Determination of a Risk Management Framework for the Zambian Construction Industry

By

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ABSTRACT

If the construction industry of a country is inefficient, it is difficult for any such country to see meaningful development. This is particularly true for countries that often see many of its projects abandoned. Globally projects continue to be abandoned. In Zambia, the number of projects being abandoned have been on the rise causing the Government of Zambia to lose large sums of financial resources. The study postulated that the solution to project abandonment is risk management. The study therefore sought to identify the causes, the effects of project abandonment in Zambia and to determine the extent to which risk management is incorporated in the construction industry. Further, the study sought to examine the existence of a relationship between project abandonment and risk management, and to finally develop a generic risk management framework for project stakeholders that can predict the exposure of a construction project to construction related risks. The study was a quantitative study were primary data was collected through the use of self-completing questionnaires purposively distributed to a convenient sample of 70 professionals. A response rate of 70% was obtained. The study employed quantitative methods for data analysis making use of the Relative Importance Index to rank the causes and effects of project abandonment and also Structural Equation Modelling to examine the relationship between project abandonment and risk management. The study identified that the main causes of project abandonment are financial, legal, organisational & operational risks and political risks thereby promoting pollution on project sites, lowered standards of living and unemployment. The use of risk management techniques among professionals and organisations in Zambia was found to be low to moderate with the qualitative techniques being used dominantly over the quantitative techniques. A strong relationship of (standard coefficient = 0.89) was established between project abandonment and risk management suggesting that a strengthened and holistic use of risk management techniques in managing construction projects would reduce project abandonment by 89%. Consequently, the study proposed a suitable risk management framework that makes use of pre-determined ranked risks, expert judgement and risk mapping to predict risks and manage them.

Key words: Construction, Framework, Project Abandonment, Risk, Risk Management, Technique

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ADR	Auditor General's Report
AfDB	African Development Bank
APMSA	Association of Project Managers in Saudi Arabia
CSO	Central Statistical Office
ETA	Event Tree Analysis
FTA	Fault Tree Analysis
GDP	Gross Domestic Product
ICE	Institute of Civil Engineers
IRM	Institute of Risk Management
NCC	National Council for Construction
PMI	Project Management Institute
RII	Relative Importance Index
SEM	Structural Equation Modelling
SPSS	Statistical Package for Social Science
STATA	Software for Statistics and Data Science
WSP	Waste Stabilisation Pond

CHAPTER ONE - BACKGROUND TO THE STUDY

1.0 Introduction

The Construction Industry is a significant industry in the economy of any underdeveloped, developing or developed country. Globally, the construction industry; contributes to the Gross Domestic Product (GDP) of a country, provides outputs for other industries and uses outputs from other industries, creates employment, contributes significantly to the informal sector and finally it is a tool for achieving sustainable development. Activities characteristically found in the industry include, building of new structures, highways, utility systems, renovations, additions, alterations and maintenance of existing structures (Behm, 2008).

According to Olanrewaju & Abdul-Aziz (2015) if the construction industry of a country is inefficient, it is difficult for any such country to have any form of meaningful development. This is true particularly for countries that often see most of its projects abandoned and as such, the intended purpose of the projects is not realised. In the past, projects that are proposed to bring about development have been abandoned and continue to be abandoned worldwide in the United States, Spain, Dubai, Saudi Arabia, Abu Dhabi and Russia (Amade, et al., 2015), Malaysia (Abdul Rahman et al., 2013), Ghana (Damoah, et al., 2018), Nigeria (Hanachor, 2012), India (Ikediashi, 2014), Botswana (Segawa, 2013), Pakistan (Haq, et al., 2014). According to Ewa (2013), there are about 4000 uncompleted or abandoned public projects littered all over Nigeria and that it would take about 30 years to get them completed.

Amade et al (2015), Abdul-Rahman et al (2015), Ikediashi et al (2018), Ihuah & Beneo (2014), define abandonment as 'the act of discontinuing any activities on a development project within the time frame of the contract agreement with no intension of returning back.' In Malaysia, the Ministry of Local Government and Housing declares a project late if it has passed its promised delivery date by 10%; if the delay stretches beyond 10%-30%, then it is considered 'sick'; and finally, if no work has been carried out or no workers are on the project site for up to six months, then it is deemed abandoned (Hussin & Omran, 2011). In the United Kingdom and United States, abandoned projects are described as buildings that are unoccupied and demonstrate noticeable signs of physical distress such as being boarded up, burned,

exposed to the elements, or have deteriorated (Jacobson, 2007 as cited by Abdul Rahman et al, 2013). Hanachor (2012) adds that one such project requires cost to be replaced.

Ayodele and Alabi (2015) opined that underlying causes of project abandonment range from inadequate planning, inadequate finance, inflation, delayed payments, incompetent project managers, design and inadequate cost control measures and contractor liquidation. Similarly, and in addition, Amade et al (2015) contends that 'most projects frequently fail to achieve their goals due to a myriad of problems ranging from imperfect project design, poor stakeholder management, delays between project identification and start up, delays during project implementation, cost overruns, and coordination failure.' Other factors seen to cause project abandonment are organisational changes, regulatory changes, and natural disasters (Aigbovboa et al., 2015), escalation of project cost due to inflation, changes in government and the failure to pay contractors due to government bureaucracy (Nwachukwu & Emoh, 2011).

'The answer to project abandonment is project management' contends (Nwachukwu & Emoh, 2011). Kishk & Ukaga (2008) cites Elkington and Smallman (2002) that established that there is a strong link between the amount of risk management undertaken on a project and the level of success. Similarly, Amade et al (2015) established a strong linear relationship between risk management and attainment of construction project objectives. In support, Ongubayo (2014) opines that it is indeed the inadequacies of risk management that lead to project abandonment. The Project Management Institute (PMI) (PMBOK, 2013) discusses project risk management as one of the knowledge areas of project management. Today numerous disciplines apply the principles of risk management for differing reasons such as, greater productivity, customer satisfaction, protecting one's reputation, saving funds, avoiding job loss. However, Mukeshkumar (2015) asserts that the concept of risk management is not popular in the construction industry and subsequently there is need to raise awareness.

1.1 Statement of the Problem

The issue of project abandonment is a challenge in Zambia. This is apparent, from the increase in the number of construction projects being abandoned. A review of the Auditor General Reports (AGRs) of 2012, 2013 and 2014 demonstrates the gravity of

project abandonment of public projects in Zambia. In 2012, according to the report of The Auditor General on The Accounts of The Republic for The Financial Year Ended 31st December (2012), five (5) projects were reported to have been abandoned by contractors. The construction of a Milenge District Hospital, Waste Stabilisation Ponds (WSPs) for Kalabo District Hospital, Lundazi airstrip and a road network for Solwezi Town were the intentions of these projects. The total amount for the contract sums of these projects was approximately K7.9 billion. Of this amount approximately K4.2 billion had been paid out, representing 54% of the contract sums (Figure 1).

According to the report of The Auditor General on The Accounts of The Republic for The Financial Year Ended 31st December (2013), the number of reported abandonments had increased to sixty-six (66) in 2013. the projects were to either construct or rehabilitate basic schools, primary schools, high schools, secondary schools, community schools, staff houses, storage sheds, markets, hospitals, clinics, health centres, a fire station, police posts, bridges and improved pit latrines in many places across the country. The contract durations ranged from as short as two (2) weeks to long as two (2) years. The total amount for the contract sums of these projects was approximately K115.3 million. Of this amount approximately K54.2 million had been paid out, representing 47% of the contract sums (Figure 1). The paid-out money could in most cases be considered as wasted resources as works in some instances had not begun at all or very little had been completed compared to the scope of works.

Similarly, in 2014, according to the report of The Auditor General on The Accounts of The Republic for The Financial Year Ended 31st December (2014), the number of public abandoned projects increased too. The total contract sums for the projects was roughly K328.2 million, of which a sum of K102.5 million representing 31% (Figure 1), had been paid out to contractors for the measured works and advance payments. Through this period, not one claim against the performance security and/ or advance payment guarantee had been made. The projects included the construction of a sample shed, national and registration passport offices, water and sanitation reticulation infrastructure, boreholes, dams, houses, bus station and a fire station.

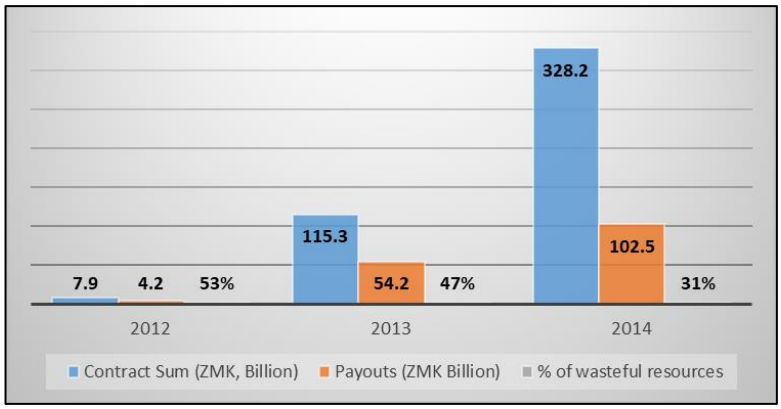

Figure 1: Percentage of Wasteful Resources 2012-2014

The responsibility of managing the projects cuts across many different ministries. The reasons for the above-mentioned project abandonments are generally not documented save for a small number of reasons highlighted as lack of seriousness by the contractors, termination of contract due to poor workmanship, failure of a ministry to pay the contractor, and the inability of the client to provide drawings and land to construct on (Office of the Auditor General 2012; Office of The Auditor General, 2013; Office of The Auditor General, 2014).

Carrero et al (2009) suggests that there are two (2) types impacts caused by project abandonment, these being of a social economic nature such as jobs losses and of an environmental nature such as aesthetics. Hanachor (2012) highlights loss of economic benefits to individuals, social-economic benefits to the community and loss of funds and the incurring of extra cost to replace projects for the government. (Oyeldele, 2013) explains that in a period of 2 years 40,000 members of unions in Nigeria were thrown into the labour market due to abandonment of construction projects.

It is clear from the auditor general's reports that resources meant for social benefits in Zambia are being lost through project abandonment, and project beneficiaries and stakeholders are consequently denied of the much-needed infrastructure.

1.2 Aim of the Study

To develop a risk management framework for project stakeholders that can predict the exposure of a project to construction related risks and the subsequent consequences.

1.3 Research Objectives

The study sought to achieve the following objectives;

a) To identify the main causes of project abandonment in the construction industry in Zambia.
b) To identify the effects of project abandonment in the construction industry in Zambia.
c) To determine the extent to which risk management is incorporated in the management of construction projects in Zambia.
d) To examine the existence of a relationship between risk management and project abandonment.
e) To recommend a risk management framework for Zambian construction industry.

1.4 Research Questions

The study sought to answer the following research questions;

a) What are the main causes of project abandonment in the construction industry in Zambia?
b) What are the effects of project abandonment in the construction industry in Zambia?
c) To what extent is risk management incorporated in the management of construction projects in Zambia?
d) Is there a relationship between risk management and project abandonment?
e) What risk management framework is suitable for the Zambian construction industry?

1.5 Scope of Study

This study shall focus on assessing risk management techniques adopted on construction projects both in the public and private sector in Zambia. The researcher's rationale is that, this presents to the study a broader range of risk management techniques to be reviewed.

1.6 Research Design

The study was a quantitative study were primary data was collected through the use of self-completing questionnaires purposively distributed to a convenient sample of 70 professionals. A response rate of 70% was obtained. The study employed quantitative methods for data analysis making use of the Relative Importance Index to rank the causes and effects of project abandonment and also Structural Equation Modelling to examine the relationship between project abandonment and risk management.

1.7 Significance of Study

The significance of this study is that it is set to benefit (a) Government and Organisations undertaking infrastructural projects in Zambia (b) Contractors and (c) scholars and academic fraternity. The number of projects being abandoned is alarming, it is hope that as a result of the finding of this research, a reduction in the number of abandoned projects shall be seen so as to save funds, achieve project objectives, grow the economy for the countries alike and to realise profits and technical experience in the case of contractors.

The research gap that the current study fills is as follows; firstly, as seen in chapter one the project abandonment is on the rise in Zambia, yet no particular study has been undertaken on project abandonment in Zambia. In addition, despite a number of studies undertaken globally on risk management in the construction industry to mitigate delays, cost overruns and project abandonment and understand the causes and effects of these, studies have not gone further to determine the actual relationship between risk management and project abandonment. Furthermore, studies have not developed frameworks to assist project organizations predict risks that they may be exposed to.

Secondly, there is a dearth of studies that make use of Structural Equation Modelling (SEM) to define relationships or rank risks in the construction industry save for the study by Chandra (2015). Several studies use different methods R.I.I and Mean Item Score Methods as discussed in the methodology to rank risks. This study therefore provides a reference for other studies in the use of S.E.M in determining relationships among variables.

1.8 Definition of Key Terms

Construction – Is the building, alterations, converting, fitting-out, commissioning, renovating, repairing, upkeep, decorating, maintaining, de-commissioning, demolishing, dismantling, assembling of engineering work (Health and Safety Authority, 2006)

Cause – Definite event or circumstance in the project or its environment, which give rise to uncertainty (AG, 2017).

Project abandonment - The act of discontinuing construction project implementation on a development project for a period of more than six (6) months (Hussin & Omran, 2011).

Risk – The combination of the probability of an event and its consequences (Haapio & Siedel, 2013).

Effect - Unplanned variation from project objectives, which arises as a result of risks occurring (AG, 2017).

Risk Management – A comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives (Banaitiene & Banaitis, 2012).

Technique – A manner of accomplishing a task (Isman, 2012).

1.9 Organization of the Report

Chapter One: Chapter 1 introduces the study and defines the statement of the problem as identified by the researcher. Then the chapter outlines the aim of the study, its specific objectives and the significance of the study.

Chapter Two: Chapter 2 presents the literature reviewed. The literature includes prior studies on risk management in the construction industry and outlines the gaps in the field of study. The chapter also highlights similar studies that have sought to understand the risk management techniques in construction management worldwide.

Chapter Three: Chapter 3 discusses the methodology the researcher adopted to collect and analyse the data.

Chapter Four: Chapter 4 focuses on the presentation, analysis and discussion of the findings. The analysis uses quantitative methods for data analysis.

Chapter Five: Chapter 5 details the conclusion and recommendations to be made by the study.

1.10 Chapter Summary

This chapter presented the background to the research, stating the problem of the study and its aim. Project abandonment is a challenge in the Zambian construction industry as the number of abandoned projects continue to increase as well as the percentage of wasteful resources. The aim of this study therefore was to develop a risk management framework for project stakeholders that can predict the exposure of a project to construction related risks and the subsequent consequences. The chapter further presented the objectives of the study and the research questions corresponding to the objectives. This chapter also discussed the scope of the research, its significance and defined key terms of the study. The next chapter discusses the literature reviewed regarding risk management in the construction industry.

CHAPTER TWO - LITERATURE REVIEW

2.0 Introduction

This chapter discusses the nature of the Zambian construction industry and its importance to the country's economy. It then gives an overview on project abandonment, reflecting on the causes and effects of project abandonment globally, that is, risks and their effects and the management thereof of the risks. In addition, the chapter presents scholarly thoughts on the purpose of risk management and the extent of use of risk management techniques in the construction industry through the appraisal of past and similar studies.

2.1 The Construction Industry in Zambia

The contribution of the construction industry to economic growth and long-term national development particularly to developing countries is acknowledged broadly (Ofori, 2015). The construction sector plays an important role in the economic uplift and development of a country. Khan (2008) argues that its role is supreme. It is a determinant of success in converting public and private resources or investment efforts into physical assets (United Nations University, 2018). The African Development Bank (2014) reports that Zambia's economic performance is largely driven by manufacturing, trading, mining, construction, transport and communications. In 2010 for example, Zambia's construction industry contributed 10.9% to Zambia's overall Gross Domestic Product (GDP), ranking the third largest contributor after wholesale and retail trading and mining (CSO, 2014). Similarly, the construction industry in 2012, was the third largest employer after the agriculture, forestry and fishing industry and the trade, wholesale and retail distribution industry. The number of people employed in the construction industry in 2012 was approximately 187,906 representing 3.4% of the total labour force of 5,966,199 people (CSO, 2012). In December 2015, the National Council for Construction (NCC) had a total of 4,953 registered contractors (NCC, 2016). Of this number, 96% were Zambian owned companies. There had been an increase in the number of companies registered from the year 2005 to 2015, from an approximate number of 1300 companies to approximately 5000 companies, thereby indicating the expansion of the industry in the past 10 years. The number of foreign contractors had also increased gradually over the same period from 0 to approximately 240 being registered. In 2019, the total number

of registered contractors and consultants was 7529. The construction industry is however, not only made up of contractors and their employees but other players such as the clients, that is, project owners. Xiaohua et al (2017) identify design teams, clients and project managers as the major players in the construction industry.

The construction industry can be characterized as a specific kind of project-based industry (Vrijhoef & Koskela, n.d.). It consists of transportation systems such as roads, bridges, walkways, rail, airports, and ports; electric energy production and distribution systems such as electric grids; water and sanitation systems that provide a supply of clean water, allow for water resource management, and support sanitation through waste disposal subsystems; housing infrastructure, including accommodation or buildings for residential and commercial purposes (retail stores, wholesale stores, and warehouses/storage facilities, including silos), office buildings, extractive industry and manufacturing factories, which are specialized types of housing infrastructure; and telecommunication installations like phone, television, or internet network installations, satellites and others (United Nations University, 2018). Demand for the different types of services in the industry largely depend on demographic, political and economic circumstances (ibid).

The construction industry in Zambia suffers from many problems and complex issues (Chilongo & Mbetwa, 2017). Of these problems, as seen in the background of the study is project abandonment. Sunitha et al (2015) highlight that it not uncommon for projects to be abandoned. Amade et al (2015) elucidate that 'failed and abandoned construction projects abound everywhere.'

2.2 An Overview on Project Abandonment

Project abandonment is the complete stopping of work on a project due to the fact that it faces too many problems hence making it seemly impossible to continue (Sunitha, et al., 2015). Ewusi-Mensah and Przasnyski (1991) cited by Amade et al (2015) on the other hand, opine that project abandonment is the discontinuation of a project under development either permanently or temporarily, by its management by reasons best known to themselves. Chilongo and Mbetwa (2017) on the other hand, defines project abandonment as the 'premature permanent closure of the project by the contractor.' Nwachukwu et al. (2010) cited by Tijani & Ajagbe (2016) described project

abandonment as the refusal or failure, to complete a contract before a practical completion date.

2.3 Causes of Project abandonment in Construction

A cause is an event or circumstance in a project or its environment, which gives rise to uncertainty (AG, 2017). There are numerous causes of project abandonment world-wide with some causes taking prominence over others in varying environments. For instance, the abandonment of government roads, a bridge and independent power producer projects in Nigeria between the years 2005 to 2010 was caused by paucity of funds, political issues, change of governments and problems with a contractor (Amade, et al., 2015). Yap et al (2014) in a study on project abandonment on housing projects in Malaysia, identified 41 causes grouped to represent causes due to mismanagement, unfavourable government policies, inefficient public delivery system, and unfavourable economic conditions.

Yap et al (2014) presented by importance, a comprehensive listing of the individual causes of abandonment as; financial difficulties faced by the owner, financial difficulties faced by the contractor, unexpected bad economic conditions and inappropriate mode of financing project. delays in interim payments, inadequate project feasibility studies, incompetent contractors or subcontractors, project control problems, inappropriate project planning and scheduling.

Additionally, bureaucracy and red tape within the project, poor contract administration, inexperienced client/owner, unfavourable government policy, fraudulent practices and briberies, litigation, inappropriate pricing/incentives of services rendered by contractors or consultants, lack of appropriate dispute resolution method, faulty tender process, lack of cooperation from local authorities, inappropriate contract arrangements (traditional design-bid-build/design and build/management contracting/etc) were also identified as causes of project abandonment in Malaysia.

Unclear lines of responsibility and authority, problems of communication and coordination, incompetent consultants, poor quality control, site acquisition problems, impact of project towards society or environment, inappropriate risk allocation among

project team members, shortage of site workers, poor relationship among project team members were furthermore identified as causes of project abandonment in Malaysia.

To add, unskilled/incompetent site workers, ambiguities or mistakes in scope of work, specifications or drawings, problems related to change orders/variation orders, involvement of large number of participants of project, lack of motivation of site workers, relationship between contractor and labour (industrial relation), unavailability of materials and equipment, poor safety management on site, cultural clash among parties involved in project, unexpected location difficulty, adverse weather or acts of God and difficulty of design and construction were identified as causes of project abandonment in Malaysia.

Sunitha et al (2015) acknowledge in a review of causes and effects of project abandonment, that project abandonment is not limited to buildings alone, but roads, industrial structures, bridges, factories, dams, electricity, communication projects and so on, get abandoned. Sunitha et al (2015) add that it essential to define the actual causes of project abandonment so that the prevention can be found. The study identified the causes of project abandonment as project characteristic related factors; procurement related factors; project management factors; project participants related factors and external factors.

The review of causes of project abandonment, beyond those identified by Yap et al., (2014), recognized poor risk management, inaccurate estimations and anxieties towards parties to the project as causes of project abandonment. Similarly, Dumo (2017), identified the causes of project abandonment to include economic, financial, legal, managerial, system-based factors.

Amade et al (2015) highlight studies that align causes of project abandonment to the different categories of participants in the construction industry, that is, highlighting causes clients, contractors and project managers on a construction project are likely to experience. This implies that some factors are likely to affect one party more than the others. Risk factors affecting clients, therefore are ineffective decision making, inadequate financing and experience whilst those affecting contractors are predominantly inefficient cash flows, contractor experience, site supervision and management effectiveness and the adequacy of designs. Equally, factors affecting

project managers are factors such as the technical know-how, experience, decision making and coordinating abilities.

