DELAYS IN CONSTRUCTION OF ELECTRICITY TRANSMISSION LINES IN ZAMBIA

By

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A dissertation submitted in partial fulfilment of the requirements for degree of Masters of Engineering in Construction Management

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SCHOOL OF ENGINEERING

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DECLARATION

I **Moses Nundwe**, hereby declare that the work presented in this dissertation is the result of my research work and that it has not previously been submitted for a degree or other qualification at this or another University.

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CERTIFICATE OF APPROVAL

This dissertation of **Moses Nundwe** is approved as fulfilling requirements of for the ward of Degree of Master of Engineering in Construction Management at the University of Zambia.

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ABSTRACT

Electricity is central to the development of any economy and in Zambia most of this energy is generated from hydropower plants. Projects for construction of electricity Transmission lines are often delayed therefore some towns which were not connected to the national grid are underdeveloped because of limited capacity of the diesel generators which were used for power generation. Delays in construction of electricity transmission lines in the energy sector is a challenge faced globally.

A study was undertaken to establish the causes of delays in the construction of electricity transmission lines in Zambia and recommendations were made for practices that could be used to improve the effectiveness and efficiency in the management of electricity transmission line projects. The Research methods adopted for the study include; a comprehensive literature review, structured interviews and a questionnaire survey. Purposive sampling was also conducted with project managers and engineers.

The main findings in the study were that; at project approval stage the ministry of Justice was involved, however the Government bureaucracy delayed the review of the draft contract. During execution of the project three factors came into play, namely late advanced payment, poor financial management by the contractor and irregular payments to subcontractors.

To address causes of the delay, a Real Time Project Management System Model was developed to ensure effectiveness and efficiency in the project delivery. Recommendations in the best practices include independence of the project manager in decision making, timely availability of financial resources and proper management of tax clearances issues.

***Key words**: Causes of delays, Construction, Energy Sector, Project, Transmission line, Zambia,*

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ACRONYMS

CSO	Central Statistics Office
ETL	Electricity Transmission Lines
EPC	Engineering Procurement Construction
GRZ	Government Republic of Zambia
PM	Project Manager
RTPMS	Real Time Project Management System
R SNDP	Revised Sixth National Development Plan

CHAPTER 1: INTRODUCTION

1.1 Background

Electricity is central to the development of any economy. And according to the Government of the Republic of Zambia's (GRZ) Revised Sixth National Development Plan (R-SNDP), a viable energy sector is key to achieving sustainable economic development in the country as it is a critical input to all sectors of the economy (www.mndp.gov.zm).

In the recent past, Zambia has experienced an increase in the demand for power due to increased industrial activities and population growth. However, this population growth has not moved at the same pace with expansion of electricity generation and transmission capacity.

This is with the fact that the country has potential for hydro, solar and thermal energy sources. Therefore, the R-SNDP's main goal was to ensure availability and accessibility to adequate and reliable supply of energy at the lowest economic, social and environmental cost.

To achieve the goals the GRZ envisaged to increase power generation by at least 1000 Mw the 2010 electricity generation capacity of 1900 Mw; Increase of rural access to electricity from 3.5 percent to at least 15 percent and national access from 22 percent to 40 percent. To achieve this objective the main aim of R-SNDP was to expand and improve infrastructure for electricity generation, transmission and distribution (*www.mndp.gov.zm*).

To meet the successes of the R-SNDP under the energy sector, GRZ commenced projects such as; Connection of Northwestern province to the grid at 132KV, Upgrading of the existing 66KV transmission lines for Pensulo (Serenje) - Chipata and Pesulo - Kasama to 330KV, connection of Luangwa town to the grid in Eastern province. Others are construction of a 330KV line form Kariba North bank Power station to Kafue west Substation (SS), construction of a 330 KV line from Itezhi Tezhi power station through Mumbwa to Kafue west and Kalumbila (www.mewd.gov.zm). Despite these efforts to connect all the towns in the country to the national grid, some towns were still using diesel powered generators while others were underdeveloped due to limited capacity of power to

support industrial development. But according to the study by Kaliba (2010) the construction industry in Zambia was faced with the challenge of schedule overruns.

The completion of projects within the contractual period is a key factor and an indicator of project success (Gaturu and Muturi 2014). Failure to complete a project within the time limit has effects of increased overhead costs on the part of the contractor and claims arising from the client for liquidated damages (Kaliba 2010). It is therefore important to meet the completion period. Construction delays occur in every project, however the impact of these delays differ from one project to another because of the difference of the environment in which they are executed. The projects in the energy sector include among others; construction of power stations, substations, electricity transmission and distribution lines. However, these projects are also faced with the challenges of delays in completion, and these delays range from 5 to 20 per cent of the project duration (Salama ,Hamid and Koegh , 2008).

These schedule delays have negative effects to on projects such as lawsuits between the employer and the contractor, cost overruns due to increase in overhead costs, loss of production and termination of contracts. Despite the inclusion of punitive clauses in the conditions of contract which are meant to influence performance of contracts on time, delays are still being experienced in the execution of transmission projects in Zambia.

Although many studies have been conducted on the causes of delays in construction industry such as in the building and road sectors (Aigbavboa et al, 2014), not much information has been revealed for projects in electricity transmission lines in Zambia. The projects involving construction of hydro power plants and transmission lines in the energy sector, are executed using Engineering, Procurement and Construction (EPC) contracts delivery system and have also not been spared with the problem of schedule delays. This study was undertaken to look at the delays in the construction of transmission line projects in Zambia which were being undertaken by the Government. Furthermore, the study was aimed at identifying the main factors causing delays and eventually propose recommendations that could be used to improve project delivery and performance.

1.2 Rationale

Zambia's economy depends largely on the mining and agriculture sectors. However these require hydro power to operate profitably. Therefore, Electricity is central for economic development in Zambia. A decade after 2000 Zambia had new industries particularly in the mining sector, while the population also grew from 9.9 million to 13.3 million in 2010 and it was projected to increase further to 15.5 million by 2015 (*Central Statistics Office, CSO*). However, the industrial and population growth in the country did not move at the same pace with the increase in power generation and transmission capacities which resulted to a power deficit and few employment opportunities due to lack of industrial development in towns which were not connected to the national electricity grid.

The GRZ devised a policy framework in *R-SNDP* aimed at Infrastructure development in power generation and transmission capacities in the country (*www.mndp.gov.zm*). The projects once completed were expected to outstrip the anticipated future growth in electricity demand and lead to achievement of Government's key success factors of stopping load shedding. Therefore, the Government commissioned projects for construction of electricity transmission lines aimed at uprating existing lines and connecting the remaining towns to the national grid (*www.mndp.gov.zm).*

The construction of electricity transmission lines (ETL) was faced with the challenge of completion within the contractual period. This problem was even common in other projects such as for roads . *(Kaliba. 2010).* According to Salama *et al* (2008), Projects in construction industry have challenges which slow down work, and these factors have not spared the energy sector. However the contracts under which electricity transmission line projects were delivered in Zambia, were drafted with conditions for time control, but the challenge to complete within the contractual period continued affecting the Industry.

Most of the studies have looked at the road sector and other infrastructure such as buildings but not so much information about ETL has been released. While it can be argued that all construction projects are similar, the projects in transmission lines are complex and involve collaboration of different engineering disciplines and are delivered using EPC. Since these types of projects are not common in the Zambian construction industry, there is lack of expertise among local contractors.

Table 1.1 shows the performance of selected projects in ETL in Zambia and further highlights that the major causes for delays were late delivery of material to sites, disputes between the client and the contractor and tax clearance issues at the port of entry. The table illustrates further that projects in ETL in Zambia have faced various problems and delay in completion time is the major problem. However, according to Mohamed (2015), Schedule overruns in construction can be avoided if project participants identify the causes of delay and label them as critical success factors and, suitable measures implemented. Therefore it was imperative that a study was conducted to identify the causal factor of delays during the undertaking of ETL projects in Zambia.

Table 1.1: Performance of selected Projects

Name of project	Start date	Original Finish date	Revised Date	Comments
132 KV line-Connection of Luangwa town to the Grid	13th December 2012	12th June 2014	31st August 2015	The overall progress on the transmission line was 21% as per revised completion date. The project delayed due to unsettled disputes between the client and the contractor.
132 KV line-Connection of Northwestern province to the grid	14th April 2014	13th April 2016	Revised finish date to be announced	The project delayed by 8 months mainly due to tax clearance issues leading to late delivery of materials
330KV line-Pensulo-kasama /Pensulo -Chipata	27th November 2012	27th May 2015	31st October 2015	Project delayed by 5 months mainly due to late delivery of materials to site

Source; www.zesco.co.zm

1.3 Objectives

1.3.1 Aim

The aim of this study was to identify the main causes of delays in construction of electricity transmission lines in Zambia and provide recommendations on management practices that could enhance effectiveness and efficiency in the implementation projects.

1.3.2 Specific Objectives

To meet the aim for the study, the specific objectives where:

- To identify factors influencing schedule overruns in construction projects for electricity transmission lines in Zambia;
- To examine the collective perspective of the causal factors of delays from the contractors' and clients' points of view; and
- To offer recommendations for improving performance for TL projects in Zambia.

1.3.3 Research Questions;

- What are factors that influence schedule overruns in construction of Electricity transmission lines in Zambia?
- What do clients and contractors perceive to be the causal factors of delays in construction of electricity transmission lines in Zambia?
- How can the performance of electricity transmission projects be improved in Zambia?

1.3.4 Scope of work

The research paper focuses only on the construction of electricity transmission lines in Zambia. It concentrates specifically on projects delivered by the government. More attention is given to projects funded by loan agreements between the GRZ and other partners. This is important because loan funded projects have times lines on which payments should start, therefore a delay in completion affects the payment time line for the loans.

1.3.5 Problem statement

Zambia has been experiencing rural-urban migration of people seeking employment, business opportunities and education because of lack power in some towns and rural areas. There has been delay in connecting other towns to the national grid and upgrading existing transmission lines for industrial development. If the affected towns and rural areas had adequate power, there could have been economic development for people to rely on.

1.3.6 Justification of the study

The study established that there were delays during the construction of ETL in Zambia. These causes of delays originated from the Government agencies, Contractor and acts of god. Furthermore the categories of causal factors of delays were; management, external, financial, workmanship, material and manpower related. The study revealed that these delays were present from initiation, planning, execution and controlling processes of the projects. It was recommended that the respective government agencies involved in implementation of ETL should improve in their efficiency of delevery. Furthermore training in project management for all team members would also help in improving the efficiency and effectiveness in the delivery of ETL projects.

A Real Time Project Management System Model was developed during the study and could be used to improve effectiveness and efficiency in the project delivery and management of electricity transmission lines and other similar projects.

1.4 Summary

This chapter presented the background, rational, and main objective of the study. It highlighted research questions and the core concepts and road map for the undertaking. Additionally the justification and problem statement was also presented.

1.5 Organization of the Dissertation

The report is organized in six chapters.

Chapter 1 outlines the background, rationale main and specific objectives of the study. It also highlights the success documented in the study.

Chapter 2 Outlines core concepts and road map of the study through the review of literature relevant to delays in construction industry

Chapter 3 presents the different types of methodologies applied and the justification for the methods used for the study

Chapter 4 presents the result of the research survey, data analysis and discussion.

Chapter 5 presents the proposed model for real-time project management system and the results for the survey

Chapter 6. In this chapter the conclusion of the study is presented followed by the recommendation and limitations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In the previous chapter an overview of delays in the construction industry, the rationale and objectives of the study were presented. This chapter presents the literature review on the topic of delays and their causes.

2.2 Previous studies on construction delays

In every construction project there are obstacles that slow down the delivery process, and these delays vary from project to project because of the difference in the environment. Projects for in the energy sector are also prone to different types of delays in the completion period and these delays range from 5 to 20 per cent of the project duration (Salamai *et al*. 2008).

The construction Industry in Zambia has not been spared by the challenges of delays in completion as revealed in the study by Kaliba *(2010).* One of the key indicators and measure of success for a project is meeting the time limit, therefore planning and scheduling are fundamental aspects in ensuring that project delivery is within the contractual period (Gaturu & Muturi, 2014). The capability and performance of the contractor in a project is also measured on the basis of the ability to complete projects within the scheduled time (Kumaraswamy and Chan, 2002).

Construction projects for ETL have larger desk issues than other projects in the industry because they are executed across many different environments with different owners of land. This causes loss of time on the project due to different requirements from affected land owners (Savacool *et al* 2014).

The factors of delay in a project can originate either internally or from external factors interfacing with the project (Tumi *et al*. 2009). Therefore it is important that project managers and other participants remain focused during the execution of the projects and use past experiences in identifying potential bottlenecks to complete projects within schedule.

According to Assaf and Al-Hejji, *(2006*), schedule overruns in projects are one of the major causes of loss of revenue to the employer because of rescheduling of production and subsequent increase in overhead costs which result in higher cost to the contractor due to fixed costs in addition to the inflation effect manifested in the increasing prices for material and other services.

EPC contracts are used in the delivery of electricity transmission line projects. These projects are cross functional, therefore, different professionals are engaged in the design as studied by Zhu *et al* (2013). For that reason EPC projects are faced with delays because of different players with different management and technical skills, and poor communication and coordination within the project team. Ineffective communication results into poor designs that do not reflect the opinion and approval of all project team members. This results into repeated revision of designs during implementation of the project thereby causing further delays. Therefore effective communication tools and channels are important in avoiding delays in project implementation (Dinakar, 2014).

Construction projects have various stages and actions of delivery and these actions are interdependent. A delay in a project is used to indicate a stage or action in a project not happening as planned on the schedule but deferred to a later time due to a circumstance and eventually extending the period of execution upon which contracted parties had agreed without stopping the work (Dinakar, 2014). There are different types of delays as illustrated in figure 2-1, and these can be classified as non-excusable, excusable, critical, non-critical compensable and non-compensable delays.

2.2.1 Non excusable and excusable delays*;*

Non-excusable delays are delays caused by the contractor. Therefore contractors requested to make up lost time by accelerating the works or compensating the owner. The owner is entitled to claim damages from the contractor for not completing the project on time. (Mohammed & Isah, 2012).

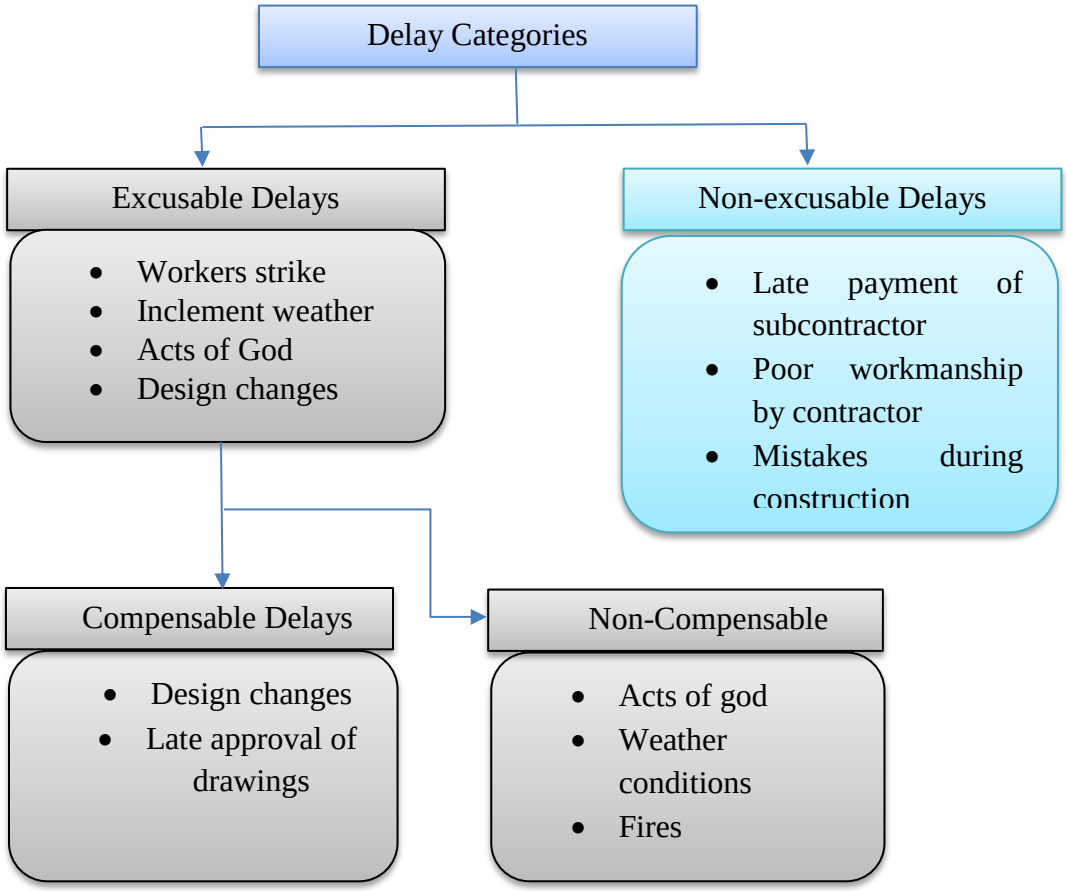

Figure 2.1: Delay Categories (Theodore, 2009)

A non-excusable delay is a delay which the contractor either causes or hedges the risks and is generally not entitled to relief and must either make up the lost time through acceleration or compensate the owner. This compensation usually comes about through either liquidated damages or actual damages, provided there is no clause for liquidated damages in the contract. Examples of non-excusable delays are;

- Late payment of subcontractors
- Untimely performance by suppliers
- Poor workmanship by the contractor
- Mistakes during construction

The work of Mohammed & Isah (2012) shows that excusable delays are delays caused by unforeseen circumstances or events beyond the contractor's or sub-contractor's control. In

this case the contractor or subcontractor have no influence on the occurrence of such delays and therefore they are not liable in any circumstance.

