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**ADDIS ABABA UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
SCHOOL OF COMMERCE
DEPARTMENT OF PROJECT MANAGEMENT**

**Assessments of the Causes of Schedule Delay in Road
Construction Projects; the case of Eshetu Lemma Road
Contractor**

**A Research Project Work Submitted to the School of Graduate Studies of
AAU in Partial Fulfillment of the Requirement for the Degree of Master of
Arts in Project Management**

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June, 2018

Addis Ababa, Ethiopia

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Declaration

I, the undersigned, declare that the study entitled “Assessments of the Causes of Schedule Delay in Road Construction Projects; the case of Eshetu Lemma Road Contractor” is the result of my own effort and study that all sources of materials used for the study have been acknowledged. I have conducted the study independently with the guidance and comments of the research advisor.

This study has not been submitted for any degree in any university. It is conducted for the partial fulfillment of the requirement for the Degree of Master of Arts in Project Management.

Berhane Bekele

Date

Letter of Certification

This is to certify that Berhane Bekele has conducted this project work entitled “*Assessments of the Causes of Schedule Delay in Road Construction Projects; the case of Eshetu Lemma Road Contractor*” is under my supervision.

This project work is original and suitable for the submission in partial fulfillment of the requirement for the award of Master of Arts Degree in Project Management.

Wubeshet Bekalu (PhD)

Date and Signature

Acknowledgment

This work is a synergistic product of many minds. I am forever grateful to the inspiration and guidance of many great men and women. For the development and production of this thesis, I feel a deep sense of gratitude to: My advisor, Wubeshet Bekalu (PhD) for his intellectual advice, support, constructive comments and thorough guidance.

Yohannes Mulugeta (Ing.) for his unreserved effort to guide and support me with high level of integrity, without his support it is almost impossible to complete this study.

I would also like to express my appreciation to all individuals who contributed to this thesis through providing valuable information and by scarifying their precious time in filling the questionnaires.

And finally, to the source and supplier of all potential, the Omni-Potent One, the father and Lord of all creation, and His Son, Jesus Christ, and my divine potential counselor, the Holy Spirit for giving me life and strength and the privilege to thank Him.

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Acronyms

ERA: Ethiopian Road Authority

ETCA: Ethiopian Transport Construction Authority

GTP: Growth and Transformation Plan

IPMA: International Project Management Association

ISO: International Organization for Standardization

PMBOK: Project Management Body of Knowledge

PMI: Project Management Institute

RII: Relative Importance Index

RSDP: Road Sector Development Programme

Abstract

Generally delay (time overrun) is a condition the actual work does not complete in an estimated time period. Construction delay is a common problem in construction projects in Ethiopia and occurring in every type and phase of a construction projects. Therefore this study was carried out to identify the major causes of delay for road construction projects. Sixty one (61) project delay attributes were identified through detailed literature review and experts support. The study adopts quantitative methods with the help of primary and secondary data. Primary data was collected using self-administered questionnaires on 40 selected respondents from clients, consultants and contractor. Secondary data was collected through reviewing of related materials such as road construction project contract documents and project completion reports. This research categorized the causes of delay under four main groups of client related, consultant related, contractor related, and external related and then assessed their impacts on delay using relative importance index (RII) as a basis for analysis. The RII for all delay factors and group of categories was computed so as to rank the factors. The top five most influential causes of road construction project delays were identified as: (1) Deficiencies in planning and scheduling of projects with mean values equals to 4.492 or (RII=0.898), (2) Inflation and escalation of material prices with mean values of 4.308 or (RII=0.862), (3) Delay of financing and payments by owners (mean value=4.133) or (RII=0.827), (4) Difficulties in financing the project by contractor (mean value=4.075) or (RII=0.815), and (5) Insufficient estimation of original contract duration 3.992 or (RII=0.798). The study concluded that contractor related category is the most prominent delay factor with a relative importance index values of (RII = 0.639), followed by consultants related (RII = 0.632), then clients related (RII = 0.617) and external related delay causes exhibited the least aggregated relative importance index of (RII = 0.541).

Key Words: *Delay, Delay causes, Project, Project Management, Relative Importance Index (RII), Road construction projects*

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

In the context of Ethiopia, road is the most important infrastructure that provides access to rural and urban areas in the country. Road plays crucial role to reduce transportation cost and support economic growth in the country. However, in the late 1990's; the road network coverage was limited to major urban areas and some rural areas. Most areas in the country were isolated from economic centers, market and basic social services. The existing road network was largely deteriorated and in poor condition.

The Government of Ethiopia has well recognized that limited road network coverage and poor condition of the existing road network has been an impediment to economic recovery and economic growth. Therefore, to address the problems in the road sector; the Government has launched the Road Sector Development Program (RSDP) in 1997. Since then, four phases of RSDP were implemented over the period of 1997 - 2015 and the fifth phase; RSDP V has been implemented since July 2015 (ERA 2016).

- RSDP I - From July 1997 to June 2002 (5 years plan)
- RSDP II - From July 2002 to June 2007 (5 years plan)
- RSDP III - From July 2007 to June 2010 (3 years plan)
- RSDP IV - From July 2010 to June 2015 (5 years plan)
- RSDP V - From July 2015 to June 2020 (Ongoing)

With the major objectives of

- Improve transport operating efficiency and reduce road transport costs for freight and passengers so as to encourage production, distribution and export;
- Provide access to previously neglected food deficit rural areas to support efficient production, exchange and distribution throughout the country, and
- Develop adequate institutional capacity of the road sub-sector both at central as well as regional level.

In Ethiopia road transport is the dominant mode and accounts for 90 to 95 percent of motorized inter-urban freight and passenger movements. However, because of its limited road network, provision of infrastructure has remained one of the formidable challenges for Ethiopia in its endeavor towards socio-economic development and poverty reduction (ERA, 2008a)

1.1.1 History of Road Building in Ethiopia

Historic chronicles of the 17th and 18th centuries show that there were a number of small roads trails and foot paths, in addition to the traditional shoulder porter age, animals like mules, donkeys and horses and camels were used as a means of transportation in Ethiopia.

In the 18th century, especially during the reign of Emperor Tewodros, although the technology was primitive it was believed that planned road construction efforts were made. It is also believed that Emperor Yohannes IV, who succeeded Tewodros, was engaged in road building. However due to the danger of invasion by Egyptians, Derbush and Turkish the Emperor was not able to achieve his desires.

It was prior to the second Italian occupation i.e. between the years 1896 and 1936 that a great success was made in road construction. Emperor Menilik was said to be a successful road builder participating himself in the construction. In 1903 the road from Eritrea to Addis Ababa and the road from Addis to Addis Alem were built. In addition it was during this time that the first Asphalt roads appeared in Addis.

During the 5 years of Italian occupation about 6000km road were built by them, approximately 2500 km of them were given a single asphalt surface treatment, drainage structures were usually of stone masonry and at least three tunnels were built. From the time the Italian packed off to home to the eventual creation of the Imperial Highway Authority (1941 to 1951) road construction or maintenance activity was almost subsided for a stagnation period of one decade because of lack of funds, equipment and expertise.

1.1.2 Background of the Organizations and Projects

Following the eviction of the Italian occupiers, the Imperial Ethiopian Government was convinced that a Road Agency solely responsible for rehabilitating/restoring and expanding the road network throughout the country had to be established. Accordingly, the Imperial Highway Authority (IHA) was established under proclamation No. 115/1951 as a semi-autonomous agency with specific duties to plan, design, construct, and maintain roads. Responsibilities for construction and maintenance of roads remained under a single autonomous authority (IHA) for 26 years (1951-1977). The Ministry of Transport and Communication turned out to be the supervising authority of ERA. The Ethiopian Roads Authority has been reestablished under proclamation 133/1978 incorporating, among others, the Rural Roads Department in addition to the Highway Department.

In 1980, the Military Government that took power in 1974 reformed the agency into the Ethiopian Transport Construction Authority (ETCA) by proclamation No. 189/1980 and became answerable to the newly formed Ministry of Construction. The proclamation enlarged responsibility of the Authority by expanding its task to incorporate the construction of Airports, Seaports, Railways, and Municipal Roads.

During the establishment of ERA in 1951 the total road network amounted to 6,400 km, which was mainly built during the Italian invasion. In ERA history, major high way construction works were dominated by international contractors between 1960 and 1970. Between 1972 and 1976, the domestic construction industry had started to develop and became active to same extent in the road construction sector. Unfortunately, their development was impeded by the adverse policy environment created by the Derg regime.

According to proclamation No 133/1978, the reestablished Ethiopian Roads Authority included Rural Roads Department in addition to the Highway Department and other Departments and divisions. The purpose was to reconstruct, rehabilitate and maintain Rural Roads. In 1980, by proclamation No 189 of 1980, ERA was reformed into the Ethiopian Transport Construction Authority (ETCA) with increased responsibility that included Airport, Seaports, Railways and Municipal Roads.

In 1990, by the proclamation No 26, 1990, ETCA became ERA with responsibility only for roads and formally accountable to the Ministry of Construction. The powers and duties of ERA included contract Administration and supervision in addition to the maintenance of roads.

In 1993 ERA was also reestablished by Proclamation No 63/1993 with the view to providing a strong administration under the leadership of the Board. During this time as part of its reforms, the Transitional Government of Ethiopia assigned administration of rural roads to the Regional self Governments and Highways to ERA as part of the Central government's responsibility. To cope up with the existing situations ERA was again reestablished by proclamation No 80/1997 with the objective to develop and administer highways, to ensure the standard of road construction and to create proper conditions on which the road network is coordinately promoted.

According to the proclamation, ERA is legally autonomous agency responsible for the management of the country's roads. The proclamation further stipulates that trunk and major link, which make up the federal road network system, are administered by the Ethiopian Roads Authority. ERA's primary function is to maintain the existing road network through the districts as its corporate responsibility.

Road Sector Development Program (RSDP)

Recognizing the importance of the road transport in supporting social and economic growth and its role as a catalyst to meet poverty reduction targets, the Government of Ethiopia has placed increased emphasis on improvement of the quality and extent of road infrastructure in the country. To address constraints in the road sector, related to restricted road network coverage and poor condition, the Government formulated the Road Sector Development Program in 1997.

In 1997 the road network had grown to 26,550 km, of which 3,708 km were paved. Then, as a result of the RSDP investment, the total road network in Ethiopia has increased on average by about 4.2% each year. By June 2010 and the completion of the RSDP III, the total classified road network had increased to 49,000 km (excluding community roads). This is an increase of some 22,450 km since the launch of the program in June 1997, giving a road density of 44.4 km per 1000 km² and 0.58 km per 1000 population.

The proportion of the road network in good condition has also increased, from 22% in 1997 to 56% in 2010. Improvements have been realized in the quality of regional roads and rural accessibility has improved through the construction of new link roads and rural roads, in addition to a significant number of new community roads. The overall disbursement over 13 years of RSDP was ETB 60.4 billion (USD 5962.6 million) and this disbursement was 100% of the plan. An assessment of contribution of finance to the implementation of the RSDP shows that 70% came from internal sources (the Government, the Road Fund and the Community). The remaining 30% has been pooled from the international community. Specifically, the share of the Government of Ethiopia is the highest (53.8%), followed by Road Fund (14.2%), the IDA (11.8%) and EU (8.6%).