2.3 Effects of Project abandonment in Construction

Sunitha et al (2015) discuss the effect of abandonment as lowered standard of living, lowered employment opportunities, the emerging of disappointed users of proposed project, decrease in economic activities and revenues, difficulties in obtaining foreign and the wastage of valuable resources. Effects are unplanned variations from project objectives, which arises as a result of risks occurring (AG, 2017).

Yap et al (2014) agree that project abandonment is a waste of resources. This was seen from the effects of project abandonment on private housing projects in Malaysia as purchased houses not completed denied the buyer the opportunity for rental collection or the possibility of living in the house. Some buyers had obtained loans to facilitate the purchase thereby continuing to service loans despite the not having a property.

The effects of project abandonment can be summarized two-fold, that is, environmental and socio-economic impacts (Carrero, et al., 2009). The short-term environmental effects are modification in the landscape and aesthetics of project site whilst short-term socio-economic effects are unemployment and conflicts among stakeholders. On the other hand, long-term environmental effect are erosion and pollution with loss of economic value, marginalization of a population, cost transfer between the public and private stakeholders being long-term social economic effects (ibid). Yap et al (2014) citing Chan (2009) and Perumal (2009) point out in agreement that abandoned sites threaten public health by promoting rubbish dumps and pools of stagnant water thereby encouraging mosquito breeding and on the other hand sites having infrastructure promote criminals and drug dealing a hazard to the population.

2.4 Risk Defined

Risk is present in all projects irrespective of their size or sector (Banaitiene & Banaitis, 2012). Risks and uncertainties inherent in the construction industry are more than any other industries (ibid). And so, risks are all around us. Some being predictable and whilst others are unforeseen (Darnall and Preston, 2010) and so, reinforcing the need to successfully manage them. The Project Management Institute (PMI, 2013) defines

risk as an uncertain event or condition that if it occurs has a positive or negative effect on a project's objectives. Hillson (2012) cites a similar definition of risk developed by the Institute of Civil Engineers (ICE) as a possible occurrence that could affect negatively or positively the achievement for the objectives of the investment. Haapio & Siedel (2013) cite the Institute of Risk Management's (IRM) definition of risk as a combination of the probability of an event and its consequences. The probability of risk is also understood to be the likelihood of occurrence of an event and consequences on the other hand, are understood to be impacts. Similarly, Simu (2009) cites international standard IEC 62198:2001 that define risk as "combination of the probability of an event occurring and its consequences for project objectives." The main constructs seen from the definitions herein provided are that risks are uncertain, and their likelihood of occurrence and the consequences thereof should they occur have an impact on project success. The management of risks in projects is about proactively working with project stakeholders to minimize the risk and maximize the opportunities associated with project decision (Loosemore, et al., 2012).

The quantification of risks is the magnitude and frequency of each event (Petrovic, 2017). Risk often varies in the likelihood of its occurrence and its impacts from one project to another and risk changes its nature during the project life cycle (Smith, Merna & Jobling, 2006). 'A risk may have one or more causes and, if it occurs, it may have one or more impacts' (PMI, 2013). Often, risks are only perceived as negative events as the possibility of loss (Zenghua, 2011). Risk, though, does not necessarily involve only bad outcomes and negative consequences; it can also refer to the chances of positive events (Goh & Abdul-Rahman, 2013).

2.5 Risk Groupings

Project risks often tend to be interrelated, but they can sometimes be considered in isolation (Goh & Abdul-Rahman, 2013). Bhasvar (2013) classifies risks into technical risks, construction risks, physical risks, organizational risks, financial risks, social-political risks and environmental risks pointing out that risks have significant impacts on construction projects in terms of its primary objectives. Equally, Shankar & Balasubramanian (2015) classifying risks into construction risk, design risk, environmental risk, financial risk, management risk, political risk, procurement risk, sub-contractors' risk, technology risk, point out that consequences of the negative

events are detrimental to any project particularly construction projects. It is valuable noting that design and sub-contractors' risks are classified as construction and organizational risks respectively by Bhasvar (2013).

Bhavsar (2013) further defines these as Technical Risks: incomplete design, inadequate specification, inadequate site investigation, change in scope, construction procedures, insufficient resource availability; Construction Risks: labour productivity, labour disputes, site condition, equipment failures, design changes, too high quality standard, new technology; Physical Risks: damage to structure, damage to equipment, labour injuries, equipment and material fire and theft; Organisational Risks: contractual relations, contractor's experience, attitudes of participants, inexperienced work force, communication; Financial Risks: increased material cost, low market demand, exchange rate fluctuation, payment delays, improper estimation, taxes; Socio-political Risks changes in laws and regulations, pollution and safety rules, bribery/corruption, language/cultural barrier, law and order, war and civil disorder, requirement for permits and their approval; Environmental Risks; natural disasters, weather implications. The Human Sciences Research Council (2011) opine political risks are risks a project company and lenders face the risk that the project execution may be negatively affected by acts of the contracting authority (Government), another agency of the government or the host country's legislature. Schieg (2006) terms financial risks as cost risks that caused by planning changes, complicated project conditions and client's failure to pay.

To risk categories identified by Bhasvar (2013) and Shankar & Balasubramanian (2015), (Kamane & Mahadik, n.d.) further identifies legal risks that include but are not limited to employment law, leasing of property, breach of contracts, environmental regulation and health and safety laws stating that legal risks arise due to non-compliance of regulatory requirements. The duo also defines natural disasters as force majeure risks explaining that environmental risks are risks relating to occurrence of environmental incidents all through implementation of the project such as loss of flora and fauna, loss of fertile lands, rehabilitation and resettlement problems and not natural weather conditions.

Abdul Rahman et al., (2013) opined that factors pertaining to project abandonments can be categorised into financial, economic, legal, managerial, system-related and

unforeseen risks. Evidently, the groupings or categorizations of risks are not distinctively defined and therefore overlap.

Zenghua (2011), contends that risk management issues in construction projects may be classified in a 3 main categories, these being, socioeconomic factors such as environmental protection, public safety regulation, economic instability and exchange rate fluctuation; organizational relationships such as contractual relations, attitudes of participants and communication; and finally technological problems such as design assumptions, site conditions, construction procedures and construction occupational safety.

Zavadskas et al., (2010) supports this thinking in that they opine that projects risk can be divided into three groups, that is, external risks, internal risks and project risks. These are further divided as follows;

- External Risks; to include political risk, economic risk, social risk and weather risk. This is supported by (Szymanski, 2017) that define external risks as socio-economic risks. The Orange Book (2017) suggests the use of the 'PESTLE' model to analyse external risks to any project not wholly within the organisations control but to which action can be taken to mitigate the risk. PESTLE standing for;
    - Political risks
    - Environmental risks
    - Socio-cultural risks
    - Technological risks
    - Legal risks
    - Environmental risks.
- Internal Risks; to include resource risk, project member risk (such as team member turnover, staffing build-up, insufficient knowledge or communication), stakeholder risk, designers' risk, contractor risk, subcontractor risk, suppliers' risk, construction site risk, document and information risk. Rahacek (2017) adds team and project member risk to this definition of internal risks.
- Project Risks; to include time risk, cost risk, quality risk (such as defect in interim results, lack of application of project methods and controls).

2.6 The Risk Management Process

Banaitiene & Banaitis (2012) define risk management as a 'comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives.' Mahendra et al (2013) defines risk management in a similar manner as 'a process which consists of identification of risks, assessment with qualitatively and quantitatively, response with a suitable method for handling risks, and then control the risks by monitoring.' The latter spells out the process with the former definition spelling out the purpose of risk management, that is, ensuring that project objectives are met. Project objectives include but are not limited to time, cost, quality, safety and environmental sustainability (Banaitiene & Banaitis, 2012). Amade et al (2013) citing Chitkara (2011), suggest that project risk management is the art and science of managing risks caused by unforeseen changes (uncertainties) which may require deviations from the planned approach and may therefore affect the achievement of the project objectives.

According to Zavadskas et al., (2010) the project life cycle consists of initiating, planning, executing, monitoring and controlling and closing. Therefore, risk management must be implemented from the early stages of a project initiation through to completion. The aim of risk management is to decrease undesirable risks and to make the most of optimistic risks, in order to ensure project objectives are met.

The PMI though proposed six (6) processes, that is, plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk response and control risks (PMBOK, 2013). The plan risk management process involves the planning of how risk management will be conducted in the project's life cycle ensuring the effectiveness of the entire risk management process. In the risk identification stage, risks that may affect the project are identified and once risks are identified, they are then analyzed to prioritise them based on the likelihood of occurrence and the consequences. The planning of risk response is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives. The last and final process is the controlling of risks by instigating risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project (PMBOK, 2013).

However, many scholars typically identify 4 steps in risk management to have risk identification, assessment, control and monitoring as shown in Figure 2. Mahendra et al (2013) express 4 steps of risk management to include identification, assessment, response planning and control. Likewise, (Bhavsar, 2013 and Banaitis & Banaitiene, 2012) suggest risk identification, risk assessment, risk response planning or mitigation and risk monitoring and control

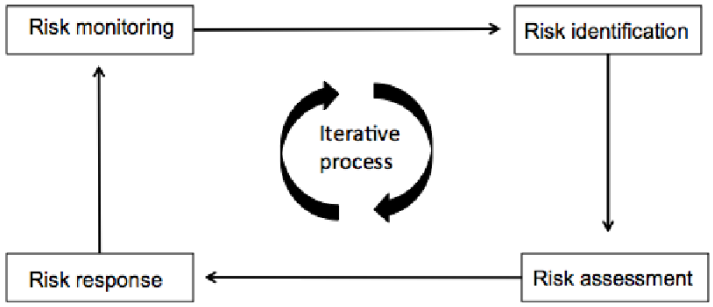

Figure 2: Risk Management Process

Adopted from (Petrovic, 2017) citing Hillson 2004

Risk management is an iterative process. Each time new risks arise, or risks change their nature during the project lifecycle, the process loops back to the risk identification stage (Goh & Abdul-Rahman, 2013). Risks management presents an opportunity to be proactive rather than reactive (Mahendra, et al., 2013). According to Hansen-Addy & Fekpe (2015), citing (Osipova & Eriksson, 2011; Schieg, 2006; Zou et al 2010) failure to manage potential risks on projects adequately can have adverse effects on the overall success of the project. This level of risk can be decreased by adopting risk management practices (Nawaz, et al., 2019).

2.7 Effects of Poor Risk Management on Project Abandonment

Once a risk outbreak occurs as a consequence of poor risk management, an error or a failure that causes harm to either people or material, i.e. defects in the final product, might also occur (Simu, 2009). According to Yazdanifard & Ratsiepe, (2011) poor risk management it is counted as a major aspect contributing to project failure. TenSix Consulting (2020) opine that project failure is the worst-case scenario emanating from the failure adequately manage risk among having unhappy clients, unrealised benefits and reputational damage as it never completes or delivers anything of value.

2.8 Risk Management Techniques

The risk management process includes varying techniques used during identification, analysis, mitigation and monitoring.

2.8.1 Risk Identification Technique

The identification of risks is important in the management of risks. This stage attempts to determine potential risks inherent in any project including sources of risks (Hansen-Addy & Fekpe, 2015). Banitiene & Banatis (2013) point out that it is the most important stage of a risk management process as it attempts to identify the source of risks and the type of risks. The identification of risks must be done in such a manner to ensure that all possible risks to a project are identified. However, Schieg (2006) argues that it is impossible to identify all risks at the beginning of the project since not all risks may be recognizable but do emerge during implementation and so the task of risk management is therefore to cover essential risks as completely as possible. Ogunyabo (2014) contends that the level of risk identification and analysis is minimal during the project execution phase with more effort being spent of the monitoring and control of risk. It is therefore imperative to ensure all possible risks are identified from the get-go. According to The Orange Book (2004), the identification of risk can be separated into two distinct phases; an initial risk identification and continuous identification necessary for the identification of risks not previously identified. Zavadskas et al., (2010) suggests that risk identification is about defining sources of uncertainty. In this regard, one needs to understand what they are dealing with in order to be able to manage it.

There are several risk identification methods. The choice of the technique is based on whether the methods require less time or take a long time to perform, the cost effectiveness of the method and availability of input data (Lichtenstien, 1996).

- **Interview and Questionnaires**

  Here experts in risk management are interviewed to assess risk parameters, identify possible mitigation, contingency measures and to elicit information. This is technique that has been used historically by personnel departments and other consultants to extract information (Rehacek, 2017).

- **Checklists**

  These are simple and useful predetermined lists of factors that are possible for the project (Rehacek, 2017). The checklist which contains a list of the risks identified in projects undertaken in the past and the responses to those risks provides a head start in risk identification.

- **Brainstorming**

  This is a technique of solving specific problems, amassing information, stimulating creative thinking through spontaneous participation in discussions (Human Sciences Research Council, 2011). This is the most popular technique as it is used to generate ideas and identify risks (Bhasvar et al., 2013). It is used for idea generation (Mahendra, et al., 2013). The relevant persons associated with project gather at one place. There is one facilitator who is briefing about various aspects with the participants and then after noting down the factors (ibid). It encourages everyone on a project team to generate a large quantity of potential risks affecting the project (Odimabo, et al., 2018)

- **Expert Judgement**

  Specialist areas such as health and safety require specialists to identify all the possible risks (Human Sciences Research Council, 2011). Experts therefore identify possible risks.

- **Delphi Technique**

  This technique is comparable to brainstorming, but the participants do not know each other, and they are not at the same place. Anonymity of group members is one on the main characteristics. They identify the factors without consulting other participants. The facilitator like in brainstorming, sums up the identified. This technique can be utilized by involving a panel of experts in risk management to identify risks or estimate the impact and probability of previously identified specific risks through questionnaires (Odimabo, et al., 2018).

- **Historical Information/Experience**

  Here personnel with abundant experience on the project can be of help in avoiding or solving similar problems encountered before (Rehacek, 2017). Also known as experiential, this technique involves individuals obtaining

information through past experiences in the construction industry (Odimabo, et al., 2018).

2.8.2 Risk Analysis Techniques

In this step, analysis of risks is conducted. Risks analysis techniques are also referred to as risk assessment techniques. Zavadskas et al., (2010) describes risk analysis as the process of estimating the consequences of uncertain events/conditions. The objectives of analysis are to separate the minor acceptable risks from the major risks, and to provide data to assist in the evaluation and treatment of risks (Human Sciences Research Council, 2011). Risk analysis facilitates identification of risk priorities in particular to identifying the most significant risks with which senior management should concern themselves and captures the reasons for decisions made about what is and is not tolerable exposure (The Orange Book, 2004). The qualitative analysis assesses the probability of occurrence of risks and the severity of such occurrence on a project. The quantitative analysis attempts to quantify the impacts of risk occurrence on the project in terms of costs and time (Hansen-Addy & Fekpe, 2015).

2.8.2.1 Qualitative Risk Analysis

Qualitative methods of risk analysis are used in construction companies most frequently, ahead of Quantitative (Banaitiene & Banaitis, 2012). Qualitative analysis involves characterizing the likelihood and consequences in terms of non-quantitative ratings (AG, 2017). They are relatively quick to conduct and provide a simple visual rating (ibid). Qualitative analysis is therefore subjective (Petrovic, 2017). The likelihood of occurrence might be classified as high, medium or low and the impact minor, significant or major. In this type of analysis, identified risks are prioritized in terms of their likelihood and impact on the project objectives (Burtonshaw-Gunn, 2009) to rank them in order of severity (Lowe, 2002). Ranking and corresponding risks to activities is very crucial step of this qualitative risk analysis (Podieh, 2015).

- **Hierarchical Risk Breakdown Structure**

  Hierarchical RBS is applied to systemize the threats according to their sources to identify the areas with the highest exposure to those risks. This method breaks down activities into small units and creates hierarchical series of activities, additionally the method can include risk dependencies and a

prioritization of them depending on how quick response they require. (Petrovic, 2017). This can be based on the work breakdown structure (WBS) (Larson & Gray, 2011).

- **Risk register and Ranking**

  A risk register is a tool that project teams can use to document and address project risks throughout the project life cycle. It is a comprehensive living document listing of risks and the way they are being addressed as part of the project risk management process (AG, 2017). It logs in several information for individual risk factors, including a description, potential causes, ownership, probability, impacts, mitigation and fall-back plans and status (Oduoza, 2019).

- **Probability/Impact Risk Rating Matrix**

  The Risk Probability and Impact Matrix, Figure 3, is used to determine the importance of each risk impact based on the probability and impact ratings. Each word descriptor of the rating has an associated number; the product of the probability number and impact number defines the risk score. The colour of the zone indicates the priority of the risk for risk response with red zone signifying high importance, yellow is medium importance, and green is low importance (AG, 2017).

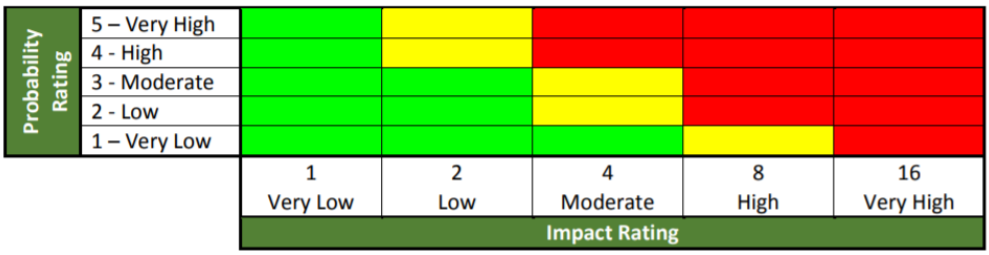

Figure 3: Risk Probability and Impact Matrix

Adopted from Petrovic (2017)

The high priority score threats, meaning high impact and likelihood, are viewed as high-risk and could necessitate an urgent response while low scored threats could be further monitored and given attention only if needed (Petrovic, 2017).

- **Risk Mapping**

  Risk Mapping, Figure 4, is a tool used in the identification, control, and management of risk. It can form the first step in the risk management process

or it can stand alone as the primary risk management process for companies that have not yet developed a full risk management system (Ingram & Headey, 2004).

Figure 4: Risk Mapping Cycle

Adopted from (Ingram & Headey, 2004)

Risk maps objectively analyse risk severity for the important risk factors (Sharma, 2013). Group Map (2019) give a graphical four-tier risk severity categorization based on a risk map. Sharma (2013) proposes four different categorization names for risks mapped in the same way from critical risks, difficult risks, routine risks and minor risks to be critical, high, moderate and low respectively with impact being plotted on the x-axis, however (Figure 5). Sharma (2013) further recommends that critical risks are eliminated or reduced, high risks are monitored on a rotational basis, moderate are frequently monitored and low are monitored minimally.

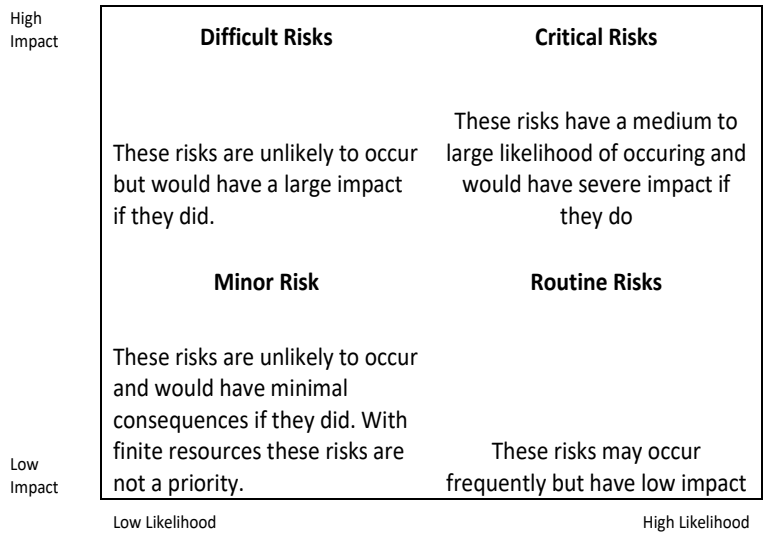

Figure 5: Risk Assessment Map

Adopted from (Group Map, 2019)

2.8.2.2 Quantitative Risk Analysis

Qualitative analysis uses numerical values for both likelihood and impact from a variety of sources rather than the descriptive scales used in qualitative analysis (Human Sciences Research Council, 2011). Quantitative risk analysis attempts to estimate the frequency of risks and the magnitude of their consequences (Banaitiene & Banaitis, 2012).

- **Decision Tree Analysis**

  This analysis is also referred to as the diagramming technique. These models are sometimes very complex and can lead to the need for effective graphical presentation as well as mathematical and computational efficiency (Odimabo, et al., 2018). Decision trees are very helpful to both formulate the problem and evaluate options (Mahendra et al., 2013; Rehacek, 2017). Decision tree analyses are commonly used when certain risks have an exceptionally high impact on the two main project objectives: time and cost (Heldman, 2005). There are two types of decisions trees; called Fault tree analysis (FTA) and Event tree analysis (ETA).

  Fault Tree Analysis (FTA): This is a technique that provides a systematic description of the combinations of possible occurrences in a system, which can result in an undesirable outcome. (Bemeleit, et al., 2005)

Event Tree Analysis (ETA): Event tree analysis is based on binary logic, in which an event either has or has not happened or a component has or has not failed. The consequences of the event are followed through a series of possible paths. Each path is assigned a probability of occurrence (Bemeleit, et al., 2005)

- **Scenario Analysis/ Probability Analysis/ Monte Carlo Simulations**

  Some organizations use quantitative approaches that are built on traditional statistical and probabilistic models and techniques (IMA, 2007). The disadvantage to these approaches is that they require more time, data, and analysis (ibid). A project simulation is done using a model to show the potential impact of different level of uncertainties on project objectives. The Monte Carlo Simulation is one such method (Mahendra, et al., 2013) that is also called the Scenario Technique (Gajewska & Ropel, 2011) or the Probabilistic Analysis Technique (Bhavsar, 2013).