2.2.2 Critical and non- critical delays

Delays that affect the project finishing point or in some situations milestone dates are regarded as critical delays and delays that do not affect the project completion or a milestone date are considered as non-critical delays. If these events are delayed, the project completion date or milestone will be delayed (Mohammed & Isah, 2012).

2.2.3 Compensable and non-compensable delays

There are two types of delays; compensable and non- compensable delays .Delays which are caused by the client or client's agent are referred to as compensable delays. These delays originate from nonperformance of a task or an action by the client's or clients agent which leads to schedule overrun. An example of this type of delay is late approval of drawings by the client. Therefore because of schedule overruns the contractor incurs additional overhead cost and is entitled to claim financial damages (Mohammed & Isah, 2012).

Non-compensable delays are delays which are out of control and result in schedule overruns on project. Therefore the contractor is entitled to claim extension of time for completion. These types of delays are caused by natural events such as acts of God, political events, workers strikes or unusual weather conditions (Mohammed & Isah, 2012).

There are two types of excusable delays; compensable and non-compensable. Compensable delays are caused by the client or client's agent where the contractor is entitled to a time extension and compensation (Dinakar, 2014). An example of this would be late approval of drawings by the client. An excusable compensable delay leads to schedule extensions which result into the contractor incurring additional overhead costs. While non-compensable delays, are delays caused by third parties or events outside the control of both the client and the contractor. Examples include; acts of God, workers strikes and fires.

2.2.4 Causes of delays

Salunkhe and Patil (2014) established that the main causes of delay reported by various project agencies in India were; delay in land acquisition, delay in equipment erection, inadequate mobilisation by the contractor, delay in forest clearance, fund constraints, alteration in scope of work, annulment of tender, law and order problem, delay in supply of equipment, slow progress of civil work and escalation in cost.

Aigbavboa *et al*, (2014) observed that construction delays usually occur during the construction phase and this is mostly caused by poor coordination, ineffective planning and scheduling of projects, delays in approving major changes in the scope of work, delay in delivery and procurement of material, bad weather conditions, and political interference. Whereas a study by Haseeb, *et al* (2011) in Kuwait established that the main causes of delays in construction projects were; payments, inaccurate time estimation, quality of material, poor site management, old technology, natural disaster, unforeseen site conditions and shortage of material. And other delays caused by subcontractors, change in drawings, improper equipment, inaccurate cost estimation, change orders, organization changes and regulation changes.

According to Kaliba (2010), the major causes of delays in the construction projects in Zambia, particularly in the road sector, were delayed payments, change orders/scope, poor sub-contractor performance, unqualified manpower, weather conditions, poor management, schedule mismanagement, lack of equipment, material procurement and poor coordination on site.

In India, the Federation of Indian Chambers of Commerce and Industry (FCCI) in its paper titled 'Transmission line the Real Bottleneck' indicated that; right of way or way leave acquisition was one of the major factors of delay faced by developers due to inability to acquire land and timely clearances from stakeholders. Furthermore the paper highlighted that, the power transmission sector had not moved at the same pace with the increasing demand for power and generation capacity in the country due to time overruns in construction of transmission lines. The other challenges were; bidding processes, planning, technology and innovation. The study further revealed that delays in delivery of projects in the power transmission sector posed a negative effect on the entire economy. Therefore

it is anticipated that the delays in construction of transmission lines in Zambia can equally pose a negative effect on the economy if not addressed.

David (2005) studied Time and Cost overruns in power projects in Kenya and the study revealed that there were variables that significantly contributed to time and cost overruns in power projects .The study further highlighted that the main factors for overruns in time and cost were; contractor inabilities, poor preparations, resource planning, interpretation, scope of works, bureaucracy in government, poor time estimates and risk allocation. Government bureaucracy was considered to be the main bottleneck in project delivery due to the lengthy processes of approvals in various agencies. The study highlighted that the frequency of the factors depended on the environment and time of project delivery.

These revelations from different parts of the world indicate that all construction projects risk schedule overruns (Assaf and Al-Hejji, 2006). Therefore it is imperative that managements monitor project progress to reduce chances of delay incidence or identify them at early stages. Furthermore, good practice in planning, coordination and change of management system procedures of public institutions need to be identified and consequences understood (Tumi, Oman and Pakir, 2009).

2.2.5 Summary of causes of delays in construction

Studies conducted elsewhere revealed that there were factors that cause delays in construction projects. The delays can originate either from the client, consultants, contractors, subcontractors or government agencies. There are different types of delays in construction and these are; excusable and non-excusable delays. Excusable delays are delays were the contractor is eligible for extension of time while non excusable delays are those where the contractor is not entitled to extension and results in payment of damages to the client. Form literature review the causes of delays in construction were; poor management skills, lack of technical expertise, poor internal and external communication, poor coordination, centralised management, poor supervision and slow decision making. Others are late mobilisation, incompetent contractor staff, poor planning, scheduling or resource management skills, design changes, poor quality control plans, mistakes during construction, inexperience in similar works, shortage of materials, poor quality of

materials, unclear material specification, late procurement of material from abroad, misuse of material, delay of material delivery to site, shortage of manpower, unavailability of equipment on request, wrong allocation of equipment, different nationalities of workforce on site, poor financing by the contractor, irregular payment of subcontractors, advance payment, late work progress payment, inclement weather conditions, inadequate site investigation, vandalism, work permits. delays in producing detailed design drawings, unclear and inadequate details in drawing designs, complexity of project design, insufficient data collection and survey before design, misunderstanding of owners requirement by design engineer, lack of advanced engineering design software, shortage of construction material on the market, damage of sorted material while they are needed urgently, equipment breakdown, shortage of equipment , low productivity and efficiency of equipment, lack of high technology mechanical equipment, shortage of labor, personal conflicts among workers, delay in obtaining permit from municipality, hot weather effect on construction activities, effect of social and cultural factors, accidents during construction, differing site conditions, changes in government regulations and laws, delay in performing final inspection and certification by the third party, poor qualification of the contractors staff, improper construction methods by the contractor, type of construction contract, and ineffective delay penalties. Table 2.1 to Table 2.5 illustrate the causes of delays according to various categories.

Table 2.1: Causes of delays by the Client (Rajiv, Assf and Hejji 2005)

No	Causes of Delay
1	Delay to present and handover site to the contractor
2	Delay in work progress payments
3	Change order by the owner
4	Slow decision making by the owner
5	Poor communication and coordination by the project team

Table 2.2: Causes of delay by Public Authorities (Rajik 2013, Assaf and Hejji 2005)

No	Causes of delays
1	Changes in Inflation rates
2	Obtaining permits
3	Changes in government regulations and laws

Table 2.3: Causes of delays by Contractor (Rajik 2013, Assaf and Hejji 2005)

No	Causes of delays
1	Incompetence project team
2	Difficulties in financing the project
3	Delays in Sub contractor work
4	Poor site management and supervision
5	Mistakes during construction
6	Unavailability of professional construction management
7	Delay in Site mobilization
8	Poor planning and scheduling skills

Table 2.4: Causes of delays by consultant (Rajik 2013, Assaf and Hejji 2005)

No	Causes of delays
1	Delay in approving major changes in the scope
2	Late in reviewing and approving design documents
3	Conflicts between the design engineer and consultant
4	Inadequate experience by the consultant
5	Misunderstanding of the owner's requirements by the design engineer
6	Delays in producing design documents
7	Complexity of the design

Table 2.5: Contractual relationship delays (Rajik 2013, Assaf and Hejji, 2005)

No	Causes of delays
1	Short and unrealistic contract duration
2	Legal disputes by various parties
3	Inaccuracy in cost estimates
4	Excessive contracts and subcontracts
5	Mistakes and discrepancies in contract documents
6	Controlling sub-contractors by general contractor
7	Poor project delivery methods

Table 2.6: External causes of delays (Rajik 2013, Assaf and Hejji 2005)

No	Causes of delays
1	Delays in material delivery
2	Changes in material typed and specification during construction
3	Problems with neighbors
4	Unforeseen climate conditions
5	Effect of social and cultural factors
6	Waiting for test samples
7	Accidents during construction

Table 2.7: Causes of delays by Equipment (Rajik 2013, Assaf and Hejji 2005***)***

No	Causes of delays
1	Equipment breakdown
2	Shortage of equipment
3	Low level of equipment operators
4	Low productivity and efficiency of equipment
5	Lack of high technology mechanical equipment

Table 2.8: Causes of delays due to Material (Rajik 2013, Assaf and Hejji 2005)

No	Causes of delays
1	Shortage of construction materials in market
2	Changes in materials types and specifications during construction
3	Delay in material delivery
4	Damage of sorted material while they are needed urgently
5	Delay in manufacturing building materials
6	Late procurement of materials

Table 2.9: Causes of delay in UAE (Motaleb and Kishk 2010)

No	Causes of delays
1	Change orders
2	Lack of capability of client representative
3	Slow decision making by client
4	Lack of experience of client in construction
5	Poor site management and supervision
6	Incompetent project team
7	Incompetent project team
8	Inflation/prices fluctuation
9	Inaccurate time estimating
10	Late delivery of materials
11	Improper project planning / scheduling

Table 2.10: financial related causes of delays (Haseeb et al, 2011)

No	Causes of delays
1	Client's contraints
2	Contractor's financial problems
3	Inadequate fund allocation

4	Monthly payments problems
5	Inflation
6	High interest rates
7	Delay in payment to supplier and subcontractor
8	Client's financial problems

2.2.6 Method of minimizing delays in construction

Construction delays affect the project cash flow negatively, because of extra costs that are incurred such as overhead costs (Gbahabo and Ajuwon 2017). Delays in construction are a major source of disputes between the contractor and the client (Sambasivan and Soon, 2007). However, EPC contracts are drafted with clauses that are meant to reduce the risk of occurrences of delays on the project and how the affected party could recover from the effect of such delays. The use of liquidated damages clauses in the conditions of contract adds to the certainty of the outcome of construction contracts. Therefore to minimize the risk of delays on a project depends largely on how the contract document is drafted. Table 2.1 shows recommendations from several studies on best practices on minimizing the risk of delays in construction projects.

Table 2.11: Causal factors

No	Method
1	Regular progress meeting (Majid 2006)
2	Use of latest technology (Majid 2006)
3	Use of modern construction equipment (Majid 2006)
4	Use of appropriate construction methods (Majid 2006)
5	Effective strategic planning (Majid 2006)
6	Efficient material procurement (Majid 2006)
7	Efficient initial cost estimate (Majid 2006)
8	Defined communication channels (Majid 2006)
9	Frequent coordination between the parties involved (Majid 2006)
10	Reference to past experiences (Majid 2006)

11	Effective project planning and scheduling (Majid 2006)
12	Improved project management skills (Ghahabo and Ajuwon 2017)
13	Reference to similar projects (Ghahabo and Ajuwon 2017)
14	Implementation of Computer-Aided Cost and forecasting Models
15	Risk identification and contingency planning (Ghahabo and Ajuwon 2017)
16	Screening bidders with questionable capability (Ghahabo and Ajuwon 2017)

Table 2.12: Analysis of literature reviewed

S/N	Author	Objectives	Methodology	Conclusions	Comments (if any)
1	Alinaitwe, Apolot and Tindiwensi, (2013)	To investigate the causes of delays and cost overruns on construction projects in Uganda's public sector	Literature review, Interviews, Questionnaires survey.	The paper concluded that; changes in the scope, delayed payments to contractors, poor monitoring and control and high inflation and interest rates were the five most important causes of delays and cost overruns	The study focused on public sector projects but did not include Government projects in the energy sector especially Transmission Lines.
2	Sovacool , Gilbert, and Nugent, (2014)	An international comparative assessment of construction cost overruns for Electricity infrastructure.	Review of Institution Data base	The study established that electricity infrastructure projects have substantial construction risks.	The study did not outline the challenges involved in electricity transmission line projects**.**
2	Kaliba , (2010)	To establish the factors that lead to cost escalation, schedule overrun and quality shortfalls Analyze how the identified factors relate to overall project performance	Literature review, Interviews, Questionnaires survey.	The study established that cost escalations, schedule overruns and schedule overruns continue to as challenges on construction projects despite years of discussions. The major causal factors of cost escalations were; insufficient analysis of costs change orders and Inflation.	This study focused on public sector projects but did not look at the projects in the construction of electricity transmission lines.

		and their impacts on projects and Evaluate the possible options for alleviating or reducing cost overruns and quality shortfalls on construction projects.		Financial difficulties on the part of the contractor, change orders, and poor subcontractor performance were three major causal factors foe schedule overruns. While late release of project funds by the client , poor financial management by the contractors and longtime gap between feasibility study and implementation of projects were the causal factors for quality shortfalls	
	David, (2005)	Time and cost overrun in power projects in Kenya	Literature review and questionnaire survey.	The study revealed that they were factors contributing to time and cost overruns significantly. These factors were; Contractor inability, poor project preparation , resource planning , Interpretation of requirements, Risk allocation, Government bureaucracy and works definition,	The study outlined the causal factors contributing to time and cost overruns but did not provide a model and policy framework for operation to minimize the delays originating from government agencies, contractor and client.
3	Ramanathan , Narayanan	To review the and identify the application of past	Literature review, Interviews,	The study established that none of the previous studies could be	

	& Idrus, (2012)	studies on determining the factors causing time and cost overrun in current projects	Questionnaires survey.	generalized and considered directly applicable in current projects.	

S/N	Author	Objectives	Methodology	Conclusions	Comments
4	Sambasivan. and Soon, (2007)	To identify the delay factors and their impacts on project completion	Literature review, Interviews, Questionnaires survey.	The study established 10 major causes of delays which included; contractors poor planning , contractor's poor site supervision , inexperience of the contractor, inadequate client' s client finance and payments for the completed works ,problems with subcontractors, shortage in material , labor supply, equipment availability and failure, lack of communication between parties and mistakes during the construction stage, The six major effects were; time overrun, cost overrun, disputes, arbitration, litigation, total abandonment	Ten major causal factors of delays were identified in the study and their associated effects. However the was no attempt to give recommendations for the best practices that could be used to cushion the delays and the effects.

S/N	Author	Objectives	Methodology	Conclusions	Comments
5	Dinakar, (2014)	To identify various causes of delays. How unpredicted delays can cause delays resulting in delays of the total project. The effects of the delays on the project. Study the causes and effects of the delays at various projects and to find out the most important causes.	Literature review, Interviews, Questionnaires survey.	The study concluded that all the parties; the Client, Contractor and the consultant shared the same responsibility for the delays in construction. It further highlighted that improper communication between the parties involved was the major problem while external reasons such as lack of equipment, material and qualified labor were next in the row.	The study pointed out that poor communication between the parties involved was a major problem but did not give recommendation on the techniques and tools that could be used to improve communication

S/N	Author	Objectives	Methodology	Conclusions	Comments
6	Mustafa, (2015)	To evaluate the extent the time delay and cost increases in Addis Ababa road construction, To identify the factors influencing time and cost overruns in road construction in Addis Ababa. To discuss the effect of delay and time overruns in road	Literature review, desk study and Questionnaires survey.	The study established that, time overruns ranges from 25% to 264 % of the contract period and cost overruns ranges from 4.11% to 135 % of the contract amount. Factors influencing delays were; delay to deliver the site, financial problems of the contractor, Poor	The study gave recommendations for communication and coordination between all parties but did not offer the associated tools and techniques that could be used and policy frame work for proper use of advance payment.

		construction in Addis Ababa, To Formulate recommendations on the results obtained.		planning and site management and causes of cost of overruns were; design changes, fluctuations in cost of materials inadequate review of drawings and contract document. The effect of time overruns were; cost overruns, disputes and arbitrations. The study recommended improved communication, coordination planning and site management and proper use of advance payment.	

S/N	Author	Objectives	Methodology	Conclusions	Comments
7	Abd El-Razek., Bassioni. & Mobarak(2008)	To identify the main causes of delay that affect	Literature review, Interviews, Questionnaires survey.	The most important causes of delay identified in the study were; financing by the contractor, design changes by the owner, partial payments during construction and non-utilization of professional construction/contractual management.	The study highlighted that joint effort by all participants was required to cushion the delays but did not propose the policy frame work for implementation

		building projects in Egypt		The study recommended that joint effort based on teamwork was required to mitigate delays.	

