execution) has the highest estimate influence of 0.707.

Table 4.23 Residual variances

Indicator	Estimate	Std. Error	z-value	P	95% Confidence Interval	
					Lower	Upper
B1	1.214	0.213	5.694	< .001	0.796	1.632
B2	1.093	0.195	5.601	< .001	0.711	1.475
B3	0.955	0.194	4.927	< .001	0.575	1.334
B4	0.996	0.229	4.345	< .001	0.547	1.445
B5	1.205	0.233	5.166	< .001	0.748	1.662
C1	0.413	0.071	5.804	< .001	0.273	0.552
C2	0.588	0.112	5.259	< .001	0.369	0.807
C3	0.532	0.113	4.693	< .001	0.310	0.754
C4	0.602	0.107	5.634	< .001	0.392	0.811
C5	0.561	0.095	5.909	< .001	0.375	0.748
D1	0.870	0.170	5.126	< .001	0.537	1.203
D2	0.841	0.161	5.217	< .001	0.525	1.157
D3	0.374	0.088	4.258	< .001	0.202	0.547
D4	0.860	0.149	5.789	< .001	0.569	1.152
D5	0.712	0.130	5.490	< .001	0.458	0.966
E1	0.538	0.096	5.585	< .001	0.349	0.727

Table 4.23 Residual variances

Indicator	Estimate	Std. Error	z-value	P	95% Confidence Interval	
					Lower	Upper
E2	0.661	0.113	5.844	< .001	0.440	0.883
E3	0.529	0.093	5.697	< .001	0.347	0.711
E4	0.551	0.104	5.324	< .001	0.348	0.754
E5	0.707	0.121	5.861	< .001	0.471	0.943
F1	0.733	0.138	5.314	< .001	0.463	1.004
F2	1.117	0.197	5.660	< .001	0.730	1.503
F3	1.056	0.206	5.126	< .001	0.652	1.460
F4	0.712	0.189	3.777	< .001	0.343	1.082
F5	1.337	0.280	4.783	< .001	0.789	1.885

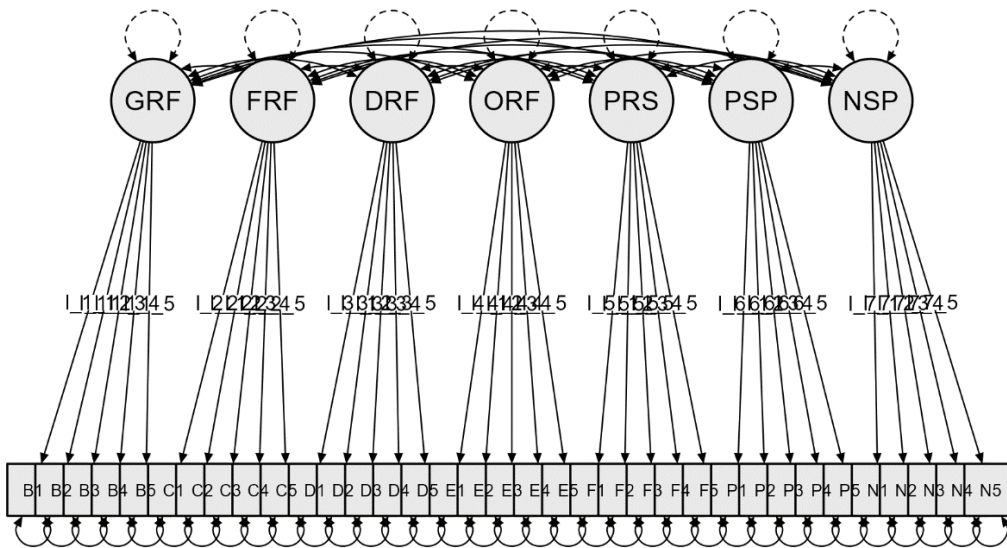


Figure 4.1: Confirmatory Factor Analysis: Model plot

Confirmatory Factor Analysis (CFA) was used in this study to test the measurement model and, as part of CFA, factor loadings were assessed for each item. The model-fit measures were used to assess the model's overall goodness of fit (CFI, TLI and RMSEA). The model fit indices showed values which are above the threshold in Tables 4.24 and 4.25 below. For determining whether a model shows an adequate fit according to the

Comparative Fit Index (CFI), different rules of thumb have been proposed by Bentler, (1990), and a $CFI \geq 0.95$ is considered very good, (van Laar and Johan, 2021). Therefore, CFI of 0.962 in Table 4.24 below is considered to be an indication of an adequate fit. Another model-fit that was applied in this study was Tucker-Lewis Index (TLI) which is considered very good as it is greater than 0.95. From Table 4.24, it is considered that the value of 0.982 is good as it is within its respective acceptance level.