  Scenario analysis shows the influence of different scenarios of a project or impact of different risk on a project if they occur simultaneously (Rehacek, 2017). A random sampling is undertaken using uncertain risk factors to generate a wide range of possible outcomes. This is usually done by creating a mathematical model and then running simulations on the model to determine the impacts of identified risks on a construction project (Odimabo, et al., 2018).

- **Sensitivity Analysis**

  Sensitivity analysis is also called the modelling technique (Gajewska & Ropel, 2011). A model is developed and the sensitivity of different elements on project outcome is checked (Rehacek, 2017). Scenario analysis gives the impact of different scenario of the project or impact of different risk if that occurs simultaneously (Mahendra, et al., 2013). 'Sensitivity analysis or what-if analysis as it is sometimes called is a technique that seeks to determine which task variable in a project, for example, cost, time, quality has the greatest impact on project parameters' (Odimabo, et al., 2018). Sensitivity analysis allows a project manager to identify which activity schedule risk has the strongest correlation with the completion time of the construction project (ibid).

- **ABC Analysis**

  The ABC analysis is an inventory categorization method analyzing materials at three levels with A being the highest consumption items, B medium consumption C being the least consumption (Mahagaonkar & Kelkar, 2017) thereby drawing attention to the most critical items.

2.8.3 Risk Control Techniques

The final step in the management of risks involves monitoring and responding to current and emerging risks (Banaitiene, et al., 2011; Wang, et al., 2004; Hansen-Addy & Fekpe, 2015). Any negative risks are to be handled through risk avoidance, acceptance, transfer and mitigation. On the other hand, positive risk can be enhanced and shared. A risk response framework adopted by the Human Sciences Research Council (2011) suggests responses to as a guide that risk that have a low risk rating and low risk magnitude are to be accepted and kept under periodic review; risks with medium rating and medium magnitude are either to be reduced or mitigated; and finally high risk rating and magnitude risks require immediate attention so that they are avoided, reduced or transferred. Similarly, Odimabo et al., (2018) and Petrovic (2017) provide a guide (Figures 6 and 7) on how risk should be treated based on its ranking by probability and consequence.

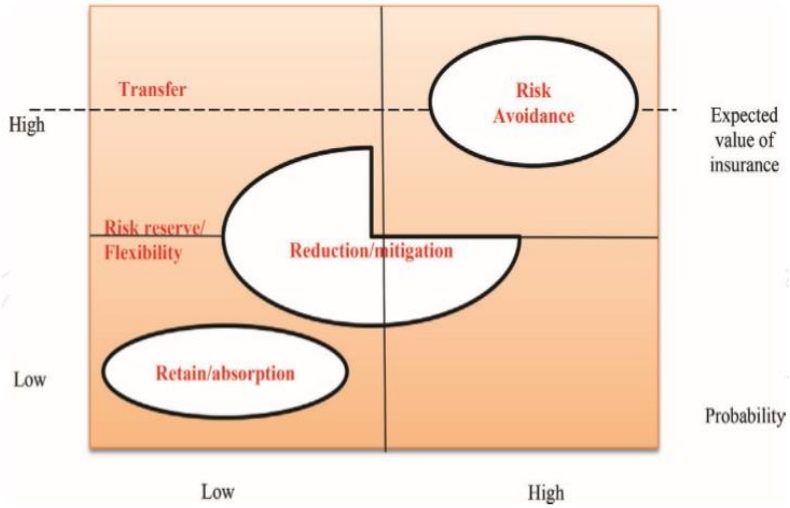

Figure 6: Risk Treatment

Adopted from (Odimabo, et al., 2018)

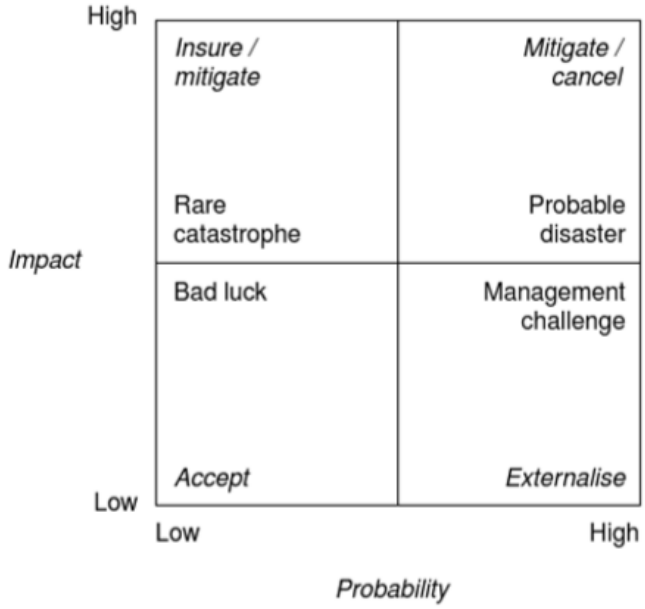

Figure 7: Risk Control

Adopted from (Petrovic, 2017)

- **Risk Avoidance**

  Risk avoidance is changing the project plan to eliminate the risk or to protect the project objectives from its impact (AG, 2017). Risk can be warded off by removing the cause of the risk by executing the project in a different direction while still aiming to accomplish project objectives (Rehacek, 2017).

- **Risk Transfer and Sharing**

  Risk is transferred to another entity demonstrating the ability to neutralize risk (Szymanski, 2017). Transferring risk involves finding some other party who is willing to accept responsibility for its management, and who will bear the liability of the risk should it occur (Mahendra et al 2013). The risk still exists however it is owned and managed by another party (Mahendra et al 2013). The transfer should only be done when the agent is in a better position to manage the risk than the principal (Winch, 2010) cited in Petrovic, (2017). Examples of risk transfer are insurance, outsourcing, partnerships (Human Sciences Research Council, 2011) joint ventures (Koolwijk, 2010).

- **Risk Mitigation**

  The purpose of treatment is that whilst continuing within the organisation with the activity giving rise to the risk, action is taken constraining the risk to an

acceptable level (The Orange Book, 2004). Risk mitigation reduces the probability and/or impact of an adverse risk event to an acceptable threshold (Mahendra et al., 2013; Goh & Abdul-Rahman, 2013). There are two strategies for mitigating risk (a) reduces the likelihood that the event will occur and/or (b) reduce the impact that the adverse event would have on the project (Larson & Gray, 2011). Mitigation strategies can, according to Cooper et al. (2005), include: contingency planning, quality assurance, separation or relocation of activities and resources, contract terms and conditions, crisis management and disaster recovery plans (Gajewska & Ropel, 2011).

- **Risk Acceptance or Retention**

  This is taking no action to influence the likelihood or impact of a risk (Human Sciences Research Council, 2011). Ultimately it is not possible to eliminate all threats or take advantage of all opportunities. Risk retention involves acknowledging that a particular risk situation exists and making a conscious decision to accept the associated level of risk, without engaging in any special efforts to control it (Goh & Abdul-Rahman, 2013) citing (Kerzner, 2003). Accepted risks should be subject to effective monitoring, control and management to ensure that they are within the contingency allowances set (Kamane & Mahadik, n.d.).

- **Risk Exploitation or Enhancement**

  Enhancement is the opposite of mitigation in that action is taken to increase the probability and/or the positive impact of an opportunity (Larson & Gray, 2011; Mahendra, et al., 2013) Exploitation is grasping an opportunity to make sure it will happen and its impact will be realized (Ghahramanzadeh, 2013).

2.8.4 Risk Monitoring Techniques

Risks and the effectiveness of control measures need to be monitored to ensure changing circumstances do not alter risk priorities. Few risks remain static (Awuni, 2019). this process involves keeping track of the identified risks, monitoring the residual risks and identifying new risks, as well as reviewing the execution of risk responses and evaluating their effectiveness (Öngel, 2009) It guarantees new risks are detected and managed (Petrovic, 2017). Schieg (2006) opines that the risk monitoring process ‘helps guarantee that the risk position of the project corresponds to the risk

situation strived for.' It is essential to ensure that the desired effects of the implementation of risk responses are achieved throughout the project life cycle (Goh & Abdul-Rahman, 2013). This agrees with The Orange Book (2004) points out that risks are monitored to check whether the risk profile is changing, and further action is necessary as well as to gain assurance that risk management strategies are effective.

- **Incident Investigation**

  The fact that an incident has happened it suggests that the risk control measure is inadequate (Health and Safety Executive, 2004). This process allows for understanding how and why things went wrong to identify deficiencies in the control process thereby preventing reoccurrence (ibid).

- **Risk Register Updates**

  Risk register is updated to include outcomes of risk reassessments, audits, and risk reviews as risk probability, impact, rank, response could have changed over time. Maintaining the risk register, is an iterative process because new risks may become known as the project progresses through its life cycle, previously identified risks are retired, and other risks may be updated (AG, 2017).

- **Risk Audit**

  The audit function is an essential project control tool. The objective may be a financial audit, a performance audit, or some combination of the two (Nalewaik, 2007). The audit not only tests the accuracy of costs incurred against the construction project, but undertakes an appraisal of processes, project cost, schedule etc. The audit findings are ranked according to their potential impact and presented for decision making (Nalewaik, 2007).

2.9 Extent of Use of Risk Management Techniques

Risk management techniques are rarely used by the participants in construction projects. In a study on risk management in construction projects in the Czech Republic, Rehacek (2017) found that risk management techniques were in use by professionals in the construction industry by they were not aware of it. Similarly, Mahendra et al (2013) found that participants used to handle the risks with an informal approach. Risk management was sporadic was not employed because of limited knowledge and awareness among the construction industry (Mahendra et al., 2013).

Formal risk analysis and management techniques are rarely used by construction industry due to lack of knowledge and expertise (Kamane & Mahadik, n.d.). The importance of implementing an effective risk management is shared among actors in the industry, however, the greatest reason for inadequate implementation of risk management and insufficient capture of knowledge in relation to risk is the lack of time, competence and the corporate culture (Petrovic, 2017). Banaitiene & Banaitis (2012) recommended improved risk management education and training to influence practice in Lithuania as the use of risk management in the Lithuanian construction companies is low to moderate, with little differences between the types, sizes and risk tolerance of the organizations, and experience and risk tolerance of the individual respondents. Nketekete, et al., (2016) also recommended that risk management could accomplished through adequate training of professionals using (Nketekete, et al., 2016) of accredited institutions.

2.10 Risk Maturity

Risk maturity is used in Best Practice Benchmarks, indicating increasing levels of sophistication and other features (PMI, 2002). Risk maturity assessment helps to identify the extent to which risk management has been embedded in your institution and therefore whether remedial steps are required to improve risk activities (Öngel, 2009). There are five levels of risk maturity for an organization;

- **Risk naive**; no formal approach developed for risk management.
- **Risk aware;** scattered silo-based approach to risk management.
- **Risk defined;** strategy and policies in place and communicated.
- **Risk managed;** enterprise-wide approach to risk management developed and communicated.
- **Risk enabled;** risk management and internal control fully embedded in the operations (Kingston City Group, 2019).

Maturity is assessed through models that measure the capability of the risk management process inside of an organization (Serpella, et al., 2015). Tables 1, 2 & 3, show an indepth study of risk maturity models by Caiado et al (2016) that measure the level of sophistication of organisation over several dimensions shown such as culture and risk management processes.

Table 1: Part I - Key Risk Management Maturity Models

(Adopted from Caiado et al.,2016)

Author	Model	Description (What it is and where it is applied?)	Maturity levels	Dimensions
Hillson (1997)	Risk Management Maturity (**RMM**)	It is intended to serve organizations that want to implement a formalized risk management or improve their existing approach. The model helps organizations assess their current level of capacity and maturity of risk management, to identify targets for improvement and to create strategies to develop or improve their level of maturity of the risk management capacity.	Level 1: naive Level 2: novice Level 3: normalized Level 4: natural	(1) definitions, (2) culture, (3) process (4) experience and (5) application
Project Management Solutions (2002)	Project Management Maturity Model (**PMMM**)	The model was developed to help organizations improve their project management processes, providing a conceptual framework and became an industry standard in measuring the maturity of project management. In addition, it serves for improvement, drawing a logical path and monitoring the progress.	Level 1: initial process Level 2: structured process and standards Level 3: organizational standards and institutionalized process Level 4: managed process Level 5: optimizing process	(1) risk identification, (2) risk quantification, (3) risk response development, (4) risk control, and (5) risk documentation
Pangeran et al (2012)	Risk Management Capacity Model **(RMCM)**	The RMCM was developed by adopting the RMM (Hillson, 1997) and the RMML, Risk Management Maturity Level (INCOSE, 2002), generic models that can be applied to all organizations. The RMCM is used to assess the ability of public sector organizations risk management dealing with the development of the PPP (Public Private Partnership) concession scheme.	Level 1: ad hoc Level 2: initial Level 3: competent Level 4: excellent	(1) culture, (2) process, (3) experience, (4) application and (5) partnership
PMI – EUA (RISK SIG, 2002)	**RMM**	The RMM model focuses on risk management and provides a less formal methodology that can be achieved much more easily than a formal evaluation of CMMI. It's more like a generic maturity model focused to risk trying to assist organizations that want to implement formal risk processes or improve their current approach. May be applicable to all types of projects and to all types of organizations in any industry, business or government sectors.	Level 1: ad hoc Level 2: initial Level 3: repeatable Level 4: managed	(1) culture, (2) process, (3) experience and (4) application

Table 2: Part II - Key Risk Management Maturity Models

(Adopted from Caiado et al.,2016)

Author	Model	Description (What it is and where it is applied?)	Maturity levels	Dimensions
IACCM (2003)	Business Risk Management Maturity Model (**BRM3**)	It is a tool for organizations to assess the level of maturity in the business risk management. Proposes help an organization assess whether their approach to risk management is adequate or not, to compare its approach to best practices or in contrast to its competitors and create a benchmark accepted for organizational risk management.	Level 1: novice Level 2: competent Level 3: proficient Level 4: expert	(1) culture, (2) process, (3) experience and (4) application.
Hopkison et Lovelock (2004)	Project Risk Maturity Model (**RMM**)	The Project RMM was developed by HVR Consulting Services in 1999 in order to adapt the Hillson Risk Maturity Model to project. This tool allows the user to evaluate the capacity of the risk management process being applied in any project. It also allows capacity improvements are assessed and capabilities of different designs are compared.	Level 1: naive Level 2: novice Level 3: normalised Level 4: natural	(1) project stakeholders, (2) risk identification, (3) risk analysis, (4) risk reponses, (5) project management, and (6) risk management culture
COSO (2004)	Enterprise Risk Management (**ERM**)	Evaluation of ERM maturity level is crucial because it allows the indentation of strengths and weaknesses from which an organization can derive measures to fill the gaps and improve corporate governance and risk management.	Level 1: very weak, Level 2: poor, Level 3: mid, Level 4: good, Level 5: optimized	(1) internal environment, (2) objective setting, (3) event identification, (4) risk assessment, (5) risk response, (6) control activities, (7) information and communication (8) monitoring
Ren et Yeo (2004)	Risk Management Capability Maturity Model (**RM-CMM**) for CoPS projects.	The model provides a framework for complex system projects for products to benchmark the current approach to risk management in contrast to standard five maturity levels. The tool allows the assessment of the current level of the organization, to identification of realistic goals to be improved and the development of action plans to enhance their risk management maturity	Level 1: initial Level 2: repeatable Level 3: defined Level 4: managed Level 5: optimizing	Risk management knowledge and technology: (1) integration with other processes and (2) management of risk knowledge Risk management process: (1) risk identification; (2) risk analysis; and (3)risk mitigation Organizational culture: (1) attitude toward risks and uncertainty; (2) stakeholders relationships; and (3) leadership and commitment to risk management

Table 3: Part III - Key Risk Management Maturity Models

(Adopted from Caiado et al.,2016)

Author	Model	Description (What it is and where it is applied?)	Maturity levels	Dimensions
RIMS (2006)	Risk Maturity Model (**RMM**) for Enterprise Risk Management (ERM)	The RIMS Risk Maturity Model is a tool used for risk management and used by other executives with risk management responsibilities to develop sustainable business risk management programs. This online resource for ERM enables risk professionals to rate their risk management programs and receive a report in real time. The analysis, based on the guidelines established in the model serves as a road map for improvement of organizations.	Level 1: ad hoc Level 2: initial Level 3: repeatable Level 4: managed nível 5: leadership	(1) adoption of ERM-based approach, (2) ERM process management, (3) the risk appetite of management, (4) root cause discipline, (5) uncovering risks, (6) performance management (7) business resiliency and sustainability
Ferrendo (2007)	Operational Risk Management Maturity Model (**ORMMM**)	This model, as a sector model may be useful to improve the development of "internal control systems" between mutual insurance companies and also among the companies, being an especially powerful tool for the larger insurance companies. The objective model finds a way to adapt the Scrop (capital requirement for operational risk) to the state of the entity's management system. With that, objectively measures the level of quality of the organization's management system.	Level 1: traditional Level 2: awareness Level 3: monitoring Level 4: quantifications Level 5: integration	(1) practical application, (2) processes, (3) culture, and (4) experience
Ongel (2009)	**RMMM** used for construction industry	Simplified model of maturity designed to quickly achieve the weaknesses and it is applicable to all kinds of designs and to all kinds of organizations of any sector, government or commercial sector.	Level 1: ad hoc Level 2: established Level 3: managed Level 4: integrated	(1) culture, (2) processes, (3) awareness, (4) skills / experience, (5) image (6) application, (7) confidence, and (8) resources
OGC (2010)	Portfolio, Program and Project Management Maturity Model **(P3M3)**	The model's emphasis is to identify the current capabilities of an organization, allowing it to compare your current state to your desired state and determine the necessary improvements. The OGC has a self-assessment tool available and sets the P3M3 without interdependencies between models, so that independent evaluations can be performed.	Level 1: initial process Level 2: repeatable process Level 3: defined process Level 4: managed process Level 5: optimized process	(1) organizational context, (2) organizational objectives stakeholders, (3) involvement, (4) support structure (5) support culture, (6) roles and responsibilities, (7) early warning indicators (8) MoR approach, (9) overcoming barriers to MoR, (10) reporting (11) review cycle (12) continuous improvement

2.11 Suitability of Risk Management Techniques

Fischer (2015) citing Chihuri and Pretorius, (2010) opines that the lack of appreciation of the benefits associated with risk management implementation, inadequate time to implement risk management effectively on fast paced projects, deficiency in project risk management knowledge and perception that project risk management is costly are barriers to effective risk management. Goh & Abdul-Rahman, (2013) claim an effective risk management system not only brings a higher level of awareness of the consequences of risk but also focuses on a more structured approach, more effective centralized control and better transfer of risk information between parties. Hedman (2005) suggests that risk management efforts should be weighed against the benefits and outcomes from the chosen method, for example smaller projects may sometimes require only identification and acting on the identified risks, while larger projects require more in-depth analysis.

2.12 Past and Similar Research

There are studies that have been undertaken on risk management in the construction industry globally. One such study, is a study by Choudry & Igbal (2013) that sought to identify risk management systems in the construction industry in Pakistan. The study established that financial and economic risks, followed by quality are the most important risks in Pakistan. It further established that the risk management practices of most organizations were dominantly qualitative, reactive and unstructured. In addition, the study determined that there was an awareness of risk management and the desire to learn however the major barriers to effective risk management were the lack of a formal risk management system and a mechanism for joint risk management by the parties. In this study, questionnaires were administered to three groups, that is, client, consultant and contractor based on registrations at the Pakistan Engineering Council.

Equally, a study by Banaitiene & Banaitis (2012) whose objectives were to assess the contractors' opinion on the significance of undertaking risk management on construction projects in Lithuania as well as explore the risk management practices found that the use of risk management practices by construction companies was low to moderate with qualitative methods being used more frequently than quantitative methods. Likewise, a study on sustainable risk management in the construction

industry in Singapore by Hwang and Chen (2012) found that the implementation of risk management was low. This was attributed to attitudes of the industry players that doubted the benefits of risk management as opposed to Lithuania where the suitability of such techniques for construction projects was doubted (Banaitiene & Banaitis, 2013). Banaitiene & Banaitis (2013) further determined that sustainable risk management in the construction industry can be achieved through the development of proper internal tools and systems and of sufficient financial investment to support efforts. In this regard, the research sought to provide a framework that any given organizations can use to manage its risks. Hwang & Chen (2012) further advocate for development of certifications that focus on risk management.

On the other hand, a study on risk management techniques in developing countries by Mahendra et al (2013) found that risk management techniques were rarely employed on construction projects in developing countries owing to the fact that participants in the construction industry where not sufficiently knowledgeable and aware on the need to undertake risk management.

Chandra (2015) found that financial risks influenced project risks in Surabya. The study employed structural equation modelling (SEM) to study the relationship between risk factors and project success in Surabya. The strength of the relationship was determined to be of standardised coefficient of 0.65 compared to 0.97 found by this study. The difference is explained by the different environments of study and the fact that both studies measured simultaneously the influence of slightly varying factors. Chandra (2015) does not go on to develop a framework for risk management but concludes the study by determining relationships between project success and several risk groups.

2.13 Summary

The Zambian construction industry is a key contributor to the country's economy. However, the industry is experiences issues among them being project abandonment. Project abandonment occurs everywhere, and the causes of project abandonment are categorised into project risks, internal and external project risks. It essential to define the actual causes of project abandonment so that the prevention can be found. Risk management provides the approach to comprehensively identifying, analyzing and

responding to risks to achieve the project objectives through a systematic way. However, risk management techniques are rarely used by the participants in construction projects. There is need for increased appreciation of risk management. The next chapter discusses the methodology of the study, the research design, sampling techniques as well as data collection and analysis methods.

CHAPTER THREE - METHODOLOGY

3.1 Introduction

This chapter discusses the research design, the sampling methods and sample size adopted by the research. It further, discusses the development of data collection methods, the data collection itself and analysis methods used in the research. The chapter finally confers the soundness, reliability and the generalizability of data.