Ethiopia's road network has been improving each year. In the past sixteen years, the GOE has been vigorously engaged in new road construction as well as expansion of the existing road network through Ethiopia's Road Sector Development Programs (RSDP). According to 2014 UNDP Human Development report, Ethiopia has invested 142 billion Birr (\$7.1 billion) on road construction projects over the past 16 years; out of which \$ 5.4 billion (77%) was funded from internal sources. During the GTP II period covering 2015/16 to 2019/20, the GOE anticipates a further expansion of the country's road network to 220,000 kilometers (136,701 miles). According to ERA's 2016 report the total road network of federal road reached to 28,032 km of which 14,632 km paved with asphalt and 13,400 km unpaved. Over the past years of RSDP history the performance was improved but still there is a big gap for improvement.

Over the last nineteen years of the RSDP, participation of the local construction industry has increased in terms of both the value and number of projects. For instance, the total value of contracts awarded to local contractors is about ETB 82.7 billion, which accounts 45% of the total contract amount awarded since July 1997. Some local contractors are now taking bigger contracts, with values amounting as much as ETB 2.7 billion. The Chart below shows total cost of projects awarded to local and foreign contractors.

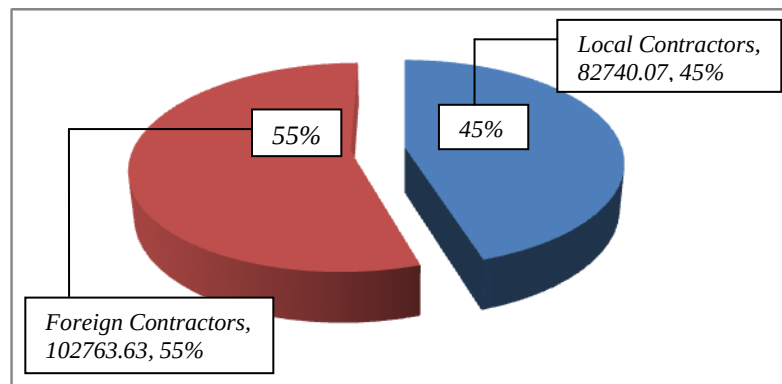


Fig. 1.1 Participation of local and foreign Contractors (1998-2016)

Organizational Profile

Eshetu Lemma Road Contractor is a Grade-1 Road construction company. The company was established in September 1996 EC in Addis Ababa, Ethiopia and is registered under Ethiopian law. It is ISO 9001:2008 Quality Management System certified company.

Currently the company engaged only in road construction works. Ever since its establishment the company has successfully accomplished different road construction works for different government sectors in Ethiopia such as federal government, regional states and for private organizations. Currently the company is undertaking a number of road construction projects in different parts of the country including the capital Addis Ababa.

Since 1991 the construction industry is amongst one of the economic sector growing in the country. Considering the above, this company is established to create its opportunity and to put his milestone by giving a better construction work service on this mushrooming sector. Since the demand in construction sector is growing every year the company will not face customer problem and it can generate more revenue to the country and can create job opportunity for a sizable number of citizens.

Looking ahead, Eshetu Lemma Road Contractor will adhere to the principle of excellent performance and outstanding quality. Due to its satisfactory services the company stick to the philosophy of *"creating roads and bridges and*

contributing to the society, putting employees in the first place and perusing excellence"

Management objectives: First-class service, first- class quality, first-class management, and first class profits rate.

Core values: Treat credibility as core value and fulfill promise to the society. Quality is another core value system and promise to deliver satisfactory service to the clients.

1.2 Statement of the Problem

Over the past years of RSDP history the performance was improved but still there is a big gap for improvement. The issue of addressing huge network expansion and improvement as well as backlogs of maintenance needs under funding constraints, weak local construction industry, few international contractors, weak capacity of own force with leaner qualified staffing resources is indeed a great challenge for Ethiopian road sector. In addition slow pace of institutional change, weak implementation capacity of the local construction industry, high turnover of professional and managerial staffs, and lengthy contract procurement processes can be cited as major challenges (ERA 2016).

Delays in construction projects are more likely to happen in almost all projects due to the miscommunication between contractors, subcontractors, property owners or any other reasons. Delays are constantly occurring in road construction projects and they could causes great impact on economic growth. It is one of the common problems that upset the construction companies in terms of competitiveness and long term sustainable in the global market Sweis *et al.*, 2008, Construction projects are delayed because of several reasons. The problem of project delay still not solved even today when the technology is advanced and project management practices are more common than before (Yang *et al.*, 2013).

Delays and cost overruns are the most common problems causing delay in the construction industry in both developed and developing countries (Enshassi *et al.*, 2009). Delays occur in every construction project and the magnitude of these delays varies significantly from project to project and country to country (Wael *et al.*, 2007). Cost and time overruns are the key problems of any construction projects. These issues are causing the negative impact on the development of country economic growth and prosperity (Raj K. Shah, 2016).

A number of researches also carried out to investigate the causes of delay in construction projects. Al-Momani (2000) surveyed causes of delay in 130 public projects in Jordan. According to his research the important delay causes were

related with: (1) design, (2) user changes, (3) weather, (4) site conditions, (5) late supply, (6) financial conditions and (7) rise quantity of work. On the other hand according to Al-Ghafly (1995), the main causes of delay include finance, delay in agreement and decision-making by owner, variations in the plan and size (project scope), problem in gaining a work permit, and organization and communication problems.

Aziz (2013) also identifies high-impact value of delay causes in Egypt as: Funding problems, different strategies patterns for bribes, Shortage of equipment, Ineffective project planning and scheduling, Poor site management and investigation, Poor monetary control on site, Rework, Selecting non-skilled contractors, Sudden Accidents, poor planning, low-skilled working team, Inadequate contractor experience, Frequent equipment breakdowns, Global financial crisis, Complexity of the work (project type, project scale, etc.), Project Legal arguments between project stakeholders, disagreement between joint-ownership variation, poor construction method, non-skilled labor, and Conflicts.

According to Mahamid I. (2013) the top risks causing time overrun in road construction projects in Palestine are: financial status of the contractors, payment delays by the owner, the political situation, poor communication between construction parties, lack of equipment efficiency and high competition in bids. Study in Zambia also indicate that; delayed payments, financial processes and difficulties on the part of contractors and clients, contract modification, economic problems, materials procurement, changes in drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, poor coordination on site, changes in specifications and labour disputes and strikes were found to be the major causes of schedule delays in road construction projects (C. Kaliba *et al.* 2009).

According to Tsegay and H. Luo (2017) the influential causes of delay are corruption, unavailability of utilities at site, inflation/price increases in materials, lack of quality materials, late design and design documents, slow delivery of materials, late in approving and receiving of complete project work, poor site management and performance, late release budget/funds, and ineffective project planning and scheduling. According to Siraw Y. (2014), the most common and frequent factors contributing to time overrun includes slow site clearance, supply of materials, Inflation, and exchange rate fluctuation, progress payments delay by owner, unforeseen site condition, slow equipment movement and quality of materials, contractor's financial problems and inaccurate cost estimation.

Delay is a common problem of projects in Ethiopia. In his study conducted on 15 completed projects in different regions of the country (Ethiopia), Abdissa

(2003) has shown that projects were delayed from 20.66% to 500% of original contract duration. Werku and Jha (2016) on the other hand also indicated that, in Ethiopia about 91.75% of projects delayed 352% of its contractual time.

Even though a number of studies has been carried out previously on the subject under current study focuses, the previous study does not fully addressed all possible delay attributed to project delay. Because of the unique features of projects, the causes of project delay may vary for specific project from country to country, region to region, and even project to project. Therefore further study can be also undertaken to investigate major causes and the magnitude of their effect on project. Therefore, this study tried to identify the most important and frequent causes of schedule delay in road construction projects in the case of Eshetu Lemma Road Contractor and it also aimed to provide an input for the management of the company to mitigate the possible causes of delay in construction projects.

1.3 Research Questions

- What are the major causes of project delay in road construction projects?
- How much is the contribution of each of these factors for the project delay?
- How do the responsibilities of delay are apportioned to the stakeholders?

1.4 Objectives of the Study

1.4.1 General Objective

The main objective of this study is to identifying the major causes of schedule delay in road construction projects.

1.4.2. Specific Objectives

The primary aim of this study is:

- To study the contribution of each of these causes for project delay.
- To study how do the responsibilities of delay apportioned to the stakeholders.
- To study the differences in perceptions among the three major parties in construction on the causes of delay.

1.5 Significance of the Study

This research will have a significant importance in understanding the extent of delay in road construction projects. It will also help us to know the major causes of road construction project delay and the apportioning of these causes to the major stakeholders in road construction projects. Besides it can also propose way of mitigation in order to control and mitigate project delay causes and provide inputs for the management of ELRC in order to take corrective actions and make informed decisions to promote the successful completion of projects by mitigating the most common causes of delay.

In addition it will also be important to the researcher as it add theoretical and practical knowledge on how to conduct research and it may also significantly important to scholars and researchers who require basis for further research in this area.

1.6 Scope and Limitations of the Study

The study was focused on assessment of causes of schedule delay in the case of Eshetu Lemma Road Contractor road construction projects from the perspectives of the three major parties in construction namely owner, contractors and consultants to identify the most common and frequently occurring causes of delay in road construction projects.

The major challenge of this study was shortage of time. Due to limitation of time this study does not cover the causalities and magnitude of each identified causes on project delay (the magnitude of project delay in relation to each specific cause), rather it focuses on the relative importance of each cause.

1.7 Organization of the Paper

This study is organized in five consequential chapters. The first chapter deals with the introduction part of the paper comprising back ground of the study, statement of the problem, objectives of the study and scope & limitations of the study. The second chapter focuses on review of literatures related to the topic of this study. The third chapter deals with the research methodology, design, approaches used throughout the data collection and analysis. The fourth chapter presents the overall finding of the study which prevails about the most important and frequently occurring causes of delay from the perspectives of the three main groups (clients/ owner, contractors and consultants). The last chapter, chapter five encompasses the conclusion and recommendation part of the study. Conclusions are be made from the previous chapter so that we can make some recommendations.

CHAPTER TWO: REVIEW OF RELATED LITERATURES

2.1 Introduction

The focus area of this chapter is on review of literatures related to the topic under the study. The reviewed literatures are related with the area of project management and most importantly literatures are selected from road and other construction project management areas. Reviewed literatures include books, International journals, articles, thesis papers, reports which are related to the study topic. Most of the literatures' discussed here under are conducted on different countries, environment under different conditions and time to ascertain the fact that causes of delay could be different in different countries and under situations.

2.2 Overview of Project and Project Management

2.2.1 Project

According to the Project Management Body of Knowledge (PMBOK), a project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates that a project has a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists. Projects can also have social, economic, and environmental impacts that far outlive the projects themselves (PMBOK 5th edition). International Project Management Association (IPMA) defines a project as a time and cost constrained operation to realize a set of defined deliverables up to quality standards and requirements. On the other hand the Association of Project Managers (APM) defines a project as a unique, transient endeavor undertaken to achieve a desired outcome.

According to Robert K. Wysocki (2014) definition Project is a sequence of unique, complex, and connected activities that have one goal or purpose and that must be completed by a specific time, within budget, and according to specification. A Business-focused definition of a Project by the same author Robert K. Wysocki (2014) is a sequence of finite dependent activities whose successful completion results in the delivery of the expected business value that validated doing the project. *Gary R. H. (2003) also defines a project as a temporary endeavor undertaken to achieve a particular aim. A project is actually the response to a need, the solution to a problem. Further, it's a solution that promises a benefit—typically a financial benefit. The fundamental purpose for most projects is to either make money or save money.*

By definition, a project is temporary in nature; that means that it has a specific start and finish. A project consists of a well-defined collection of small jobs (tasks) and ordinarily culminates in the creation of an end product or products (deliverables). There will be a preferred sequence of execution for the project's tasks (the schedule). A project is a unique, one-time undertaking; it will never again be done exactly the same way, by the same people, and within the same environment (*Gary R. H., 2003*).