Table 4.24 Fit indices

Index	Value
Comparative Fit Index (CFI)	0.962
Tucker-Lewis Index (TLI)	0.982

Root mean square error of approximation (RMSEA) also evaluates the extent to which the model approximates the data, and it is considered very good if $p\text{-value} \leq 0.05$ (van Laar and Johan, 2021). A RMSEA of 0.037 which is less than 0.05 in Table 4.26 below is considered to be an indication of a close fit.

Table 4.25 Other fit measures

Metric	Value
Root Mean Square Error of Approximation (RMSEA)	0.037

4.4 FINAL DATA ANALYSIS: REGRESSION WITH MEDIATION

Final data analysis

According to Table 4.26, the results of the direct effects analysis show that finance risk factors (FF) had a negative but insignificant effect on project scheduling (IPS), with an estimate of -0.057 ($p=0.765$). Similarly, design risk factors (DF) had a negative but insignificant effect on project scheduling, with an estimate of -0.042 ($p=0.774$). On the other hand, owner risk factors (OF) had a positive but insignificant effect on project scheduling, with an estimate of 0.246 ($p=0.161$).

Table 4.26: Direct effects

	Estimate	Std. Error	z-value	p	95% Confidence Interval	
					Lower	Upper
FF → IPS	-0.057	0.190	-0.299	0.765	-0.428	0.315
DF → IPS	-0.042	0.145	-0.287	0.774	-0.327	0.243
OF → IPS	0.246	0.176	1.401	0.161	-0.098	0.591

Note. Delta method standard errors, normal theory confidence intervals, ML estimator.

The results of the indirect effects analysis from Table 4.27 show that the relationship between finance risk factors and project scheduling was mediated by government risk factors (GF), with an estimate of 0.075 ($p=0.271$). However, the relationship between design and owners risk factors and project scheduling was not mediated by government risk factors, with estimates of 0.010 ($p=0.653$) and 0.020 ($p=0.494$), respectively.

Table 4.27: Indirect effects

	Estimate	Std. Error	z-value	p	95% Confidence Interval	
					Lower	Upper
FF → GF → IPS	0.075	0.068	1.101	0.271	-0.058	0.208
DF → GF → IPS	0.010	0.021	0.450	0.653	-0.032	0.052
OF → GF → IPS	0.020	0.029	0.684	0.494	-0.037	0.077

Note. Delta method standard errors, normal theory confidence intervals, ML estimator.

The results of the total effects analysis on Table 4.28 show that finance risk factors had a positive but insignificant effect on project scheduling, with an estimate of 0.018 ($p=0.920$). Similarly, design risk factors had a negative but insignificant effect on project scheduling, with an estimate of -0.032 ($p=0.826$). On the other hand, owners risk factors had a positive but insignificant effect on project scheduling, with an estimate of 0.266 ($p=0.132$).

The results of this study suggest that finance, design, owners and government risk factors have no significant direct effect on government infrastructure projects' schedules. However, the relationship between finance risk factors and project scheduling is mediated by government risk factors, which implies that government risk factors play a role in the relationship between finance risk factors and project scheduling. The insignificant total

effects suggest that the impact of finance, design, owners and government risk factors on project scheduling is minimal. It is possible that other factors not considered in this study, such as political instability, corruption and social and environmental factors, may have a more significant impact on project scheduling.

Table 4.28: Total effects

		Estimate	Std. Error	z-value	p	95% Confidence Interval	
						Lower	Upper
FF	→ IPS	0.018	0.180	0.100	0.920	-0.335	0.371
DF	→ IPS	-0.032	0.146	-0.219	0.826	-0.319	0.255
OF	→ IPS	0.266	0.177	1.508	0.132	-0.080	0.612

Note. Delta method standard errors, normal theory confidence intervals, ML estimator.