S/N	Author	Objectives	Methodology	Conclusions	Comments
8	Ubani, Okorocha, Emeribe. (2010)	To identify and analyze the factors influencing time and cost overruns on construction projects in South East Nigeria	Literature review, Interviews, Questionnaires survey.	The study established that materials and external related factors were crucial factors contributing to delays on construction projects in South East Nigeria	
9	Patil, Gupta, Desai and Sajane, (2013)	To identify the causes of delays in construction industry in India To test the importance of the causes of delay between parties involved in project To study the difference in perceptions of the these major parties in any construction, namely owners, contractors and consultants	Literature review, Interviews, Questionnaires survey	The study revealed that the problem of construction delays in transportation infrastructure projects was frequent and notable and the top five ranked causal factors were; Land acquisition, Environmental Impact of the project, financial closure, change orders by the client, poor site management and supervision by the contractor.	The study established that, there were causal factors of delays in transportation infrastructure projects but did not identify the tools and techniques which were used in attempt to cushion the delays

S/N	Author	Objectives	Methodology	Conclusions	Comments
10	Chirwa, Samwinga and Shakantu, (2011)	Time Project Delivery: Case study of Malawian Education Projects.	Literature review, Case study and Evaluation of Secondary Data.	The study established the causal factors of delays in construction industry in Malawi were not unique. However the extents of delays and poor project management skills were the major cause of concern. Furthermore initiatives to assist contractors to complete within stipulated contract period were not universally successful. The role of the regulatory bodies in the built environment was also important in arresting the challenge of underperformance by contractors.	The study indicated that the construction industry in Malawi was not spared from schedule overruns. However there were no recommendations regarding policy frame work on how to implement the development of training in project management training.
10	Swarnadhi , Pathi and Boyd,(2005)	To investigate how construction project performance is achieved in Botswana in relation to time predictability	Literature review, Interviews, Questionnaires survey.	The paper confirmed that known factors were applicable in time expectedness of projects and also identified the Botswana specific context. These factors included government influence making projects more complex, the geography constraints making material and plant supply difficult and multi-cultural issues adding people	This study focused on public sector projects but did not look at the projects in the construction of electricity transmission lines.

				management problems to projects.	

S/N	Author	Objectives	Methodology	Conclusions	Comments
12	Mohamed and Isah, (2012)	To identify the major causes of delays in Nigeria construction industry, To identify the effects of delays in Construction projects. To recommend strategies for improving delivery.	Literature review, Interviews, Questionnaires survey	The study revealed that delays require management actions to control the causes from design stage. Furthermore, adequate planning, coordination and proper monitoring by experienced and qualified professionals could reduce the impact.	The paper gave recommendations for management actions that could assist in minimizing delays. However, there were no proposals for appropriate tools and techniques for coordination and monitoring.
13	Gopal. Aditya., Suma. 2011	The purpose of the paper was to develop a GIS Based 4D Model for Planning and Scheduling of a Construction project	Literature review, Interviews, Questionnaires survey	The study established that major rework can be avoided up to 20% through identification of clashes from the GIS layer of 3D views of the structure under construction	Further research is required for calibration and validation of the model for different projects.
14	Aigbavboa, Thwala, and Mukuka, 2014	To identify the causal factors and effects of delays in construction projects	Literature review, Interviews, Questionnaires survey	The study concluded that construction delays usually occurs during construction phase and are caused by; Poor coordination, delay material delivery, poor planning and scheduling skills, delays in	The paper recommended use of proper communication channels but did not propose the tools and techniques that can be applied.

				approvals , late procurement of materials to site	
15	Motaleb and Kishk, (2010)	To identify the main causes and effects of construction project delays in the UAE.	Literature review and Questionnaires survey	The paper established that client related factors were the most important causes of delays. Followed by financial matters faced by the contractors	The study did not look at projects in the energy sector.

CHAPTER 3: METHODOLOGY

3.1 Introduction

In the previous chapter, various literature reviewed on delays and schedule overruns in construction projects were presented. The main objective of the literature review was to ascertain the causal factors of delays in construction industry which could be applicable to the study of delays in construction of electricity transmission lines in Zambia. This exercise was undertaken to; avoid duplication of information, develop the research questions and to develop the road map for the study. This chapter outlines the methodology applied to undertake the research in this dissertation so as to address the defined aim and objectives for the study. The chapter explains the different methods that could be used for research purposes. It further explains how the problem was investigated and describes the tools and techniques used to carry out the investigation. It also describes the characteristics of the research sample and the methods of data analysis used.

3.2 Research Methodology

This is the approach or steps used by the researcher to study the research problem. It explains the reason behind the use of the research tools and techniques. It describes the tools and techniques relevant to the study and why they are applicable. Research methodology analyses research methods applicable for the objectives and research questions and why other methods cannot be used (Kothari and Gaurav, 2014).

3.3 Research Methods

There are different methods used to conduct a research so as to arrive at a solution for a given problem and these can be grouped as follows:

i) The first group are methods used for data collection. These methods are used where the data existing is not satisfactory to attain the required solution.

ii) The second group comprise statistical techniques for establishing relationship between the data and the unknowns and

iii) The third group are those methods applied when evaluating the accuracy of the results obtained.

3.3.1 Data collection techniques

Data collection technique can be categorized as;

- Primary and
- Secondary.

3.3.2 Primary Technique

The Primary technique is where the researcher collects data for the first time, and thus has to be original in character because the collector of data is the first to ever embark on collecting it. There are different methods of data collection under the primary technique and these methods include; observations, interviews and administrations of questionnaires (Kothari and Gaurav, 2014).

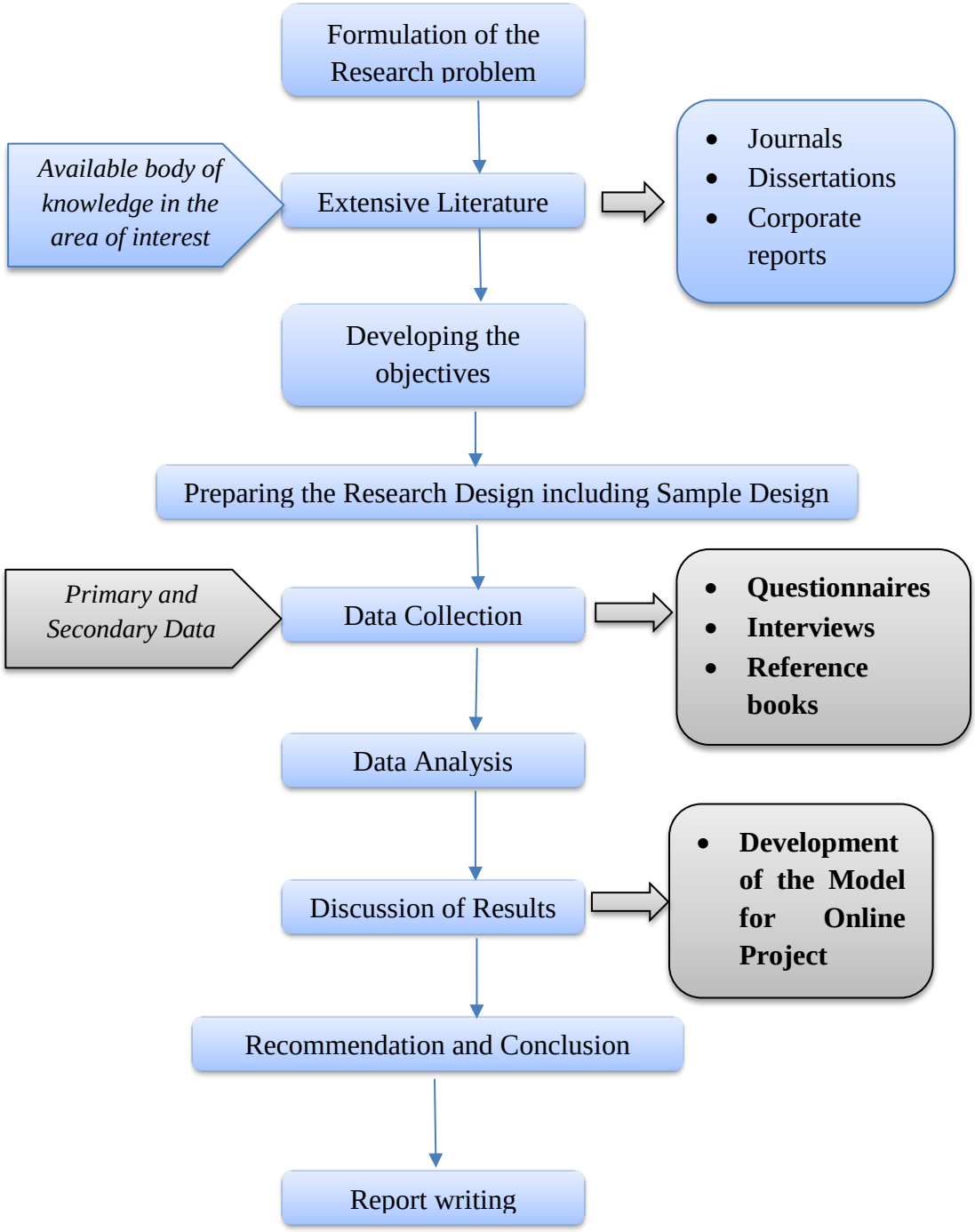

Figure 3.1*:* A flow chart of Research Methodology

(i) **Observation method**

Under the observation method the information is sought by way of investigators direct observation without asking from the respondent. It requires the researcher to be part of a

particular organization and get familiar with the group being studied with the aim of learning and understanding the system. Therefore to collect data in the construction industry the researcher would join the firm and monitor closely the activities being undertaken with the intention of studying the construction process. The core advantage is that biasness is eliminated when observation is done correctly. Secondly, the information collected represents the actuals and thirdly, it does not depend on the respondent's willingness to respond. Therefore it does not demand corporation on the part of the respondents.

However, there are limitations, firstly it is very expensive and secondly the information collected is very limited. Thirdly, unforeseen influences may interfere with the observational task. And in the event that people are rarely accessible to direct observation, it becomes difficult to collect information (Kothari and Gaurav, 2014).

(ii) Case Study

Case study method is a system of qualitative analysis which comprises a cautious and thorough observation of a social unit or a few real life situations. This method emphasizes complete examination of a limited number of events or conditions and their interrelations. Therefore a case study is fundamentally an exhaustive investigation of the particular unit under consideration. The case study method offers the merit of finding the factors that explain the behavior patterns of the given unit as a combined totality (Kothari and Guarav, 2014).

Government projects for electricity transmission lines were chosen as case studies. These were; connection of Northwestern province to the grid, 330KV line from Pensulo to Chipata/Kasama and connection of Luangwa town to the grid at 132KV. During the study these were the only commissioned projects, therefore they represented a general principle.

(iii) Survey research

This method involves using tools to collect data for a selected sample from a population. Under this technique interviews and questionnaire are used. This method is appropriate for both descriptive and explanatory researches

a) Interviewing

This method of survey involves a person known as the interviewer asking questions to the other person known as the interviewee about the subject of research and recording the responses. Interview survey is based on an interactive rapport between the interviewer and the respondent (Kothari and Gaurav, 2014). An Interview were the interviewer adheres to a set of predetermined questions with a standardized method of recording responses is referred to as structured interview. Under this method the interviewer adheres to a defined procedure of asking questions in a form and order. Whereas interviews were the interviewer has the freedom of deciding which questions to ask on the research topic depending the circumstances are referred to as non-structured interviews (Kothari and Gaurav, 2014).The chief merit of this method are;

- Incorporates the illiterate respondents
- Allows clarification of issues thus avoiding misunderstanding
- There is higher response questionnaires
- The interviewer can collect additional information from the respondents

While the weaknesses of the interview methods are:

- The presence of the interviewer may influence the responses from the interviewee;
- There is a possibility of bias from the interviewer as well as the respondent
- If population is big and wide spread the exercise becomes expensive; and
- High profile respondents may not be easily approached and too committed to be engaged in an interview.

b) Collection of data through Questionnaires

A questionnaire comprises a number of questions printed or typed in a definite order on a form or set of forms. The questionnaires are mailed to the respondents who are expected to read the questions and reply by writing down their views in the spaces provided. (Kothari and Guarav, 2014). Questionnaires can either be posted or delivered by hand to the respondent by the researcher.

The advantages of collecting data using questionnaire survey technique are:

- There are less expensive compared to interviews;
- The interviewer does not influence responses therefore , answers are in respondents own words;
- Respondents have no pressure when answering therefore there is enough time to give well thought answers; and
- Respondents who are not friendly can be easily reached conveniently.

The disadvantages of this method include;

- Questionnaires require respondents who are educated;
- when there is language barrier respondents fail to attend to the questions;
- the response rate is very slow from respondents; and
- There are possibilities of misunderstanding questions.

The essentials of a good questionnaire are:

- It should be simple and short; the questionnaire should not be very long so as to irritate the respondent;
- Words with ambiguity should be avoided; use simple and familiar words;
- Words with emotional connotation should be avoided; and
- Avoid use of technical terms and vague expressions which can cause misinterpretations.

3.3.3 Secondary technique

Secondary data means existing data. It refers to the data which has previously been collected and examined. This could either be published or unpublished (Kothari and, Guarav. 2014). An example of such a method is literature review. Before using secondary data the researcher must examine the following:

- Reliability of data: who collected the data? What were the sources of data? Were they collected by proper methods? What level of accuracy was required?
- Suitability of data; data is not always suitable for all inquiries the researcher must carefully scrutinize the definition of terms and units of collection used at the time of collection from the primary source; and

- Adequacy of data; the researcher need to determine the accuracy of data on the present inquiry by comparing the previous and present sample of inquiry.

Secondary data collection technique has the following merits;

- It's not expensive because data is already available; and
- It allows for examination of trends such as traffic, energy consumption or population growth.

The main disadvantages are:

- Firms which are in competitive businesses may not share some information making the data inadequate; and
- Ethical issues of confidentiality may prevent certain information from being availed.

3.4 Research design

This study was designed to address the problem identified in Section 1.2. And to achieve the objectives of the study, efficient, economical and effective techniques were used. Additionally, in order to understand the concepts and theory of the problem, literature review was conducted and this created the theoretical framework for the research. The process of literature review continued up to report writing and recommendation stage. The second phase was data collection which was done through interviews and questionnaire surveys. The third phase was analysis of collected data and the final phase was development of the real time project management system flow chart model, thereafter conclusion and recommendations for the management practices that could help cushion the delays in construction of electricity transmission lines in Zambia were formulated.

3.4.1 Literature review

The main objective of the literature review was to ascertain the causes of delays in construction industry which were applicable in the construction of electricity transmission lines in Zambia. This process was undertaken for the purpose of appreciating the knowledge gaps on the subject matter and to formulate the theoretical framework.

During the study the following sources of information about delays in construction industry were reviewed:

- Journals Articles;
- Books;
- Government and corporate reports;
- Newspapers;
- Thesis and dissertations; and
- Internet publications.

3.4.2 Data Collection

(*a) Interview survey*

Interview survey was used to collect preliminary data for causes of the delays in construction of electricity transmission lines in Zambia. During the process, causes of delays in construction industry identified in literature review where presented for scrutiny for the purpose of identifying the delays which were applicable in transmission lines. This exercise was carried out with seven professionals engaged in electricity transmission lines projects in Zambia and the main participants were project managers and engineers from the client. The interviews were undertaken with participants from the Governments main agency dealing with the generation, transmission and distribution of electricity in Zambia.

(b) Questionnaires survey

Questionnaire survey was also used for data collection for the study owing to its advantages such as, less expensive and free from biasness of the respondents. With this method, the respondents were able to express themselves freely without any influence from the interviewer. Additionally, since most of the respondents in the population of study had tight schedules, it also allowed the respondents to answer the questionnaire at their own free time.

(i) Questionnaire design

The questionnaire was designed to collect data about the presence of delays in the construction of transmission lines in Zambia and establish level of impact of the delays. A draft questionnaire was developed and presented to the supervisor for quality control. Subsequently, the revised questionnaire was then presented to prospective respondents

involved in the construction of transmission line projects to establish whether the main aspects of the subject had been considered.

Secondly, the questionnaire included the respondent's background to establish their experience in the construction industry. In the other section, the respondents were asked to express the view about the presence of delays due to particular aspects identified in literature review and from the initial interview survey about the types of delays in construction of transmission lines. The last section of the questionnaire was ranking of the impacts of delays. The last component requested the respondents to list delays which were not captured by the questionnaire and also give recommendations on the management practices that could be applied to cushion the delays in the construction of transmission lines in Zambia. These aspects in the questionnaire assured reliability and validity of the survey method used for the study.

(ii) Questionnaire distribution

The questionnaire was presented to key personal in the construction of transmission lines from the client and contractor so as to have a collective perspective on the matter. This was very important because other personal may not have accurate information regarding contractual and management issues that could be associated with delays and thereby giving inaccurate information which could cause distortion on data.

The distribution exercise was undertaken by way of emails because most the respondents were very far and time was limited. This method was very effective as it was easy to reach the respondent regardless of their geographical location. Additionally responses were sent back as soft copies thereby reducing time for capturing data since the information provided could easily be copied and pasted.

To obtain high response the following aspects were considered;

- Providing an introductory letter;
- Explaining the purpose of the study;
- Assurance that the information provided was confidential and meant for academic purposes only;
- Assurance that the respondents name was not going to be disclosed at no time;
- Avoiding ambiguity on all the statements; and

- Avoiding leading questions.

3.4.4 Sample survey

The population for this study composed project managers and engineers from the contractor and client involved in projects for construction of electricity transmission lines in Zambia. The research method was quantitative and judgmental sampling was applied. This was because of the limited number of firms involved in construction of electricity transmission lines in Zambia. The sample size for the study comprised all the key personnel engaged in construction of ETL from the client and contractors. And these were nine from the client and eight from the contractors.

3.5 Method of analysis

Descriptive statistical techniques were used to analyze data collected from the survey. To ensure accuracy and reliability data analysis was conducted using computer software such as; statistical package for social scientist (SPSS) and excel

In section B of the questionnaire, the respondents were asked to rate the impact of the causal factors identified through literature review using the Likert scale, provided in Table 3.1, with the scale ranging from 1to 5.