3.2 Research Design

This study was a quantitative study. The study gathered multiple perspectives from respondents on varied questions there by prompting the use of quantitative methods. Easterby et al (2012) opine that the main strengths of quantitative methods are that they provide wide coverage of the range of situations; they can be fast and economical; and, with statistical analysis of data from large samples, their outcomes may be of considerable relevance to policy decisions.

3.3 Population

The population has been determined by obtaining the number of registered contractors and consultants in Zambia. A search of the National Council for Construction online database revealed a total of 7470 registered contractors. Similarly, a search of the Association for Consulting Engineers of Zambia online database revealed a total of 59 registered consulting firms. Therefore, the population for the two categories was 7529. The number of clients, however, could not be determined as a client could be any stakeholder or several government departments desiring to undertake a construction project. Hence making the population unknown and infinite.

3.4 Sampling Design and Sample Size

The respondents were selected through a purposive sampling. Easterby et al (2012) opine that purposive sampling is ‘a form of non-probability sampling design where the criteria for inclusion in a sample are defined, and entities are first screened to see whether they meet the criteria for inclusion; those entities that meet the criteria are included in the sample.’ The study approached registered professionals for the purposes of ensuring that different categories of respondents were reached, that is, respondents from the public or private sector and working in a client, contractor or

consultant organisation. Primarily, the respondents needed to have been registered professionals working in the construction industry in Zambia to be interviewed through the use of questionnaires.

The sample size was calculated using the following formula developed by Cochran (1977) for infinite population;

Equation 1: $$n = \frac{m}{1 + [(m-1) / N]}$$

Where n, m and N represent sample size of limited, unlimited and available population

Equation 2: $$m = \frac{Z^2 * P * [1-P]}{C^2}$$

Where Z represents Z Value (e.g. 1.96 for 95% confidence interval), P represents the value of the population being estimated (0.05), C^2 represents the sampling error.

$$m = \frac{1.96^2 * 0.05 * [1-0.05]}{0.05^2} = 385$$

$$n = \frac{385}{1 + [(385-1) / 7529]} = 366.3168$$

THEREFORE **n = 366**

Therefore, the required sample size was 366 respondents. However, the study reduced the sample size from 366 to a convenient sample size of 70 because of time limitations of the research period. Table 4 presents from similar research justification for convenient sample sizes as the study has done.

Table 4: Sample Size on Similar Research

No.	Study Title	Reference	Sample Size
1.	Construction Risk Identification	(Maytorena, et al., n.d.)	Sample Size: 51 Reason: Judgement sampling based on professional role.
2.	Risk management knowledge and practices in the Ghanaian construction industry	(Hansen-Addy & Fekpe, 2015)	Sample Size: 136 Reason: Targeted Sampling from Professional Bodies including the Association of Building, Civil Engineering Contractors of Ghana (ABCECG), Ghana Institute of Architects (GIA), Ghana Real Estate Developers Association (GREDA) and the Chartered Institute of Building, Ghana (CIOB).
3.	Construction Project delays in Lusaka, Zambia: Causes and Effects	(Aigbavboa, et al., 2014)	Sample Size: 50 Reason: Distributed to construction professionals.
4.	Risk management practices of building construction project stakeholders in Tamale.	(Podieh, 2015)	Sample Size: 50 Reason: A selection of a convenient sample due to a lack of database of all stakeholders and construction managers.
5.	Risk management in Construction Projects	(Namkumbe, 2013)	Sample Size: 60 Reason: A population size of 7191 contractors was reduced to 137 by selecting on class 1 and 11 contractors based in city of research Dar-es-salaam.

3.5 Data Collection Methods

There are two data categories states Oluwatosin (2017) citing Douglas, (2017). These are primary and secondary data. Oluwatosin (2017) defines primary data as data that 'is collected for the first time by the researcher' and secondary data as 'data already collected or produced by others.' He further explains that 'primary data sources include surveys, observations, experiments, questionnaire, personal interview etc. on the other contrary, secondary data collection sources are government publications, websites, books, journal articles, internal records etc.' Hox & Boejie (2005) suggests that primary data is collected for the specific research problem at hand and for the purposes of adding to the existing body of knowledge on the problem as hand.

Furthermore, Hox & Boejie (2005) explain that secondary data is material made available for re-use by other researchers.

This is supported by Easterby et al (2012) that opine that if a study is using quantitative methods, the study can collect their own primary data or can use secondary data already collected and stored within archival databases. Easterby et al (2012) further highlight that collecting one's own research data gives control over both the structure of the sample and the data obtained from each respondent and gives more confidence compared with using secondary data from an existing archive.

This study however made use of both the primary data and secondary data to analyse the research problem. Through the collection of primary data, the study was able to generate quantitative data. Hox & Boejie, (2005) clarifies that quantitative data is 'data that can be described numerically in terms of objects, variables and their values' whilst qualitative data is 'data involving understanding the complexity, detail, and context of the research subject, often consisting texts such as interview transcripts and field notes or audio-visual material.' The secondary data also informed the development of the data collection tool informing the study on kind of questions to ask the respondents

3.5.1 Primary Data Collection

Easterby et al (2012) opine that surveys such as face to face interviews or self-administering questionnaires are good ways of collecting opinions and behaviour of large numbers of people. This study carried out a survey to collect data and make observations on experiences and practices regarding project abandonment and risk management. The total number of respondents was 49 out of the 70 approached representing a 70% response rate.

The study sort to gather data on various variables such as the experience of respondents with abandoned projects, their perceptions or experiences on the causes and effect of project abandonment and the use and frequency of use of risk management techniques henceforth employing the use of structured questionnaires. Hox & Boejie, (2005) support the use of structured questionnaires to collect on large numbers of variables and representative of respondents.

The primary data for the study was obtained by administering self-completing structured questionnaires to construction professionals such as construction managers,

project managers, engineers, architects and quantity surveyors drawn from both government and private institutional projects. These professionals were further categorised into three groups, that is, the client, consultant and contractor organisations.

3.5.1.1 Questionnaires

The study developed a questionnaire and thereafter carried out a pilot test by requesting professionals to assess the tool and recommend on the correctness and completeness of the instructions to the respondents. The questionnaire was piloted by purposively distributing it through email to 10 professionals. The responses and criticisms received were incorporated to produce the final version annexed as Appendix A – Informed Consent and Questionnaire. The piloted questionnaire and the final version had four (4) sections. The first section presented questions on social economic data, organisation, position, sector of the construction industry and the experience to allow for cross tabulation of data thereby understanding practices among different respondent categories. The second section sought to determine the cause and effects of project abandonment an objective of the study. The third section presented enquiries to support the ranking by importance of risks regarding project abandonment. The fourth section presented questions on the levels of risk management in organisations and/or application of risk management techniques allowing for the determination of categories of risk maturity for the organisations the respondents represented.

The piloting of the questionnaire was necessary to ensure that the data collection from the survey would be reliable and valid data, guaranteeing the ability to measure the intended variables and to make meaningful observations on risk management in the construction industry in Zambia. Altoryman (2014) in a study on the 'Identification and assessment of risk factors affecting construction projects in the Gulf region: Kuwait and Bahrain' used a sample size of 10 to pilot the questionnaire among different professionals in the construction industry.

The pilot allowed for the changing of one (1) question from 'What are the causes of project abandonment in the construction Industry in Zambia?' to 'What risks factors do you believe are causing project abandonment in the construction industry in

Zambia?' as, in some instances respondents made phone calls stating that they did not know the causes but could share what they thought (or perceived) to be the causes.

The researcher through conducting a literature review, identified 38 causes of project abandonment that were accordingly grouped into 8 risk categories as; political risks, financial (to include internal and economic risks), environmental and social risks, technological risks, legal risks and to represent internal and projects risks, organisational and operational risks, project management risks and design risks.

The questionnaire had both closed questions and open-ended questions for the purposes of collecting data. The researcher reasoned that the use of closed questions simplifies the coding of key research constructs and consequently the analysis and comparison of the numerous responses to be analysed. A 5-point Likert scale was adopted to collect responses of the study were 1 represented 'strongly disagree', 2 'disagree', 3 'neutral', 4 'agree' and 5 'strongly agree' henceforth measuring the level of agreement or disagreement to a statement or proposed response made by the research. Similarly, a 4-point Likert scale was adopted were 1 represented 'never', 2 'sometimes', 3 'often', 4 'very often' measuring frequency of use of risk management techniques.

On the other hand, the use of open-ended questions allowed for flexibility in the answering of the questions posed by the study to the respondents and thereby promoted an in-depth understanding of the effects of project abandonment and inferring of concepts. The questionnaire only posed one open-ended question to the respondents on what they believed where the effects of project abandonment. Through past research, the study identified 9 effects, hence the study sought to identify on effects of project abandonment through the responses to the open-ended question.

The survey was conducted by distributing the self-administering questionnaire through email. The respondents either filled in a soft copy form and other decided to print fill in a hard copy and mail back a scan copy. To add, the choice of use of questionnaire was to ensure receipt of short and precise answers already presented in multiple choice form considering that the sample was large.

3.5.2 Secondary Data Collection

Secondary data was obtained through the review of relevant literature and archival sources such as peer reviewed journals, textbooks, conference papers and periodicals as shown in the list of references.

3.6 Data Analysis Methods

3.6.1 Statistical Methods

The research employed a quantitative approach to analyse data. Responses from the closed end section were coded and uploaded into Microsoft Excel for exportation into a statistical package called Statistical Package for Social Sciences (SPSS) and Software for Statistics and Data Science (STATA). STATA was used by the study as it is more robust and user friendly in fitting structural equation models.

The use of emails to distribute the data allowed for the requesting of data to be resubmitted where data was found to be incomplete before coding. This ensured that all the questionnaires received back could be analysed hence maintain the 70% response rate.

Before exportation into statistical packages, the coded data in Microsoft Excel was used to develop frequencies and charts for presentation of data. In addition, to rank the perceived contribution of risks to project abandonment, rank the effects of project abandonment and to rank the frequency of use of risk management techniques the Relative Importance Index was calculated using Microsoft Excel. The purpose of ranking the mentioned variables was to determine the main causes of project abandonment, the main effects of project abandonment and the most used techniques in managing construction projects. The relative importance index is a statistical method used to determine the ranking of different factors (Hossen, et al., 2015). The study therefore chose to use the RII method to analyse the multiple responses and allowing for the ranking of responses as prioritised by the respondents.

To determine the Relative Importance Index, the following formula was used;

Equation 3: RII = ΣW/ (A x N) $RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5XN}$

Equation 4: RII = ΣW/ (A x N) $RII = \frac{4n_4 + 3n_3 + 2n_2 + 1n_1}{4XN}$

Where;

w - is the weighting as assigned by each respondent on a scale of one to five for causes and effect of project abandonment. A scale of one to four was however used for the determination of most highly used risk management techniques by respondents. Different scales were used because the first measured the level of agreement to the questions posed that is from strongly agreeing at one end to strongly disagreeing at the other end, additionally providing a neutral ground. The second scale measured frequency from never using a particular technique to always using it for risk management. A neutral position could not be provided as this question requested to determine the realities and not their perceptions. In other words, it either the used the technique at varying frequencies or they did not.

A - is the highest weight.

N - is the total number of the responses.

Rooshdi et al (2018) cites Akadiri (2011), who defines five important levels of RII values: high (H) ($0.8 \leq RI \leq 1$), high medium (H–M) ($0.6 \leq RI \leq 0.8$), medium (M) ($0.4 \leq RI \leq 0.6$), medium-low (M-L) ($0.2 \leq RI \leq 0.4$) and low (L) ($0 \leq RI \leq 0.2$). The study made use of these levels to define the extent to which risk management is used in Zambia.

SPSS was used to provide descriptive statistics of findings of the study through the presentation of information using cross-tabulation thereby giving better insight on findings in relation to the demographics.

To examine the existence of a relationship between project abandonment and risk management, data was imported into STATA from analysis and Structural Equation Modelling (SEM) was used. Structural equation modelling (SEM) is a collection of

statistical techniques that allow a set of relationships between one or more independent variables and one or more dependant variables to be examined (Ullman & Bentler, 2012). Structural Equation Modelling is also referred to as causal modelling, causal analysis, simultaneous equation modelling analysis of covariance structures, path analysis, or confirmatory factor analysis (ibid). Stein et al (2012) explains that Structural equation modelling (SEM) is a multivariate statistical framework that is used to model complex relationships between directly and indirectly observed (latent) variables. A latent variable is a variable that cannot be observed but its presence can be detected by their effects on variables that are observable (Salkind, 2010). Hence, Stein et al (2012) posits that SEM is used to estimate a system of linear equations to test the fit of a hypothesized "causal" model. Thus, the research made use of SEM for the reason that, the identified multiple causes and effects, 38 and 9 respectively, needed to be simultaneously examined at the same time establish causality which cannot done using RII. This way their combined influence as risks on project abandonment could be measured.

Stein et al (2012) further explains that SEM Figure 8, comprises two (2) sub-models. The first, being a measurement model estimating the relationship between the measured variable and the latent factor and the second, being structural model developing a relationship between the latent factors. The study made use of both sub-models as risk groups (latent factors) were defined through the identified causes (measured variables) underscored by the literature review; and project abandonment (latent factor) on the other hand was defined by its effects (measured variable) also identified through literature review; and the relationship between the individual risk groups and project abandonment additional to the relationship between the combined risks and project abandonment were determined.

The relationships discussed above can be visualised through path diagrams as shown by (Neils, 2012) here.

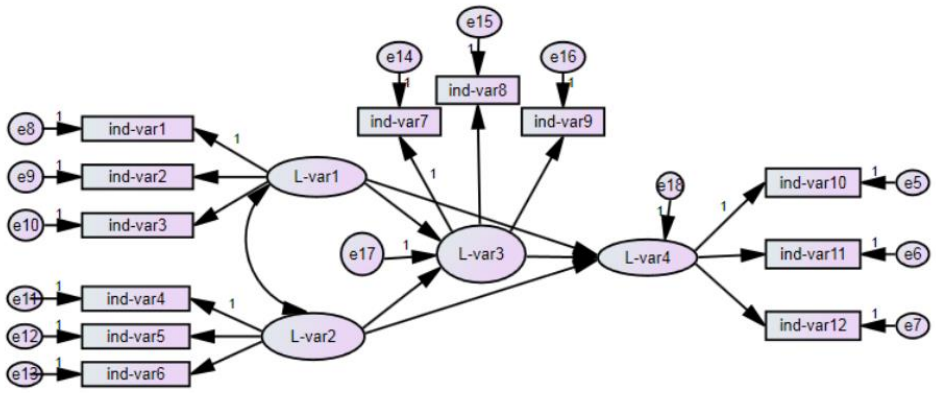

Figure 8: Example of SEM Path Diagram

Where;

- A rectangle or box represents the observed or measure variable. In this study the measured variables were the 38 causes of project abandonment (the risks) and the 9 effects of project abandonment (project abandonment). Therefore, risk management was measured by risks and project abandonment by its effects.
- An eclipse latent factors or unmeasured or unobserved variables. In this study, the latent variables are (1) risk management measured by risks and (2) project abandonment measured by the effects.
- A circle represents the error. Therefore, Stein et. al., (2012) posits that the relationships are free of measurement error, because the error has been estimated and removed.
- The headed arrows or paths are used to define causal relationships in the model, with the variable at the tail of the arrow causing the variable statistically representing regression coefficients. The lack of a line connecting variables implies that no direct relationship has been hypothesized (ibid)

3.7 Methodology of Similar Research

Aigbavboa et al (2014) in a study to determine the causes and effects of project delays in Zambia, administered structured questionnaires to construction professional that included architects, quantity surveyors, builders, civil engineers, land surveyors and project managers. The study examined their perceptions on project delays using a 5-

point Likert Scale. The study proceeded to calculate the Mean Item Score (M.I.S) and standard deviations for the purposes ranking the causes and effects.

Table 5: Research Methods from Similar Research

No.	Study Title	Reference	Objectives of Study	Research Methods
1.	A Study on Risk Assessment in Construction Projects	(Jayasudha & Vidivelli, 2014)	To identify risk management methods and processes. To find the ways of managing risks that are the most effectively managed with the co-operation of several project participants.	Data Collection: Questionnaire Data Analysis: Significance Score
2.	Analysis of major risks in construction projects	(Jayasudha & Vidivelli, 2016)	To determine the level of use of risk management and propose a construction planning tool and techniques to be used on building projects.	Data Collection: Questionnaire Data Analysis: Mean Item Score
3.	Risk mapping in construction projects	(Yildiz, et al., n.d.)	To propose a risk mapping methodology for international construction projects. To develop a risk mapping tool that uses the proposed methodology and incorporates "a lessons learned database" to help decision-makers to assign risk ratings.	Data Collection: Questionnaire Data Analysis: Structural Equation Modelling
4.	Assessment of risk in construction industry	(Neeraj & Balasubramanian, 2015)	To identify and assess the risks and to develop a risk management framework which the investors/ developers/ contractors can adopt when contracting construction work in India.	Data Collection: Questionnaires Data Analysis: Mean Score

Similarly, a study on risk management on construction projects by (Banaitiene & Banaitis, 2012) administered questionnaires to project managers, civil engineers and design engineers at top or middle management level the majority of whom had experience of more than 15 years in construction and project management. The study examined the opinions of the professional by use of a Likert Scale.

A study in Saudi Arabia by (Ikediashi, et al., 2018) utilized the Likert Scale, SPSS and on the contrary used the Relative Importance Index (R.I.I) to determine the causes of project failures. The questionnaire was administered to professional members of the Association of Project Managers in Saudi Arabia (APMSA). Another study on causes and effects of abandonment in Nigeria (Amade, et al., 2015) utilized the R.I.I method for the purposes of ranking the causes and effects as opposed to the use of M.I.S. Table 5 indicates methods used by other studies;

3.8 Credibility of Results

Osipova, (2008) cites Robson (2002) that states that explains that to test the trustworthiness of a research three concepts are usually considered. The validity, reliability and generalizability of findings.

3.8.1 The reliability of data

The reliability of data refers to similar observations being reached by other observers (Klenke, 2008) or the same results being obtained from using the method on repeated occasions. The use of a structured questionnaire ensured that similar data would be observed if a repeat survey was to be administered. Additionally, pertinent questions were rephrased within the same questionnaire hence checking that the correct response was obtained.

3.8.2 The validity of data

Taherdoost (2016) cites Ghauri & Gronhaug (2005) that clarifies that validity explains how well the collected data covers the actual area of investigation, thus, enabling the measuring of that intended to be measured (Taherdoost, 2016). Yasar & Cogenli (2014) cite Cresswell (2005) who add that validity means that scores from an instrument make sense, are meaningful, and enable a study to draw good conclusions from the sample you are studying to the population. The data was valid in that it enabled the study to achieve its objectives by answering the research questions.

3.8.3 The generalizability of findings

Generalizability is about applying research results to other situations or populations (Osipova, 2008). Similarly, according to Easterby-Smith et al (2012) generalizability

refers to whether the concepts derived from the study have relevance to other settings and/or the sample is sufficiently diverse to allow inferences to similar contexts. The findings of this research are limited to the construction industry in Zambia and therefore can only be generalized to that extent.

3.9 Chapter Summary

This was a quantitative study as it made use of quantitative data collection and analysis methods. The calculated sample of 366 was reduced to a convenient sample of 70. A survey was undertaken using self-completing questionnaires purposively distributed to professional to collect primary data. A response rate of 70% was recorded. The secondary data was collected from books, conference papers, journal and theses for information. This informed the development of the primary data collection tool the questionnaire. The study used statistical methods namely the Relative Importance Index (R.I.I) and Structural Equation Model (S.E.M) to quantitatively analyse the data. The data collected, and the methods used were deemed to be valid and reliable. The following chapter details and discusses the findings of the research.

CHAPTER FOUR - RESULTS AND DISCUSSION OF FINDINGS

4.0 Introduction

The previous chapter presented the methodology adopted in this study. This involved the outlining of the research design, sample size selection and the method of data collection and analysis employed. This chapter focuses on the presentation of results, analysis of results and a discussion thereof. The chapter gives a detailed description of the findings and presents them using charts, frequencies, tables, cross tabulations and models. The chapter further discusses the extent to which risk management is incorporated in the management of projects in the construction industry in Zambia. It further presents the causes and effects of project abandonment in the Zambian construction industry and defines the existing relationships or the extent of causality between project risks and project abandonment.

4.1 Respondents Characteristics

The following are the characteristics of the respondents.

4.1.1 Respondents by Profession

Figure 9 shows the representation of respondents by profession. Of the total number of respondents, 70% where engineers, with 15% being professionals from other fields of study not categorized by the questionnaire such as finance managers (see appendix Informed Consent and Questionnaire). Furthermore, 12% of the respondents were contract managers with the remaining 3% being quantity surveyors.

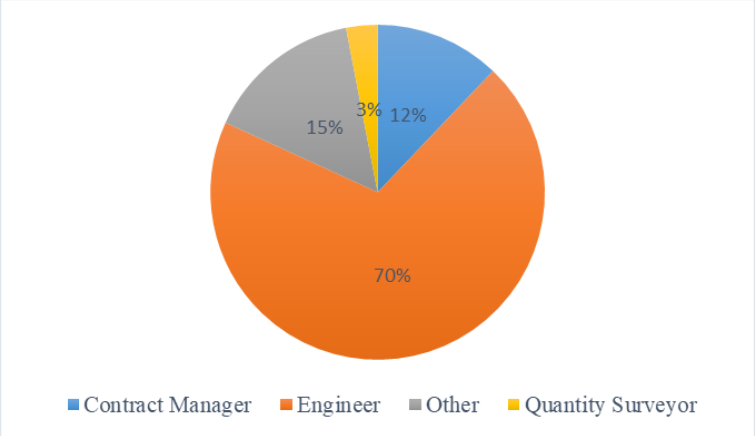

Figure 9: Respondents by Profession

4.1.2 Respondents by Experience in the Construction Industry in Zambia

Figure 10 is a pie chart showing the experience of the respondents in the construction industry in Zambia. Of the total number of respondents, 27% had less than 5 years' experience in the industry. Similarly, 34% had 5 to 10 years' experience; 27% had 11 to 15 years; 6% had 16 to 20 years and finally 6% had over 20 years' experience in the construction industry.