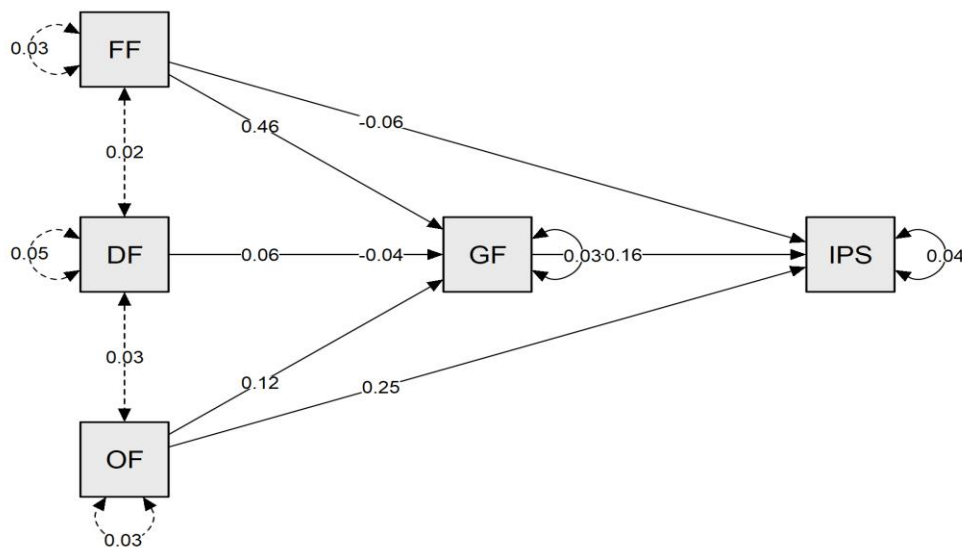


Figure 4.2: Final model

4.4 PREVALENCE OF RISK FACTOR CATEGORIES ON GOVERNMENT INFRASTRUCTURE PROJECTS

The second objective of the study is to determine the prevalence of risk factor categories on government infrastructure projects in Lesotho. A critical literature review has been deployed to analyse the perceptions of the main stakeholders such as clients, consultants and contractors, in relation to the schedule of construction projects. The successful delivery of these projects is dependent on several factors that stakeholders

need to consider. On the other hand, risk factors that hinder the progress and completion of the projects within its schedule must be identified, analysed, and appropriate mitigations be applied to avoid schedule and cost overruns.

The lack of communication among project stakeholders has been identified as a major factor that leads to conflicts and ultimately project failure. Ineffective communication between different partners (the client, consultants, and contractors as well as failure to determine communication channels) were recognized to have a negative impact on the project duration. In order for the project to be successful, all stakeholders must be aware of project changes and incorporate them. This finding is similar to what is reported by Otobo (2016) in Nigerian construction projects. He found that consultants' failure to communicate on time with site teams and clients about the level of work done delays payments hence project delay.

Qualified and skilled professionals play a crucial role in the success of a project, regardless of its size or complexity. Experienced professionals are able to avoid challenges on time, and deliver according to expectations. Therefore, contractors should appoint qualified and experienced sub-contractors as their capabilities are crucial in successful implementation of construction projects. Harthi (2015) supports this finding and indicates that contractors should only take competent staff during contract process and make consultations for advice on recruitment and selection.

The study findings reveal that inadequate experience and skills of contractors are key factors in the delay of construction projects. Contractors who lack appropriate skills and experience are unable to plan and manage projects efficiently, leading to delays. This finding is similar to what is reported by Alharbi (2021), who found that unskilled workers cause mistakes leading to defects and rework. Similarly, it was observed that appointment of unqualified staff results in poor performance and affects the completion of project activities, (Al-Geth and Ishak, 2020). Planning is also a fundamental part that determines successful implementation of construction projects because clear outlines of deliverables as well as the milestones are stated clearly.

Knowledgeable project teams are champions who surpass clients' expectations and complete the projects ahead of schedule and within the budget. These teams should be established early enough to define the project scope and functions precisely (Zou et al. 2014), and their effectiveness is crucial across all the project phases on infrastructure projects (Makabate, 2016). The positive involvement of the client is also crucial in the success of the entire project. Therefore, delays in these projects are avoided where clients are able to deliver a good project brief to the project team and be active in the project process, especially in project decision-making, which is essential for the smooth running of the project activities. The involvement of the owner in construction projects is a major factor that contributes to projects' success. Makabate (2016) supports this in his study findings in Qatar where he indicated that the influence of the owner is a significant success factor as the client is the main player in the project. Booyens et al.'s (2015) findings are also in line with the study findings about the positive involvement of the owner in the project.