Table 3.1: Rating scale

Scale		**Impact**	**Weight**
1		Strong Disagree	20%
2		Disagree	40%
3		Neutral	60%
4		Agree	80%
5		Strong agree	100%

The analysis used the used the relative importance index (RII) in order to determine the relative importance for each cause of delay

$$RII = \frac{\sum W}{A*N} \quad \text{.....Equation 3-1 } \textit{Relative importance index}$$

Where;

- W is the weight provided by each respondent ranging from 1 to 5;
- A= 5 (which is fixed for all calculations and represents the highest possible weight on the Likert scale.);
- N is the total number of respondents; and
- RII is ranging from 0 to 1. The higher the value of RII implied the more importance of the factor as a cause of delay.

Based on the calculations of RII, the causal factors of delays were ranked in descending order, according to their relative importance.

3.5. Development of the Model

The causes of delay in construction of Electricity transmission lines in Zambia were ranked and arranged according to the following categories; management, external, contractor, client and financial. After establishing the highest ranked causes of delays from each category, an interview survey was conducted with Project managers to establish the tools and techniques used for time control in electricity transmission line projects. The results from survey indicated that there were gaps between time of identifying a delay and the time of resolution. Therefore a model was developed for Real Time Project Management System based on the use of a collaborative software. This model was presented to respondents to assess whether the concept could bridge the gap between the time of identifying the delay and the time of resolving the delay.

3.6 Summary

This chapter highlighted the methodology applied to undertake the research and address the aims and objectives and how data was collected. The advantages for the tools and techniques used to carry out the study were also highlighted in this chapter. The chapter further presented the tools used to investigate the problem and how data was analysed. The next chapter discusses data collection and analysis for the study.

CHAPTER 4: DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

In the previous chapter the methodology used to undertake the research, collect and analyze data were presented. The chapter further highlighted the advantages and disadvantages of different techniques for data collection and why the method employed in this study was adopted. In this chapter the analysis of the results obtained from the survey conducted through questionnaire and interviews is presented.

4.2 Interview

Preliminary interviews aimed at identifying the delays that impact on transmission line projects were conducted and this survey was targeted at seven professionals working for the Client in transmission line projects. The respondents for the interviews were sampled using non probabilistic judgmental method based on experience in implementation of new transmission line projects in Zambia. Primary interviews were conducted with four Project managers from the client and three from the contractor.

4.2.1 Profiles of respondents and their firms in questionnaire survey

Five of the respondents were Engineers from the prominent Client executing transmission line projects in Zambia and the other three respondents were engineers from contractors engaged in transmission lines projects in Zambia. Out of the Five Engineers from the Client, two had more than ten years' experience in transmission line projects and were in top management while the other three had four years' experience and were in middle management. Three of the respondents from the contractors were all engineers and had more than seven years' experience in transmission line projects. Therefore the profile for the respondents provided an assurance of validity for the data collected.

4.2.2 Delays that impact on transmission lines projects

All the respondents for the interviews agreed that there were delays that impact on transmission line projects resulting in schedule overruns. Seventy three (73) causal factors identified through literature review were presented to the respondents and thirty five were pointed out as the major causal delays factors associated with execution of transmission lines in Zambia.

The factors identified included; Poor organization management, Lack of technical expertise, Poor internal and external communication, Poor coordination with project participants, Centralized management, Slow in decision making, Late mobilization, Incompetent contractor staff, Poor planning, scheduling or resource management skills, Design changes, Poor quality control plans, Mistakes during construction, Inexperience in similar works, Shortage of materials, Poor quality of materials, Unclear Material specification, Late material delivery on site, Misuse of material, Poor storage of material, Delay of material delivery to site, Poor quality of materials, Shortage of manpower, Inadequate skill of man power, Low productivity, Unavailability of equipment on request, Wrong allocation of equipment, Different nationalities of workforce on site, Poor financing by the contractor, Irregular payment of subcontractors, Late advance payment, Late work progress payment, Inclement weather conditions, Inadequate site investigation, Vandalism, Work permits

4.3 Questionnaire survey

The questionnaire survey was conducted over a period of three months, from March 2015 to May 2015. The mode of distribution was through emails and hard copy distribution by hand. These questionnaires were sent to the Client and Contractor's key personnel working on transmission line projects in Zambia. The method of sampling for the respondents was non probabilistic and judgmental sampling because there were few personnel engaged in undertaking the construction of transmission lines in Zambia. Therefore of the key personnel were included in the sample. Questionnaire survey was aimed at establishing the ranking of the major factors causing delays in transmission line projects identified during preliminary interviews and also getting other views and recommendations from the respondents on the best practices that could be applied to cushion the delays and associated effects.

To establish the reliability of the instrument for data collection, the Alpha coefficient of reliability was calculated using the statistical software SPSS. The alpha coefficient of reliability knowns as Cronbach alpha was used in SPSS and it is given by;

$$alpha = \frac{nr_{ii}}{1+(n-1)r_{ii}} \quad \text{.....Equation 4-1}$$

Where n = the number of items in the test or survey (questionnaire)

And r_{ii} = the average of the inter item correlations.

The analysis in SPSS for the survey of 35 items (causal factors of delays) produced an alpha of 0.962 which was very close to 1 as shown in table 4.1. Indicating that the instrument of data collection was very reliable because of high level of internal consistency according to Bryman and Cramer (2005)

Table 4.1: Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.963	0.962	35

Appendix 3 shows the results of standard deviation for the scores as calculated in SPSS. The average standard deviation was close to 1.2, which indicated that the scores were clustered together. The lower value of standard deviation in the scores indicated that the views of the respondents were similar hence indicating that the contractor and the Client had similar views on the causes of delays. Therefore the aspect of biasness on the part of the Client and Contractor was minimal (Bryman and Cramer, 2005).

4.3.1 Questionnaire response

The main focus of the survey was to obtain the general perspective of Client and Contractor on the causal factors of delays during the undertaking of ETL projects in Zambia. Therefore the same questionnaire was used and a total of 19 were distributed to key personal from the Client and Contractor who were actively involved in transmission line projects. Figure 4.1 illustrates that out of 19 questionnaires distributed, 17 respondents replied thereby giving a percentage positive response of 89.5%. The main reason why other respondents could not reply was because they were not permitted by their employers to disclose

information concerning the company operations and performance on projects even when such information was meant for academic purposes.

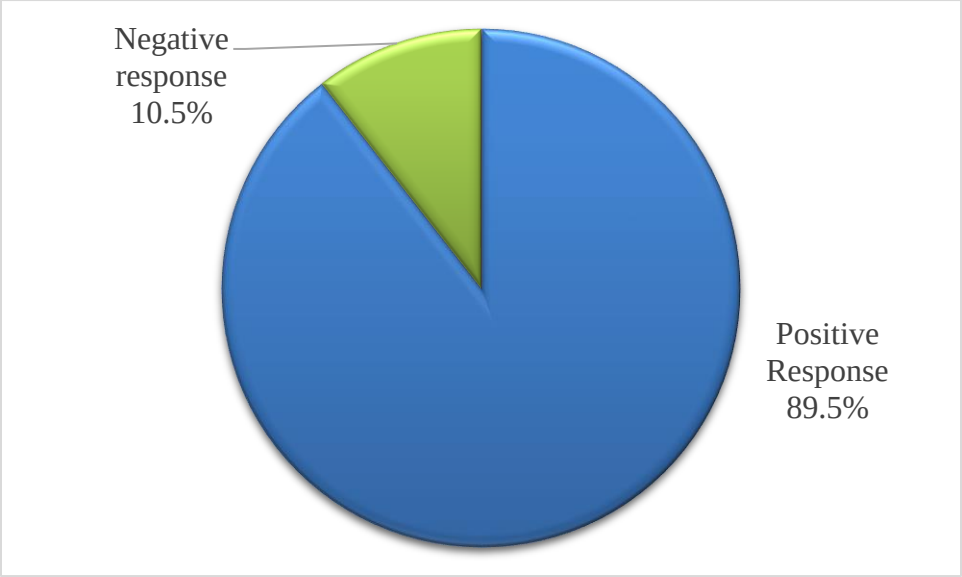

Figure 4.1: Percentage response for questionnaire survey

4.3.2 Profile of respondents

The main target for the survey were key personnel engaged in electricity transmission line projects by the Client and Contractors in the public and private sectors respectively. This was in order to ensure that the data was collected from personnel involved in the daily management and operations of the project and were Knowledgeable in the projects

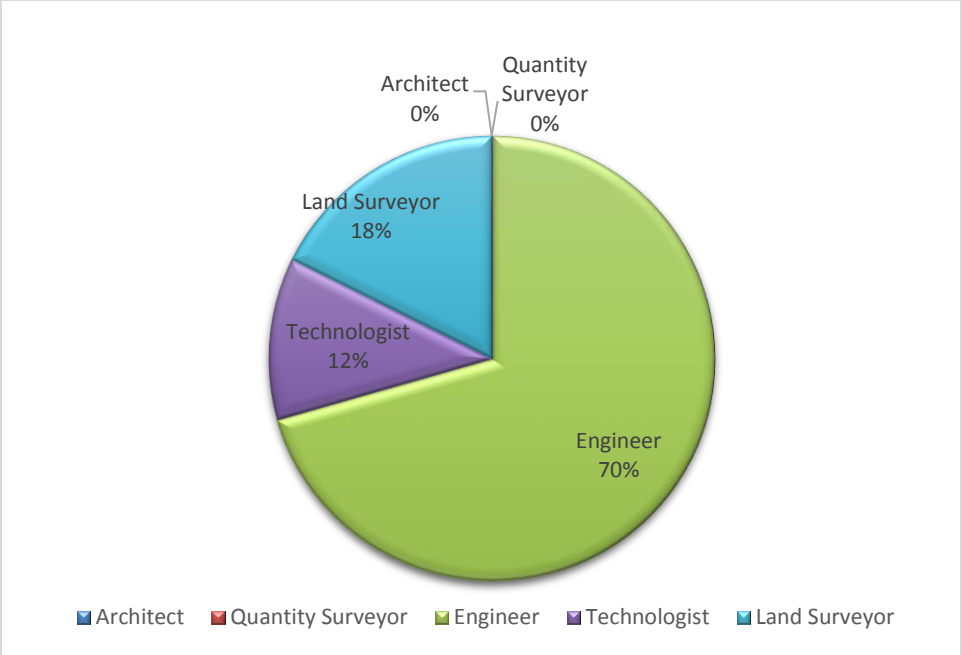

Figure 4.2: Percentage of professionals engaged in the survey

Figure 4.2 shows the percentages of the respondents that participated in the survey. As indicated, 70% of the respondents were Engineers, 12% were Clerk of works, 18% were Land surveyors. The survey results further illustrate that most of the key personal engaged in ETL projects had Engineering background.

Construction delays vary according to the size of the project. The size of the transmission line project is measured by the length of the line and voltage level. Figure 4.3 shows the length of the ETL on which the respondents were working. The figure illustrates that 100% of the respondents were operating on ETL projects which were more than 100km. The length of the ETL was important because the longer the line, the more challenges were bound to be experienced such as lengthy stretch of mountainous terrains giving challenges of material transportations and also different geotechnical configurations which require different foundations types. While protected areas and national parks give challenges of adhering to requirements from regulatory bodies on Environmental social impact for such projects, which demand that the affected settlers and farms owners are compensated for the acquisition of the wayleave (Solvacool et al 2014).

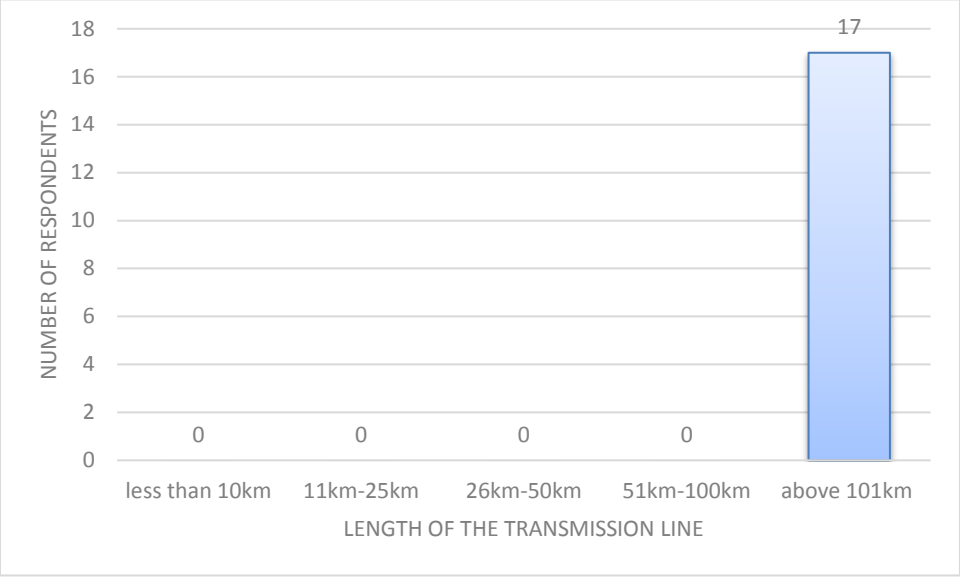

Figure 4.3: Length of the transmission line project worked on by respondents

i) Experience in the construction of ETL

According to Sambasivian et al (2007) ,Lack of experience in similar works is one of the major causes of delays in construction, therefore a survey was conducted to establish the experience for the key personnel engaged in ETL as shown in Figure 4.4 below. The results from the figure indicated that the respondent's years of experience in ETL projects ranged from 3 to 15 years. They were few respondents with more 15 years of experience owing to the fact that projects in ETL projects in Zambia have not been active after independence and there was only one major firm in the industry and the expansion in transmission capacity was necessitated by the increase in demand due to population growth and development in mining industry in the past 10 years. It was important to consider the experience of the respondents because this had a bearing on the validity of the data collected.

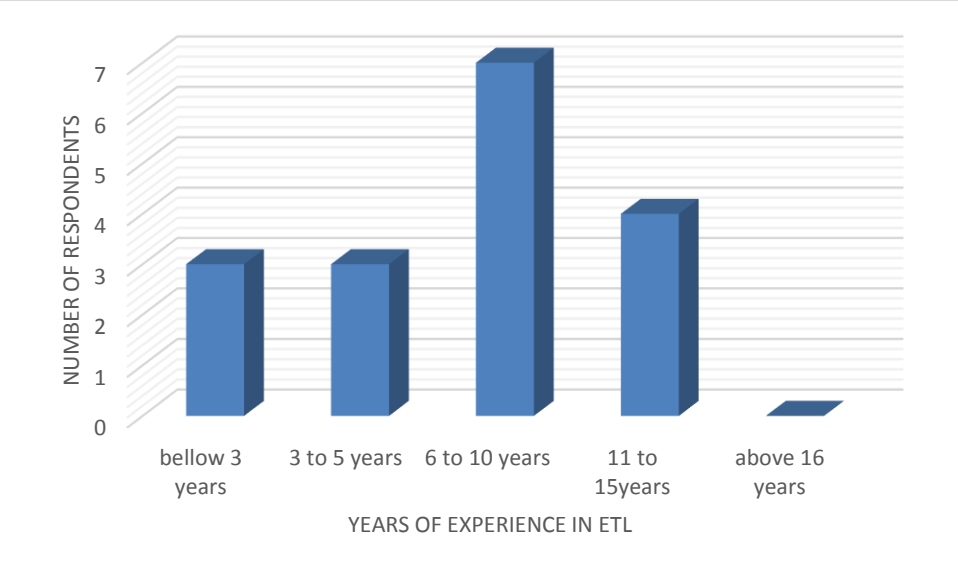

Figure 4.4: Experience of respondents

(a) Schedule overrun during Construction of ETL

Projects in the construction industry world over are faced with the challenges of delays as established in literature review therefore to ascertain this revelation, respondents were asked whether they had experienced construction delays on the project during the construction of ETL and figure 4.5 illustrates the results obtained during the survey.

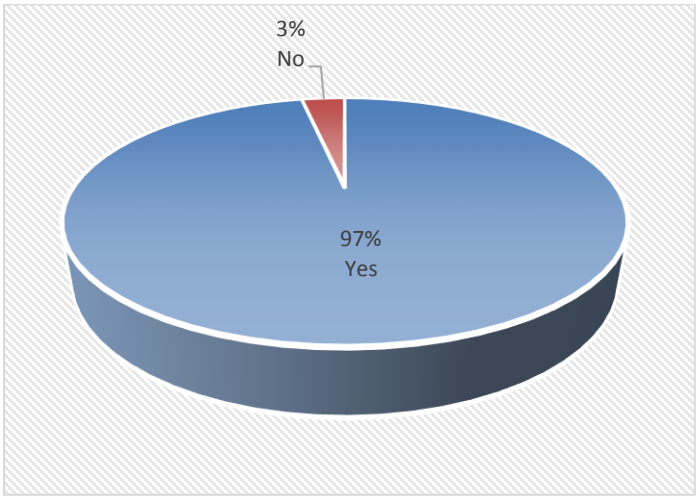

Figure 4.5: Response on Construction delays

The survey results shown in figure 4.5 indicate that 97% of the respondents had experienced construction delays which eventually affected the project duration during the

construction of ETL. The results demonstrate that projects in construction of ETL in Zambia are not spared with the factors that impact on completion period resulting into schedule overruns. This result harmonizes with other studies from literature review that established that delays occur in all construction projects.