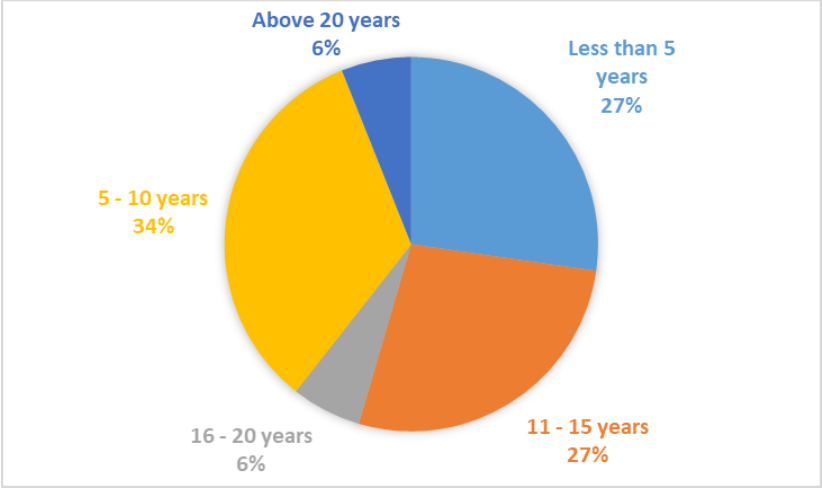

Figure 10: Respondents by Experience in the Construction Industry in Zambia

4.1.3 Respondents by Sector

Of the total number of respondents, 61% were working in the private sector, with the remaining 39% being from the public sector, that is, government agencies and government departments (Figure 11).

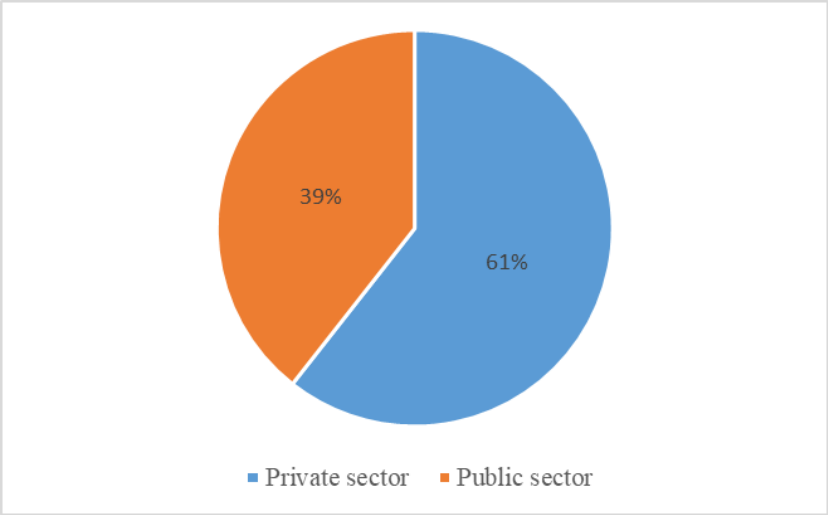

Figure 11: Respondents by Sector

4.1.4 Respondents by Organization Type

The respondents were also categorized by the type of the organisations they were employed in as follows (Figure 12); 21% of the respondents represented the clients, with 28% representing the consultants, 15% contractors, equally 15% representing other professions identified by the questionnaire such as financiers and funders and finally another 21% representing project managers.

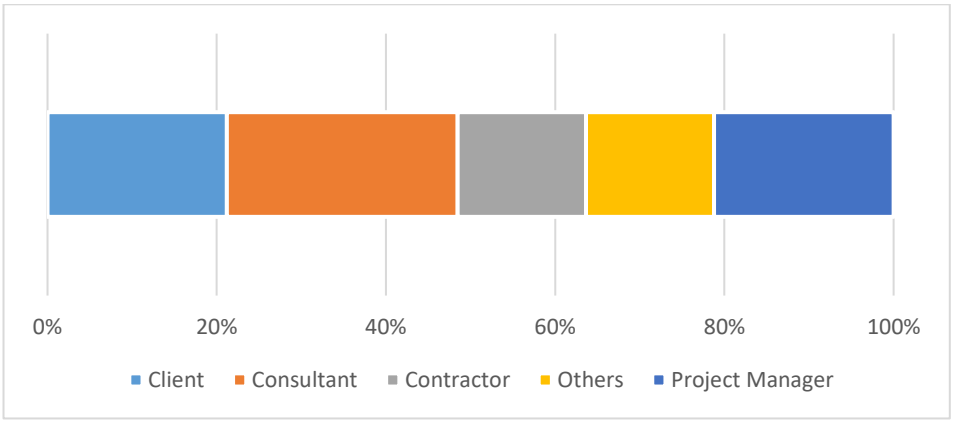

Figure 12: Respondents by Organisation Types

4.1.5 Respondents by Organization Size

The respondents were further categorized by the size of the organisations that they were employed in as follows (Figure 13); above 300 employees represented 34%, 201 to 300 employees 0%, 101 to 200 employees 6%, 50 to 100 employees 27% and less than 50 employees represented by 33%.

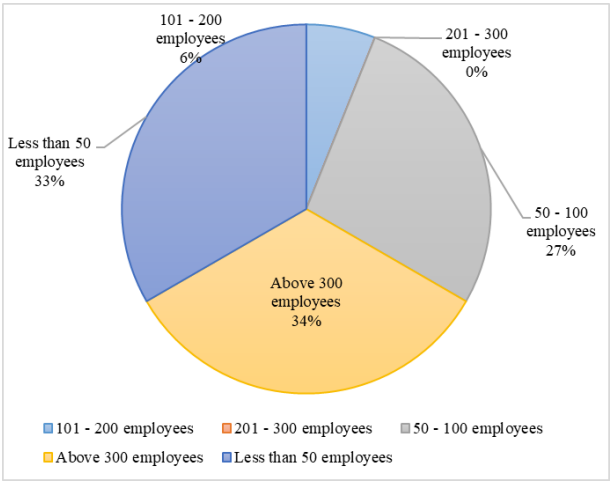

Figure 13: Respondents by Organisation Size

4.2 Respondents Experience Regarding Project Abandonment in Zambia

Figure 14 shows the percentage of respondents that have experienced project abandonment in Zambia. When the respondents were asked if they had worked on a project that had been abandoned in Zambia, 55% said 'yes'. This therefore indicates that project abandonment does occur in Zambia.

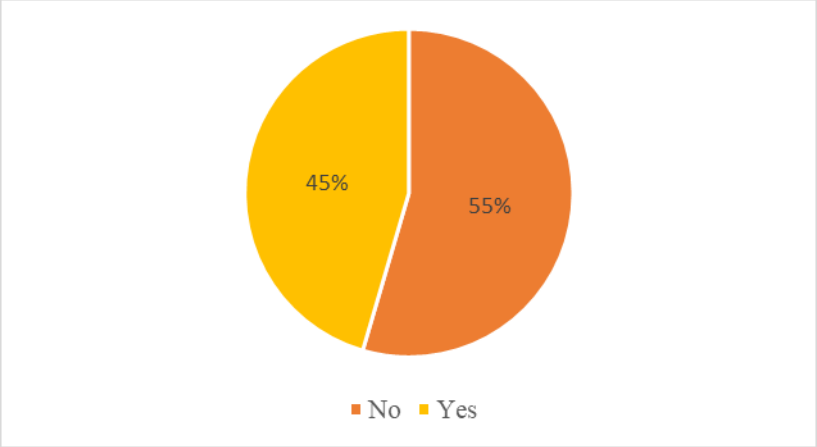

Figure 14: Professionals' Experience regarding Project Abandonment in Zambia

Table 6 shows the experience of project abandonment by respondents by organisation type. The consultants and clients each represented 15.2% of those that had experienced project abandonment, followed by other categories (funders) representing 9.1% and the project managers and contractors each represented by 3.0%.

Table 6: Project Abandonment by Organisation Type

			Organization Type					
			Client	Consultant	Contractor	Others	Project Managers	Total
Project Abandonment	No	% of Total	6.1%	12.1%	12.1%	12.1%	12.1%	54.5%
	Yes	% of Total	15.2%	15.2%	3.0%	9.1%	3.0%	45.5%
Total		% of Total	21.2%	27.3%	15.2%	21.2%	15.2%	100.0%

Table 7 shows the percentages of professionals that have experienced project abandonment by sector. Of the 60.6% of the respondents from the private sector, 21.2% had experience project abandonment in their line of work. Similarly, of the 39.4% of respondents from the public sector 24.2% had experienced project abandonment. Table 7 also shows that the respondents from the public sector experienced project abandonment more than those in the private sector. However, the

percentages were not significantly different with 24.2% of the 45.5% of respondents being from the public sector.

Table 7: Project Abandonment by Sector

			Sector		
			Private Sector	Public Sector	Total
Project Abandonment	No	% of Total	39.4%	15.2%	54.5%
	Yes	% of Total	21.2%	24.2%	45.5%
Total		% of Total	60.6%	39.4%	100.0%

4.3 Use of Risk Management Techniques in the Management of Construction Projects

The extent to which risk management is incorporated in the construction industry in Zambia was determined firstly by asking the respondents if they made use of risk management techniques in managing construction projects. Secondly, the extent was also determined by examining the perceived risk maturity of respondents of the organisations in which the respondents worked and managed projects. Finally, the risk management incorporation in the management of construction projects was determined through the R.I.I, giving an indication of frequent use of particular techniques where used and giving insight into the most preferred techniques in Zambia.

4.3.1 Use of Techniques

Figure 15 shows responses about the use of risk management techniques in managing construction projects. The findings were that 67% of the respondents made use of risk management techniques. Therefore, 33% did not make use of risk management techniques in managing construction projects.

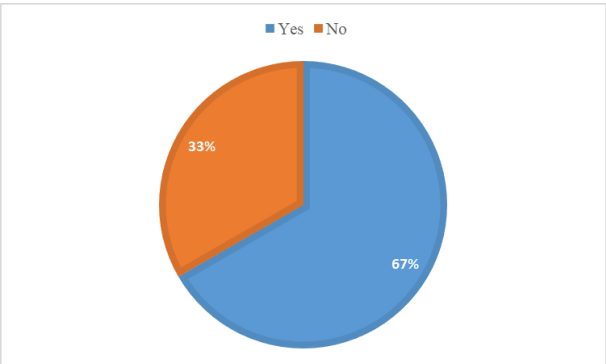

Figure 15: Professionals' Use of Risk Management Techniques in Construction

4.3.2 Maturity Levels

To determine the maturity levels, the study used the Risk Maturity Model defined by Kingston City Group (2019) that aligns to the Project Management Maturity Model Table 1. Figure 16, shows the maturity levels of the organisations the respondents are employed in. Only 15% of the organisations could be termed as enabled, in that risk management and controls were fully embedded into the operations. Similarly, 15% managed, in that the organization's approach to risk management is developed and communicated inhouse; 27% of the organisations are defined implying that strategies and policies in place and communicated but hardly employed; 15% of the organisations fell in the aware category mean that scattered approach to risk management existed. Finally, 28% of organizations were categorized as naive regarding the incorporation or use of risk management techniques in managing construction projects in that, no approach had been developed to manage risk.

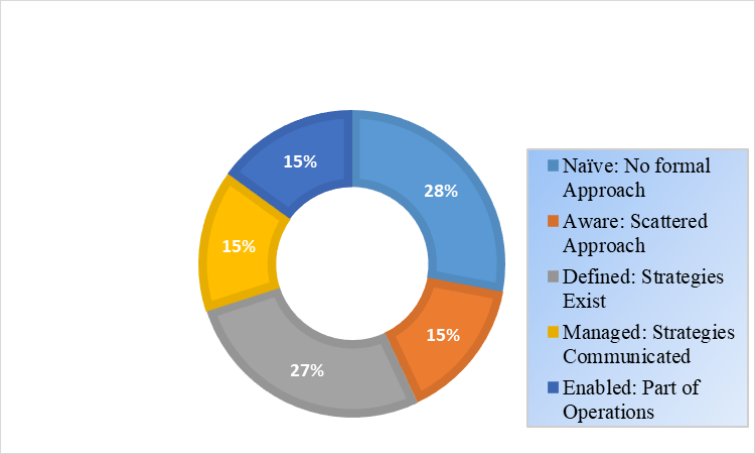

Figure 16: Organisational Risk Maturity

4.3.3 Use of Techniques By Sector

Table 8 shows the use techniques by sector. It is seen in the table that 42.4% of the total respondents made that made use of risk management techniques are from the private sector whilst only 12.1% represented the public sector.

Table 8: Use of Techniques by Sector

			Sector		
			Private Sector	Public Sector	Total
Use of Techniques	No	% of Total	18.2%	27.3%	54.5%
	Yes	% of Total	42.4%	12.1%	45.5%
Total		% of Total	60.6%	39.4%	100.0%

4.3.4 Risk Management Techniques

Tables 9, 10, 11 and 12 show the different types of techniques identified by the study through the 4 processes of risk management, that is, risk identification, risk analysis, risk monitoring and risk control. The study identified 6 risk identification techniques, 10 risk analysis techniques, 3 risk monitoring techniques and 4 risk control techniques.

Table 9: Risk Identification Techniques Ranking

No.	Risk Identification Techniques	R.I.I
1	Expert Judgement	0.7727
2	Checklist	0.7121
3	Historical Information Analysis	0.7045
4	Brainstorming	0.6894
5	Interviews	0.5379
6	Delphi Technique	0.4394

Table 10: Risk Analysis Techniques Ranking

No.	Risk Analysis Techniques	R.I.I
1	Risk Register and Ranking	0.6439
2	Risk Mapping	0.6061
3	Cost Risk Analysis	0.6061
4	Break-Even Analysis	0.5455
5	Hierarchical Risk Breakdown Structure	0.5379
6	Probability Analysis	0.5227
7	Decision Tree Analysis	0.5152
8	Sensitivity Analysis	0.4848
9	ABC Analysis	0.4394
10	Monte Carlo Simulation	0.3939

Table 11: Risk Monitoring Techniques Ranking

No.	Risk Monitoring Techniques	R.I.I
1	Incident Investigation	0.6742
2	Risk Audit	0.6591
3	Risk Register Updates	0.5758

Table 12: Risk Control Techniques Ranking

No.	Risk Control Techniques	R.I.I
1	Risk Transfer [Insurance]	0.7955
2	Performance Guaranties	0.7500
3	Risk Avoidance	0.6970
4	Risk Control	0.6591

The respondents identified which risk management techniques their organisations frequently made use of in managing construction projects. The study determined that the use of these techniques was low to moderate. The possible answers were never, sometimes, often and always being scored 1,2,3,4 respectively. The R.I.I for the different ranged from as low as 0.4394 to 0.7727 for risk identification techniques, 0.3939 to 0.6439 for risk analysis techniques, 0.5758 to 0.6742 for risk monitoring techniques and finally, 0.6591 to 0.7955 for risk control techniques. The two (2) most frequently used risk identification techniques used in the construction industry in Zambia are the expert judgement and checklist. Similarly, risk registers/ranking and risk mapping for analysing risks, incident identification and risk audits for monitoring risks and lastly risk transfer and performance guaranties for controlling risks.

It was noted from the low R.I.I's regarding use of techniques that the extent of use of the techniques was low to moderate. This is agreement with the maturity rating discussed above in that only 15% of organisations fully used risk management techniques in their management of construction projects.

4.4 The Causes of Project Abandonment in the Construction Industry in Zambia

The study identified 38 causes of project abandonment from a globally perspective through literature review (Table 13). The respondents through identified which of these risk factors they perceived based on experience to be causes project abandonment in the construction industry in Zambia. The possible answers for each of the risk factors identified where strongly agree, agree, neither agree or disagree, disagree and strongly disagree being scored 5,4,3,2,1 respectively. The study then through the use of R.I.I ranked the risks. The study further grouped the risk factors and ranked the risks by risk categories. Additionally, the study showed the relationship between the risk categories and project abandonment.

Late payments (RII=0.9212), funding constraints (RII=0.8848) followed by political interference (RII=0.8606) were ranked to be the highest causes of project abandonment in Zambia.

Of the 8 risk groups established and ranked (Table 14), political risks (RII=0.8197) were ranked highest, followed by financial risks (RII=0.7870) and project management (RII=0.7612) risks respectively. On the other hand, design and technological risks were ranked lowest, indicating that these were less likely to cause project abandonment.

Table 13: Project Abandonment Risk Factors

No.	Risk Factors	R.I.I
1	Late payments	0.9212
2	Funding Constraints	0.8848
3	Political Interference	0.8606
4	Construction Cost Overruns	0.8303
5	Bureaucratic Delays	0.8242
6	Corruption	0.8182
7	Failure to comply with quality requirements	0.7818
8	Delay consultant or contractor procurement	0.7818
9	Political Continuity	0.7758
10	Cost Escalations	0.7697
11	Poor inter-organization communication	0.7576
12	Scheduling delays	0.7515
3	Inexperienced work force	0.7333
14	Supplier Risks and Material Availability	0.7333
15	Lack of Management Commitment	0.7273
16	Inadequate equipment availability	0.7273
17	Resettlement Costs	0.7212
18	Delayed material deliveries	0.7030
19	Estimate errors and completeness	0.6970
20	Claims	0.6848
21	Unforeseen geotechnical site conditions	0.6848
22	Change in regulations	0.6788
23	Community interference or lack of stakeholder engagement.	0.6606
24	Design errors and omissions	0.6545
25	High Staff turnover	0.6485
26	Team Conflicts	0.6485
27	Enforceability of Contracts	0.6424
28	Unforeseen social impacts	0.6364
29	Legal Disputes	0.6182
30	Design changes	0.6121
31	Incomplete environmental impact assessment	0.6121
32	Inadequate way leaves	0.5879
33	Inadequate site protection	0.5636
34	Occupational health and safety issues/accidents	0.5515
35	Unforeseen weather conditions	0.5455
36	Technological maturity	0.5030
37	Technology changes	0.4667
38	Design process takes longer than anticipated	0.4303

Table 14: Construction Project Risk Groups

No.	Risk Group	R.I.I
1	Political Risks	0.8197
2	Financial Risks	0.7870
3	Project Management Risks	0.7612
4	Organizational and Operational Risks	0.6980
5	Legal Risks	0.6465
6	Environmental and Social Risks	0.6053
7	Design Risks	0.4222
8	Technological Risks	0.4848

4.5 The Effects of Project Abandonment in the Construction Industry in Zambia

The study likewise identified 9 effects of project abandonment from literature review. The respondents pointed out through a Likert scale the effects of project abandonment in Zambia. The study found that pollution of project site was ranked highest followed by the lack of achievement of economic returns and social benefits as well as unemployment respectively. The Table 15 shows that the effects R.I.I ranged from 0.7636 to 0.9273 indicating a strong agreement to the effects of project abandonment identified by the study. Pollution (RII=0.9273) was ranked the highest followed by lowered standards of living (RII=0.9030) then unemployment (RII=0.8667). Conversely, ranked the effect ranked the least was project aesthetics (RII=7636).

To aid the identification of additional effects of project, an open-ended question was asked to the respondents through the questionnaire. The respondents indicated the following from the open-ended question as effects of project abandonment beyond those initially identified by the study;

- Bad reputation/negative risk rating for the country and project owners.
- Erodes confidence in the local contractors.
- Creates stakeholder backlash and loss of trust in each other.

The many other responses basically reinforce the findings of the study through literature review. The respondents felt that project abandonment; defers developments, slows down economic growth, negatively affects a country's GDP, denies beneficiaries the opportunity to improve their livelihood, creates conflict among

contracting parties, erodes investor confidence or trust by the lending community, affects the ability to attract other investments.

Table 15: Effects of Project Abandonment

No.	Effects of Project Abandonment	R.I.I
1	Left over project materials are left to pollute the project site.	0.9273
2	Lack of achievement of economic returns and social benefits (lowered standards of living)	0.9030
3	Unemployment	0.8667
4	Structure Deterioration	0.8485
5	Conflict among contracting parties	0.8242
6	Finances spent become a wasted resource.	0.8121
7	Project remains an environmental hazard to the population.	0.8121
8	Difficult to obtain foreign aid or the ability to attract investment.	0.8121
9	Project site affects aesthetics	0.7636

4.6 The Relationship Between Project Abandonment and Risk Management

The objective of the study was to explore if there existed a relationship between project abandonment and risk management. The study firstly through structural equation modelling (S.E.M) determined the extent of relationships between each project risk and project abandonment. The following relationships were noted; financial risk (0.97), legal risks (0.89), operational risks (0.87), political risks (0.79), technological risk (0.68), design risks (0.66), project management risks (0.32). This therefore means that financial, legal, operational, political, technological, design, project management risks and environmental-social risk are likely to cause project abandonment 97%, 89%, 87%, 79%, 68%, 66%, 32% and 23% of the time respectively.

Table 16: Strength of Relationship based on Structural Equation Modelling

Risk Group	Project Abandonment
Financial Risk	0.97
Legal Risk	0.89
Organizational and Operational Risk	0.87
Political Risk	0.79
Technological Risk	0.68
Design Risk	0.66
Project Management Risk	0.32
Environmental and Social Risk	0.23

Table 16 indicates that financial, legal and organisation and operational risk are more likely to cause project abandonment than other risks. The study therefore found that even though the respondents ranked highly political risks, financial and project management risks respectively as the causers of project abandonment the strongest relationship lie between financial, legal, organisational and operational risks.

The models are shown presented here;

Figure 17 depicts the strength of relationship of standard coefficient 0.97 between financial risk and project abandonment, implying that financial risks are likely to cause project abandonment 97% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by financial risk is 97%.

Figure 18 depicts the strength of relationship of standard coefficient 0.89 between legal risk and project abandonment, implying that legal risks are likely to cause project abandonment 89% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by legal risk is 89%.