Some of the special features of a project according to (Rory B. and Steve B., 2007) include:

- A project has a clear start and finish.
- A project passes through a number of distinct phases (initiation, design, implementation and handover).
- Projects are often time-limited (they must finish by a certain date).
- Projects have a clear budget which is usually broken down to a budget per work package.
- Activities are essentially unique and non-repetitive - you only get one opportunity to get it right.
- Resources may be sourced from different functional departments and contractors, and need to be coordinated.
- The project manager as project leader is responsible for the successful completion of the whole project.
- Multi-disciplined project teams are formed to manage the project. In large companies the project team would probably work within a matrix organization structure.

2.2.2 Project Management

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (PMI, 2013). This application of knowledge requires the effective management of the project management processes.

A process is a set of interrelated actions and activities performed to create a pre-specified product, service, or result. Each process is characterized by its inputs, the tools and techniques that can be applied, and the resulting outputs. Project management is accomplished through the appropriate application and integration of the 47 logically grouped project management processes, which are categorized into five Process Groups. These five Process Groups are:

- Initiating,
- Planning,
- Executing,
- Monitoring and Controlling, and

- Closing. (PMBOK 5th edition).

Initiating Process Group: Those processes performed to define a new project or a new phase of an existing project by obtaining authorization to start the project or phase.

Planning Process Group: Those processes required to establish the scope of the project, refine the objectives, and define the course of action required to attain the objectives that the project was undertaken to achieve.

Executing Process Group: Those processes performed to complete the work defined in the project management plan to satisfy the project specifications.

Monitoring and controlling Process Group: Those processes required to track, review, and regulate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes.

Closing Process Group: Those processes performed to finalize all activities across all Process Groups to formally close the project or phase.

The definition of project management that offered by Robert K. Wysocki (2014) is designed to be a working definition that includes the six-question litmus test to check its validity by using it to answer these six questions. Project management is a set of tools, templates, and processes designed to answer the following six questions: What business situation is being addressed by this project? What does the business need to do? What will you do? How will you do it? How will you know you did it? And How well did you do?

According to Kerzner H. (2009) Project management is the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. Furthermore, project management utilizes the systems approach to management by having functional personnel (the vertical hierarchy) assigned to a specific project (the horizontal hierarchy).

As David M. (2009) cited Project management is defined in BS 6079 as ‘the planning, monitoring and control of all aspects of a project and the motivation of all those involved to achieve the project objectives on time and to cost, quality and performance. The purpose of project management was described by Lock as a system for foreseeing or predicting as many risks and problems as possible in relation to a project and then planning, organizing and controlling the activities required to overcome such risks and problems so that the project is completed successfully.

2.2.2.1 The Ten Knowledge areas of Project Management

A Knowledge Area represents a complete set of concepts, terms, and activities that make up a professional field, project management field, or area of specialization. These ten Knowledge Areas are used on most projects most of the time. Project teams should utilize these ten knowledge Areas and other Knowledge Areas, as appropriate, for their specific project. The Knowledge Areas are: Project Integration Management, Project Scope Management, Project Time Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management and Project Stakeholder Management (PMI, 2013).

1. Project Integration Management - This Knowledge Area addresses the glue that links all of the deliverables from the Process Groups into a unified whole (Robert K. Wysocki, 2014). It describes the process required to ensure that the various elements of project are properly coordinated (PMI, 2013).

2. Project Scope Management - The major focus of the Project Scope Management Knowledge Area is the identification and documentation of client requirements. Many ways exist to approach requirements gathering and documentation (Robert K. Wysocki, 2014). Project scope management is what we make sure that our project includes all the relevant to achieving the project's objectives. The process includes: planning scope management, collecting requirements, defining scope, creating work breakdown structure, validating the scope and controlling the scope (PMI, 2013).

3. Project Time Management - Project time management includes the processes required to manage the timely completion of the project (PMI, 2013). It includes both a planning and a control component. The planning component provides time estimates for both the duration of a project task (that is, how long will it take in terms of clock time to complete the task) and the actual effort or labor time required to complete the task. The duration is used to estimate the total time needed to complete the project. The labor time is used to estimate the total labor cost of the project. The control component is part of the Monitoring and Controlling Process Group and involves comparing estimated times to actual times as well as managing the schedule and cost variances (Robert K. Wysocki, 2014).

4. Project Cost Management - A project cost management process is a method by which costs of labor, equipment, material and administration are formally identified, approved and paid (PMI, 2000). Project Cost

Management includes both a planning and a control component. The planning component includes building the project budget and mapping those costs into the project schedule. This provides a means of controlling the consumption of budget dollars across time. Variance reports and earned value reports are used in the Monitoring and Controlling Process Group (Robert K. Wysocki, 2014).

5. Project Quality Management - Good quality management is probably one of the Knowledge Areas that gets a rather casual treatment by the project manager and the team. A good quality management program contains the following three processes:

- Quality planning process
- Quality assurance process
- Quality control process

6. Project Human Resource Management - Project human resource management is about the people management responsibilities or management of team member (Robert K. Wysocki, 2014). Project team comprises individual with assigned roles and responsibilities for completing the project (PMI, 2013).

7. Project Communications Management - Project communications management includes the processes that are required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information. At the heart of many of the top ten reasons why projects fail is poor communications. As many as 70 percent of the IS/IT project failures can be traced back to poor communications. A good communications management process will have provisions in the process that answer the following questions:

- Who are the project stakeholders?
- What do they need to know about the project?
- How should their needs be met? (Robert K. Wysocki, 2014)

8. Project Risk Management - In project management, a risk is some future event that happens with some probability and results in a change, either positive or negative, to the project. The risk analysis and management process can answers the following questions: What are the risks? What is the probability of loss that results from them? How much are the losses likely to cost? What might the losses be if the worst happens? What are the alternatives? How can the losses be reduced or eliminated? Will the alternatives produce other risks?

Effective project managers treat risk management as a dynamic part of every project. Their plan has the following four parts:

- Risk identification
- Risk assessment
- Risk mitigation
- Risk monitoring

9. Project Procurement Management - Project Procurement Management Knowledge Area consists of processes that span the Planning, Launching, Monitoring and Controlling, and Closing Process Groups. An effective procurement management life cycle consists of the following five phases:

- Vendor solicitation
- Vendor evaluation
- Vendor selection
- Vendor contracting
- Vendor management

10. Project Stakeholder Management - Project Stakeholder Management covers stakeholder identification, planning, management, and control. The PMBOK Guide defines a stakeholder as anyone who either affects or is affected by the project or its deliverables. The seven stakeholder types include: Sponsors, Clients, Customers, Business process engineers, Resource managers, Project managers, and Business analysts.

2.3 Project Schedule

A schedule is the conversion of a project action plan into an operating timetable. As such, it serves as the basis for monitoring and controlling project activity and, taken together with the plan and budget, is probably the major tool for the management of projects.

In a project environment, the scheduling function is more important than it would be in an ongoing operation because projects lack the continuity of day-to-day operations and often present much more complex problems of coordination. Indeed, project scheduling is so important that a detailed schedule is sometimes a customer-specified requirement. Properly designed, detailed schedule can also serve as a key input in establishing the monitoring and control systems for the project (Jack R. M., Samuel J. M. 2009).

2.4 Project Success

The definition of project success is obviously critical. After all, that's how you'll be judged as a project manager. Unfortunately, there are almost as many

definitions of project success as there are project management professionals. To add to the confusion, every organization has its own view of what matters in project outcomes (Gary R. H. 2002).

Since projects are temporary in nature, the success of the project should be measured in terms of completing the project within the constraints of scope, time, cost, quality, resources, and risk as approved between the project managers and senior management (PMBOK 5th edition).

Kerzner H. (2003) also defined Project success as the completion of an activity within the constraints of time, cost, and performance. This was the definition that has pertained for the past twenty years or so. Today, the definition of project success has been modified to include completion:

- Within the allocated time period
- Within the budgeted cost
- At the proper performance or specification level
- With acceptance by the customer/user
- With minimum or mutually agreed upon scope changes
- Without disturbing the main work flow of the organization
- Without changing the corporate culture

Cost, time and quality (The Iron Triangle), over the last 50 years have become inextricably linked with measuring the success of project management (Roger Atkinson, 1999). The most frequently used definition is that a project is a failure when it does not meet its cost, performance, time, or scope (C, P, T, S) targets. According to James P. Lewis (2008) there are a couple of things wrong with this definition. First, where did the targets come from? When they are just “pulled out of the air,” should failing to meet unrealistic targets be considered a failure? Second, even if all of these targets meet, does the project solve the problem it was intended to solve? Does the customer use it? If not, was it really a success? Characteristics that affect perceived project failure include:

- Insufficient use of progress/status reports
- Use of superficial status reports
- Inadequate project manager administrative, human, and technical skills
- Insufficient project manager influence and authority
- Poor coordination with client
- Lack of rapport with client and parent organization
- Client disinterest in budget criteria
- Lack of project team participation in decision making and problem solving
- Excessive structuring within the project team
- Job insecurity within the project team
- Lack of team spirit and sense of mission within the project team
- Parent organization stable, non dynamic, lacking strategic change

- Poor coordination with parent organization
- New “type” of project
- Project more complex than parent has handled previously
- Initial underfunding
- Inability to freeze design early
- Inability to close out the effort
- Unrealistic project schedules
- Inadequate change procedures (James P. Lewis 2008).

According to Eric Verzuh, (2003) the three variables (cost-schedule-quality equilibrium or triple constraint) define the overall goals of a project; therefore, any project that is “on time, on budget, high quality” is declared a success. Kerzner H. (2003) on the other hand stated that time, cost, and performance as the constraints on the project. If the project is to be accomplished for an outside customer, then the project has a fourth constraint: good customer relations.

Success factors by Kerzner H. (2003)

Primary	Secondary
• Within time • Within cost • Within quality limits • Accepted by the customer	• Follow-on work from this customer • Using the customer’s name as a reference on your literature • With minimum or mutually agreed upon scope changes • Without disturbing the main flow of work • Without changing the corporate culture • Without violating safety requirements • Providing efficiency and effectiveness of operations • Satisfying OSHA/EPA requirements • Maintaining ethical conduct • Providing a strategic alignment • Maintaining a corporate reputation • Maintaining regulatory agency relations

Table 2.1. Success Factors, Source: (Kerzner H. 2003)

Project success is often measured by the "actions" of three groups: the project manager and team, the parent organization, and the customer's organization (Kerzner H. 2001). And the success of the project can be evaluated on four different “levels”: (1) were the cost, schedule, and deliverable performance targets met? (2) Was the project managed in an efficient manner (3) is the customer happy and have the desired business results been achieved? And (4) did organizational learning take place that will lead to better projects in the future? (Gary R. H. 2002).

2.5 Project Delay

Delay in construction is a global phenomenon (Sambasivan and Soon, 2007) affecting not only the construction industry but the overall economy of countries as well (Faradi and El-Sayegh, (2006).

Delay (Time overrun) is a condition the actual work does not complete in an estimated time period. Delay or time overrun is defined as “a condition where a construction project does not complete within the designed time period”. It happens when the work of contract does not complete in its prescribed time. Time overrun is a most common incident which occurs nearly in all the projects related to the construction industry. Time delay is critical in developing countries where it exceeds its 100 % of estimated time while constructing a project (Muhammad A. *et. al.*, 2017). Delay in government construction projects, especially the road sector, has had a significant impact on economic activities in the country. Several road construction projects have littered the length and breadth of the country for which government has commenced that has yet to be completed (Twana A., 2015).