Effective planning and scheduling are crucial in the construction industry as they contribute to the success of the project, especially if done before project execution. Improper planning and scheduling of the project are significant factors that result in project schedule overruns. This problem can be avoided by employing planning and scheduling software packages for managing projects. Poor planning is a key cause of construction project failure in developing countries. If proper planning has not been developed before the execution of a project, it is likely to face risks and other challenges that were not anticipated, hence late completion of the project. The detailed clarification of the scope and deliverables guide project professionals in making better decisions on planning and scheduling approaches as indicated in prior literature by Alotaibi (2018) in the Kingdom of Saudi Arabia. Similarly, (Damoah, 2015) also found poor planning to be among the top most risk factors contributing to the late completion of construction projects in Ghana.

4.5 SEMI-STRUCTURED INTERVIEW RESULTS

This section presents the identified risk mitigation strategies and practices that can be used by the respondents to reduce the impact of the identified risk factors, and these are drawn from semi-structured interviews. In order to address the third objective, the

respondents were asked to state the mitigations that they implement in infrastructure projects. Therefore, the collected data from the respondents comprised of several mitigations for the finance risks, government risks, design risks, owner risks and other risk factors. The interviews were phase two of data collection which followed phase one; the identification of risk factors impacting on aforementioned projects. The results from the interviews are presented below.

Demographics of respondents

The respondents were requested to introduce themselves based on pre-defined characteristics. Data captured was based on their profession, age, overall experience in the construction industry, the sector where they were working, as well as their educational qualifications as shown in Table 4.29. The main reason for collecting this data was to ensure that appropriate respondents were chosen to provide relevant data in relation to the subject matter under investigation. More importantly, this information helped to improve the validity and reliability of data collected. Only five construction professionals participated in the study as they were involved in the implementation of construction projects in Lesotho. From the table below, the respondents comprised of two quantity surveyors who had eight and thirty years of experience in this industry. One respondent was a qualified architect who had been in this industry for 22 years. Besides that, one project manager with 26 years of experience participated in this study, as well as the principal structural engineer with 15 years of experience. The knowledge and experience of the respondents help to improve the validity and reliability of data collected. Generally, the participants' years of experience range from 8 to 30.

Table 4.29: Respondents Demographics

RESPONDENTS	AGE	OVERALL EXPERIENCE (YEARS)	SECTOR	EDUCATION
R1 (Quantity Surveyor)	33	8	Contractor	B.Tech in Quantity Survey
R2 (Project Manager)	55	26	Contractor	BSc in Civil Engineering, PGD in Project Management
R3 (Senior Architect)	49	22	Consultant	MSc in Architecture
R4 (Senior Quantity Surveyor)	67	30	Consultant	BSc in Quantity Survey
R5 (Principal Structural Engineer)	50	15	Government	BSc in Civil Engineering

4.5.1 Identified risk mitigations

This section presents the findings from the interviews with construction projects' professionals: contractors, consultants and owner representatives. Interview questions were asked to address objective 3 of the research study which aimed to identify risk mitigation strategies that can be used to reduce the occurrence of risks and their effects on IP. The section below presents the results that were derived from qualitative data analysis. Various themes that were identified during the data collection stage were classified into four themes, that is, the risk mitigations for the above risk categories. First, the interviewees were asked about their views on whether infrastructure projects in Lesotho experience schedule overrun or not. All the participants indicated that the majority of the abovementioned projects are completed beyond their completion date due to several risks, and some are even abandoned.

4.5.2 Thematic data analysis

Based on the raw data provided by the key participants in this study, several themes emerged regarding the risk mitigation strategies and practices implemented in

infrastructure projects to control the probability and the impact of the risks that affect the projects schedules. These themes include:

Contractual penalties: Several contractors suggested that contractual penalties should be included in the contract for any party responsible for delays to help control the probability and impact of risks that may affect the project schedule. These penalties are often paid by the government due to delayed payments to contractors and consultants.