Figure 19 depicts the strength of relationship of standard coefficient 0.87 between organisational and operational risk and project abandonment, implying that organisational and operational risks are likely to cause project abandonment 87% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by organisational and operational risk is 87%.

Figure 20 depicts the strength of relationship of standard coefficient 0.79 between political risk and project abandonment, implying that political risks are likely to cause project abandonment 79% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by political risk is 79%.

Figure 21 depicts the strength of relationship of standard coefficient 0.68 between technological risk and project abandonment, implying that technological risks are likely to cause project abandonment 68% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by technological risk is 68%.

Figure 22 depicts the strength of relationship of standard coefficient 0.66 between design risk and project abandonment, implying that design risks are likely to cause project abandonment 66% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by design risk is 66%.

Figure 23 depicts the strength of relationship of standard coefficient 0.32 between project management risk and project abandonment, implying that project management risks are likely to cause project abandonment 32% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by project management risk is 32%.

Figure 24 depicts the strength of relationship of standard coefficient 0.23 between environmental-social risk and project abandonment, implying that environmental-social risks are likely to cause project abandonment 23% of the time. Further implying that for an abandoned project, the likelihood that the abandonment was caused by environmental-social risk is 23

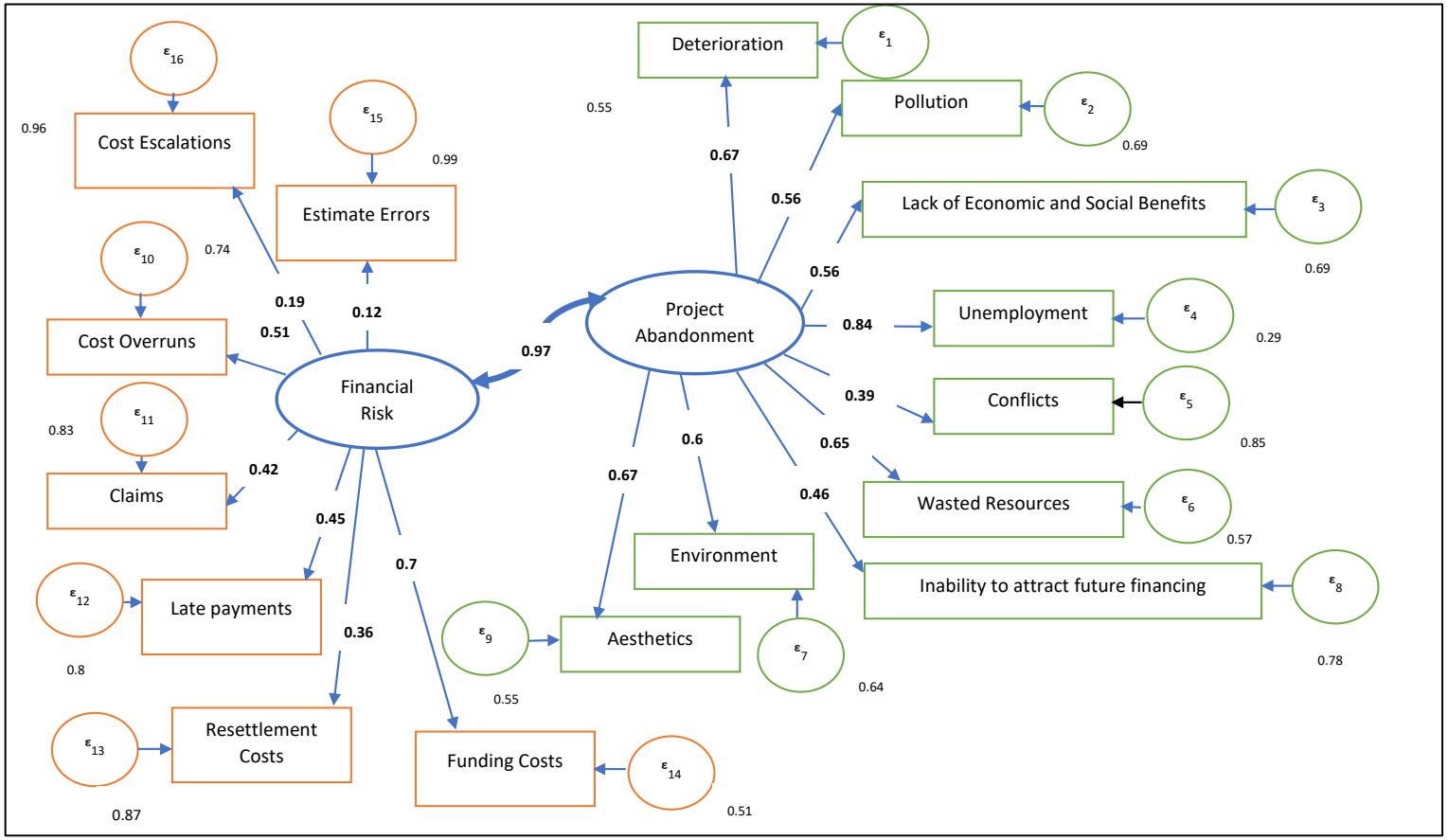

Figure 17: Strength of relationship between Financial Risk and Project Abandonment

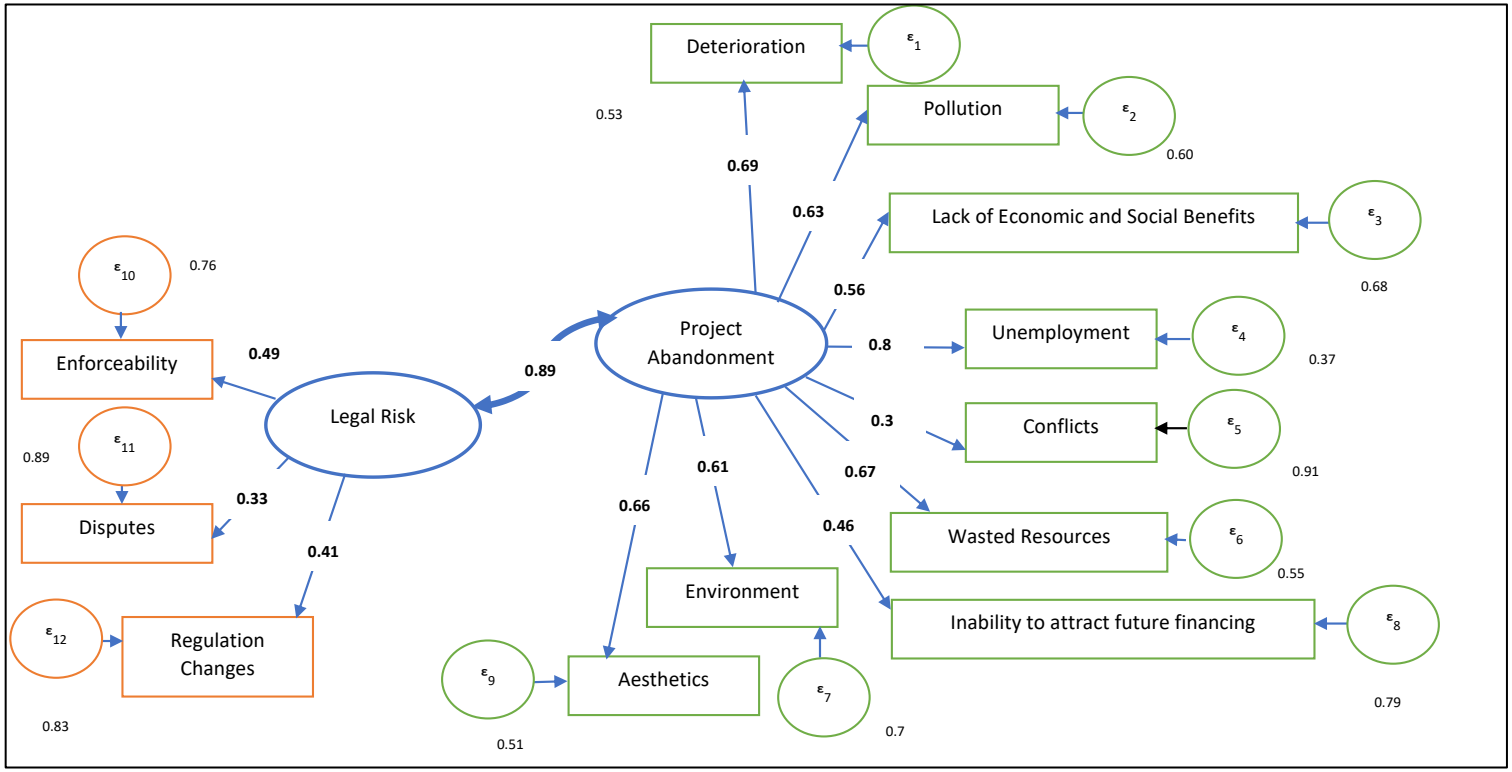

Figure 18: Strength of relationship between Legal Risk and Project Abandonment

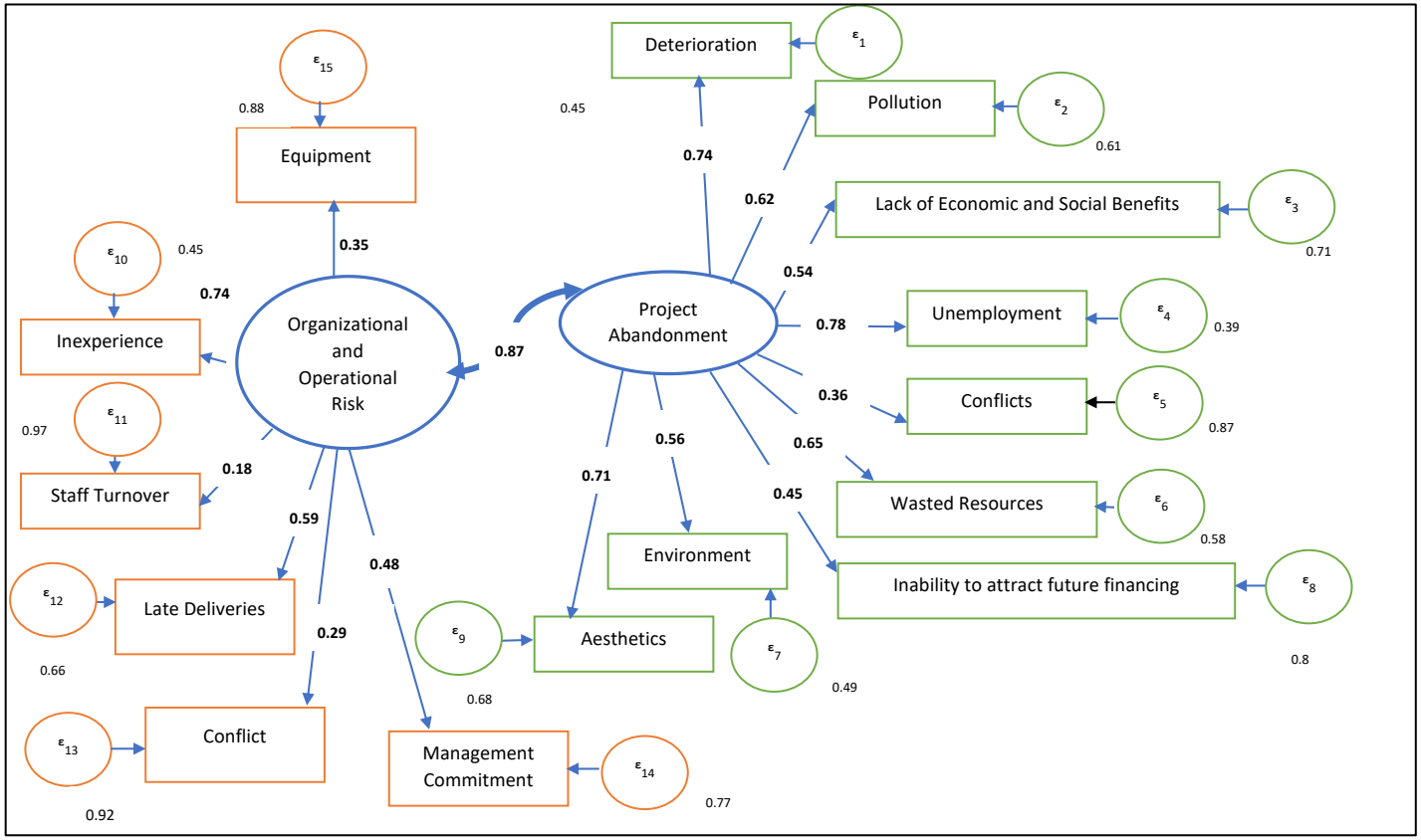

Figure 19: Strength of relationship between Organisational & Operational Risks and Project Abandonment

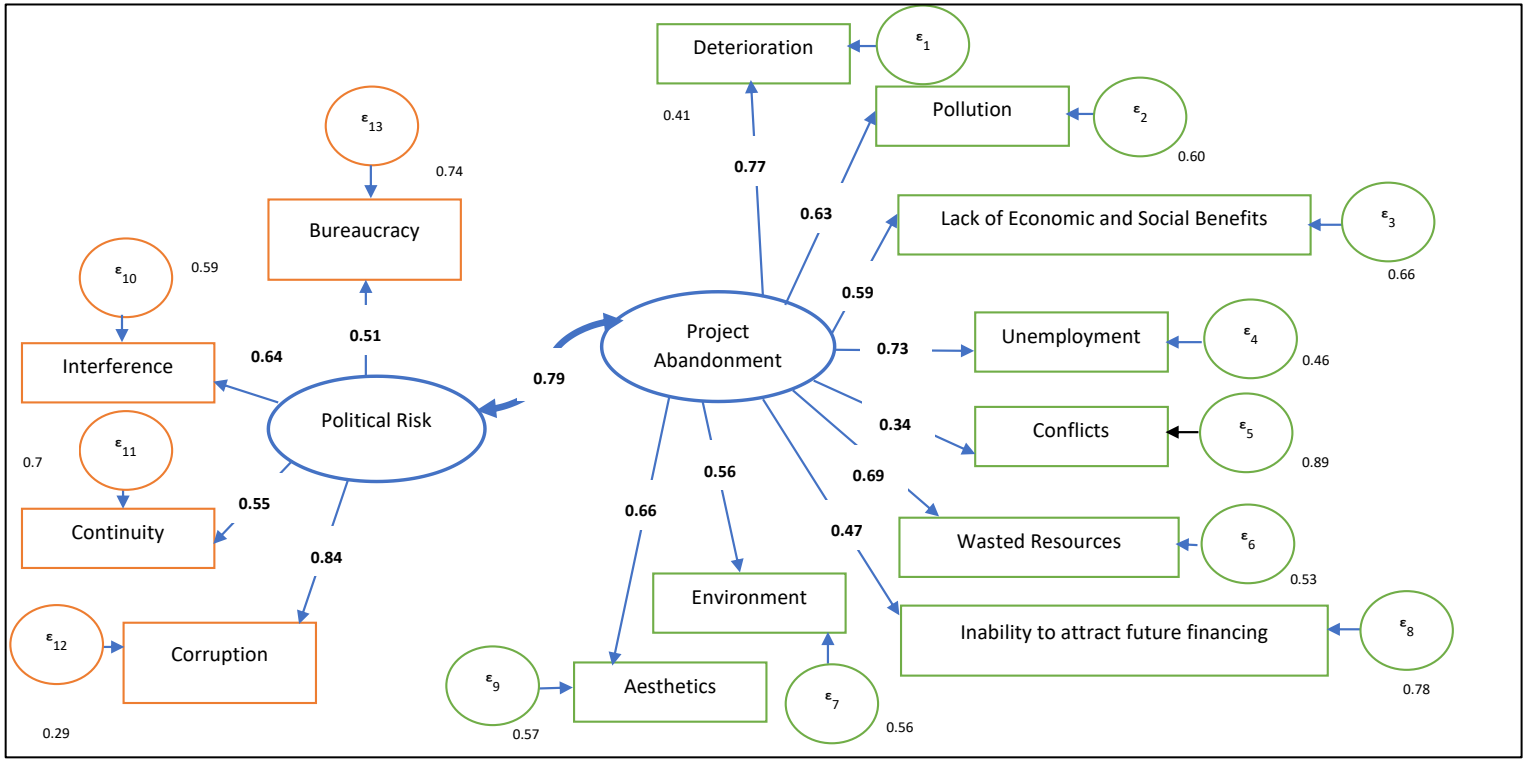

Figure 20: Strength of relationship between Political Risk and Project Abandonment

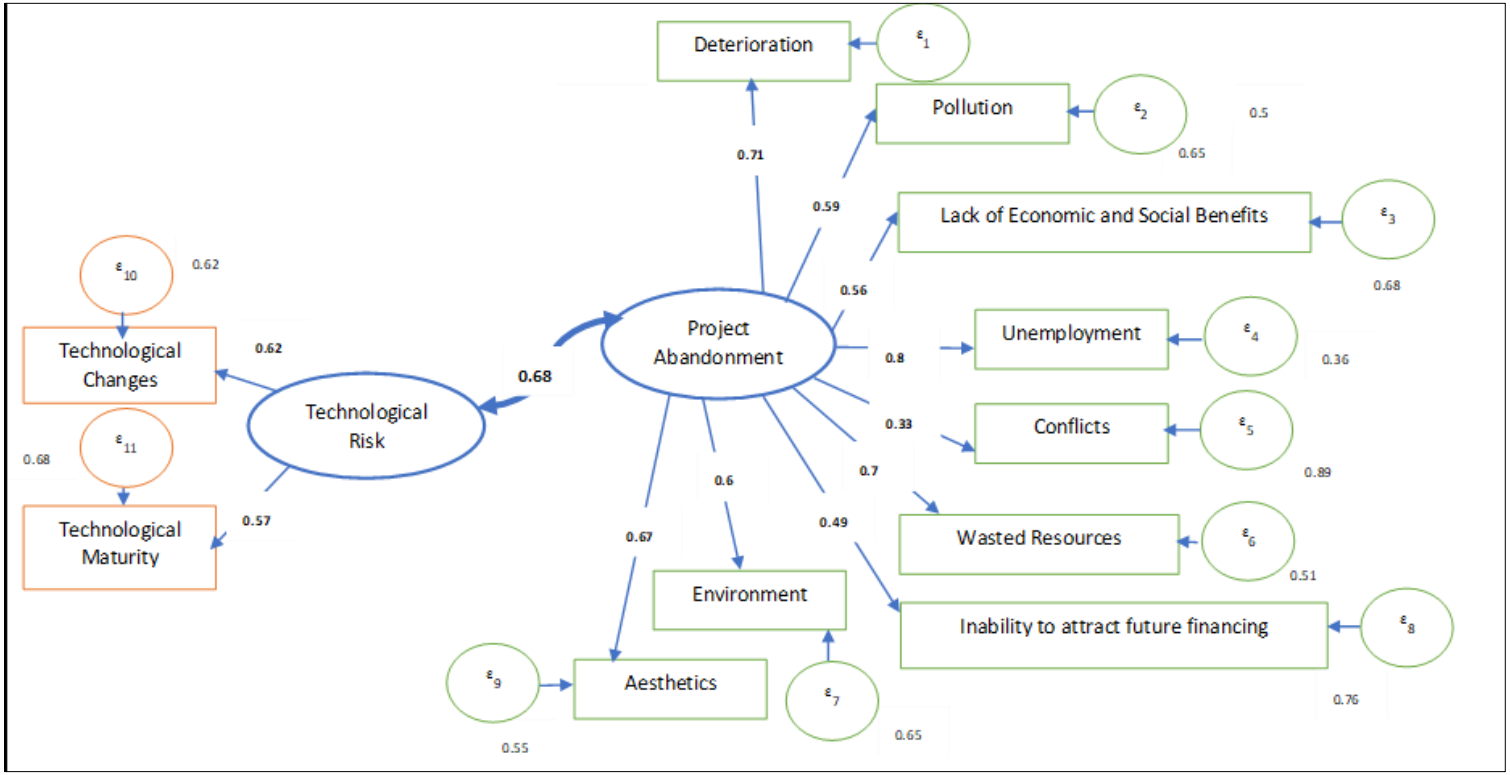

Figure 21: Strength of relationship between Technological Risk and Project Abandonment