(b) *Delays due to disagreements on line route*

Electricity transmission lines are used to evacuate power from generating stations to loading centers called substations. The hydropower generating stations are located in remote areas along the rivers, dams or gorges while the loading centers are located strategically where the load can be conveniently distributed according to demand. Therefore prior to ETL construction, a survey is undertaking to identify a cost effective line route in order to optimize the use of equipment, materials and structural designs.

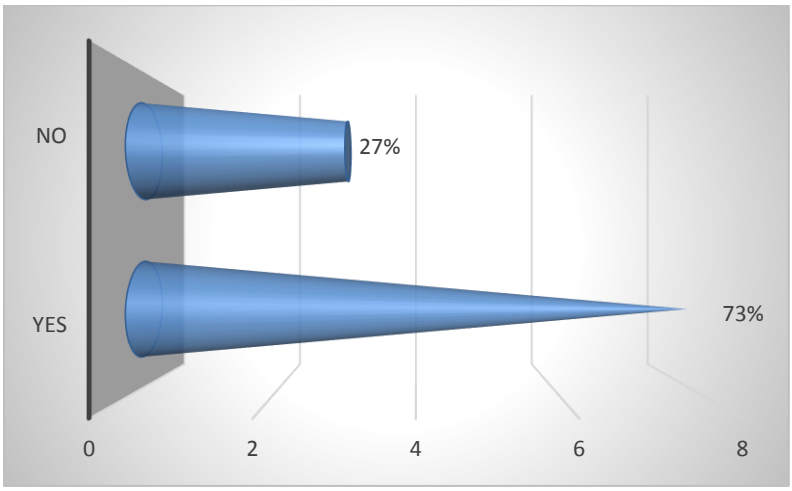

Figure 4.6: Percentage response on delays due to disagreements on line route

A survey was undertaken to establish whether there were delays due to disagreements between the Client and the Contractor on choice of appropriate line route. From figure 4.6 above, Seventy three percent (73%) of the respondents indicated that there were disagreements while 27 % indicated that there were no disagreements on the choice of line route. The results illustrates that the majority of the respondents consented that there were disagreements between the Client and Contractor on the choice of appropriate route for the transmission line and further that this was one of causal factors of delays which affected

the project duration during construction of ETLs. The main reason for the disagreement were:

- Avoiding swampy areas that would result in additional costs due to changes in type of towers and foundations designs; and
- Client avoiding changing the line route because of logistical issues that comes along with the wayleave acquisition and compensations for the people that are affected while the contractor wanted a route which was accessible to reduce transportation and cost for logistics arising from movements from the main road to construction sites.

(c) Delays due to insufficient geotechnical information in the soil investigation report

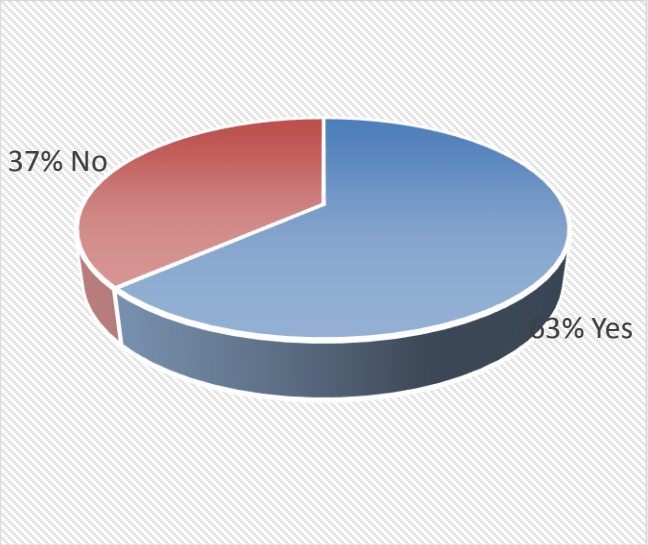

Figure 4.7: Insufficient data in the soil investigation report

Geotechnical information of the proposed line route was significant as it was the basis on which different types of tower foundations were designed during execution of ETL projects. Therefore a geotechnical report that is not adequate gives wrong impression to the designers thereby causing delays on the project due to design revisions. A survey was conducted to ascertain whether the soil investigation report was one of factors influencing delays during the execution of ETL. From the study 63% of the respondents indicated that insufficient soil investigation report was also a cause of delays as shown in figure 4.7. The geotechnical reports included in the bidding documents by the client were for the purpose of cost estimates. Therefore during implementation, the design drawings submitted by the

contractor as per EPC Conditions of Contracts, were based on generalised information which did not represent actual impression. This lead to delays due to redesigns process whenever it was discovered that approved designs could not apply at certain tower points especially on swampy areas.

(d) Delays due to design review

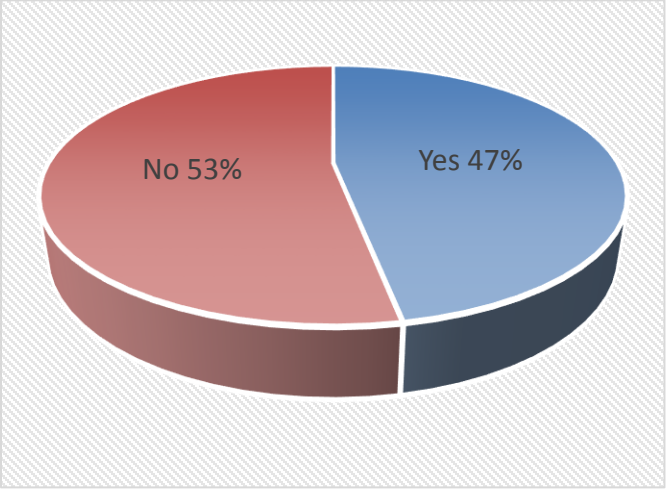

Figure 4.8: Response on delays due to design review

The delivery system for ETL contracts provides that the contractor undertakes all the designs in accordance with the specifications provided by the client for the project. Respondents were asked to express their view on whether there were delays during the review of the submitted drawings on the part of the client and 53% of the respondents indicated that there were no delays on the project due to design review as illustrated in figure 4.8 above.

(e) Delays due to late advance payment

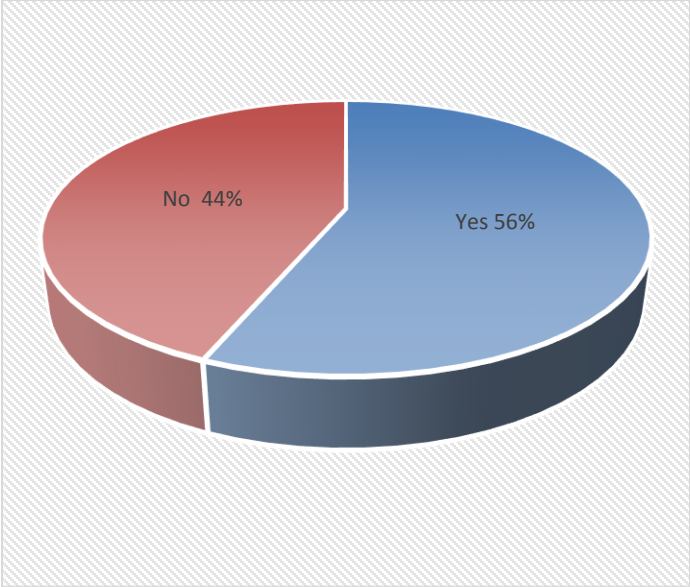

Figure 4.9: Results on delays due to late advance payments

The contracts for ETL projects, stipulated that advance payment by the Client, shall determine the project start date. Therefore delays in the issuance of advance payment could result to delays in the commencement of the project. A survey was undertaken to establish whether late advance payment was a cause for delay. Figure 4.9 shows the response on the survey and illustrates that 56% of the respondents were of the view that late advance payments by the Client was a factor of delay after contract signing. The interview survey on the same subject in the study established that the main reason for the delay was because the client did not allocate funds in a separate project account after initiation of the project to ensure that the funds were ready at contract signing. As a result, the Client started making arrangements for project funds after contract signing. This process was very long due to the long approval process at the respective line ministry. However, the Contractors did not have adequate funds in their bank account start the project whenever the Client defaulted. The contractor financial position was an evaluation criteria during bidding process, therefore, the contractor was supposed to be held responsible whenever they could not start the project because of non-availability of funds. However, if a requirement is included for

contractors to have adequate funds to run the whole project as critical evaluation criteria, would reduce the competition during bidding process as most the bidders would fall out on this aspect because the ETL projects involve the procurement of materials and equipment abroad which would be costly to most of the contractors.

(f) Delays due to late work progress payments

The payment terms under which ETL projects are delivered provides for the Contractor to request for work progress payment during the contact. Therefore as per Conditions of Contract, the client is under obligation to remit such payments within a period specified, failure to which, the Contractor has the right to halt operations until the request is adhered to. Figure 4.10 below shows the responses on late work progress payment by the client as a delay factor. The results from survey revealed that 87% of the respondents indicated that late work progress payment by the Client was a factor of delay on the ETL projects which affected the completion period.

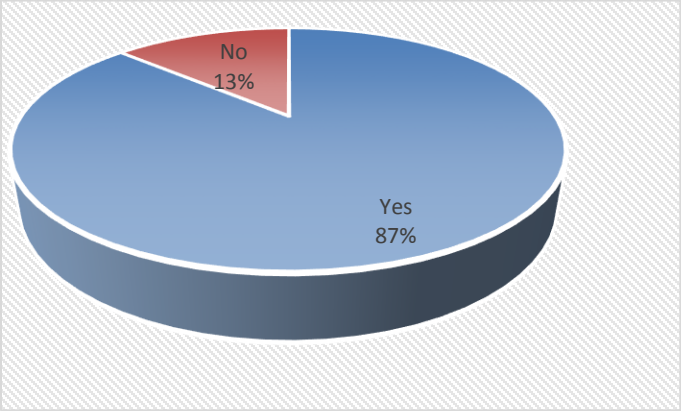

Figure 4.10: Response on late work progress payments

(g) Delay due to procurement of materials abroad

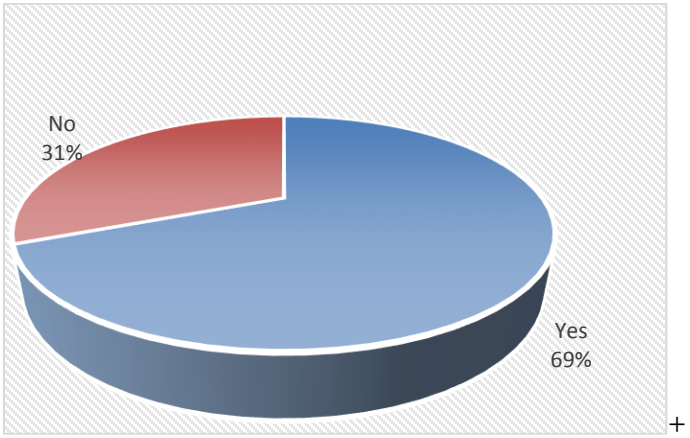

Figure 4.11: Delay due to procurement material abroad

The materials used for construction of Electricity transmission lines include steel angles, conductors and other line accessories such as insulators, clamps and jumpers. However, the materials are not available locally therefore they are imported from abroad. A survey was conducted to ascertain whether procurement of material abroad was factor of delay. The results illustrated in figure 4.11 above, revealed that procurement of material abroad by the Contractor was a contributing factor of delays. The main cause was late arrangements for tax clearances at the border by the Government. Tax clearances in construction of transmission line projects was memorandum of understanding (MOU)drafted between the Government of the republic of Zambia (GRZ) and the financiers during loan agreement. Under the MOU, GRZ concerted to contribute to the project by waiving tax on all imported material for the project. The study reviewed that the logistics for Tax clearances were not arranged in advance. Therefore, whenever the project commenced, imported material got stack at the boarder resulting in demurrages. The figure 4.12 below illustrates the results on the survey regarding delays on procurement of material due to late payment of duty and others fees at the port of entry.

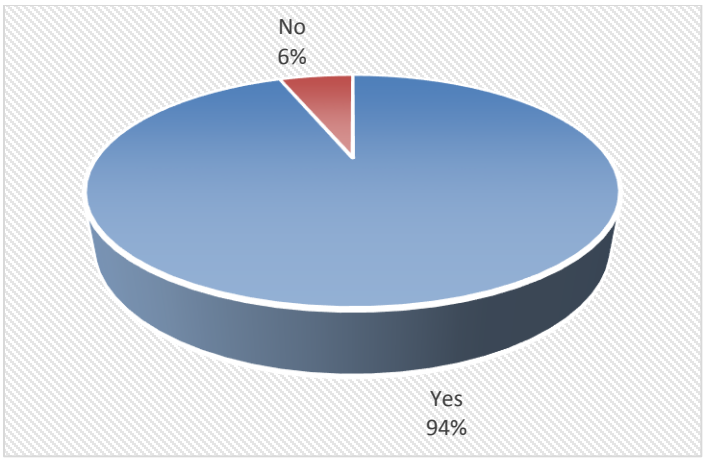

Figure 4.12: Delay due to late payment of duty and other fees at the boarder

(h) Delays due to poor supervision by Contractor

A survey was conducted to establish the views of the respondents on quality of supervision by the Contractor owing to the revelation from literature that this aspect was one of the factors that contributed to schedule overruns in construction projects. The respondents were asked whether there were delays on ETL projects arising from poor supervision by the Contractor.

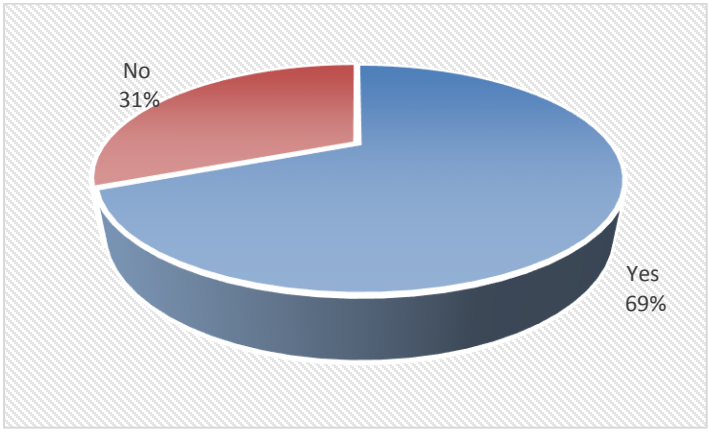

Figure 4.13: Response on poor supervision by the contractor

As shown in figure 4.13, 69% of the respondents indicated that poor supervisory skills by the contractor was a delay factor during the construction of ETL.

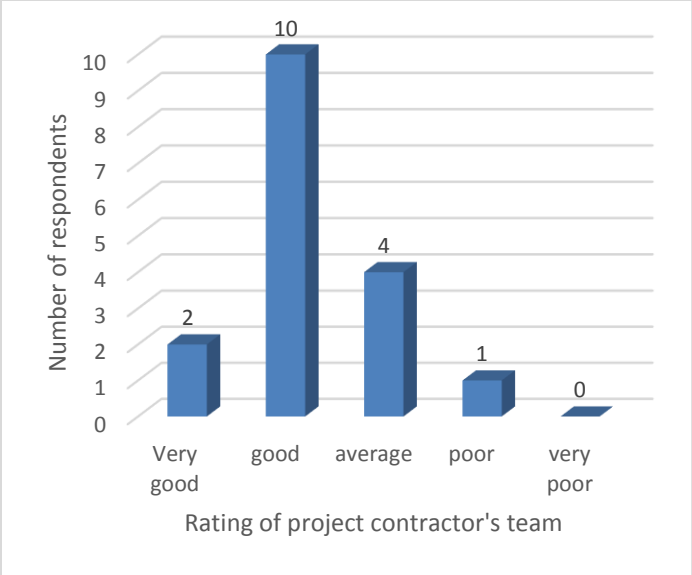

Figure 4.14: Rating of the contractor project team

Figure 4.14 shows the rating of the technical ability of the contractor's project team. The figure illustrates that 58% of the respondents indicated that the contractor's project team was technically sound on the project. However the results indicate an overall average rating therefore trainings in designs for transmission lines are required for project personal so that the majority of the project team can contribute comprehensively on the project.

(i) Delays due poor supervision by the client

During the construction of electricity transmission lines the client project team was required to supervise the works undertaken by the contractor to ensure that they were according to the specification and standard provided. This was in accordance with quality assurance plans. Therefore, a survey was conducted to establish if there were any delays on the ETL projects due to poor supervision by the client project team.

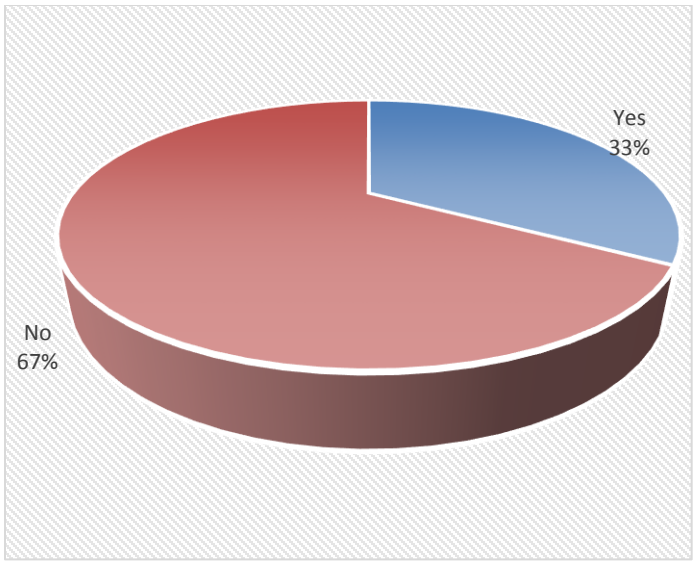

Figure 4.15: Results on delays due to poor supervision by the client

Figure 4.15, revealed that they were no delay resulting from poor supervisory skills from the client on the.