Communication: Frequent communication among stakeholders is crucial in identifying risks and solving problems before they impact the project. Contractors study the drawings and identify clashes or errors and omissions, and then immediately alert the owner and design team. Parties liable for delay are penalized to avoid further delays.

“It is the responsibility of all stakeholders to communicate frequently so that problems are solved as soon as they emerge. For instance, as the contractor, we study the drawings and identify a clash somewhere, immediately we alert the owner and the design team. We do not just expect things to be perfect. Frequent communication among us as the stakeholders help us to solve problems before they have a great impact on the project” (R1).

This finding is in agreement with earlier researchers such as Jongo et al (2019), Alotaibi (2018) who indicated that effective coordination and communication between parties is crucial for effective risk mitigation.

Experience: Contractors use their technical and managerial experience to identify risks before the commencement of the project. They review the specifications and design and draw from past projects to identify and address potential risks.

This finding supports a prior study conducted by Alhassan (2016) which asserted that contractors use their experience from similar projects to identify and mitigate risks. Alotaibi (2018) further stated that contractors use the WBS as a mitigation strategy to establish the experience of contractors’ staff.

Insurance premiums: large contractors from category A often pay insurance premiums to cover risks that may occur during the project.

Joint assessment: Joint assessment is employed to ensure that contractors and consultants are paid on time. Quantity surveyors from both sides make a joint assessment on inspection of completed work, and payment certificates are processed.

“For contractors and consultants to get their payments on time, we employ joint assessment where the quantity surveyors on both sides, that is, from the owners’ and contractors’ side make a joint assessment on inspection of completed work. After this, they easily agree on payment of the contractor, and the certificate is processed. (R5)

Contractual adherence: Contractors study the contract between themselves and the owner carefully to avoid disruptions caused by the owner. Sticking to the contract helps control the impact of risks that affect the project schedule.

Earlier study on public construction projects also confirms this finding (Alotaibi, 2018). It is stated that re-visiting the contractual agreement with the contractor during mobilisation phase of a project ensure accountability and minimise project risks.

Planning and alignment: Joint planning before the project starts helps stakeholders agree on the scope of work and avoid interference during construction. A five-year master plan ensures that all stakeholders align with the plan to avoid changes during project implementation.

“We currently have a five-year masterplan where every stakeholder especially line ministries have to align with. All the stakeholders such as Urban and Regional Planning, Department of Roads Directorate, Maseru City Council meet and make a sound plan on what should be done, in order to avoid interference during construction of the project” (R5).

These findings confirms Harthi’s (2015) study, which concluded that mitigation measures identified were to undertake pre-project planning to avoid design errors. Jongo et al (2019) also concluded that effective planning and scheduling mitigate project risks.

The data from the interviews suggests that a combination of strategies and practices, including contractual penalties, communication, experience, insurance premiums, joint assessment, contractual adherence, and planning and alignment, should be implemented

in infrastructure projects to control the probability and impact of risks that affect the projects' schedules. These strategies and practices should be employed in a comprehensive and integrated manner to ensure the timely completion of projects.

Thematic analysis

After conducting a thematic analysis, several key themes which address the question of improving the attainment of planned project duration emerged. These themes include:

Payment and cash flow: A common concern among the contractors is the issue of delayed payments, which causes cash flow deficits and disrupts project timelines. The contractors suggested that owners should be truthful about when payments will be made and that the government system should accommodate them, including enforcing the law on civil servants who cause delays. In addition, contractors' cash flows should reflect the rate of work and when the contractor anticipates a certain amount of payment. Proper planning and budgeting by contractors were also identified as necessary for cash flow management.

Design errors and omissions: Design errors and omissions were identified as key causes of project delays. The contractors suggested that they have to make follow-ups with the clients and highlight items on the critical path that determine the duration of the project. It was recommended that designers should ensure that they have adequate knowledge and understanding of construction practices.

Governance and political interference: Contractors expressed concerns about the lack of regulation and political interference in government infrastructure projects. It was suggested that the Central Tender Board, which regulated the government infrastructure projects, should be re-established to implement all government projects through the Ministry of Public Works and Transport as they have adequate expertise.

“Initially, there was the Central Tender Board (CTB) which regulated the government infrastructure projects. However, it was dissolved and projects were administered by line ministries which lack relevant construction professionals. The dissolution of CTB fuelled political interference in projects’ scope. Therefore, the only solution would be the re-

building of CTB which will implement all government projects through Ministry of Public Works and Transport as they have adequate expertise.” (R3).