2.5.1 Delay or Time Overrun in Construction Projects

Cost, time, and quality have proven their importance as the prime measures for project success. According to Ahmed, *et al* delays on construction project are a universal phenomenon. They are usually accompanied by cost overruns. Delay has a negative effect on clients, contractors, and consultants in terms of growth in adversarial relationships, mistrust, litigation, arbitration, and cash-flow problems. A project may be regarded as a successful endeavor until it satisfies the cost, time, and quality limitations applied to it. However, it is not uncommon to see a construction project failing to achieve its goal within the specified cost, time, and quality.

Construction delays are more likely to happen in almost all projects due to the miscommunication between contractors, subcontractors, property owners or any other reasons. In many cases, construction projects are delayed because of inaccurate estimate of time and project cost that was initially presented to the clients or project owners. Delays and cost overruns are the most common problems causing delay in the construction industry in both developed and developing countries (Enshassi *et al*, 2009). In practice, delays occur in every construction project and the magnitude of these delays varies significantly from project to project and country to country (Wael *et al*, 2007). Cost and time overruns are the key problems of any construction projects. These issues are causing the negative impact on the development of country economic growth and prosperity (Raj K. Shah, 2016).

According to Mahamid, *et al.* 2012, delays are constantly occurring in road construction projects and they could causes great impact on economic growth and it is one of the common problems that upset the construction companies in terms of competitiveness and long term sustainable in the global market.

Generally delay (time overrun) is a condition the actual work does not complete in an estimated time period. Time overrun is a most common incident which occurs nearly in all the projects related to the construction industry. Time delay is critical in developing countries where it exceeds its 100% of estimated time while constructing a project. Most of the construction projects experienced schedule delay or time overrun (Muhammad A. *et. al.*, 2017). Delays in the time for completion may be caused in the progress of a building and construction contract by a wide range of events. These may be actions or omissions by the parties to the contract, but they may equally be unforeseen events such as latent conditions and actions, including legal actions, by third parties (Greg G., 2004).

S. A. Assaf and S. Al-Hejji (2006) on their survey on time performance of different types of construction projects in Saudi Arabia to determine the causes of delay and their importance according to each of the project participants, i.e., the owner, consultant and the contractor; the most common cause of delay identified by all the three parties is "change orders by owner during construction", 76% of the contractors and 56% of the consultants indicated that average of time overrun is between 10% and 30% of the original duration. Mahamid I. (2017) also concluded that schedule delays are extensive in road construction projects in Saudi Arabia. According to his finding the average ratio of planned contract duration to the actual completion time is 58.24%, ranging from 2% to 172%. His study indicated that the top five important factors affecting schedule delay in road construction projects are: improper planning, poor labor productivity, additional works, rework, and lack of contractor experience.

Construction projects varies in terms of complexity in nature, location, type of contract, communication between parties, and less experienced people in such situation can have significant risks to project delay and cost overrun (Ahmed *et al.*, 1999).

2.5.2 Types of Delay

Delays in construction projects have been put in various classifications by several authors but most of these classifications have a lot in common in terms of their fundamentals. Although various types of delays have been put in several studies, they are somewhat linked to one another.

Delays can be seen in these four major categories as explained by T. J. Trauner *et al* (2009); Critical or Non critical; Excusable or Non excusable; Compensable or Non compensable and Concurrent or Non concurrent. S. Kartam (1999) on the other hand classified delay based on their Origin (owner caused delays, contractor caused delays, third party caused delays); Compensability (excusable, non excusable, Non compensable delays); and Timing (concurrent, non concurrent delays).

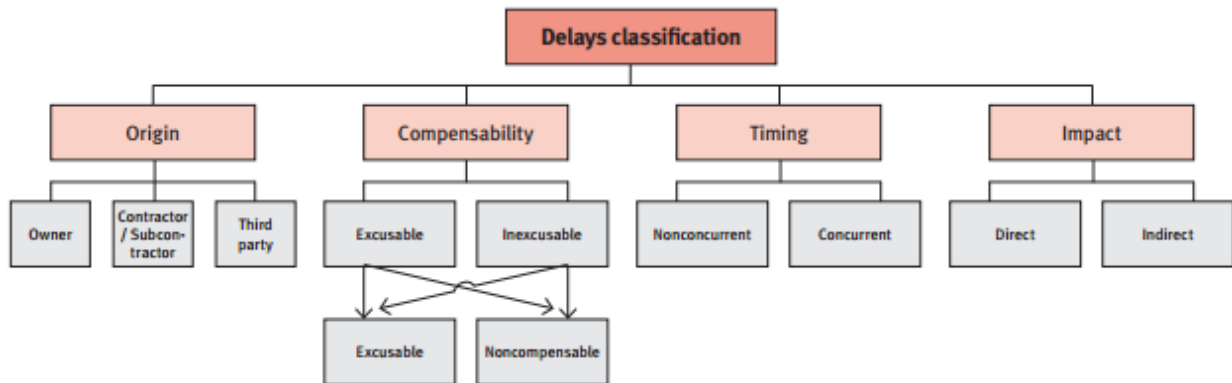


Fig 2.1 Classification of delay, Source: A. srdić, J. šelih (2015)

Muhammad A. *et al.*, (2017) classified time overrun (delay) based on the two methods: Excusable delay and Inexcusable delay (Non-Excusable delay).

Excusable delay: “Excusable delays are caused by conditions that are reasonably unforeseeable and not within the contractor’s control”. There are two types of excusable delays:

Non-compensable delays: It is a delay which is caused by third parties or incidents beyond the control of both the owner and the contractor. These delays are commonly called **“acts of God”** because they are not the responsibility or fault of any particular party. Examples include natural calamity, unhealthy weather and wrong doing by masses (strikes, fires, acts of government in its sovereign capacity, etc). Due to this, contractor gets extension in tie and does not pay any compensation to the owner and contractor for delay damages.

Compensable delays: It is a delay which is caused by the owner or the owner's agents. N. Hamzah *et al.* (2011). An example of non completion of drawings in the required time by the architect of the owner and it leads to the extension of the schedule and it imposes economical damages to the owner by the contractor. In this condition, the contractor will have to face extra indirect costs for both extended field office and home office.

Non-Excusable delays: Contractor or its suppliers are responsible for inexcusable delay and they are entitled to accelerate their work done in estimated time are to pay compensation to the owner. The contractor

compensate on the basis either on liquidated damages or actual damages. Liquidated damages base on the daily rate of estimated costs which is likely to incur in the delay of construction projects the owner by the contractor (Muhammad A. *et al.*, (2017). Late performance of subcontractors; late performance by suppliers; faulty workmanship by the contractor or subcontractors; a project specific labor strike caused by either the contractor's unwillingness to negotiate or by unfair job practices will lead to this type of delay.

Concurrent Delays: There is no clear definition for concurrent delays. S. Mubarak, (2005) defines Concurrent delay as a combination of two or more independent causes of delay occurring within the same time frame. According to (Trauner *et al.*, 2009) concurrent delays are simply defined as '*separate delays to the critical path that occur at the same time*'. Simultaneous delays, commingled delays, and intertwined delays are other names given for concurrent delays by (Nguyen, 2008). Overlapping delays is another name for concurrent delays name used by (Levy, (2006).

Categories of Delay

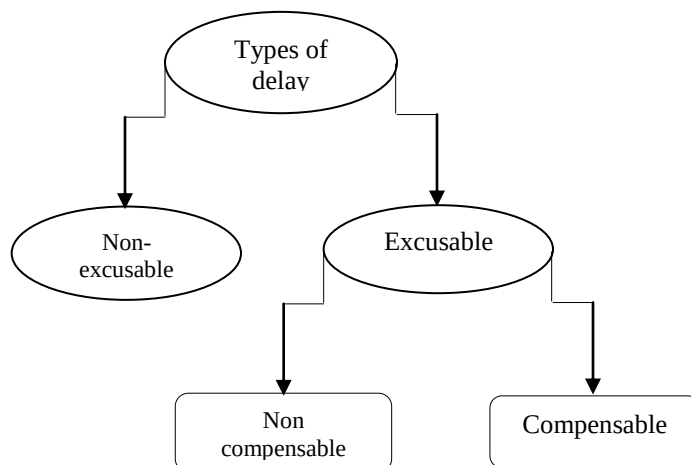


Fig: 2.2 Types of delays; Source: (Muhammad A. *et al.*, (2017).

Ahmed *et al.* (Syed M. Ahmed 2003) grouped the causes of delay by responsibility and type of delay. The result of the study as per ranking order include: Building permits approval, Change order, Changes in drawings, incomplete documents, Inspections, Changes in specifications, Decision during development stage. N. Hamzah *et al.* (2011) on their study 'Cause of Construction Delay in Malaysia- a theoretical framework: they also grouped the causes of delay by responsibility and types of delay.

2.5.3 Causes of Schedule Delay in Construction Projects

There are several causes or factors of delays that have been identified by researchers in the field of project management in the construction industry.

Some of these researchers have even attempted to categorize the causes of delays based on certain factors. These categories may have some geographical limitations and as such cannot be applied using a wholesale approach. This probably explains why there are several researches on the causes of delays in construction projects from several countries. Although there are some similarities in these findings, the differences reiterate the need to have geographic dimension to this subject matter (Twana A., 2015).

Many researchers have examined the main causes of construction delay in various types of construction projects. In Malaysia, Aftab H. M. (2014) in his study '*Contractor perspective on time overrun factors in Malaysian construction projects*' he concluded that the top ten most significant causative factors contributing to construction time overrun are frequent design changes; change in the scope of the project; financial difficulties of owner; delays in decisions making; unforeseen ground condition; delay in progress payment by owner; shortage of site workers; mistakes and Errors in design; delay preparation and approval of drawings; and incompetent subcontractors. Another study by Aftab *et al.*, (2011) on their study '*Time overrun in construction projects from the perspective of Project Management Consultant (PMC)*' in Malaysia: they concluded that major causes of time overrun by PMC are cash flow and financial difficulties faced by contractors; contractor's poor site management; inadequate contractor experience; shortage of site workers; ineffective planning and scheduling by contractors; escalation of material prices; practice of assigning contract to lowest bidder; problems with subcontractors; and lack of communication among parties.

Raj K. Shah (2016) on his study '*An Exploration of Causes for Delay and Cost Overruns in Construction Projects: in Australia, Malaysia & Ghana*' he identified the most influential causes of delay in Australia are (1) planning and scheduling deficiencies, (2) methods of construction, (3) effective monitoring and feedback process, whereas in Ghana, (1) delay in payment certificates (2) underestimating of project cost, (3) complexity of projects are the most influential factors. However, in Malaysia (1) Contractor's improper planning, (2) poor site management, (3) inadequate contractor experience are the most influential factors.

A study conducted by Arya A. and Kansal R. (2016) on their study '*Analyzing causes and effects of delays of construction projects in India*': they summarized the importance of delay factors from the contractors and consultants perspective. Late progress payment, financial problems of owner and improper study of design and three project-related factors {poor qualification of the contractor technical staff and project team, poor site arrangement, management, and poor terrain condition, and supervision} were in the top-10 lists of combined consultants and contractors. This indicates that concerns

related to the project and external factors were taken equally into account by combined contractors and consultants.