Figure 4.16: Rating of the technical ability of the client project team

Figure 4.16 presents the rating of the technical ability of the project team for the client. The results indicate that all the members of the project team from the client were above average in terms of supervisory skills.

(j) Delays due to compensation claims by the affected settlers

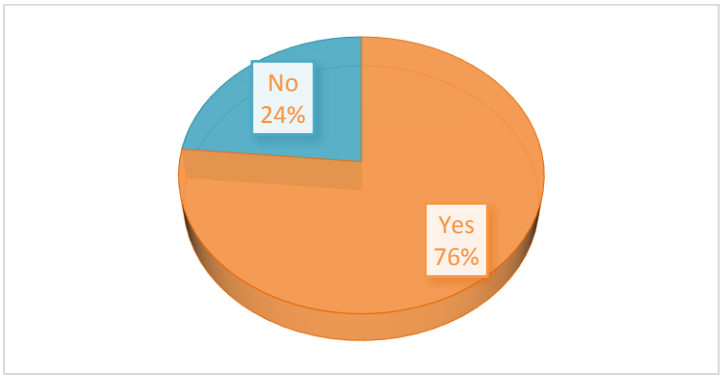

Figure 4.17: Response on delays due to compensation claims

Compensation claims by the affected settlers along the transmission line route was highlighted to be one of the causal factors of delays as shown by the majority response of 76% in figure 4.17 above. During execution affected settlers blocked construction process along their territory until their dues were paid thereby bringing the project to a halt.

(k) Delays due to Vandalism

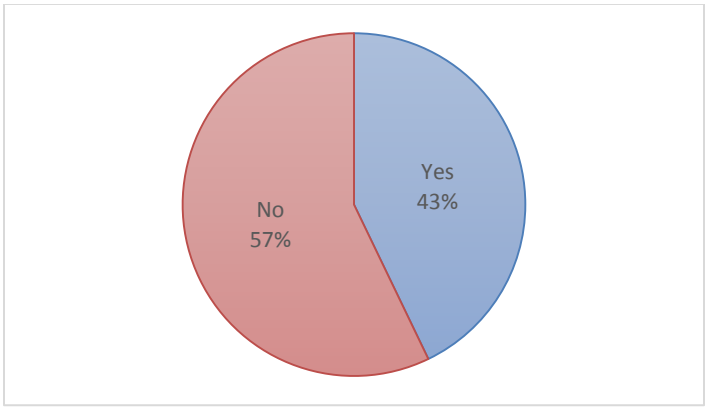

Figure 4.18: Delay due to vandalism

The lattice towers were used for supporting the conductor on a transmission line. These towers were made from steel material. Therefore, a survey was conducted to establish whether there was vandalism on the structures, which resulted in delay of the project. Figure 4.18 indicate that the vandalism did not influence delay on the project.

4.3.4 Causal factors

Factors that influence delays in construction were compiled from literature review and 73 causal factors were identified. An interview survey was conducted to establish the causal factors that were applicable to electricity transmission line projects and 35 causes of delay were identified.

In Section B of the questionnaire respondents were asked to rate the impact of these causes of delay based on the Likert scale of 1 to 5. The scores of 5,4,3,2 and 1 were used to indicate the respondent's view of level of impact for a factor of delay and the scores represented; strong agree, agree, neutral, disagree, and strong disagree respectively.

Table 4.1 shows the ranking of the causes of delay using the Relative Importance Index. From the table, the most highly ranked causes of delay were; Inclement weather conditions, poor financing by the contractor, late importation of materials, irregular payment of subcontractors, poor scheduling or resource management , delay of material delivery to site, poor quality control plans, poor coordination with project participants, incompetent contractor staff, and inexperience in similar works

Table 4.1: Ranking of causes of delay

S/N	Causal factor	RII	Ranking
1	Inclement weather conditions	0.847059	1
2	Poor financial management by the contractor	0.835294	2
3	Late importation of materials	0.835294	3
4	Irregular payment of subcontractors	0.823529	4
5	Poor planning scheduling or resource management skills	0.823529	5
6	delay of material delivery to site	0.811765	6
7	Poor quality control plans	0.811765	7
8	Poor coordination with project participants	0.811765	8
9	Incompetent contractor staff	0.800000	9

10	Inexperience in similar works	0.788235	10
11	Slow decision making	0.788235	11
12	late progress payment	0.776471	12
13	Late advance payment	0.776471	13
14	Mistakes during construction	0.776471	14
15	late mobilization	0.776471	15
16	Poor internal and external communication	0.776471	16
17	Poor Organization management	0.776471	17
18	Unavailability of equipment on request	0.764706	18
19	Inadequate skill of man power	0.764706	19
20	Shortage of materials	0.752941	20
21	Lack of technical expertise	0.752941	21
22	low productivity	0.741176	22
23	Poor quality of materials	0.741176	23
24	design changes	0.741176	24
25	Vandalism	0.729412	25
26	Inadequate site investigations	0.729412	26
27	shortage of manpower	0.729412	27
28	Poor quality of materials	0.729412	28
29	Centralized management	0.729412	29
30	Misuse of materials	0.717647	30
31	Wrong allocation of equipment	0.694118	31
32	Unclear material specification	0.694118	32
33	Work permits	0.670588	33
34	Poor storage of materials	0.658824	34
35	Different nationalities of workforce	0.611765	35

Results from the ranking in table 4.1 indicated the following;

(a) Inclement weather conditions

Inclement weather conditions (rainfall) was the highest ranked causal factor of delays in the construction of ETLs from the survey. This ***was*** attributed to the fact that, during the rainy season outdoor construction projects in Zambia were extensively interrupted by heavy down pours which lead to work stoppages and ETL projects could not be exempted. It was further revealed that after heavy rains, sites became inaccessible due to wet grounds causing earthmoving equipment to get stuck and also flooding of excavated foundation trenches.

(b) Poor financial management by the contractor.

Poor financial management results in irregular payment of employees and delays purchase of material. When salaries are not paid on time workers resort to work stoppages which causes delay in project completion. There has been an influx of contractors in the construction industry thereby increasing competition. This has occasioned to contractors underbidding to win contracts. Therefore, during project execution the contractors' budgets are strained because of the non-cost reflective rates in the contract.

(c) Late importation of material

Late importation of material was the third highest ranked cause of delay. For a project to start, it was a requirement in the EPC Conditions of Contract that advance payment was remitted to the contractor. Therefore, late advance payment and logistics for importation of material at the boarder resulted in delay on the project.

(d) Irregular payment of subcontractors

Irregular payment of subcontractors was ranked as fourth among the causes of delay. Non-payment of subcontractors on time resulted in failure to pay salaries and procure material on time thereby leading to work stoppages.

(e) Poor planning scheduling and resource management skills

Poor planning scheduling and resource management skills was ranked as fifth among the causes of delays. Lack of training in project management was one of the contributing factors for poor planning, scheduling and resource management skills for the project team. Another contribution factor was lack of policy framework for using modern project management tools by the Client. Other highly ranked causal factors were; late material delivery to site, poor quality control plans, poor coordination with project participants, Incompetent Contractor's staff and inexperience in similar works.

4.4 Interview survey data and analysis

Interviews were conducted between January and April 2015. The sampling method was judgmental owing to the limited number of firms involved in construction of transmission lines in Zambia. Six Key personal working for the contractor and seven from the client were interviewed.

4.4.1 What are the major causes of delays in construction of electricity transmission lines in Zambia?

(a) At the initial project stage

Route identification, selection, line survey and soil investigations were not given the due attention by involving all the technical personal and other stakeholders. This resulted in issues such as; disagreements between the Client and the Contractor on the line route and type of towers and foundations during the implementation stage. The main reason for differences by the parties were cost implications for changing tower designs, foundations, and line route due to affected settlers who eventually demanded compensation. In this case both parties always wanted a decision that would not inflate any cost on their part.

(b) Form of Contract

The execution of construction of transmission lines usually had bureaucracy on the side of the contractor in their establishments to the extent that the appointed project managers always referred any queries, changes in the design, and human resources issues to their

head office in the country of origin. This resulted in delays on the projects because Project managers could not discharge their functions efficiently.

(c) Lack of capacity and experience

There was lack of capacity and experience on the part of nominated subcontractors to manage projects in construction of electricity transmission lines in Zambia. This was because the field was still developing and the Government was the only one major player. However, the tendering and selection process was distorted by the submission of company profiles and curriculum vitae which were deceitful on information regarding company experience and key personal. Therefore during project execution unqualified personnel were engaged, resulting in poor quality of workmanship and loss on delivery time.

(d) The public procurement procedures

Public procurement procedures for Government institutions were lengthy such that a lot of time is taken from tendering stage up to time for contract signing. This due to to a number of stages required for approval at ministerial level. The effect was that the contractors started requesting for additional cost arising from increase in the cost of input of material due to fluctuations in inflation rates. Therefore there was late mobilization to site by the contractor and such discussions become so protracted that time for implementation of the project was lost.

(e) Political interference

There was political interference especially when dealing with multinational conglomerates that dictated terms of delivery of the projects. Therefore, in situations where an EPC contractor was procured competitively and contract signed, they would interfere with the implementation process by demanding unrealistic delivery times as long as they were the customers to be served at the conclusion of the project. This results in a lot frustrations on the contractors.

(f) Tied financing of projects.

This was the arrangement where if financing was coming from a particular country or region of the world, the financiers would want the client to pick a contractor from that country or region. Thereby resulting in procurement of the contractor without any form of competition. This resulted in delays due to lack of qualified personnel on site because the client had no influence on the responsiveness of the contractor at bidding stage.

e) Recommendation

Surveying for the line route and profile should be completed and approved before undertaking tower and foundation designs to avoid delays due to changes in designs.

4.4.3 What are the common effects of delays in the construction of transmission lines (Contractually, financially)?

- Delayed economic development as end users were unable to access power at schedule time;
- The Client was charged penalties by end users for not fulfilling power purchase agreements;
- The projects were usually completed above budget thereby affecting the capacity of Treasury to fund other developmental projects;
- The contractor experienced increase on overhead costs due to prolonged delivery period; and
- Quality of work was compromised because the contractor would start rushing to complete certain activities in trying to catch up on lost time.

4.4.4 Does the process of undertaking an EIA cause any delays on ETL project?

Environmental Impact Assessment (EIA) for was a requirement for any project by the law, However, the interview survey indicated that there was no delay as a result of undertaking of EIA.

4.4.5 What type of survey method was used?

The survey method used for undertaking ETL projects was satellite geographical position system (GPS). However, the process was demanding because the surveyors were required to walk the entire line route.

4.4.6 What best practices could be used to improve the survey techniques?

The respondents pointed out that during line route selection, Helicopters should be used so as to get the correct impression of the features along the proposed route. The use helicopters during line selection process will avoid obstacles such as rivers, mountains and restricted areas such as national parks.

4.4.7 What tools and techniques are used for time control?

The tools and techniques for time control were the Gantt charts in Microsoft project software and monthly site meetings which are convened to discuss progress and other challenges on the project.

4.4.8 How do you look at the RTPMS as a technique for ETL and other similar projects?

The concept for the real time project management flowchart model (RTPMS) developed during the study was presented to 11 respondents involved in construction of ETLs by way of purposive sampling and all the respondents for the survey gave 100% positive response to the idea and made the following views;

- The concept would enhance collaborative task management;
- Reduce on time taken to resolve issues that have potential to causing delays;
- Improve on coordination of all key players involved on the project;
- Promote transparence on whether the scheduled activities will take place or not;
- The progress report for the project will always be ready since there will a provision in the package of an updated report as indicated by all stakeholders;
- Enhance good planning and scheduling since all the stakeholders will be involved; and
- Enhance efficiency in decision making process.

CHAPTER 5: THE REAL TIME PROJECT MANAGEMENT SYSTEM MODEL

5.1 Introduction

The analysis of the data collected through Questionnaire and Interview survey was presented in the previous chapter. This chapter will highlight the Real-time Project Management System Model (RTPMS) developed based on the need to have tools and techniques for collaborative Planning, scheduling and task management, Real time decision making process, online Gantt chart, Online work progress report, task assignment and reminder. The purpose for the development of the RTPMS was to have a system that could be used to improve effectiveness and efficiency in project delivery and management of electricity transmission line and other similar projects.

5.2 The Real Time Project Management System

RTPMS model was developed based on the responses from the questionnaire and interview survey. As revealed in figure 5.1, poor scheduling and resource management, poor coordination, incompetent contractor staff and slow decision making were highest ranked management causes of delay in construction of electricity transmission line projects.

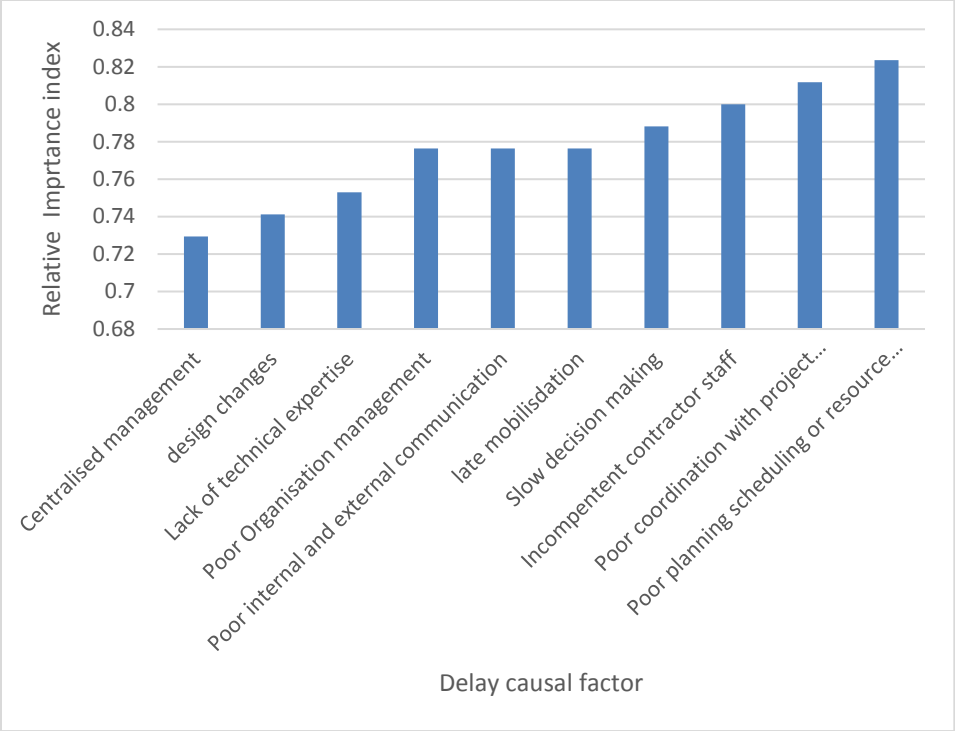

Figure 5.1: Rating of Management delay causal factors

The tools and techniques used for time control in construction of ETL were Gantt charts from Microsoft project software and monthly site progress meetings. Therefore, bottlenecks on the project were brought to the attention of project team members during site meetings. Consequently, there was a communication gap between the time of notice of a delay factor and the time of collaborative solution during the site meeting. This was in harmony with the study by Dinakar (2014) which revealed that poor communication among the parties was a major contribution to delays in construction projects. Therefore, a study was conducted to create a model for a management system that can bridge the communication gap in construction. Consequently, a Real Time Project Management System model (RTPMS) was developed to operate using an online collaborative software.