Respect for project teams' advice: Contractors reported that owners sometimes overrule the advice of the project team on bids, which results in lack of funds and project delays. They recommended that owners should respect the advice of the project team and stay away from the tender process.

Risk management: The contractors suggested that risk management should be employed throughout the project life cycle to identify risks on time, since their impact affects the duration of the project. Stakeholders complain that risk management is time-consuming, but contractors believe it is a necessary part of project management.

“Risk management is not effectively employed as some stakeholders complain that it is time consuming. As a result, some risks are not identified on time, and their impact affect the duration of the project. Therefore, contractors should use risk management throughout the project life cycle.” (R2).

In summary, the contractors highlighted the importance of adequate planning and budgeting, timely payments, and effective communication between stakeholders to improve the attainment of planned project duration. They recommended that owners should respect the advice of the project team, designers should ensure that they have adequate knowledge and understanding of construction practices, and the government system should accommodate contractors. Finally, the contractors suggested that risk management should be employed throughout the project life cycle.

4.6 SUMMARY

A comprehensive interpretation and discussion of the research findings was presented in this chapter. The chapter discussed the findings by linking them to the literature in chapter two. These research results discussed here were obtained from the two data collection phases; quantitative data which was phase one, and administered through questionnaire survey, as well as qualitative data which was phase two and administered through semi-structured interviews. The discussion mainly focused on three aspects which are,

identification of risk factors impacting on government infrastructure projects' schedules, the perceptions of the main stakeholders on the prevalence of risk factors on the aforementioned projects as well as mitigation strategies used by construction professionals in Lesotho to reduce the impact of these risks on projects' duration. A discussion of the findings followed the information given by the survey respondents, as well as the interview statements provided by the experienced professionals who are in the managerial positions.

According to quantitative results, finance risks, design risks and owner risks do not contribute significantly to the government IPS. Also, the mediation analysis where the GRF was a mediator revealed that all the three predictors have non-significant impact on IPS. Contrary to the quantitative findings, respondents in interviews argued that there are several risks that affect IPS in Lesotho. These include delay of payments to contractors and consultants, late project scope changes by the owner, corruption and bribes, design errors and omissions, and others. The interview findings revealed that some projects go as far as two years beyond their schedule, while others are even abandoned due to construction risks encountered. Therefore, different mitigations and practices were provided by these respondents to minimize the impact of these risks and attain contracted projects' duration. The mitigations suggested include contractual penalties, communication among stakeholders, joint assessment, insurance premiums, planning and alignment, contractual adherence and others.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter concludes the study and suggests recommendations that can be adopted to improve government infrastructure projects in Lesotho. The key aim is to improve efficiency in those projects and ensure they are completed according to the set schedule.

5.2 CONCLUSION

Conclusion and recommendations on objective 1

In conclusion, the study found that finance, design, owners and government risk factors have no significant direct effect on government infrastructure projects' schedules. However, the relationship between finance risk factors and project scheduling is mediated by government risk factors, indicating that government risk factors play a role in the relationship between finance risk factors and project scheduling. These findings highlight the need for stakeholders in government infrastructure projects to consider and address the various risk factors in a holistic manner to ensure timely project delivery.

Based on the results, it is recommended that stakeholders involved in government infrastructure projects should prioritize assessing and managing government risk factors as they appear to have a mediating effect on finance risk factors' impact on project scheduling. Furthermore, stakeholders should not overlook other risk factors, such as political instability, corruption, and social and environmental factors that may have a more significant impact on project scheduling. It is essential to develop and implement comprehensive risk management strategies and practices that address all potential risk factors to ensure the successful delivery of government infrastructure projects. Additionally, stakeholders should consider similar studies periodically to identify emerging risk factors and update their risk management strategies accordingly.

Conclusion and recommendations on objective 2

The second objective of this study was to determine the prevalence of different risk factor categories on government infrastructure projects' schedules in Lesotho. This objective was addressed by reviewing the existing literature. Based on the outcome of the literature,

the main stakeholders (consultants, owners and contractors) indicated that these projects can be completed within their schedules through the use of qualified or skilled construction professionals, knowledgeable project teams, effective planning and scheduling as well as effective communication among these stakeholders. These success factors are crucial to contractors, clients and the owner since they are involved in the planning and execution of projects. The findings further showed that risk factors such as lack of communication, unskilled workers, and others prevent infrastructure projects to be completed within their schedules.