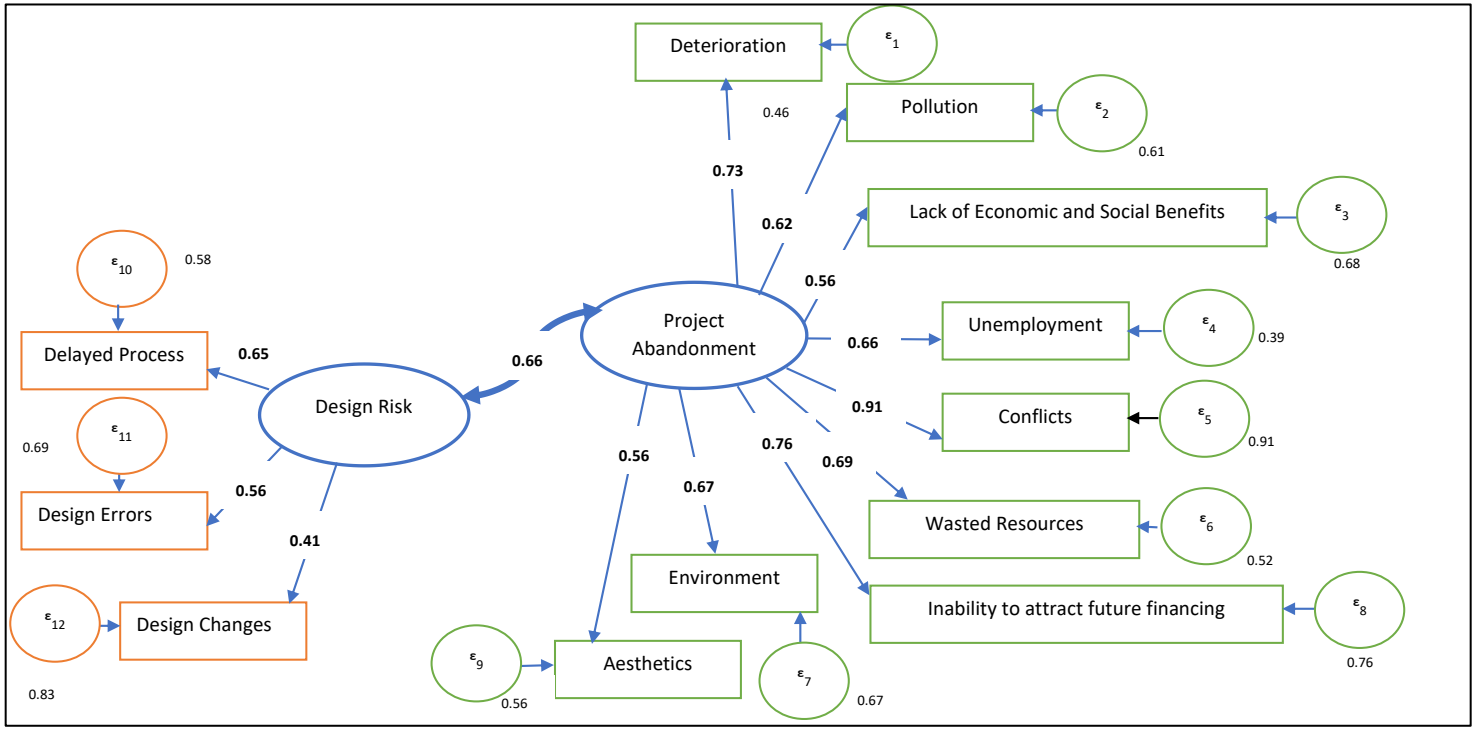

Figure 22: Strength of relationship between Design Risk and Project Abandonment

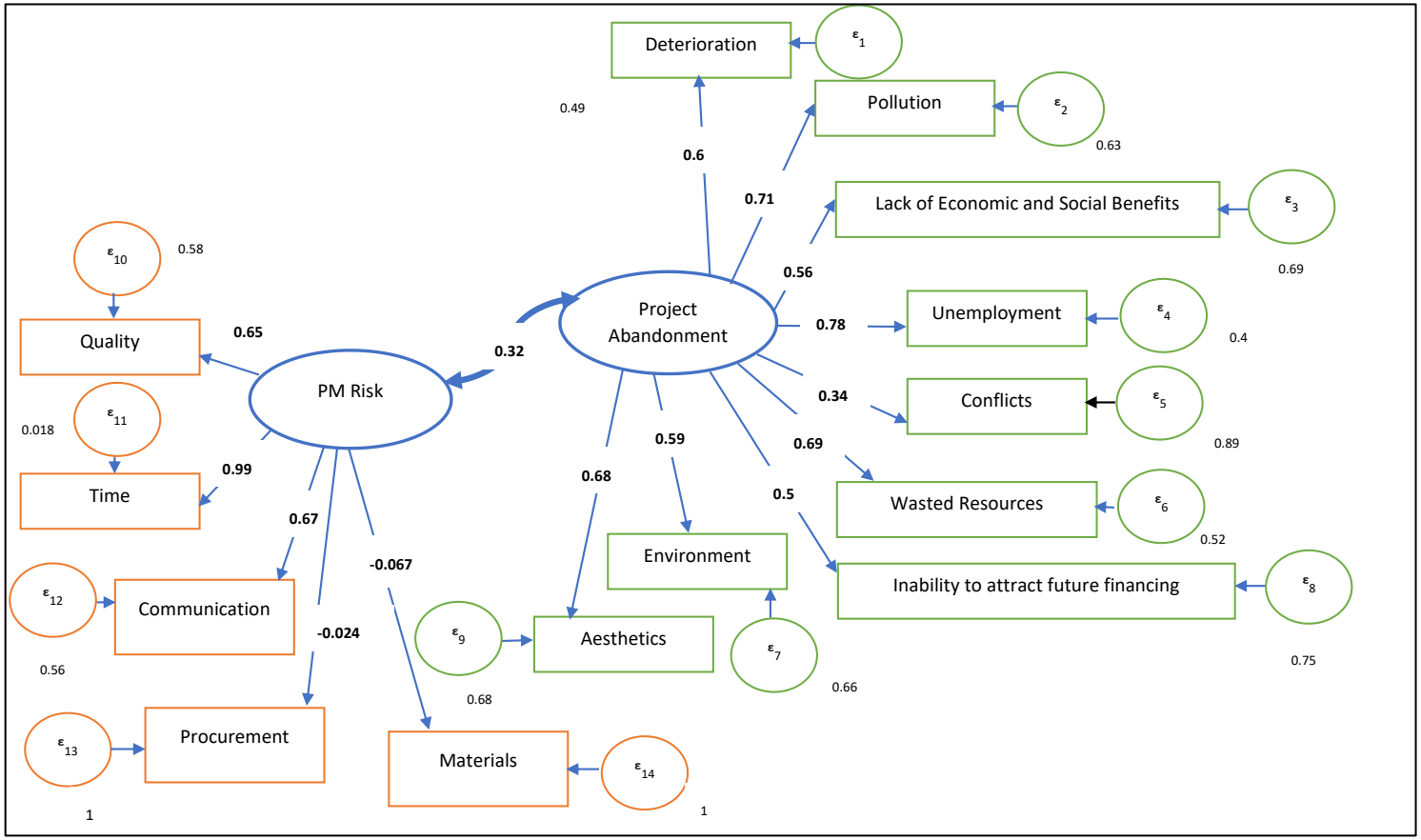

Figure 23: Strength of relationship between Project Management Risks and Project Abandonment

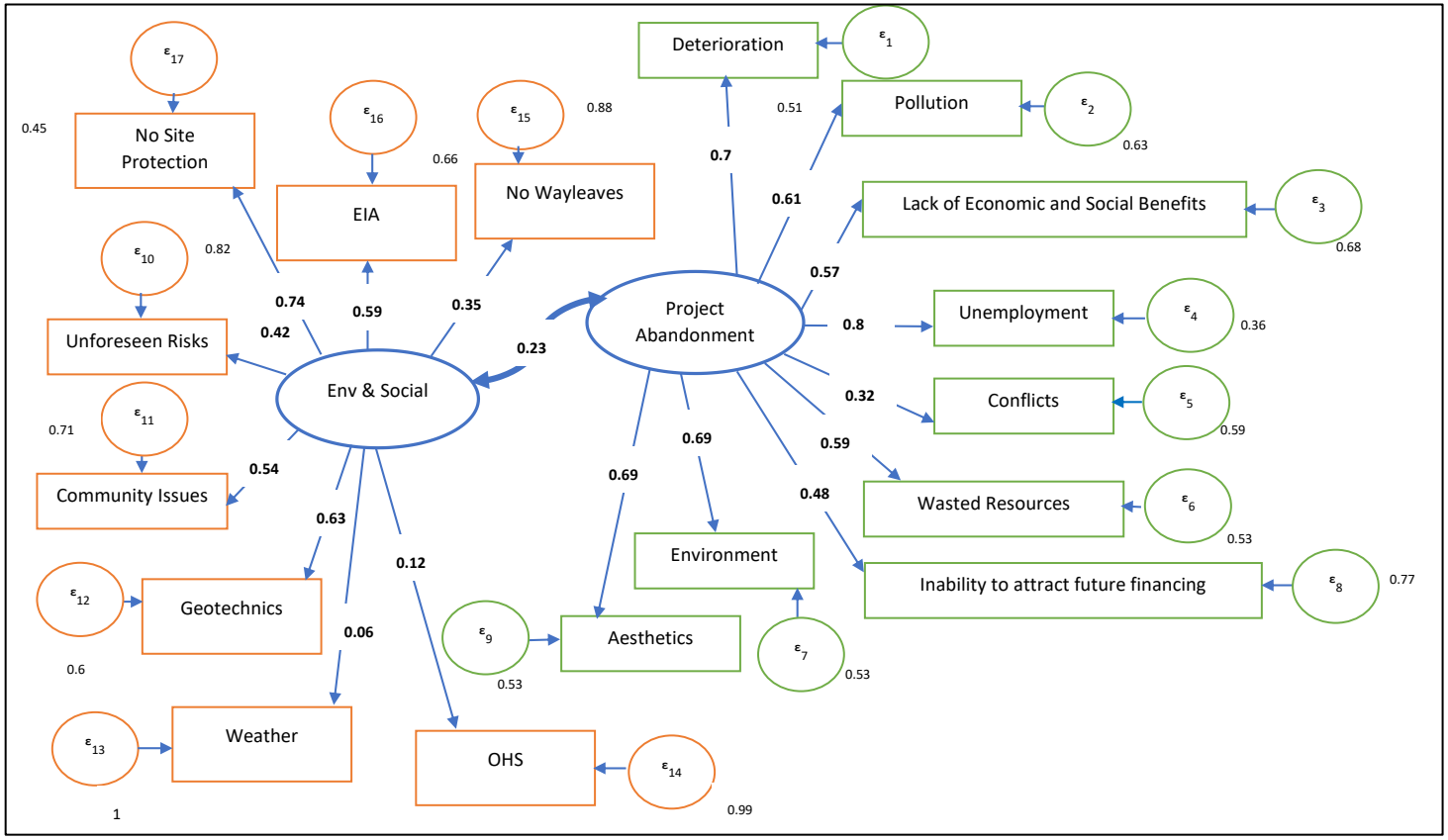

Figure 24: Strength of relationship between Environmental & Social Risks and Project Abandonment

4.7 Structural Equation Modelling in relation to Relative Importance Index Findings

Table 17 shows a comparison of the findings from SEM against the finding of RII. There was no major difference were noted. However, moderate differences were seen on the ranking of Project Management Risks and Environmental-social Risks. The two (2) were perceived to cause project abandonment more highly by the respondents. However, based on the findings of the SEM the two risks are less likely to cause project abandonment than perceived.

Table 17: SEM Findings verses RII Findings

Risk Group	SEM	RII	Difference
Financial Risk	0.97	0.79	0.18
Legal Risk	0.89	0.65	0.24
Organizational and Operational Risk	0.87	0.70	0.17
Political Risk	0.79	0.82	-0.03
Technological Risk	0.68	0.49	0.19
Design Risk	0.66	0.42	0.24
Project Management Risk	0.32	0.76	-0.44
Environmental and Social Risk	0.23	0.61	-0.38

The respondents identified which risk management techniques their organisations frequently made use of in managing construction projects. The study determined that the use of these techniques was low to moderate. The possible answers were never, sometimes, often and always being scored 1,2,3,4 respectively. The R.I.I for the different ranged from as low as 0.4394 to 0.7727 for risk identification techniques, 0.3939 to 0.6439 for risk analysis techniques, 0.5758 to 0.6742 for risk monitoring techniques and finally, 0.6591 to 0.7955 for risk control techniques. The two (2) most frequently used risk identification techniques used in the construction industry in Zambia are the expert judgement and checklist. Similarly, risk registers/ranking and risk mapping for analysing risks, incident identification and risk audits for monitoring risks and lastly risk transfer and performance guaranties for controlling risks.

It was noted from the low R.I.I's regarding use of techniques that the extent of use of the techniques was low to moderate. This is agreement with the maturity rating discussed above in that only 15% of organisations fully used risk management techniques in their management of construction projects.

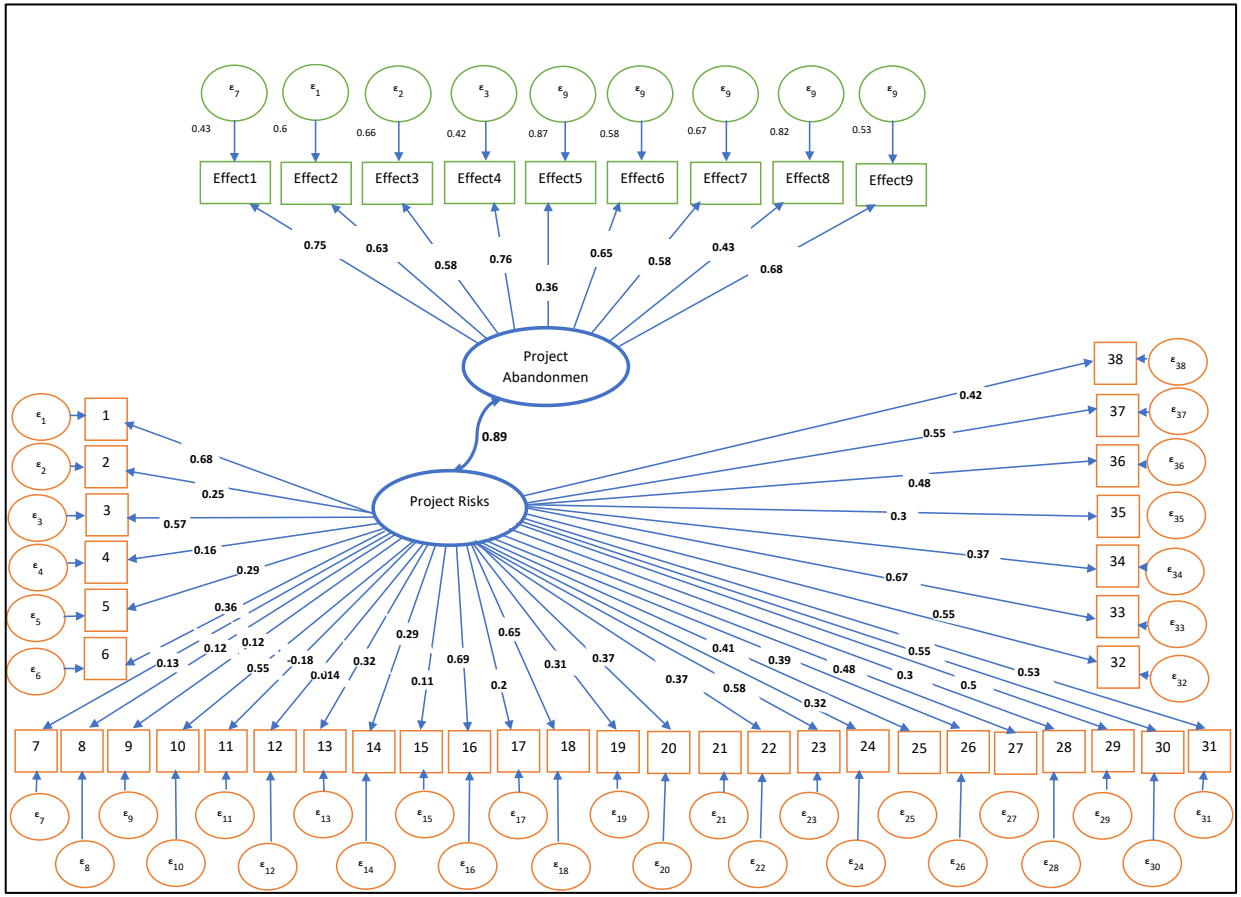

Figure 25: Strength of relationship between Project Risks and Project Abandonment

(See Table 13 to identify the risks)

The study through the structural equation modelling determined that there is a strong relationship of 0.89 between project abandonment and risk management. This infers that project risk leads to project abandonment 89% of the time. Hence implying that a strengthened and holistic incorporation of risk management techniques in managing construction projects would reduce project abandonment by 89%.

4.7 Discussion of Results

The study sought at developing a risk management framework for project stakeholders that can predict the exposure of a project to construction related risks and the subsequent consequences.

The study therefore aimed to identify the causes and effects of project abandonment in the Zambian construction industry; to rank the construction project risks causing project abandonment in Zambia; to determine the extent to which risk management is incorporated in the management of construction projects in Zambia and to recommend the suitable risk management techniques for Zambian construction industry.

4.7.1 Causes and Effects of Project Abandonment

The study sought to determine the causes and effects of project abandonment in the construction industry in Zambia. The study determined that and ranked financial, political, legal, organisational and operational risks are the main causes of project abandonment in Zambia. Chilongo (2017) in an investigation into the factors affecting project performance among contractors in Lusaka District of Zambia found that financial risks were the main causes of delay and project abandonment. Hansen-Addy & Fekpe (2015) in a study on risk management knowledge and practices in the Ghanaian construction industry found that financial risk posed the greatest risks to the construction industry. Goh & Abdul-Rahman (2013) found financial risks to be the major risks in terms of the occurrence frequency and the impacts. Choudry & Igbal (2013) found that financial, economic and quality risks were the main cause of project abandonment in Pakistan.

Furthermore, the study determined that site pollution, low economic returns, low social benefits and unemployment are the main effects of project abandonment in Zambia. Tijani & Ajagbe (2016) in their study found 10 effects of project abandonment ranking loss of strength of structural members of infrastructure, visual defect to

surrounding/project site, creation of hidden places for dangerous animals, pollution with abandoned projects usually trigger the creation of uncontrolled & unsupervised garbage disposal as the main effects of project abandonment. Ojo & Aroge (2016) in a study on effects of government abandoned projects in Nigeria found that abandoned projects increase unemployment, increase the cost of rehabilitation, lead to loss of economic value of the area and erosion on project sites.

4.7.2 Extent of Use of Risk Management Techniques in Zambia

The study determined that the use of risk management was low to moderate in the construction industry in Zambia. This can be seen firstly in the maturity levels of organisation ranging from being naïve to very few organisations being enabled to fully implement risk management in their organisation. Goh & Abdul-Rahman (2103) generalises that only 18% of organisations in Malaysia employ a formal risk management process in their practices. The reason for low use of risk management techniques is less knowledge and awareness among the people (Banaitiene & Banaitis, 2012). Hansen-Addy & Fekpe (2015) found intermediate use of risk management in Ghana's construction industry. A lack of knowledge and the associated costs of risk management application were found to be the main reason for low use risk management techniques in a study on the identification and management of major risks in the Malaysian construction industry. This study did not intend to test the knowledge of respondents but sought to know whether they implemented risk management techniques in managing construction projects.

Secondly, the low to moderate R.I.I imply low to moderate use of the techniques identified by the study. The study also noted that the R.I.I for quantitative techniques were low. The professionals mainly make use of qualitative techniques. This therefore answers the extent to which risk management is used in the construction industry in Zambia. The study also shows that the private sector makes use of risk management techniques more than the public. There is therefore need, to concentrate awareness efforts or incentives towards the public sector departments. The United States Department Homeland Security (2010) reported that the public sector has lagged behind the private sector in adopting enterprise risk management and that private companies understand and manage their risks on a holistic, enterprise-wide basis while many public agencies manage risks on an uncoordinated, ad hoc basis.

4.7.3 Suitable Risk Management Framework

Lastly, the study aimed at proposing a suitable risk management framework for the construction industry. The framework recommended here takes into consideration and makes use of the already most widely used techniques in Zambia to ensure success of its use. The use of this framework is likely to be successful as it proposes use of already known techniques and requires little quantitative analysis as the study incorporates quantitative findings of likelihood in advance. It does not propose techniques likely not to be understood by construction project managers. The strength of the framework lies in the fact that a comprehensive listing of risks that are applicable to any project within the construction industry have been identified by the study and their influence on the projects has also been examined. The framework further suggests best suitable options of controlling risks to ensure that projects are not abandoned. This is not possible with the risk registers and probability-impact matrices described in literature review, making the framework an enhancement of these.

Given that the checklist developed by the study provides a comprehensive listing of possible risks, the next step would be to rank the risks by determining the likelihood of occurrence and determining the impact of occurrence in any risk management process. As the study was able to identify the relationships between different risks and project abandonment, it can be said that the likelihood of occurrence was been readily identified based on the Zambian context. The study then proposed that the consequences be determined by expert judgement based on characteristics of the organisation. The study further proposed the use of risk mapping for risk analysis. The two techniques were found to be highly used by professional in Zambia. Sharma (2013), similarly develops a framework that uses combined Analytic Hierarchy Process (AHP) and risk mapping, thereby assigning weights to risk factors and developing a risk mapping matrix to identify possible treatment for risks.

Furthermore, the study proposed the use of any appropriate control depending on the risk posed to the construction project. The study noted that the mostly highly used risk monitoring techniques are incident investigations which is more reactive than proactive monitoring of risks. Consequently, the study proposed the use of updates on effectiveness of planned controls.