Siddesh K. Pai, and J. Raj Bharath (2013) in their study '*Analysis of Critical Causes of Delays in Indian Infrastructure Projects*' they concluded that too short original contract duration, delay in progress payments by owner, ineffective planning and scheduling of project by contractor, late in reviewing and approving design documents by consultant, mistakes and discrepancies in design documents, delay in material delivery, equipment breakdowns, shortage of labor, are effects of subsurface conditions (eg. Soil, high water table) are extremely critical causes of delay. Twana A. (2015) in his study at Kurdistan Region of Iraqi Federal Government; he concluded that delayed payments, financial processes and difficulties on the part of contractors and clients, contract modification, economic problems, materials procurement, changes in drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, and poor coordination on site, changes in specifications and labor disputes and strikes were found to be the major causes of schedule delays in road construction projects.

Muhammad A. *et al.*, (2017) on their study on Time Overrun in Public Sector Construction Projects in Pakistan as an example of developing countries: summarized their findings on the basis of average index the top most factors of time overrun in the form of non-excusable, non-compensable and compensable delay found on construction industry site as follows. Non-Excusable Delay: (1) Delay in shop drawings and sample materials; (2) Poor communication and coordination between parties; (3) Slowness in decision making process; (4) Suspension of work. Non-Compensable Delay: (1) Fire (2) Natural changing in environment; (3) Wind; (4) Snow fall. Compensable: (1) Poor site management and supervision by contractor (2) Poor communication and coordination by contractor with other parties; (3) Delays in sub-contractors work; (4) Delays in sub-contractors work.

Study on Schedule delay in Saudi Arabia Road Construction projects: size, estimate, determinants and effects by Ibrahim M. (2017) results show that the top five important factors affecting schedule delay in road construction projects in Saudi Arabia are: Improper planning; poor labor productivity; additional work (it can be as a deviation from an agreed upon well-defined scope and schedule); rework; and Lack of contractor experience. Baloyi L. & Bekker M. (2011) in their study '*Causes of construction cost and time overruns*' The 2010 FIFA World Cup stadia in South Africa: They concluded that the highest ranked contributors to time overrun on projects are concentrated around client actions, such as incomplete designs; design changes; slow decision-making; and late issue of instructions. For the contractor category the 'shortage of skills' proved to be the most significant delay factor.

Remon F. Aziz *et al.*, (2014) on their study 'Exploring delay causes of road construction projects in Egypt' they concluded that: financial problems, shortages in equipment, construction materials, skilled operators, inadequate experiences, reworks, changes or errors in design, delays in design submittal, soil and underground problems in investigation or management or expropriation, physical obstructions are the reasons for delay according to the questionnaire results. The cause (conflict, war, revolution, riot and public enemy) with revolution as in the 25 January revolution in Egypt made it to be from the top twenty causes of delay.

Study in Zambia by C. Kaliba *et al.*, (2008) in their study 'Cost escalation and schedule delays in road construction projects in Zambia' they concluded that: delayed payments, financial processes and difficulties on the part of contractors and clients, contract modification, economic problems, materials procurement, changes in drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, poor coordination on site, changes in specifications and labour disputes and strikes were found to be the major causes of schedule delays in road construction projects.

Kikwasi G. J. (2012) in his study 'causes and effects of delays and disruptions in construction projects in Tanzania': indicate seven highly ranked causes as design changes, delays in payment to contractors, information delays, funding problems, poor project management, compensation issues and disagreement on the valuation of work done. His study result also indicates that clients, consultants and contractors were involved in project delay with varying degrees. In particular, 78%, 70% and 56 for clients, consultants and contractors respectively have had projects delayed.

According to Henry A. *et al.*, (2013) on their study on Investigation into the causes of delays and cost overruns in Uganda's public sector construction projects: The five most important causes of delays in construction projects were found to be: changes to the scope of work, delayed payments, poor monitoring and control, the high cost of capital and political insecurity and instability.

And study on factors influencing successful completion of roads projects in Kenya by Ondari P. O. & Gekara J. M. (2013) indicates that supervision capacity statistically was seen to have the most significant relationship with timely completion of projects. The findings on supervision capacity further supported by financial difficulties are the major cause of suspension of works in construction projects leading to delay in the timely completion of projects. Another study in Kenya by Msafiri A. Seboru (2015) 'An investigation into factors causing delays in Road Construction projects in Kenya': he concluded that the combined views of the overall top five causes of delay identified by both consultants and contractors were: Payment by client; Slow decision-

making and bureaucracy in client organization; Claims; Inadequate planning / scheduling; and rain.

Aedwin R. V. and Shibi V. (2015) identified causes of delay related to owners, consultants, contractors, Labour, Equipment, and external factors. According to their study Owner related causes include (slow decision making, delay in delivering the site, payment delay, improper planning and scheduling, owner interference, change in orders, suspension of work, lack of communication, late decision making, conflicts among partners); Consultant (Inadequate experience, delay in approving drawings and samples, inadequate detailing and clarity in drawings, quality assurance control, mistakes & discrepancies in design documents); Contractor (delay in payment, delays in sub-contractor work, poor site management and supervision, rework due to errors, inexperience, poor qualification of staff, in effective planning, frequent change of subcontractor); Labour & Equipment (shortage of labour, low productivity level of labours, in-experienced work force, delay in material delivery, shortage of materials, shortage of equipment, equipment break down, low productivity & efficiency, poor operator skill, lack of communication); and External factors (change in government, poor soil conditions regulations, delay in obtaining permits, climatic factors, accidents during construction, delay in commissioning).

I. Mahamid (2013) in his study 'Frequency of time overrun causes in road construction in Palestine: Contractors' View; he identified factors of delay under different groups (project group, owner group, materials & equipments group, labour group, external group, contractor group, consultant group, and design group). Study in India by Divya. R., S. Ramya (2015) in their study on '*Causes, Effects and Minimization of Delays in Construction Projects*' they categorized the causes of delays into eight related groups namely: 1) Project group 2) Owner group 3) Materials and equipment group 4) Laborers group 5) External group 6) Design group 7) Contractor group 8) Consultant group.

2.5.3.1 Causes of Delay in Construction Projects in Ethiopia

Construction delay is a common problem in construction projects in Ethiopia and occurring in every type and phase of a construction projects. In Ethiopia, the construction industry is blooming and the road networks increasing from time to time all over the country. However the historical data of completed road projects shows that, none of the projects was completed as planned and within the estimated cost (Shambel and D. Patel, 2018). According to Werku and Jha 2016, Construction delays are occurring in every phase of a construction project and are common problems in construction projects in Ethiopia, and this is the major causes of project failure.

A number of researches have been carried out to examine the main causes of construction delay in various types of construction projects. Abubeker J. (2015) in his study '*Factors affecting time and cost overrun in road construction projects in Addis Ababa*' identified the most important causes of time overrun as: right of way problem, financial problems and improper planning and according to his survey result, project time overrun ranges from 25% to 264.38% of its original contract amount.

Siraw Y. (2014), in his study on analysis of factors contributing to time overruns on road construction projects under Addis Ababa City Administration' in Ethiopia, he concluded that slow site clearance, Inflation, progress payments delay by owner, contractors' financial problems, inaccurate cost estimation, and delay in commencement were the major causes of time overrun in Addis Ababa road construction. Werku and Jha (2016), in their study 'Investigating Causes of Construction Delay in Ethiopian Construction Industries' the ranking of groups based on their order of importance as: (1) Contractor's related factors, (2) Material related factors, (3) Labour related factors, (4) Designer's related factors, (5) Consultants/supervisors related factors, (6) Client related factors, (7) External related factors.

Tsegay and H. Luo (2017) on their study 'Analysis of Delay Impact on Construction Project based on RII and Correlation Coefficient: 'they summarized their findings on the bases of the average relative important index (RII), the major classification of causes of delay and investigated as external, responsibility, resource, and contract related; for all stages except they influenced by different level and sub groups of cause of delay.

1) Responsibility Related Causes

I) Client related causes: Lack of on time finance and payments, Interference on execution of work, Slowness in decision making, Late in site delivery for construction work and design, Improper project feasibility study, Poor communication and coordination,

II) Contractor related causes: Subcontractors related problems, Poor site management & performance, Ineffective project planning and scheduling, inappropriate construction methods, Poor communication and coordination, inadequate contractor experience, Rework for correcting unsatisfactory work.

III) Consultant related causes: Inadequate experience of consultant, Late in approving and receiving of complete work, Poor supervision and late testing & inspection, Poor communication and coordination.

IV) Designer related causes: Unclear and inadequate details and specification, late design and design documents, Design mistakes and errors, Misunderstanding of client's requirements.

2) Resource Related Causes

I) Construction Material related causes: Lack of quality materials, Slow delivery of material, Changes in material types and specifications, Damage of materials, Inflation /price increases in materials.

II) Finance related causes: Problem of process of financial claims, Government funding processes, Late release budget/ funds, Global financial crisis.

III) Labor related causes: Low productivity, Less motivation and morale, Unqualified /inexperienced workers, Discipline problem (conflicts and Absenteeism), Labor accidents and injuries.

IV) Equipment related causes: Insufficient or shortage of equipment, Low efficiency and productivity of equipment, Failures of equipment and lack of spare parts, Equipment allocation or mobilization problem, Equipment out dated.

3) Contract condition related causes: Absence of alternative dispute resolution (ADR), Mistakes & ambiguities in contract document, Unrealistic contract durations and cost, Inadequate delay penalties/poor incentives in contract, Insufficient details in contract documents, Lack of clear understanding of contract documents.

4) External Causes: Adverse weather condition, Force majeure (acts of God), Corruption, Effect of social and cultural factors, Policy and commitment of government, Unavailability of utilities at site.

In their study in different construction stage of projects Tsegay and H. Luo (2017) indicated that, the influential causes of delay investigated are corruption, unavailability of utilities at site, inflation/price increases in materials, lack of quality materials, late design and design documents, slow delivery of materials, late in approving and receiving of complete project work, poor site management and performance, late release budget/funds, and ineffective project planning and scheduling.

2.5.4 Effects/Consequences of Delay

Delay in construction can have a number of consequences in a project, such as late completion, lost productivity, acceleration, consequential damages, increased cost and contract termination. The party experiencing damages from delays needs to be able to recognize the delays and the parties responsible for

them in order to recover time and cost (Aedwin R. Varghese, and Shibi V. 2015).

There are numerous elements bringing about deferment, some of them are inside the contractual worker's obligation and some are inside proprietor's risk. The consequences of delay are different for different project participants which also depend on the type of project. The general consequences are cost overrun, time overrun etc. For the owner/client delay is the loss of money, loss of time, loss of other facilities etc. For the contractor, delay means the loss of wealth for more expenditure on equipment's, other materials and for hiring the skilled labour (Tushar *et al.*, 2016). Divya R. & S. Ramya (2016) also explained effects of delay as time overrun, cost overrun, dispute, total abandonment, arbitration, and litigation.

2.5.5 Methods of Minimization of construction delays

When there is a construction delay, time overrun is inevitable, there may be also a cost overrun and it can lead to the project to suffer financially, disputes may also arise among project stakeholders. Therefore project stakeholders must work to minimize risks that such delay will occur. Divya. R. and S. Ramya (2015) recommended following points in order to minimize and control delays in construction projects: Frequent progress meeting; Use up-to-date technology utilization; Use proper and modern construction equipment; Use appropriate construction methods; Effective strategic planning; Proper material procurement; Accurate initial cost estimates; Clear information and communication channels; Frequent coordination between the parties involved; and Proper emphasis on past experience.