Based on the findings derived from the literature review, it is therefore recommended that for projects that are too technical, the government as the owner should outsource independent specialist to inspect the project implementation as experienced professionals possess skills that enable them to avoid construction risks. It is further suggested that all stakeholders be involved throughout the project lifecycle to avoid frequent changes of the scope by the owner which hinder progress. Additionally, for proper planning and scheduling, contractors and consultants must upgrade their skills since there are new innovations in this industry every time.

Conclusion and recommendations on objective 3

Lastly, the third objective was to recommend various mitigation strategies and practices that can be used by stakeholders to reduce adverse effects of the identified risks and their impact on infrastructure projects. According to the research findings, the identified risk mitigation strategies that help in minimizing the probability of risk occurrence, and reduce their impact includes contractual penalties whereby the construction contract includes specific articles on delays and reimbursement in payment. Effective communication among the stakeholders, contractors' experience, insurance premiums, joint assessment, contractual adherence, and planning and alignment minimize the occurrence of certain risks which often result in minimised delays.

The recommendations related to the third objective is that the Central Tender Board should be re-established as the oversee of all government infrastructure projects since they have relevant expertise, who will address various risk factors on time in collaboration

with other stakeholders. With reference to the study results, it is suggested that the owner should avoid political interference in the implementation of these projects, projects should be executed according to defined specifications not politicians' interests. The government financial system should also be revised to accommodate contractors and consultants, so that they can get payments on time and avoid cash flow deficits. Project managers and their teams should also employ project scheduling techniques effectively to manage projects' duration because these techniques are essential for the success of the projects. Future research should look into the effectiveness of project risk management in construction projects in Lesotho.

This chapter has presented a summary of the entire research by highlighting the main findings of the study. Several recommendations were made for the current construction professionals based on the results of the study. Recommendations for future research on the topic of risk management were also made. Large infrastructure projects can achieve the desired objectives if they are planned and executed accordingly with minimum disruptions.

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APPENDICES

APPENDIX A: EDITOR'S LETTER

THE NATIONAL UNIVERSITY OF LESOTHO

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P.O. Roma 180
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FACULTY OF EDUCATION

21st May 2023

The Supervisor
Faculty of Management Sciences
Central University of Technology
Bloemfontein

Dear Supervisor

Re: proof of language editing

This letter proves that I read and edited 'Matseko Martinah Thamae's dissertation titled *An investigation of risk factors impacting on government infrastructure projects' schedules in Lesotho*.

Sincerely,



Mahao Mahao (PhD)
Head - Department of Language and Social Education
Faculty of Education, National University of Lesotho

APPENDIX B: ETHICAL CLEARANCE



FACULTY RESEARCH AND INNOVATION COMMITTEE

FACULTY OF MANAGEMENT SCIENCES

RESEARCH ETHICS APPROVAL LETTER

Date: 21/02/2022

This is to confirm that:

Applicant's Name	Ms Matseko Thamae
Supervisors' Name(s) for Student Project (where applicable) Co - Supervisor	Dr Hlalele
Level of Qualification for Student Project (where applicable)	Master of Philosophy in Management Sciences (Project Management)
Title of research project	AN INVESTIGATION OF RISK FACTORS IMPACTING ON GOVERNMENT INFRASTRUCTURE PROJECTS' SCHEDULES IN LESOTHO

Ethical clearance has been provided by the Faculty Research and Innovation Committee in view of the CUT Research Ethics and Integrity Framework, 2016 with reference number: **FMSEC01/22**

The following special conditions were set:

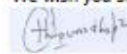
☒ None

☐ Specific conditions

The following specific conditions apply:

1. NA
2. NA
3. NA

We wish you success with your research project.

 Digitally signed by
Chipunza Chipunza
Date: 2022.02.21
14:17:43 +02'00'

Professor C Chipunza
FRIC Chairperson)

APPENDIX C: QUESTIONNAIRE

I, Matseko Thamae, student number 218011856, am a Master of Philosophy student specializing in Project Management in the Faculty of Management Sciences at Central University of Technology, Free State. You are invited to voluntarily participate in a research project entitled: AN INVESTIGATION OF RISK FACTORS IMPACTING ON GOVERNMENT INFRASTRUCTURE PROJECTS' SCHEDULES IN LESOTHO. Your privacy, anonymity and confidentiality will be maintained. The questionnaire is divided into 7 sections whereby you are expected to respond by ticking the appropriate response with (X or $\sqrt{}$) in the boxes and columns provided.