The RTPMS model flowchart is shown in figure 5.2. The model provides all project participants and other stakeholders an opportunity to have an insight on the current state of project activities, task assignment and challenges being faced on the project. Under this arrangement, the project team can submit solutions for the challenges on the project through line managers on real time basis without waiting for the site progress meeting. Furthermore, project participants receive online updates and notifications on the latest

developments on the projects which are in distance places through the computers and other mobiles online electronic gadgets like phones, tablets and iPad

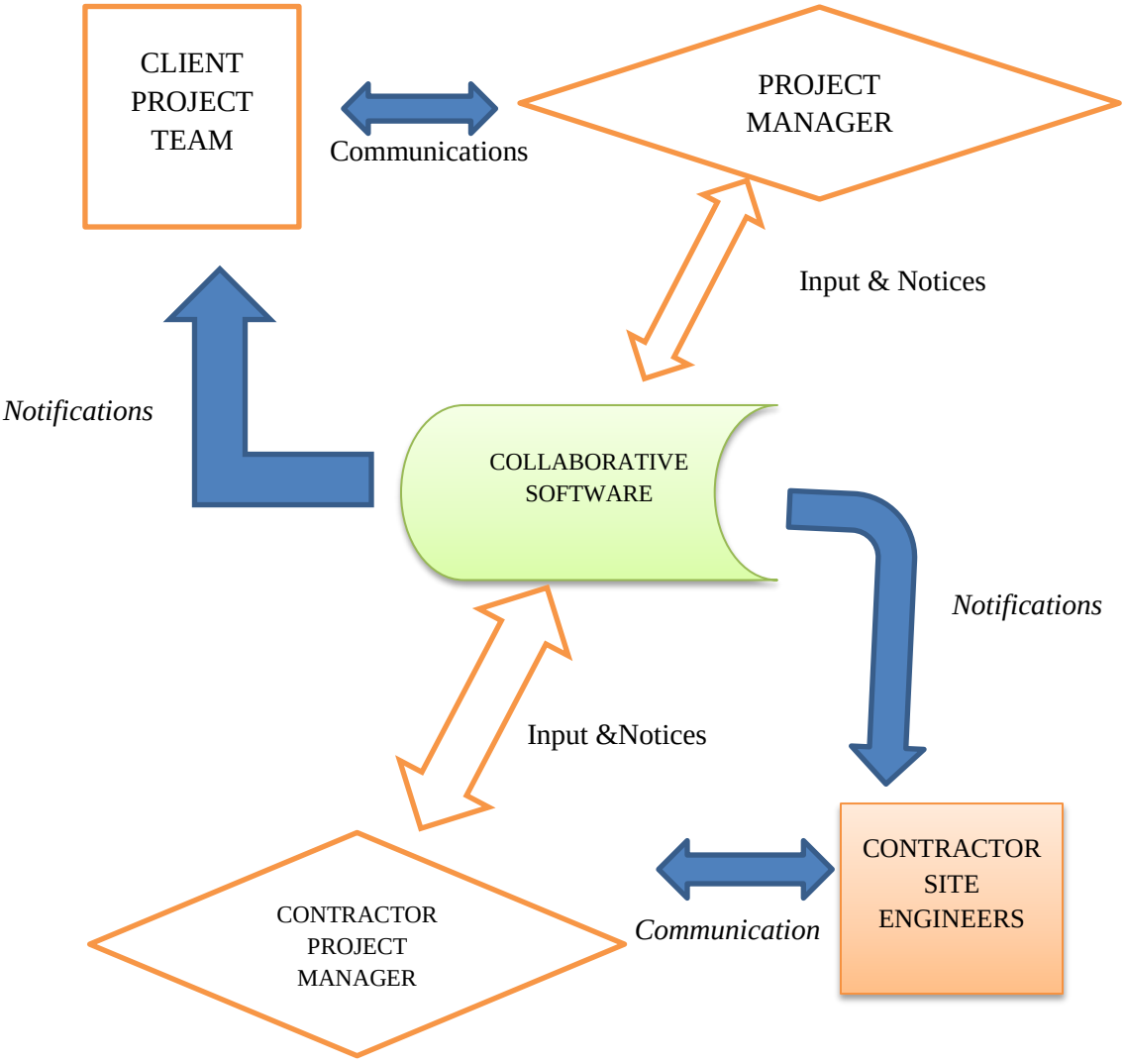

Figure 5.2: RTPMS Model Flow chart.

In the flowchart diagram, the participants will have the following roles to play;

- The Project Engineers - receive notifications and tasks on the activities from the online Gantt chart for the project and communicate work done through their respective line managers;

- The Project managers- to receive notifications about the status of the activities, make formal communication to all project participants through the collaborative software package and update the online Gantt chart and progress report; and
- Collaborative software- this will be an online software package for the project activities and project participants will require passwords to log on. Notices about activities are communicated to the project team using emails on IPad, laptops and phones.

The RTPMS model was developed to operate using collaborative project management (Coordination) tools such as:

Electronic calendar- to schedule events and automatically notify and remind the project team about the pending issues, tasks and activities. The electronic calendar is synchronized with the Gantt chart so that all project activities are online.

Workflow system- collaborative management of tasks and documents for all the project participants (Client Consultant and Contractor). This provides the participants with information on who among the assigned personal has the task on a particular document thereby giving contributions collaboratively were solutions are required. This reduces the risk of personal decisions which have an effect of causing delays to be applied in the operation system of the project.

Online proofing- to share, review, approve and reject proposals or designs on the project on real-time basis system. Under this arrangement every project participant gets access to the appropriate files and stays on the same page with regards to were the projects stands in terms of progress and other pending issues.

Online spread sheets- automated updated latest work progress report that can be accessed anytime. This will provide a readily available updated work progress report that can be accessed by login in on the software package.

The RTPMS based on online collaborative software, provides senior managers with an opportunity to check where all the projects stand on a single dash board. Project managers will also have action oriented to do list to identify what next in each project and the problems that need to be corrected without waiting for monthly site progress meeting for issues delaying the project to be reviewed and solutions discussed.

From the interview survey conducted, the current project management process was explained as shown in figure 5.3. The flowchart illustrates various stages involved when a delay factor is noticed on site. From the flowchart, the engineer reports to the project manager about a delay and if there is no solution the activity is stopped until the site meeting is held were all project team members are informed about the delay during the project progress presentation by the contractor. Once the delay is reviewed it is at this particular point that all project team members become aware of the challenges affecting the project. The solution to the delay factor is resolved or alternative way presented to the contractor followed by an instruction to proceed with the works on a particular activity. Therefore the interview survey indicated that this process created a gap between point of identification of the delay and solution implementation because site meetings were contractually held at the utmost once every month thereby by indicating that a delay could only be resolved collaboratively after one month of discovery.

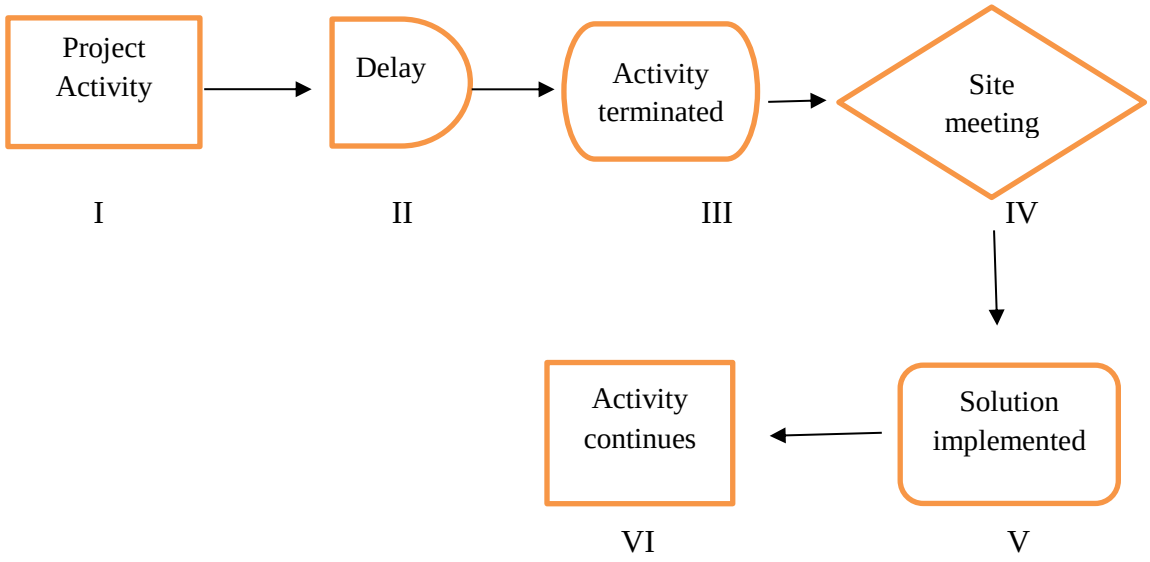

Figure 5.3: Flowchart for current project management process on delay factors.

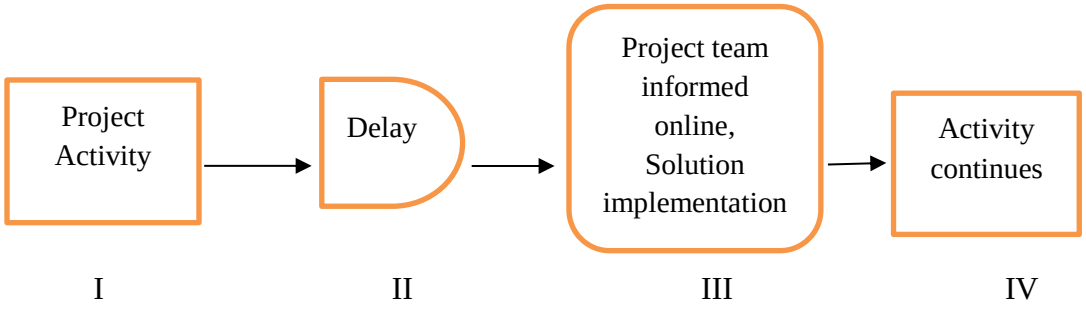

Figure 5.4: Flowchart for RTPMS process

Figure 5.4 illustrates how the RTPMS can operate to bridge the time gap for resolution of issues that result in delays during project delivery thereby making the management system faster in resolution of issues. From the flowchart diagram in figure 5.4, the project team is instantly notified about a delay on the project through the collaborative software on the internet without waiting for one month for the site meeting to be held. Therefore a collaborative solution for the delay factor is presented instantly through contributions from the project team thereby reducing the gap between delay identification stage and solution implementation. In line with the technical paper by McCall et al (2009) on transmission lines projects, the ability to resolve matters on time during construction was very cardinal in execution of projects within schedule.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Chapter 5 highlighted the operation of the RTPMS and how it could enhance efficiency and effectiveness in the delivery of transmission line and other similar projects in remote places by bridging the gap between the point of identification of delay and the time of resolution. This chapter aims at presenting the conclusions and recommendations of the study for delays in construction of electricity transmission lines in Zambia.

6.2 Conclusions

Literature by various scholars revealed that there were factors that cause delays or slowdown work in the construction industry and that the impact of these factors differ from project to project due to difference in the environment. This study established that the projects for construction of electricity transmission lines in Zambia were also not spared from the challenges. However, information from this study will be useful because not so much information has been published on delays in the construction of transmission lines in Zambia and the respondents for the study were fully involved in the transmission projects undertaken by the government. Secondly, the respondents had more than 10 years of experience, meaning that they had the wealth of knowledge capable of addressing the questions in the study. The main aim of the study was to identify the main causes of delay in the construction of the electricity transmission lines. It was established that the main causes of the delay in the construction phase in Zambia, were associated with components in either management, workmanship, financial, external, materials or manpower and based on the analysis of results, the breakdown is as follows;

i). Weather conditions

During the rainy season, the projects were delayed in some cases due to impassable roads, which made it difficult to transport materials to sites. There were also work stoppages during heavy down pours as the environment became unconducive for workers to continue their activities.

ii). Poor financial management by the contractor

The second highest ranked factor was, poor financial management by the contractor. This factor was, associated with financial problems encountered by the contractor. The main thrust of the problem, was the non-allocation of a separate bank account for the project, by contractor, so as to avoid misappropriation of funds.

iii). Late importation of materials

Late importation of materials was the third highest ranked factor of the delays. This was associated with the government's inability to finalise timely tax clearance issues for imported materials at the border.

iv). Irregular payment of subcontractors

This factor was ranked fourth among the results and was associated with financial problems encountered by the contractor. This result highlighted the importance of adequate funding of the project as a precaution for avoiding delays due to the non-payment of workers' salaries and shortage of materials at the site.

v). Poor planning scheduling or resource management skills

This fifth ranked factor was attributed to lack of training in project management and associated tools as well as techniques.

The results further established that in projects where the government was responsible for securing financing, constraints in the process, such as the late approval of contracts and release of advance payment at ministerial level` influenced delays and were attributed to bureaucracy before approval of documents. From the perspective of the client and contractor, the most highly ranked causes of delays included; poor planning and lack of management skills, delay of material delivery to the site, poor quality control, and poor coordination with project participants. These factors influenced delays and were caused by the lack of training in project management for all project participants on the part of the client and contractor. While, advance payment by the client was also a contributing factor at implementation stage, attributed to non-allocation of specific bank account for the

project. Advance payment was fundamental in project delivery because as per General Condition Contract it marked the project start date.

The results further indicated that, there were communication gaps, at the time of identification of a delay to the point of resolution. Therefore, once a challenge of delay was identified on site, the project team would wait for a site meeting held monthly as per Conditions of Contract, to discuss and give resolutions.

This study also concluded that delays in construction of electricity transmission lines in were obstacles to economic growth. This was established from the economic status of the towns, which were not connected to the national electricity grid. Additionally, despite having potential of mineral resources, mining and other manufacturing industries could not be established in these towns, because of lack of electricity.

6.3 Limitations

There were some limitation in the study arising from the fact that the main focus was to study transmission lines undertaken by the main electricity supply company in Zambia. Therefore the private sector could have different challenges to those experienced in the public sector. However, the public sector represented a holistic view, since it was the main supplier of electricity and had a broader coverage and customer-base in Zambia.

The study could also not develop a financial model for a contractor, to be used to improve financing of the project by the contractor.

6.4 Recommendations

To address the causes of delays in construction of transmission lines in Zambia, there must be an understanding of the effects and this will help project managers to have an insight on the project and plan in advance in terms of material, human resource, transport, tax issues, and financial resources including other major issues that may have potential to cause delays.

6.4.1 General recommendations

The results derived from the study indicate that; projects for construction of electricity transmission lines in Zambia will always be delayed like any other infrastructure project. Therefore the following recommendations are presented to help government avoid the delays:

- Project teams should be constituted in time and all key members from each function should participate in all the initial stages of projects to ensure accuracy in reports. Inaccurate outcomes of these reports results in wrong foundation designs and variations subsequently project implementation delays;
- Resettlement Action Plans (RAP) should be cross checked. This is in the context of ownership of land, affected structures, exotic trees and crops. Efficient RAP methodology and clear outline of what is in and out of scope is required. The key functions on the project need effective coordination and technical economic considerations to ensure timely project implementation; and
- Contractor's financial responsiveness should be proven to help cushion the delay in raising advance payment guarantees by the contractor which is a prerequisite for advance payments. The employer should make provisions to have authority to inspect the contractor's bank account before contract signing to definite proof of the financial position of the contractor.

Furthermore it is recommended that construction contracts should be divided into material supply and labour services to help reduce the weight of responsibilities on the project for a contractor and as a result cushion the effect of poor planning scheduling and resource management. It is recommended that bidders at tender stage should present as part of the evaluation criteria, evidence that they are in contract with the proposed key personnel for the project so as to ensure that they were the ones present at execution stage. This step would help cushion delays due to poor quality control plans, poor scheduling and project management. In achieving this step the engineering profession regulatory body should be engaged to include appropriate punitive measures in the code of ethics for its members to prevent them from being deceitful.

6.4.2 Specific recommendations

To enhance efficiency and effectiveness in the delivery of electricity transmission lines projects, the following recommendations can be applied on ETL projects:

- Training in project management for all key personnel will help;
- The Government should be compliant in their investment and formulate strategic policies so that financial resources are readily available before projects commences. This action will cushion the delay due to late advance payments;
- The project manager should be given a mandate to administer the project and make decisions independently. This will reduce the delays caused by unnecessary consultations for every contractual issue on the project and hence improve on speedy decision making; and
- Implementation of the Real Time Project Management System will help bridge the gap between the time of notification of the delay and point of resolution.

REFERENCES

Aigbavboa, C. O., Thwala. W. D and Mukuka, M. J., (2014) Construction project delays in Lusaka, Zambia; causes and effects, Journal of economics and behavior studies volume 6 No 11 pp 848-857.

Bryman, A., & Cramer, D., 2005, *Quantitative Data Analysis with SPSS 12 and 13; A Guide for Social Scientists*, Taylor & Francis e Library, New York.

Chirwa D.,Samwinga V. and Shakantu W., Timely Project Delivery; Case Study of Malawian Education Projects, *Association of Schools of Construction of Southern Africa, 6th Built Environment Conference*. Johannesburg, South Africa, 31st July -2nd August 2011. pp 567-583.

David, K. N., (2005), Time and Cost overruns in power projects in Kenya. MBA Dissertation, Faculty of Commerce, University of Nairobi.

El-Razek. M. E. A., Basssioni. H. A and Mobarak., A. M., (2008), Causes of delays in Building Construction Projects in Egypt, Journal of Construction Engineering and Management. Vol 134 No 11 pp 831-841.

Gardezi. S. S. S., Shafiq. N, and Khamidi F. B. M., (2013), Prospects of Building Information Modeling (BIM) in Malaysian, Construction Industry as Conflict Resolution Tool, Journal of Energy Technologies and Policy, Journal of Energy Technologies and Policy, Vol.3, No.11, pp 346-550.

Gaturu, N. S. and Muturi, W., (2014). Factors affecting the timeliness of completion of donor-funded projects in Kenya, European Journal of Business Management, 2(1), 189-202.

Ghahabo, P. T. and Ajuwon O. S., (2017) Effects of Cost Overruns and Schedule Delays In Sub-Saharan Africa, European Journal of Interdisciplinary Studies, Vol 7, No 2, pp 46-58.

Haseeb. M., Lu. X., Bibi. A., Dyian. M and Rabbani. W., (2011), Causes and effects of delays in large construction projects of Pakistan. Kuwait chapter of Arabian Journal of Business and Management Review Vol 1, No 4, pp18-39,

Kaliba, C., Muya, M., & Mumba, K., (2009). Cost escalation and schedule delays in road construction projects in Zambia. International Journal of Project Management, 27(5), 522-531

McCall, C., Hogan, J. M. and Retz D., (2009), Designs and Construction Challenges of Overhead Transmission Line Foundations, *American Society of Civil Engineers, Transmission and Substation Conference,* 17th November.

Mohammed K. A. and Isah A. D., (2012), Causes of Delays In Nigeria Construcrion Industry, Interdisciplinary Journal of Construction research In Business, Vol 4, No 2, pp 785- 794.