Conceptual Framework

Delays occur in every construction project and the magnitude of these delays varies considerably from country to country even project to project based on prevailing factors contributing to construction projects.

A number of studies have been conducted in regard to delays in construction projects for decades with scholars advancing various factors and groups of factors that contribute to causing delays.

From the literatures reviewed during this study 61 delay causes were identified. Each delay cause is described on the questionnaire designed for the survey. Literatures reviewed indicate categorization of various factors in groups of up to eight (8) categories of owner related, consultant related, contractor related, design-related, labour related, material & equipment related, project related, and external factor related. However L. Muhwezi *et al* (2014) they grouped in to four broad categories of causes of schedule delays in

construction projects as clients related, consultant related, contractors related and external factors related. This study therefore, re-clustered these factors into four (4) broad categories of client related, consultant related, contractor related, and external related factors.

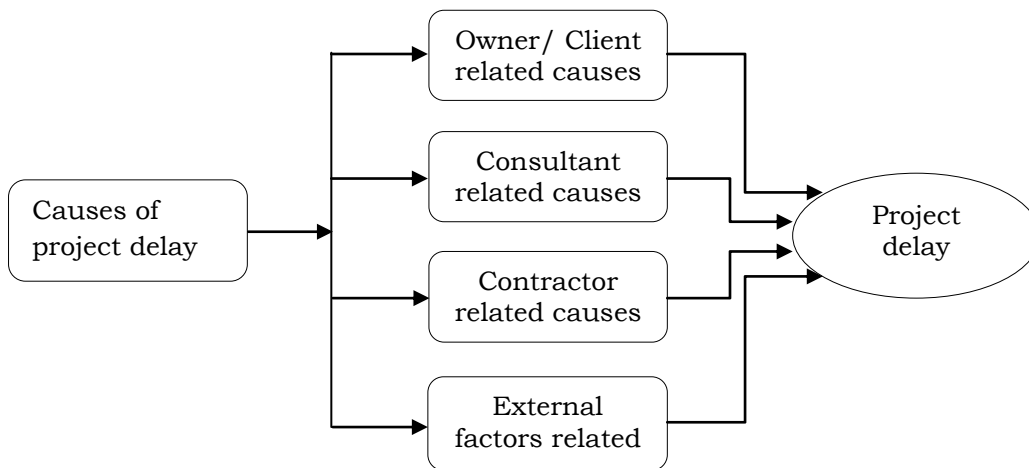


Fig: 2.3 Conceptual framework

CHAPTER THREE: RESEARCH METODOLOGY

1.1 Introduction

This chapter deals with the methodology and procedures followed to determine the style and methods of collecting information and data from the study population through field sources. The aim of this study is to identify the common causes of delay in road construction projects from the owner, contractor, and consultant perspectives. This chapter discusses the scope of research, research design, description of study population, study sample, methodology, location and statistical tools used in the research.

3.2. Research Design

The research methodology is a description of how the objectives can be realized. In this study quantitative research methods were employed. For this purpose a questionnaire was developed to assess the perceptions of owners, contractors and consultants on the relative importance of causes and effects of delays in road construction projects. Quantitative data were obtained through questionnaire. The data collected through these methods will be analyzed and the results will be presented.

3.3. Types and Sources of Data

Both primary and secondary data were used in relation to the topic under discussion. Primary source of data obtained through questionnaire results. Secondary data collected from secondary sources of data such as books, journals, reports, and related articles from the internet. The sources of data were the main parties in the construction namely; owner/ client, contractor and consultant.

3.4. Data collection and Instrument

The data used in this study were gathered from the main parties in the construction (clients, contractor, and consultants) who participated in the road construction project using questionnaire and document review. Questions used in the questionnaire are close ended (based on likert scale).

Document review was also employed to collect relevant secondary data from secondary sources (project completion reports, books, journals, reports, contract documents).

The questionnaire used in this study was adopted from the questionnaire used by L. Muhwezi *et al* (2014), based on the literature review and some additional suitable questions developed with the expert assistance in the field under study. The questionnaire has 61 well-organized road construction project delay

causes and these causes were categorized into the following four major groups such as Client related, Consultant related, Contractor related and External factor related delay causes. Delay causes related to each groups are described on the questionnaire.

The questionnaire designed to assess the perspective of respondents from each group (clients, consultants and contractors) on the importance/severity and likelihood /frequency of occurrence of delay causes. Then the calculated mean has been taken to compute the Relative Importance Index and to rank each delay attribute based on their order of importance.

3.5. Study Population and Sampling procedure and Sample Size

3.5.1 Study Population

The population of the study comprises the main parties of road construction projects namely owners/client staff, Contractor (PM, office engineers, site engineers, materials engineers, highway engineer & supervisors) and consultants (resident engineer) who are involved in road construction projects. The study population only covers employees with engineering educational background and engaged in road construction projects. Therefore out of the total number of employees who are engaged in road construction project work, only 10.96% or 25 employees are professional engineers, project managers and supervisors with more than one year of experience in road project construction.

3.5.2 Sampling Procedure

Purposive (non probability, deliberate) sampling technique was used to select the respondents under owners, consultants and contractors. This method is used because of the small number of study population. William, (2005) indicates the importance of purposive sampling method in allowing the researcher to get information from a sample of the population that one thinks knows most about the subject matter.

3.6. Data Analysis

The data obtained from the survey used a Likert scale range from 1 (very low) to 5 (very high) and the data analysis is determined to establish the relative importance of various factors that contribute to construction delays. Ranking of the attributes in terms of their criticality as perceived by the respondents was done by use of Relative Importance Index (RII). Divya. R, S. Ramya (2015), L. Muhwezi *et al* (2014), and Tsegay G., Hanbin Luo (2017) 4) used the RII method to determine the relative importance of the various causes of delays for construction projects. The same method is adopted in this study.

Analysis of data consists of the following:

- 1) Calculating the Relative Importance Index (RII)

2) Ranking of factors in each category based on the Relative Importance Index (RII)

$$RII = \frac{\sum W}{A * N}$$

Where,

RII is the Relative Importance Index,

W = weighting given to each factor by the respondents (ranging from 1 to 5),

A = highest weight (i.e. 5),

N = total number of respondents.

The values of RII ranges from 0 to 1 (0 not inclusive); the higher the RII, the more important the cause of delay is. The RII value is ranked and the results are shown using tables and/or graphs. The RII is used to rank different causes. The RII then being classified based on the RII classification table as shown below in table 3.1.

Scale	Level of Importance	RII
1	Not Important at all	$0.0 < RII \leq 0.2$
2	Slightly Important	$0.2 < RII \leq 0.4$
3	Moderately Important	$0.4 < RII \leq 0.6$
4	Important	$0.6 < RII \leq 0.8$
5	Highly Important	$0.8 < RII \leq 1.0$

Table 3.1 Classification of RII

A five point likert scale ranging from “very high” to “very low” effect was used. The same classification is used as Jawal N. A. (2015) used in his study “Assessment of delay causes of construction projects in Palestine”. If the mean value ranging:

From 1 - 1.8	Considered to be Very low effect
1.81 - 2.6	Low effect
2.61 - 3.4	Medium effect
3.41 - 4.2	High effect
4.21 - 5.0	Very high effect

3.7. Ethical Considerations

Ethical consideration is part of this study. Documents reviewed from the organization will remain confidential. Name of projects also changed using codes for the sake of confidentiality. The findings and results from this study will not used for other purpose. During this study respondents are also free to respond their own opinion from their experience, and their personal information such as name and religion was not mentioned.

CHAPTER FOUR: RESULT AND DISCUSSION

This chapter deals with the presentation of the data collected from respondents through questionnaire and document review. An attempt was made to collect relevant data from targeted contractors, Clients/owner, and consultants through designed questionnaire. The questionnaire used in this study has Sixty one set of questions which are related to clients, contractors, consultants, and external factors.

4.1. Respondents Characteristics

Among the 42 responses two of them were only partially completed. 50% of the responses were from the contractor group and the rest 50% of the responses were from clients and consultants 25% from each group.

Respondent	Questionnaire Distributed (#)	Questionnaire Collected (#)		Response from Total (%)
		Invalid/ Incomplete Questionnaire	Complete/ Valid response	
Clients	13	2	10	25%
Consultant	12	-	10	25%
Contractor	25	-	20	50%
Total	50	2	40	100%

Table 4.1 Distributed Questionnaires, Respondents and Response

Respondents by Educational Background

Figure 4.1 shows that among the 40 respondents only one respondent have diploma, 65% or 26 respondents have 1st degree, and 32.5% or 13 respondents have 2nd degree (Masters Degree) in civil engineering.

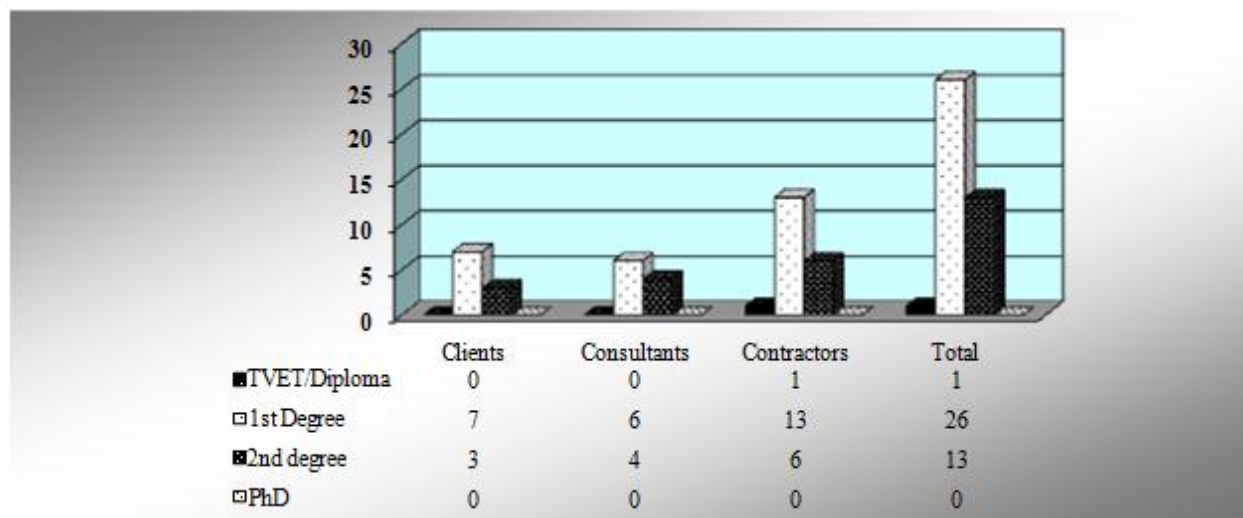


Figure 4.1 Respondents by educational background

Respondents Experience in Road Construction

Among the respondents 15% or 6 respondents have 1 to 5 years experience, 35% or 14 respondents have 6 to 10 years of experience, 47.5% or 19 respondents have 11 to 15 years of experience, and 2.5% or 1 respondent have 16+ years of experience in road construction. Werku & Jha (2016), Aziz (2013), Owolabi J. D., *et al* (2014), and N. Jawal (2015) used similar groupings of respondent's years of experience in their study as indicated below.