SECTION A: DEMOGRAPHICS

A1. Gender

Male ☐ Female ☐

A2. Age

20-30 years ☐ 31-40 years ☐ 40-50 years ☐ above 50 ☐

A3. Profession

Project Manager	☐	Civil Engineer	☐
Contracts Manager	☐	Architect	☐
Government Officer	☐	Quantity Surveyor	☐
Other, please specify _____			

A4. Your experience in construction industry: 1-5 years 6-10 years

11-15 years ☐ above 15 years ☐

A5. Number of infrastructure projects you have worked in over the past 5 years

☐ ☐ ☐ ☐

1-10

11-20

21-30

above 30

IDENTIFICATION OF RISK FACTORS IMPACTING ON GOVERNMENT INFRASTRUCTURE PROJECTS.

SECTION C: FINANCE RISK FACTORS

Indicate the extent to which you agree with the following statements about the contribution of finance risk factors on infrastructure projects' schedule overrun, using the following scale where:

1. Strongly disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly agree

Finance Risk Factors	1	2	3	4	5
C1. Delay in payments to contractors is an obstacle to the successful completion of the project.					
C2. Failure of the project to be completed on time is linked to the financial difficulties of the client.					
C3. Sudden changes of prices contribute to the unsuccessful project delivery.					
C4. Poor cost estimation affects the success of the project					
C5. Finance failure of the contractor influences late project completion					

SECTION D: DESIGN RISK FACTORS

Indicate the extent to which you agree with the following statements about the contribution of design on infrastructure projects' schedule overrun, using the following scale where:

1. Strongly disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly agree

Design Risk Factors	1	2	3	4	5

D1. Late completion of projects is influenced by designers who produce unclear and inadequate details in drawings.					
D2. Design work is awarded to unqualified designers.					
D3. Design errors and omissions delay project activities and delivery.					
D4. Complex project design contributes to projects' schedule overrun.					
D5. Delay in approving design working drawings impact on the projects' schedule.					

SECTION E: OWNER RISK FACTORS

Indicate the extent to which the owner affects infrastructure projects' duration using the scale below:

1. Strongly disagree 2. Disagree 3. Neutral
4. Agree 5. Strongly agree

Owner Risk Factors	1	2	3	4	5
E1. Late changes of the project scope by the owner affect project duration.					
E2. Owner's disputes with the contractors affect projects schedules hence cost.					
E3. Owner's slowness in decision making hinders progress in projects that lead to schedule overruns					
E4. Owners make frequent changes in the design during project implementation					
E5. Suspension of work by the owner during project execution restrain project work activities therefore projects exceeds their contract schedule					

APPENDIX D: QUESTIONNAIRE INTERVIEW QUESTIONS

I, Matseko Thamae, student number 218011856, am a Master of Philosophy in Management Sciences student, specializing in Project Management in the Faculty of Management Sciences at Central University of Technology, Free State. You are invited to voluntarily participate in a research project entitled: AN INVESTIGATION OF RISK FACTORS IMPACTING ON GOVERNMENT INFRASTRUCTURE PROJECTS' SCHEDULES IN LESOTHO. I will protect and maintain your privacy by keeping your responses confidential so that they will not be identified by anyone reading the report

SECTION A: DEMOGRAPHICS

A1. Type of your organisation

Consultant

Contractor

Government

A2. Profession

Architecture

Quantity Surveyor

Civil Engineer

Other, please specify_____

A4. Your overall experience in construction industry:

5-10 years

11-15 years

16-20 years

Above 20 years

A5. Your Educational qualifications

Diploma

Degree

Master's Degree

SECTION B: This section identifies risk mitigation strategies that can be used to reduce risks and their adverse effects on government infrastructure projects.

B1. Based on your experience in the construction industry, which risk mitigation strategies and practices do you implement in your infrastructure projects to control the probability and the impact of the risks that affect the projects' schedules?

B2. Do you have any comments or suggestions to improve the attainment of planned project duration?