Motaleb. O and Kishk., M., (2010) An investigation into the causes and effects of construction delays in UAE, Association of Researchers in Construction Management pp 1149-1157

Mustefa A. J., (2015), Factors affecting Time and Cost Overruns in Road Construction Projects in Addis Ababa, Master's thesis, Addis Ababa Institute of technology, School of Civil and Environmental Engineering, Addis Ababa University.

Naik. G. M., Aditya. M and Naik. S. B., (2011) GIS Based 4D Model Development for Planning and Scheduling of a Construction Project, International Journal of Innovation, Management and Technology, Vol 2 No 6 pp 447-451.

Sambasivan M. and Soon Y. W., (2007) Causes and Effects of Delays in Malaysian Construction Industry, International Journal of Project Management, Vol 25 pp 517-526.

Salama, M. Hamid E. and Keogh B., (2008), Investigating the Causes of Delay within Oil and Gas Projects in U.A.E, *Association of Researchers in construction management, 24th Annual ARCOM Conference*, Cardiff, United Kingdom, 1-3 September 2008. pp 819-827.

Salunkhe, A. A, and Patil, R. S., (2014), Effects of Construction Delays on Project Time Overrun; India scenario, International journal of research in engineering and technology Vol 03, issue 01,pp 543-547.

Swarnadhipathi K. and Boyd D.,(2007), An Investigation of Construction Project Performance in Botswana using time Predictability, *Association of Researchers in construction management, 23rd Annual ARCOM conference* , Belfast , United Kingdom, 3-5 September 2007, pp 641-650.

Tarwil. N. M., Khiory. A. M., Arshad. I., Hamzah. N., Jasri. F. M, and Badaruzzaman. W. H. W., (2012), Factors Contribute to Delay project Construction in Higher Learning Education Case study UKM. Research Journal of Applied Sciences, Engineering and Technology 5(11); 3112-3116.

Theodore, T., (2009), Types of Construction Delays, Understanding them clearly, analyzing them correctly, 2nd Edition, Oxford. Elsevier Inc, pp 25-36.

Tumi, S. A. H. and Oman. H, Pakir., A. H. K., (2009), Causes of Delay in Construction Industry in Libya . International conference on Economics and Administration 265-272.

Zhu. F., Sun. X., Xu. X. and Haider. Z., (2014), A Knowledge Integration Framework of EPC project based on KBS and Stakeholder Networks, International Journal of Innovative Computing, Information and Control, Vol 10(2), pp. 703-715

Republic of Uganda, 2015, Ministry of Finance Planning and Economic Development, Budget Monitoring and Accountability Unity, paper 9/15, Available; www.finance.go.ug (Sep 21, 2016).

Mohamed M. B. I., (2015) A Study of Project Delays In Sudan Construction Industry, Master's Thesis, Lee Kong Chan Faculty of Engineering and Science. University of Tunku Abdul Rahman.

Ministry of National Planning and Development (2011), Government Republic of Zambia, *Revised Sixth National Development Plan*, available; www.mndp.gov.zm (Nov 18, 2017)

Ministry of Energy and Water development 2011, Government Republic of Zambia, Available; www.mewd.gov.zm (Nov 18, 2017)

Central statistics office, available on http://www.zamstats.gov.zm

APPENDIX 1: QUESTIONNAIRE

You have been selected to take part in this questionnaire; your input will be highly appreciated. The study is about Causes of delays in Construction of Electricity Transmission lines in Zambia. This survey is purely for academic purposes all information will be confidential

INSTRUCTIONS

To respond to the question put a Cross (X) or tick appropriately

TECHNICAL TEAM

Section A: Background

A1 BACKGROUND INFORMATION (tick)

1. Background of respondent
    a. Architect [ ]
    b. Quantity Surveyor [ ]
    c. Engineer [ ]
    d. Other state)……..
2. How many years has your company been in existence?
    a. 0 – 2 [ ]
    b. 3 – 5 [ ]
    c. 6 – 9 [ ]
    d. 10 – 15 [ ]
    e. 16+ [ ]
3. Number of years in current job?
    a. 0 – 2 [ ]
    b. 3 – 5 [ ]
    c. 6 – 9 [ ]
    d. 10 – 15 [ ]
    e. 16+ [ ]

4. If working for the contractor which other continent (s) have you executed similar works?
    a. Asia [ ]
    b. Europe [ ]
    c. Africa [ ]
    d. North or South America [ ]
    e. Oceania countries [ ]
5. Did you experience some delays in your current or previous project?
    a. Yes [ ]
    b. NO [ ]
6. If the answer to question 5 was ‘yes’, was the project duration affected?
    a. Yes [ ]
    b. No [ ]
7. What was/is the voltage level of the current/previous transmission line project you worked on?
    a. 33KV [ ]
    b. 66kv [ ]
    c. 132KV [ ]
    d. 330kv [ ]
    e. Above 330kv [ ]
8. What was the length of the transmission line?
    a. Below 10km [ ]
    b. 11km -25km [ ]
    c. 26km- 50km [ ]
    d. 51km -100km [ ]
    e. 101km and above [ ]

A2.2 Geotechnical Information

1. Was soil investigations carried out for the project?
    a. Yes [ ]
    b. No [ ]

2. Who conducted the soil investigations?
   a. Client [ ]
   b. Contractor [ ]
   c. Consultant [ ]
3. At which points were soil investigations done?
   a. Each tower point [ ]
   b. At corner points only [ ]
   c. At intermediate points only [ ]
   d. Other, specify.....

A2.3 Foundation and Tower Designs

4. On the project you are or were working on, were there any change in design for the foundation at any particular tower point?
   a. Yes [ ]
   b. No [ ]
5. If yes in 4 was the change in design for the tower foundation due to Line passing through a terrain not discovered during the line survey?
   a. Yes [ ]
   b. No [ ]
6. If yes in 5, was the change in design for the tower foundation due to insufficient information in the soil investigations report?
   a. Yes [ ]
   b. No [ ]
7. If yes in 6 was the change in design for the tower foundation due to Change in initial line direction due existing features such as settlements, not discovered during initial line survey?
   a. Yes [ ]
   b. No [ ]
8. During design review, have design changes been approved on time?
   a. (Yes) all the time [ ]
   b. (Yes)once [ ]

c. Yes but not frequently [ ]

d. Not at all [ ]

9. Did the review process cause delays on the project?

a. Yes [ ]

b. No [ ]

10. Did the change in design cause any delay on the project?

a. Yes [ ]

b. No [ ]

11. How do you rate the adequacy of the designs submitted by the contractor?

a. Very good, 5 [ ]

b. Good, 4 [ ]

c. Average ,3 [ ]

d. Poor, 2 [ ]

e. Very poor, 1 [ ]

12. How do you rate the drawings submitted by the contractor (rate on a scale of 1 to 5) ?

a. Very good, 5 [ ]

b. Good, 4 [ ]

c. Average ,3 [ ]

d. Poor, 2 [ ]

e. Very poor, 1 [ ]

13. Do you experience any delay in execution of the project due to the quality of the drawings submitted because of the need for revision?

a. Yes

b. No

14. If yes in 13 what are your recommendations on how to avoid the same?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

A3 Contract Administration

15. Was the advance payment paid on time?

a. Yes [ ]

b. No [ ]

16. If No in question 15, by how long was the Advance payment delayed?

a. One month [ ]

b. Two months [ ]

c. Three to Six Months [ ]

d. Seven to Nine Months [ ]

e. Eight to Twelve months [ ]

f. More than One year [ ]

17. If No in 15, explain why and give recommendations?

_____

_____

_____

_____

_____

_____

_____

18. Has there been delay in payment of Interim payment certificates?

a. Yes [ ]

b. No [ ]

19. What materials/supplies are procured abroad? (List)

……

……

……

20. Has there been delay in procurement of materials abroad?

a. Yes [ ]

b. No [ ]

21. During procurement of materials abroad, has there been delay due to payment of duty and other fees at the boarder?

a. Yes [ ]

b. No [ ]

22. Has the Client or employer responded on time when requested to carry out inspections on site?

a. (Yes) all the time (4) [ ]

b. (Yes)once (3) [ ]

c. Yes but not frequently (2) [ ]

d. Not at all (1) [ ]

23. How do rate the presence of the client supervisors on site?

a. Very good, 5 [ ]

b. Good, 4 [ ]

c. Average ,3 [ ]

d. Poor, 2 [ ]

e. Very poor, 1 [ ]

24. Has there been delays on site due non presence of the client supervisors to inspect the works?

a. Yes [ ]

b. No [ ]

25. How do you rate the quality of the supervisors for the projects on the client side?

a. Very good, 5 [ ]
b. Good, 4 [ ]
c. Average ,3 [ ]
d. Poor, 2 [ ]
e. Very poor, 1 [ ]

26. How do you rate the quality of the supervisors for the projects on the Contractors side?

a. Very good ,5 [ ]
b. Good ,4 [ ]
c. Average,3 [ ]
d. Poor,2 [ ]
e. Very poor,1 [ ]

27. How do you rate the technical ability of the project team from the client's side?

a. Very good, 5 [ ]
b. Good, 4 [ ]
c. Average, 3 [ ]
d. Poor, 2 [ ]
e. Very poor, 1 [ ]

28. How do you rate the technical ability of the project team from the Contractors side?

a. Very good, 5 [ ]
b. Good, 4 [ ]
c. Average,3 [ ]
d. Poor, 2 [ ]
e. Very poor, 1 [ ]

29. Have you experienced project delays due to poor supervision on the part of the Contractor?

a. Yes [ ]
b. No [ ]

30. Have you experienced project delays due to poor supervision on the part of the Client?

a. Yes [ ]

b. No [ ]

31. How do you rate the efficiency of compensation payments for the affected settlers?

a. Very good (5) [ ]
b. Good (4) [ ]
c. Average (3) [ ]
d. Poor(2) [ ]
e. Very poor (1) [ ]

32. Has there been any delay on the project due to compensation claims from the affected settlers

a. Yes [ ]
b. No [ ]

33. Have you experienced project delays due to late acquisition of the way leave?

a. Yes [ ]
b. NO [ ]

34. How often do you think there is compromise by the client in invoking penalties on the contractor for non-completion on time?

a. Very often (5) [ ]
b. Often(4) [ ]
c. Average (3) [ ]
d. Rarely (2) [ ]
e. Not at all (1) [ ]

35. How often do works on site match with the program of works?

a. Very often (5) [ ]
b. Often (4) [ ]
c. Average (3)
d. Rarely (2) [ ]
e. Not at all (1) [ ]

36. Have you experienced vandalism on newly installed towers

a. Yes [ ]
b. No [ ]

37. If yes in 45, has vandalism caused delay on the project?

a. Yes [ ]

b. No [ ]

38. If yes in 45, how often has vandalism occurred?

a. Very often (5) [ ]

b. Often (4) [ ]

c. Neutral (3) [ ]

d. Rarely (2) [ ]

e. Very rare (1) [ ]

Section B: Causes of delay

39. For the causes of delays listed in the table below, please rate the impact of each delay by ticking the box which matches your view most closely;

Description		Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1
A	**Management**					
1	Poor organisation management					
2.	Lack of technical expertise					
3	Poor internal and external communication					
4.	Poor coordination with project participants					
5.	Centralised management					
6	Slow in decision making by the Client					
7	Late mobilisation					
8.	Incompetent contractor staff					

9.	Poor planning, scheduling or resource management skills					
10	Design changes					
B	**Workmanship**					
1	Poor quality control plans					
2	Mistakes during construction					
3	Inexperience in similar works					
4	Shortage of materials					
5	Poor quality of materials					
6	Unclear Material specification					
C	**Materials**					
1	Late material delivery on site					
2	Misuse of material					
3	Poor storage of material					
4	Delay of material delivery to site					
5	Poor quality of materials					
	Manpower					
1	Shortage of manpower					
2	Inadequate skill of man power					
3	Low productivity					
4	Unavailability of equipment on request					
5	Wrong allocation of equipment					
6	Different nationalities of workforce on site					
D	**Financial**					
1	Poor financing management by the contractor					
2	Irregular payment of subcontractors					

3	Late advance payment					
4	Late work progress payment					
E	**External**					
1	Inclement weather conditions					
2	Inadequate site investigation					
3	Vandalism					
4	Work permits					

40. Other than the causes of delays listed above, please write down any delays that you have encountered and rate as above by indicating 5,4,3,2 or 1

a. **.....**

b. **.....**

c. **.....**

d. **.....**

e. **.....**

f. **.....**

g. **.....**

41. What are your recommendations' for avoiding the delays during construction of new transmission lines

_____

_____

_____

_____

APPENDIX 2: INTERVIEW QUESTIONS

1. What are the major causes of delays in construction of ETL in Zambia?

   _____

   _____

   _____

   _____

2. What are the common effects of delays in the construction of transmission lines (Contractually, financially)?

   _____

   _____

   _____

   _____

   _____

3. Does the process of undertaking an EIA cause any delays on ETL project?

   _____

   _____

   _____

   _____

   _____

4. What type of survey method are commonly used?

   _____

   _____

   _____

   _____

   _____

5. What best practices could be used to improve the survey techniques?

   _____

   _____

   _____

   _____

   _____

6. What tools and techniques are used for time control during the life cycle of ETL projects?

   _____
   _____
   _____
   _____
   _____

7. How do you look at the RTPMFM as a technique for ETL and other similar projects?

   _____
   _____
   _____
   _____

APPENDIX 3: DESCRIPTIVE STATISTICS

Descriptive Statistics

	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
VAR00033	17	4.2353	.20164	.83137	.691
VAR00029	17	4.1765	.24608	1.01460	1.029
VAR00018	17	4.1765	.21412	.88284	.779
VAR00030	17	4.1176	.22496	.92752	.860
VAR00010	17	4.1176	.18947	.78121	.610
VAR00021	17	4.0588	.20056	.82694	.684
VAR00012	17	4.0588	.20056	.82694	.684
VAR00005	17	4.0588	.20056	.82694	.684
VAR00009	17	4.0000	.24254	1.00000	1.000
VAR00014	17	3.9412	.23437	.96635	.934
VAR00007	17	3.9412	.24957	1.02899	1.059
VAR00031	17	3.8824	.20797	.85749	.735
VAR00002	17	3.8824	.26956	1.11144	1.235
VAR00032	17	3.8824	.22496	.92752	.860
VAR00013	17	3.8824	.20797	.85749	.735
VAR00008	17	3.8824	.28287	1.16632	1.360
VAR00004	17	3.8824	.16896	.69663	.485
VAR00024	17	3.8235	.27433	1.13111	1.279
VAR00026	17	3.8235	.24608	1.01460	1.029
VAR00015	17	3.7647	.21911	.90342	.816
VAR00003	17	3.7647	.27825	1.14725	1.316
VAR00022	17	3.7059	.26795	1.10480	1.221

VAR00025	17	3.7059	.23894	.98518	.971
VAR00011	17	3.7059	.20588	.84887	.721
VAR00035	17	3.6471	.25641	1.05719	1.118
VAR00034	17	3.6471	.22592	.93148	.868
VAR00016	17	3.6471	.28364	1.16946	1.368
VAR00023	17	3.6471	.24164	.99632	.993
VAR00006	17	3.6471	.22592	.93148	.868
VAR00019	17	3.5882	.24343	1.00367	1.007
VAR00027	17	3.4706	.24431	1.00733	1.015
VAR00017	17	3.4706	.24431	1.00733	1.015
VAR00036	17	3.3529	.22592	.93148	.868
VAR00020	17	3.2941	.20588	.84887	.721
VAR00028	17	3.0588	.20056	.82694	.684
Valid N (listwise)					

Case Processing Summary

		N	%
Cases	Valid	17	100.0
	Excluded[a]	0	0.0
	Total	17	100.0

a. Listwise deletion based on all variables in the procedure.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
VAR00002	129.0588	459.934	.808	.961
VAR00003	129.1765	464.529	.684	.962
VAR00004	129.0588	478.934	.665	.962
VAR00005	128.8824	468.235	.860	.961
VAR00006	129.2941	478.971	.487	.963
VAR00007	129.0000	465.250	.752	.961
VAR00008	129.0588	454.809	.875	.960
VAR00009	128.9412	465.934	.759	.961
VAR00010	128.8235	473.529	.751	.961
VAR00011	129.2353	487.941	.294	.964
VAR00012	128.8824	469.110	.834	.961
VAR00013	129.0588	472.559	.708	.961
VAR00014	129.0000	467.500	.748	.961
VAR00015	129.1765	490.654	.205	.964
VAR00016	129.2941	463.096	.700	.961
VAR00017	129.4706	473.265	.580	.962
VAR00018	128.7647	480.066	.487	.963
VAR00019	129.3529	479.368	.439	.963
VAR00020	129.6471	469.743	.794	.961
VAR00021	128.8824	472.735	.730	.961
VAR00022	129.2353	460.691	.796	.961
VAR00023	129.2941	461.971	.857	.960
VAR00024	129.1176	454.360	.913	.960
VAR00025	129.2353	465.816	.774	.961

VAR00026	129.1176	468.485	.687	.962
VAR00027	129.4706	462.890	.825	.961
VAR00028	129.8824	492.735	.171	.964
VAR00029	128.7647	463.441	.806	.961
VAR00030	128.8235	472.529	.652	.962
VAR00031	129.0588	474.684	.649	.962
VAR00032	129.0588	475.059	.588	.962
VAR00033	128.7059	503.096	-.110	.966
VAR00034	129.2941	469.846	.717	.961
VAR00035	129.2941	479.346	.415	.963
VAR00036	129.5882	480.757	.442	.963