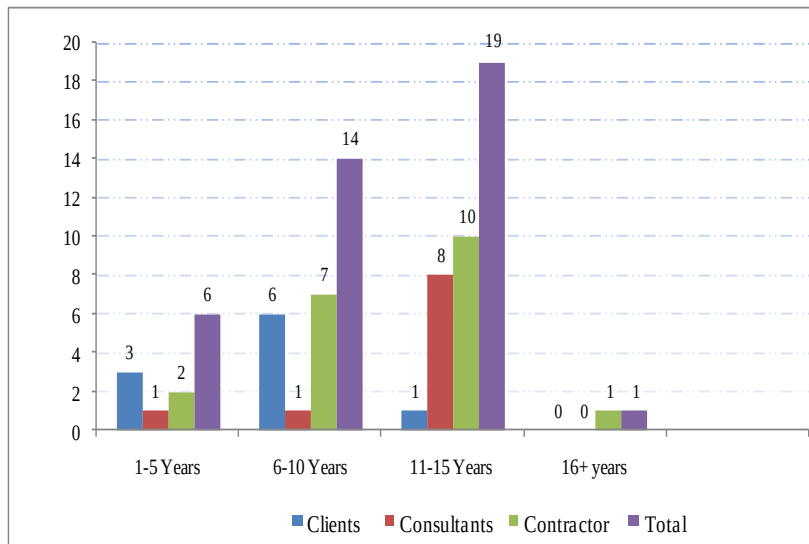


Fig 4.2: Work experience of respondents (in years)

Respondents by Gender and Age

Table 4.2 shows that among the total of 40 respondents 95% or 38 respondents are male and only 5% or 2 respondents were female and regarding the age group 20% or 8 respondents are 21-30 years of age, 57.5% or 23 respondents are between 31-40 years of age, and 22.5% or 9 respondents are between 41-50 years of age.

Respondents	Male				Female			
	Age (in years)				Age (in years)			
	21-30	31-40	41-50	>51	21-30	31-40	41-50	>51
Clients	3	7	-	-	-	-	-	-
Consultants	1	7	2	-	-	-	-	-
Contractors	3	8	7	-	1	1	-	-
Total	7	22	9	-	1	1	-	-

Table 4.2: Respondents by Gender and Age

4.2 Organization performance on road projects construction

S. N	Project Name	Contract Signed Date	Contract duration	Length in Km	Date of commencement	Original completion date	Actual completion date	Total No of delay in (Days)	Delay in %
1	A	Jan 2016	270 CD	7.2	03 Mar, 2017	03 Dec, 2017	Current status (93%)	180 to date	66.67
2	B	24 Mar, 2016	240 CD	2.3	8 Apr, 2016	04 Dec, 2016	Current status (90%)	545 to date	227.08
3	C	29 June 2016	365 CD	4.2	13 July 2016	13 July 2017	Current status (89%)	317 to date	86.85
4	D	20 June 2016	120 CD	2.1	15 Sept, 2016	13 Jan 2016	Current status (50%)	865 to date	720.83
5	E	21 Jan, 2015	300 CD	7.82	01 Feb, 2015	28 Nov, 2015	22 Apr, 2017	512	170.67
6	F	16 June 2012	540 CD	3.35	14 July 2012	07 Dec, 2013	June 2015	540	100
7	G	3 Oct 2011	300 CD	6.5	11 Oct 2011	26 July 2012	27 Nov 2014	840	280
8	H	17 May 2015	180 CD	3.33	18 May 2015	18 Nov, 2015	Dec 2016	395	219.4
9	I	12 June 2014	300 D	3.5	13 July 2014	14 May 2015	May 2018	1105	368.33

Table 4.3 Performance of road projects construction

The above Table 4.3 shows that almost all completed road projects were completed beyond their original completion date. Ongoing projects also running far behind the schedule from the minimum of 66.67% to the maximum of 720.83% at their current status, the percentage of delay will also increase at their actual completion. The extent of project delay for completed projects ranges from 100% to 368.33% with the average delay equals to 227.68%. The causes of road construction projects delay are vary project to project based on complexity and nature of the project, location of the projects, type of contract, and communication between project stakeholders. Possible causes of delay identified and classified under four major categories (clients, consultants, contractor, and external related) which are used on survey questionnaire.

4.3. Causes of Schedule delay in road construction projects

This part of the paper consists of results and discussion of causes of schedule delay in road construction projects. The causes of delay are discussed under four groups, Causes related to clients, delay causes related to consultants, causes related to contractors and related to external factors. Each delay causes are assessed from the view point of clients, consultants and contractors. Each factor is evaluated and ranked based on their severity/importance and likelihood of occurrence as perceived by respondents and the calculated mean are taken to rank delay causes using Relative Importance Index (RII).

4.4. Client related delays

S. N	Causes of Delay	Clients			Consultants			Contractors			Average		
		Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank
1	Delay of financing and payments by owner	3.55	0.71	1	4.7	0.94	1	4.15	0.83	1	4.133	0.827	1
2	Delay in decision making	3.3	0.66	3	4.0	0.80	3	3.575	0.715	3	3.625	0.725	2
3	Delay in revising and approving documents (design, drawings, submittals, sample materials etc.) by owner	3.5	0.70	2	3.8	0.76	5	3.375	0.675	5	3.558	0.712	3
4	Intermittent stoppage of work due to cash flow constraints	3.3	0.66	3	3.9	0.78	4	3.275	0.655	6	3.492	0.698	4
5	Delay in site delivery to the contractor	2.95	0.59	5	4.2	0.84	2	3.275	0.655	6	3.475	0.695	5
6	Design changes by owner or his agent during construction	2.7	0.54	10	3.35	0.67	7	3.575	0.715	3	3.208	0.642	6
7	Corruption tendencies	2.5	0.50	11	3.5	0.70	6	3.6	0.72	2	3.2	0.640	7
8	Suspension of work	2.95	0.59	5	3.35	0.67	7	3.125	0.625	10	3.142	0.628	8
9	Poor communication and coordination with other parties	2.8	0.56	9	3.1	0.62	9	3.25	0.65	8	3.05	0.610	9
10	Lack of experience of owner in road construction projects	2.85	0.57	8	2.75	0.55	11	3.0	0.60	11	2.867	0.573	10
11	Bureaucracy (Excessively complicated administrative procedure)	2.45	0.49	12	2.6	0.52	13	3.15	0.63	9	2.733	0.547	11
12	Changes in material types and specifications during construction	2.3	0.46	14	2.8	0.56	10	2.9	0.58	12	2.667	0.533	12

13	Unrealistic enforced contract duration	2.9	0.58	7	2.65	0.53	12	2.375	0.475	15	2.642	0.528	13
14	Delay by owner in handing over process or approval of completed work	2.4	0.48	13	2.15	0.43	14	2.4	0.48	14	2.317	0.463	14
15	Unfavorable contract clauses	2.0	0.40	15	1.75	0.35	15	2.625	0.525	13	2.125	0.425	15
	Grand Mean	2.83	0.566		3.24	0.648		3.177	0.635		3.082	0.617	

Table 4.4 Client related delays

The results presented in Table 4.4 above show that from the 15 delay causes related to the clients/ owner, “Delay of financing and payments by owner” ranked on the first place by all groups of respondents (clients, consultants and contractor) with the mean value of 4.133 or the average relative importance index value equals to (RII=0.827). Respondents from consultants group considered “Delay of financing and payments by owner” as the most important causes contributing to schedule delay by giving the highest point (4.7) among this category of delay causes.

The second most important client related cause of delay is “Delay in decision making” with relative importance index value of (0.725), followed by “Delay in revising and approving documents (design, drawings, submittals, sample materials etc.) by owner” (RII=0.712).

“Intermittent stoppage of work due to cash flow constraints”, “Delay in site delivery to the contractor”, “Design changes by owner or his agent during construction”, “Corruption tendencies”, “Suspension of work”, “Poor communication and coordination with other parties”, and “Lack of experience of owner in road construction projects” are among the client related causes of delay with their order of importance with a relative importance index values of (RII=0.698), (RII=0.695), (RII=0.642), (RII=0.640), (RII=0.628), (RII=0.610), & (RII=0.573) respectively.

From this group of category (client’s related delays), “Corruption tendencies” is the second most important delay causes in the view of contractors next to “Delay of financing and payments by owner” followed by “Delay in decision making by owner”, and then “Design changes by owner or his agent during construction” even the clients have not recognized it as most influential causes of delay. L. Muhwezi *et al* (2014) categorized “corruption tendencies” under client related delay causes, so in this study too.

From the analysis depicted on Table 4.4 above, we conclude that the degree of effect of the causes of delay in road construction projects is as follows: Delay of financing and payments by owner, Delay in decision making, Delay in revising and approving documents (design, drawings, submittals, sample materials etc.) by owner, Intermittent stoppage of work due to cash flow constraints and Delay in site delivery to the contractor are appeared high impacts on delays and delay by owner in handing over process or approval of completed work, and unfavorable contract clauses are the appears to be low impact on delays from this category with the mean value of 2.317 and 2.125 respectively.

4.5. Consultant related delays

S. N	Causes of Delay	Clients			Consultants			Contractors			Average		
		Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank
1	Insufficient estimation of original contract duration	4.15	0.83	1	4.25	0.85	1	3.575	0.715	2	3.992	0.798	1
2	Delay in approval of submittals, design drawings, and sample materials, etc.	3.5	0.70	3	3.8	0.76	2	3.375	0.675	5	3.558	0.712	2
3	Inadequate site investigation	3.6	0.72	2	2.85	0.57	6	3.4	0.68	4	3.283	0.657	3
4	Corruption tendencies	2.5	0.50	10	3.5	0.70	3	3.6	0.72	1	3.2	0.640	4
5	Lack of experience of consultants	3.05	0.61	6	3.1	0.62	4	3.45	0.69	3	3.2	0.640	4
6	Mistakes or discrepancies in documents or design & specifications issued by consultants	3.5	0.70	3	2.8	0.56	7	3.075	0.615	8	3.125	0.625	6
7	Poor communication and coordination with other parties	2.8	0.56	8	3.1	0.62	4	3.25	0.65	7	3.05	0.610	7
8	Delay in performing inspection and testing	3.4	0.68	5	2.75	0.55	8	2.975	0.595	10	3.042	0.608	8
9	Slow response to contractor inquiries	2.9	0.58	7	2.55	0.51	10	3.325	0.665	6	2.925	0.585	9
10	Delay in preparing interim payment certificates	2.4	0.48	11	2.75	0.55	8	3.075	0.615	8	2.742	0.548	10
11	Unclear and inadequate details in drawings	2.75	0.55	9	2.35	0.47	11	2.75	0.55	11	2.617	0.523	11
	Grand Mean	3.14	0.628		3.073	0.615		3.259	0.652		3.157	0.632	

Table 4.5 Consultants related delays

The relative importance indices and ranks of the eleven (11) factors that are classified under the "Consultant related factors category" are shown in Table 4.5. "Insufficient estimation of original contract duration" identified as the most important causes of delay among the consultant related causes of delay and ranked on the first place by respondents from clients and consultants and second place by contractor groups with the mean value of (3.992) or average relative importance index values of (RII=0.798). "Delay in approval of submittals, design drawings, and sample materials, etc" ranked second with the RII values of (RII=0.712), followed by "Inadequate site investigation" (RII=0.657) and "Corruption tendencies" (RII=0.640), then "Lack of experience of consultants" (RII=0.640).

According to the questionnaire survey result "Mistakes or discrepancies in documents or design & specifications issued by consultants" (RII=0.625), "Poor communication and coordination with other parties" (RII=0.610), "Delay in performing inspection and testing" (RII=0.608), "Slow response to contractor inquiries" (RII=0.585), and "Delay in preparing interim payment certificates" (RII=0.548) ranked from six to ten based on their order of importance.