4.8 Proposed Generic Risk Management Framework for the Construction Industry in Zambia

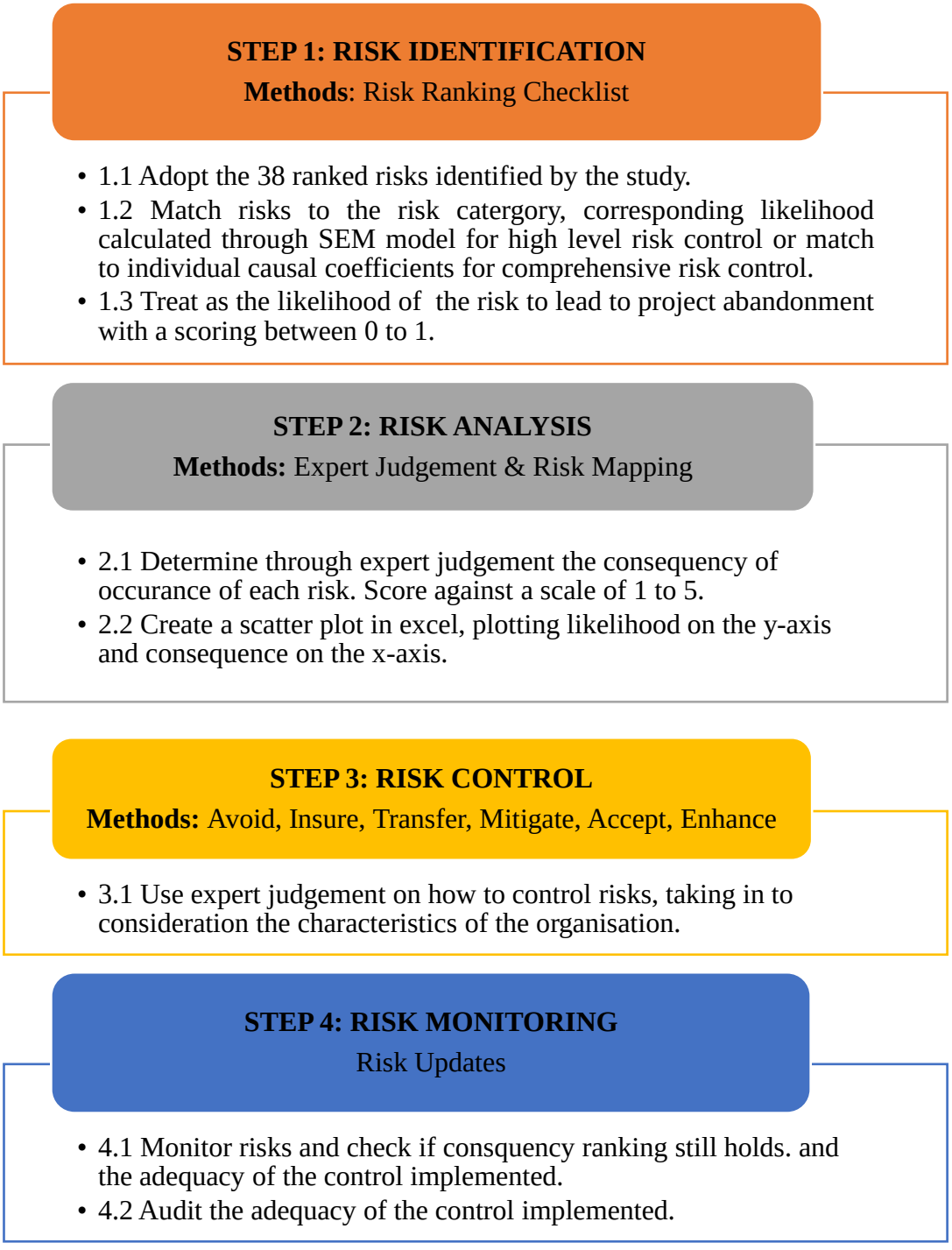

Figure 26: Proposed Risk Management Framework for the Construction Industry in Zambia

The study developed the proposed generic risk management framework (figure 26) that is able to predict risk and the consequences thereof. The framework suggests four (4) steps for risk management as discussed in the framework.

4.9 Risk Mapping and Control Guide

The study further built a risk register illustrating the implementation of the framework through step 1 to step 4. The study for purposes of communicating the process focused on plotting 6 risks. The researcher for purposes of illustration assigned consequences to each risk denoting entries and risk expert with the organisation would propose. See Table 18.

Table 18: Example of Risk & Likelihood Adoption and Consequence Determination

No.	Risk Identified	Consequence Rating	S.E.M Score
1	Late payments	4.6	0.97
2	Political Continuity	1.8	0.87
3	Community interference or lack of stakeholder engagement.	3.5	0.23
4	Inadequate way leave	0.7	0.23
5	Occupational health and safety issues/accidents	0.4	0.23
6	Technology changes	3.6	0.68

The consequence rating and the SEM scores were then plotted on the x and y axis respectively using excel thereby creating a scatter plot representation. The results are shown in Figure 27.

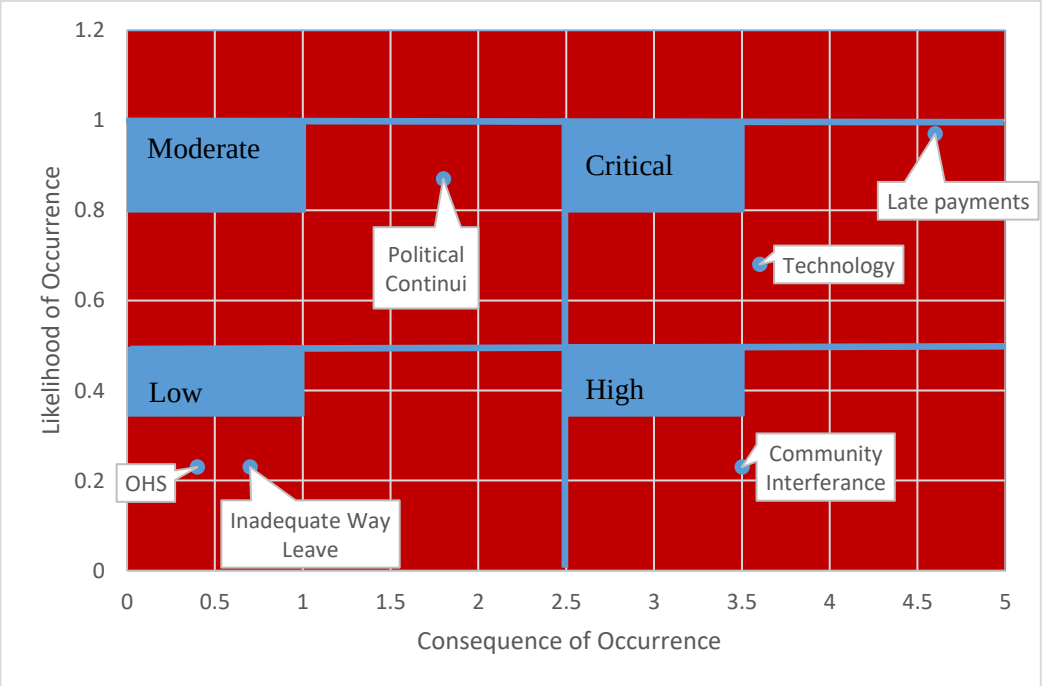

Figure 27: Construction Project Risk Mapping

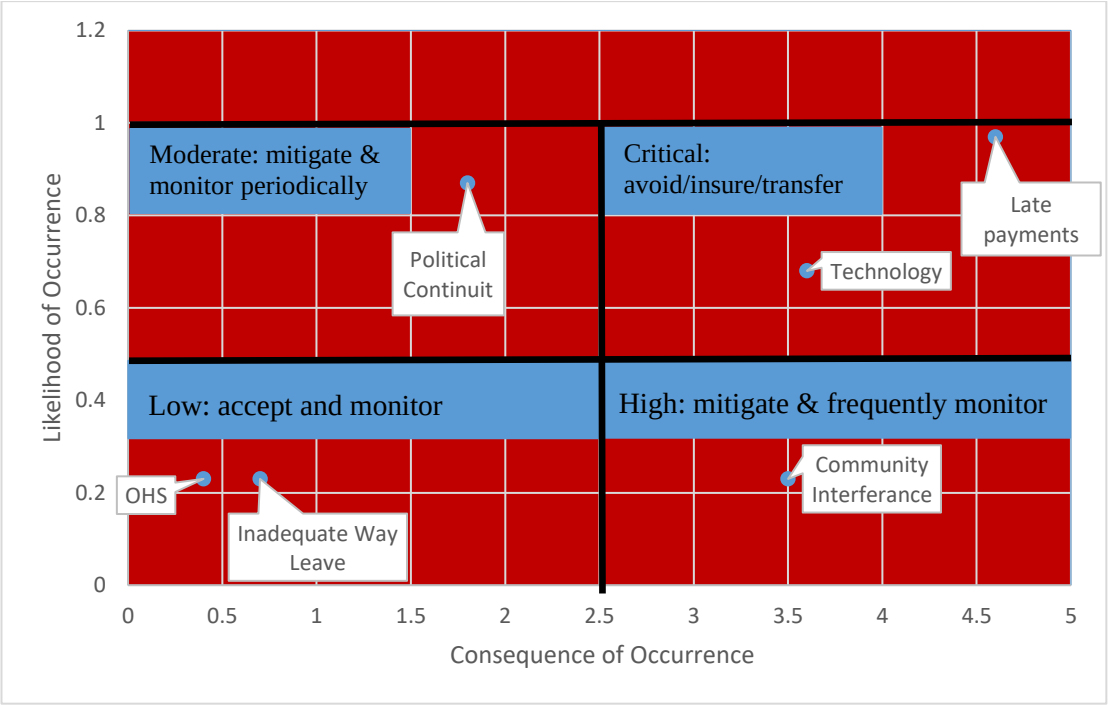

Figure 28: Risk Control Guide

Based on the illustration (Figure 28) the following risks are categorised as follows;

1. **Critical Risks** – meaning that late payments and technological risks posing extreme risk and so a project reserve fund may be created to reduce risks of late payments and for technological risks low-tech solutions provided.
2. **High Risks** – meaning that community interference has significant impact but is less likely to occur and must be monitored frequently or mitigated through appropriate measure such as community engagements.
3. **Moderate Risks** – meaning that political risks are less significant but have a higher likelihood of occurrence. Therefore, must be mitigated for instance through active stakeholder management and monitored periodically.
4. **Low Risks** – meaning that occupational health & safety as well as risks arising from inadequate way leaves are insignificant and less likely to occur. In this regard, the risk is to be accepted and monitored minimally.

4.10 Summary

This chapter provided the findings and discussed them therein. The study found that Zambian professionals had experienced project abandonment with the public sector experiencing project abandonment more that the private sector. Further, the study found that a low number of organizations could be said to be enabled in the

use of risk management techniques. In addition, organizations were found to make use of qualitative techniques more than quantitative techniques.

The study was able to rank the causes and effects of project abandonment and further went on to develop a framework making use of the commonly used techniques in Zambia as per the findings of the study.

The next chapter concludes the study and gives recommendations.

CHAPTER FIVE - CONCLUSION AND RECOMMENDATION

5.0 Introduction

Given the findings of the research and the discussion thereof, this chapter confirms the achievement of the objectives of the study and makes recommendations herein.

5.1 Conclusion

The study raised the following research questions;

a) What are the main causes of project abandonment in the construction industry in Zambia?
b) What are the effects of project abandonment in the construction industry in Zambia?
c) To what extent is risk management incorporated in the management of construction projects in Zambia?
d) Is there a relationship between risk management and project abandonment?
e) What risk management framework is suitable for the Zambian construction industry?

The study was able to answer all the questions as discussed here in;

5.1.1 Main Cause of Project Abandonment

The study was able to identify several causes of project abandonment as discussed in Chapter 4. Then by use of the RII method, the study identified and concluded that the main causes of project abandonment in Zambia were financial risks, legal risks, political risks and organisational risks. The study therefore made the following recommendations;

a) Enhance, make easily and publicly accessible the existing a national register managed by the National Council for Construction on projects undertaken to not only provide project details but allowing for the capturing of reasons for project abandonment.
b) Investigate applicable and viable risk management control mechanisms to handle financial, legal, political and organisational risks. This is an area for future research.

5.1.2 Effects of Project Abandonment

The study was able to identify through the use of the RII method the effects of project abandonment as; projects having left over project materials that then pollute the sites and make them unsightly as well as the failure to achieve of economic returns and social benefits, unemployment, structure deterioration, conflict among contracting parties, wastage of resource, environmental hazards and declined ability to attract financing. The study therefore concluded that pollution, lowered standards of living and unemployment are the main effects of project abandonment.

The study there recommends that Professional institutions such as the Engineering Institution of Zambia, National Council for Construction of Zambia are to provide short courses on risk management to avoid project abandonment in the construction industry in Zambia.

5.1.3 Extent of Use of Risk Management Techniques

The study determined through the use of descriptive statistics the extent of use of risk management techniques in the Zambian Construction Industry and therefore concluded that there was low to moderate and aligned to qualitative techniques. The study further identified that the public sector lagged behind in the use of risk management techniques in managing construction projects.

The study therefore recommends that;

a) Government departments, construction companies and stakeholders to adopt the proposed generic risk management framework developed by the study to minimize the rate of project abandonment in Zambia.
b) National Council for Construction and Engineering Institution of Zambia to encourage knowledge sharing and exchange programs of professionals in the public sector and those in the private sector through sponsoring conferences having themes on risk management in construction.

5.1.4 Existence of Relationship between Risk Management and Project Management

The study found that there is an existing relationship between risk management and project abandonment. The study therefore concluded that there is a strong relationship

(standard coefficient = 0.89) between risk management and project abandonment. The study therefore recommends that;

a) Government departments and project managers are incentivized through receipt of certification for Best Practice recognition for consistent demonstrated use of the risk management framework. This could encourage the consistent use of risk management techniques in managing projects thereby reducing the number of projects abandoned and wasteful resources.

5.1.5 Risk Management Framework for Zambia

Given the low to moderate use of risk management techniques in managing construction projects and the dominant use of qualitative techniques. The study concluded the suitable framework for use in the Zambian Construction Industry is the use of a combination a pre-determined checklist having the likelihood of occurrence already assigned to it for risk identification, expert judgement for determination of consequences and subsequent risk mapping for identification of risk control techniques. This requires limited contribution from the project manager and already suggests control measures to be explored.

5.2 Limitations of the Study

The study was limited by time and therefore the study did not have time to validate the framework developed. To validate the risk management framework of the study, propose the use of the framework on construction project sites over a reasonable time frame allowing for the exposure to a wide range of risk through the different stages of the projects life.

In addition to the above, because of time the study was unable to administer the questionnaires to the calculated sample size of 366 and therefore administered the questionnaire to a convenient sample of 70 as discussed in the methodology section.

5.3 Future Research

This research was able to identify and suggest generic risk control approaches to risks based on the final categorization from the risk mapping exercise. The map suggests the control a project manager can adopt, for example, risks identified as critical risks

could be avoided, transferred or mitigated. Future research can explore the applicable, viable and most practical ways all risks identified can either be avoided, mitigated, transferred or enhanced.

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APPENDIX A: INFORMED CONSENT AND QUESTIONNAIRE

INFORMED CONSENT

THE UNIVERSITY OF ZAMBIA

School of Engineering

Department of Civil and Environmental Engineering

31st July 2018

Dear Sir or Madam,

RE: SURVEY QUESTIONNAIRE ON RISK MANAGEMENT IN THE CONSTRUCTION INDUSTRY IN ZAMBIA

I am a student at the University of Zambia currently pursuing a Master of Engineering degree in Construction Management. My research topic is "A Study of Risk Management Techniques in the Construction Industry in Zambia."

The study ultimately aims at developing a generic risk management framework to mitigate construction project abandonment that has been on the increase in Zambia. In addition, the study shall determine the causes and effects of project abandonment; determine the level of use of risk management techniques in the construction industry and finally determine if there is a relationship between project abandonment and risk management.

You are likely to take 20 minutes to complete the questionnaire. Please note that there is no compensation for taking part in this survey. Your name and ID are not required

in this survey. The data provided will be treated as confidential and shall only be used for research purposes.

If you wish to participate, kindly sign below and fill in the attached questionnaire. If you choose not to take part in the survey, kindly indicate 'declined' on the questionnaire. I kindly request you to take part in this survey by completing the attached questionnaire. Answer all questions if applicable.

Please contact the undersigned for any clarifications. I look forward to receiving a filled in questionnaire from you.

Yours Faithfully,

Engineer Sumbi Mukumba Shimwambwa.

I have carefully read through this form and I understand the purpose of the research. By signing this form, I freely give my consent to participate in this survey.

Signature: _____

Date: _____

A Study of Risk Management Techniques in the Construction Industry in Zambia

QUESTIONNAIRE

Questionnaire ID Number: _____

Section 1: Demographic Characteristics

Tick where appropriate (√)

	What is your profession?		(√)
	a.	Engineer [Civil, Electrical, Mechanical, Environmental]	
	b.	Contract Manager	
	c.	Quantity Surveyor	
1	d.	Other [please specify] _____	
	What type of organisation do you work in?		(√)
	a.	Consultant	
	b.	Contractor	
	c.	Client	
	d.	Project Manager	
	e.	Financier	
2	f.	Other [please specify] _____	
	What is the type of sector you work for?		(√)
	a.	Private Sector	
3	b.	Public Sector	
	How many years of experience do you have in the construction industry in Zambia?		(√)
	a.	Less than 5 years	
	b.	5 - 10 years	
	c.	11 - 15 years	
	d.	16 -20 years	
4	e.	Above 20 years	
	How many employees are in your organisation?		(√)
5	a.	Less than 50 employees	

	b.	50 - 100 employees	
	c.	101 - 200 employees	
	d.	201 - 300 employees	
	e.	Above 300	

Section 2: Causes and Effects of Project Abandonment in Zambia

Tick where appropriate (√)

6. Have you ever worked on a project that has been abandon in Zambia?

Yes ☐ No ☐

Circle the answer where appropriate ◯

7.	What risks factors do you believe are causing project abandonment in the construction industry in Zambia?	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Design Risks						
7.1	Design process takes longer than anticipated	1	2	3	4	5
7.2	Design errors and omissions	1	2	3	4	5
7.3	Design changes	1	2	3	4	5
Financial Risks						
7.4	Construction Cost Overruns	1	2	3	4	5
7.5	Claims	1	2	3	4	5
7.6	Late payments	1	2	3	4	5
7.7	Resettlement Costs	1	2	3	4	5
7.8	Funding Constraints	1	2	3	4	5
7.9	Estimate errors and completeness	1	2	3	4	5
7.10	Cost Escalations	1	2	3	4	5
Technological Risks						

7.11	Technology changes	1	2	3	4	5
7.12	Technological maturity	1	2	3	4	5
Environmental and Social Risks						
7.13	Unforeseen social impacts	1	2	3	4	5
7.14	Community interference or lack of stakeholder engagement.	1	2	3	4	5
7.15	Unforeseen geotechnical site conditions	1	2	3	4	5
7.16	Unforeseen weather conditions	1	2	3	4	5
7.17	Occupational health and safety issues/accidents	1	2	3	4	5
7.18	Inadequate way leave	1	2	3	4	5
7.19	Incomplete environmental impact assessment	1	2	3	4	5
7.20	Inadequate site protection	1	2	3	4	5
Organizational and Operational Risks						
7.21	Inexperienced work force	1	2	3	4	5
7.22	High Staff turnover	1	2	3	4	5
7.23	Delayed material deliveries	1	2	3	4	5
7.24	Team Conflicts	1	2	3	4	5
7.24	Lack of Management Commitment	1	2	3	4	5
7.26	Inadequate equipment availability	1	2	3	4	5
Project Management Risks						
7.27	Failure to comply with quality requirements	1	2	3	4	5
7.28	Scheduling delays	1	2	3	4	5
7.29	Poor inter-organization communication	1	2	3	4	5

7.30	Delay consultant or contractor procurement	1	2	3	4	5
7.31	Supplier Risks and Material Availability					
Legal Risks		1	2	3	4	5
7.31	Enforceability of Contracts	1	2	3	4	5
7.32	Legal Disputes					
7.33	Change in regulations	1	2	3	4	5
Political Risks						
7.34	Political Interference	1	2	3	4	5
7.35	Political Continuity	1	2	3	4	5
7.36	Corruption	1	2	3	4	5
7.37	Bureaucratic Delays	1	2	3	4	5

Circle the answer where appropriate ◯

8.	What do you believe are the effects of construction project abandonment in Zambia?	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
8.1	Structure Deterioration	1	2	3	4	5
8.2	Left over project materials are left to pollute the project site.	1	2	3	4	5
8.3	Lack of achievement of economic returns and social benefits (lowered standards of leaving)	1	2	3	4	5
8.4	Unemployment	1	2	3	4	5
8.5	Conflict among contracting parties	1	2	3	4	5
8.6	Finances spent become a wasted resource.	1	2	3	4	5

8.7	Project remains an environmental hazard to the population.	1	2	3	4	5
8.8	Difficult to obtain foreign aid or the ability to attract investment.	1	2	3	4	5
8.9	Project site affects aesthetics	1	2	3	4	5

8.11 What do you believe are the effects of construction project abandonment in Zambia?

_____

_____

_____

_____

Section 3: Risk Management Techniques in Zambia

Tick where appropriate (√)

9. Does your organisation make use of risk management in ensuring project success?

Yes ☐ No ☐

Circle the answer where appropriate ◯

SN	**Risk Management Techniques in Zambia**		**Frequency of Use**			
10	What risk management ***identification*** techniques does your organisation make use of?		Never	Sometimes	Often	Always
	a.	Interviews	1	2	3	4
	b.	Checklist	1	2	3	4
	c.	Expert Judgement	1	2	3	4

	d.	Delphi Technique	1	2	3	4
	e.	Brainstorming	1	2	3	4
		Historical Information Analysis	1	2	3	4
	f.	Other [please specify] _____ _____	1	2	3	4
11	What risk management ***analysis/assessment*** techniques does your organisation make use of?		Never	Sometimes	Often	Always
	a.	Hierarchical Risk Breakdown Structure	1	2	3	4
	b.	Risk Register and Ranking	1	2	3	4
	c.	Risk Mapping	1	2	3	4
	d.	Decision Tree Analysis	1	2	3	4
	e.	Monte Carlo Simulation	1	2	3	4
	f.	ABC Analysis	1	2	3	4
	g.	Sensitivity Analysis	1	2	3	4
	h.	Probability Analysis	1	2	3	4
	i.	Other [please specify] _____ _____	1	2	3	4
12	What risk management ***monitoring*** techniques does your organisation make use of?		Never	Sometimes	Often	Always
	a.	Incident Investigation	1	2	3	4
	b.	Risk Register Updates	1	2	3	4
	c.	Risk Audit	1	2	3	4
	f.	Other [please specify] _____ _____	1	2	3	4
11	What risk management ***control*** techniques does your organisation make use of?		Never	Sometimes	Often	Always
	a.	Risk Avoidance	1	2	3	4

	b.	Risk Mitigation	1	2	3	4
	c.	Performance Guaranties	1	2	3	4
	d.	Risk Transfer [Insurance]	1	2	3	4
	e.	Risk Sharing	1	2	3	4
	f.	Risk Exploitation	1	2	3	4
	g.	Other [please specify] _____ _____	1	2	3	4

14. How would you rate your organisation's Risk Maturity?

1. Naive - No formal approach developed for risk management.
2. Aware - Scattered approach to risk management.
3. Defined - Strategies and policies in place and communicated
4. Managed - Organization's approach to risk management is developed and communicated
5. Enabled - Risk management and controls are fully embedded into the operations

THANK YOU FOR YOUR PARTICIPATION!