Based on the respondents from the contractor group "corruption tendencies" is the most influential causes (high impact value) of delay in this category ranked in the first place followed by "Insufficient estimation of original contract duration", and then "Lack of experience of consultants".

From the analysis depicted on Table 4.5 above, we conclude that, all of the delay causes in this category except the first two factors are appeared to medium impacts on delays in road construction projects.

4.6. Contractor Related Delays

S. N	Causes of Delay	Clients			Consultants			Contractors			Average		
		Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank
1	Deficiency in planning and scheduling of project	4.7	0.94	1	4.6	0.92	2	4.175	0.835	1	4.492	0.898	1
2	Difficulties in financing the project by contractor	3.9	0.78	2	4.8	0.96	1	3.525	0.705	3	4.075	0.815	2
3	Under estimation of cost of the road project by contractor	3.8	0.76	3	4.45	0.89	4	3.275	0.655	9	3.842	0.768	3
4	Frequent equipment breakdowns /Equipment failure/	3.15	0.63	9	4.5	0.90	3	3.425	0.685	5	3.692	0.738	4
5	Delay in mobilization	3.45	0.69	6	4.1	0.82	6	3.425	0.685	5	3.658	0.732	5
6	Delay in procurement and procedures of long lead items	3.5	0.70	5	4.15	0.83	5	3.175	0.635	13	3.608	0.722	6
7	Shortage of equipment	2.8	0.56	14	4.0	0.80	7	3.65	0.73	2	3.483	0.697	7
8	Delays due to material delivery	3.15	0.63	9	3.7	0.74	10	3.475	0.695	4	3.442	0.688	8
9	Poor site management and supervision	3.55	0.71	4	3.7	0.74	10	3.075	0.615	16	3.442	0.688	8
10	Inappropriate construction methods	3.1	0.62	11	3.25	0.65	16	3.35	0.67	8	3.233	0.647	10
11	Shortage of construction materials	2.65	0.53	17	3.8	0.76	9	3.2	0.64	11	3.217	0.643	11
12	Low productivity of labor	2.55	0.51	18	3.55	0.71	13	3.425	0.685	5	3.175	0.635	12
13	Difficulty in accessing Bank (Credit, LC etc)	2.85	0.57	13	3.65	0.73	12	2.975	0.595	19	3.158	0.632	13
14	Incompetent project team	2.5	0.50	20	3.9	0.78	8	3.05	0.61	17	3.15	0.630	14
15	Unsafe practice at site (Poor safety conditions on site)	3.4	0.68	7	3.05	0.61	19	2.85	0.57	22	3.1	0.620	15
16	Poor communication and coordination with other parties	2.8	0.56	14	3.1	0.62	18	3.25	0.65	10	3.05	0.610	16
17	Centralization with Top Management	3.2	0.64	8	2.6	0.52	23	3.125	0.625	15	2.975	0.595	17
18	Inadequate contractor experience	2.4	0.48	21	3.55	0.71	13	2.95	0.59	20	2.967	0.593	18
19	Unreliable subcontractors	2.95	0.59	12	2.75	0.55	21	3.15	0.63	14	2.95	0.590	19
20	Under estimation of complexity of the road projects	2.4	0.48	21	3.2	0.64	17	3.2	0.64	11	2.933	0.587	20
21	Equipment allocation problem	2.55	0.51	18	3.05	0.61	19	3.05	0.61	17	2.883	0.577	21

22	Unqualified workforce	2.25	0.45	24	3.35	0.67	15	2.875	0.575	21	2.825	0.565	22
23	Delays related to sub-contractors work	2.8	0.56	14	2.6	0.52	23	2.775	0.555	24	2.725	0.545	23
24	Shortage of labors	2.4	0.48	21	2.7	0.54	22	2.55	0.51	25	2.55	0.510	24
25	Rework due to errors during construction	2.2	0.44	25	2.55	0.51	25	2.525	0.505	26	2.425	0.485	25
26	Personal conflicts among labor	1.85	0.37	26	1.45	0.29	26	2.825	0.565	23	2.042	0.408	26
	Grand Mean	2.956	0.591		3.465	0.693		3.166	0.633		3.196	0.639	

Table 4.6 Contractor related delays

From the analysis depicted on Table 4.6 above, we conclude that “Deficiency in planning and scheduling of project” is appeared to have very high impact on delays in road construction projects with the mean value of 4.492. The relative importance indices and ranks of the twenty six (26) factors that are classified under the “Contractor related factors category” are shown in Table 4.6. The survey result shows that “Deficiency in planning and scheduling of project” considered as the most important causing delay in road construction projects at the category of contractor related causes of delay with the average Relative Importance Index equals to 0.898. Respondents from Client group ranked “Deficiency in planning and scheduling of project” on the first place and “Difficulties in financing the project by contractor” on second place with the mean value of 4.7 and 3.9 respectively. However, “Difficulties in financing the project by contractor” considered by respondents from consultant group as the most important delay causing factor with the mean value of 4.8 followed by “Deficiency in planning and scheduling of project” with the mean value of 4.6.

“Difficulties in financing the project by contractor” (RII=0.815), “Under estimation of cost of the road project by contractor” (RII=0.768), “Frequent equipment breakdowns /Equipment failure/” RII=0.7383, “Delay in mobilization” (RII=0.732) are among the top five most important causes of delay in this category. “Shortage of equipment”, “Delay in procurement and procedures of long lead items”, “Delays due to material delivery”, “Poor site management and supervision”, and “Inappropriate construction methods” ranked from six to ten among contractor related delay causes based on their order of importance.

Based on the survey result “Under estimation of cost of the road project by contractor”, “Poor site management and supervision” and “Delay in procurement and procedures of long lead items” ranked by clients from third to fifth place among this category (Contractor related) of delay causes, even though contractors deny this by ranking these causes on nine, sixteen and thirteen place respectively.

According to the survey result, the least important causes of delay in this category identified as “Personal conflicts among labor” with the mean value given by respondents from client and consultant groups 1.85 and 1.45 respectively and with the average Relative Importance Index Value equals to 0.408.

The grand mean values of all causes of this group equals to 3.196. Among the respondents of the three groups (clients, consultants, and contractors), consultants gave the highest mean value for this group of causes which is equals to 3.465.

4.7. External Factor Related Delays

S. N	Causes of Delay	Clients			Consultants			Contractors			Grand Average		
		Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank
1	Inflation and fluctuation of material prices	4.3	0.86	1	4.5	0.90	1	4.125	0.825	1	4.308	0.862	1
2	Unforeseen site conditions (Unexpected subsurface conditions e.g. Soil type, Utility line, high water table, etc.)	3.55	0.71	2	3.35	0.67	3	3.175	0.635	2	3.358	0.672	2
3	Unforeseen Weather conditions (rain)	2.9	0.58	5	3.95	0.79	2	3.025	0.605	3	3.292	0.658	3
4	Geopolitical and regional stability	3.05	0.61	4	2.8	0.56	4	2.85	0.57	5	2.9	0.580	4
5	Global financial crisis	3.15	0.63	3	2.15	0.43	9	2.725	0.545	7	2.675	0.535	5
6	Restriction at job site (Poor site access, traffic congestion)	2.75	0.55	7	2.35	0.47	8	2.65	0.53	8	2.583	0.517	6
7	Delay in performing final inspection and certification by a third party	2.55	0.51	8	2.6	0.52	7	2.5	0.50	10	2.55	0.510	7
8	Lack of site utilities or services such as (water, electricity, etc.)	1.85	0.37	12	2.7	0.54	6	2.875	0.575	4	2.475	0.495	8
9	Problem with nearby structure or facilities (Disturbance to public activities, effect of social and cultural factors)	2.85	0.57	6	1.65	0.33	12	2.85	0.57	5	2.45	0.490	9
10	Force Majeure (earthquake, etc.)	2.45	0.49	9	2.75	0.55	5	2.025	0.405	13	2.408	0.482	10
11	Changes in government regulations and laws	2.05	0.41	11	2.15	0.43	9	2.25	0.45	12	2.15	0.430	11
12	Accident during construction	2.25	0.45	10	1.5	0.30	13	2.6	0.52	9	2.117	0.423	12
13	Culture in public holidays	1.4	0.28	13	1.9	0.38	11	2.475	0.495	11	1.925	0.385	13
	Grand Mean	2.7	0.54		2.642	0.528		2.779	0.556		2.707	0.541	

Table 4.7 External factor related delays

The results presented in Table 4.7 shows that the relative importance indices and ranks of the thirteen (13) factors that are classified under the “External related factors category”. The surveyed clients, consultants, and contractors ranked the “*Inflation and fluctuation of material prices*” as the most important causes of delay in road construction projects with the mean value of 4.3 given by clients, 4.5 by consultants, 4.125 by contractors, and with the average mean value of 4.308, or with a Relative Importance Index values of (RII=0.862). Respondents from all groups have relatively similar ranking of causes of this category.

The respondents attributed the second important causes of delay from this category is “Unforeseen site conditions (Unexpected subsurface conditions e.g. Soil type, Utility line, high water table, etc.)” (RII=0.672), followed by “Unforeseen Weather conditions (rain)” (RII=0.658), and “Geopolitical and regional stability” (RII=0.580), then Global financial crisis (RII=0.535). The least important causes of delay in this category include “Culture in public holidays” (RII=0.385), “Accidents during construction” (RII=0.423), and “Changes in government regulations and laws” with a relative importance index value equals to 0.430.

The grand mean values of all causes in this group given by contractors (2.779) are slightly higher than the value given by consultants (2.642) and clients (2.7) and the average mean equals to (2.707).

4.8. Ranking of group causes

S.N	Group	Clients		Consultants		Contractor		Average		
		RII	Rank	RII	Rank	RII	Rank	Mean	RII	Rank
1	Contractor	0.591	2	0.693	1	0.633	3	3.196	0.639	1
2	Consultants	0.628	1	0.615	3	0.652	1	3.157	0.632	2
3	Clients	0.566	3	0.648	2	0.635	2	3.082	0.617	3
4	External related	0.540	4	0.528	4	0.556	4	2.707	0.541	4

Table 4.8 Ranking of group causes

The relative importance index rank presented in Table 4.8 above shows that contractor group of causes are the most contributing factors to project delay with the relative importance index value equals to 0.639. This result is consistent with the findings of Werku and Jha (2016), and Aziz (2013), even though Aziz (2013) grouped delay causes in to nine major groups. The consultant related causes (RII=0.631) ranked second, followed by client related causes (RII=0.617). The external factor related delay causes category demonstrated the least aggregated relative importance index of (RII=0.541).

Contractors group of causes ranked on the first and second place by consultants and clients respectively. The average relative importance index value of (RII=0.639) placed this group on the first place even though respondents from this group placed them on third place. Consultant group causes ranked first by clients and contractor, and third by themselves, however the average values of (RII=0.632) placed this group on the second place. Therefore, according to the survey result contractor group of causes are the most influential causes of delay followed by consultant group.

The result of ranking order of group causes in this study almost consistent with the ranking of Werku and Jha (2016). They ranked groups based on their order of importance as: (1) Contractor's related, (2) Material related, (3) Labour related, (4) Designer's related, (5) Consultants/supervisors related, (6) Client related, (7) External related factors. In this study delay attributes re-categorized under four major groups (Clients, consultants, contractors and external) related causes. Most of material and labour related causes are categorized under contractor related causes; and designer related factors under consultant related causes. Therefore according to this categorization, contractor related causes placed on the first place, followed by consultant related, and then client related, finally external related causes.

4.9. Overall ranking of delay causes

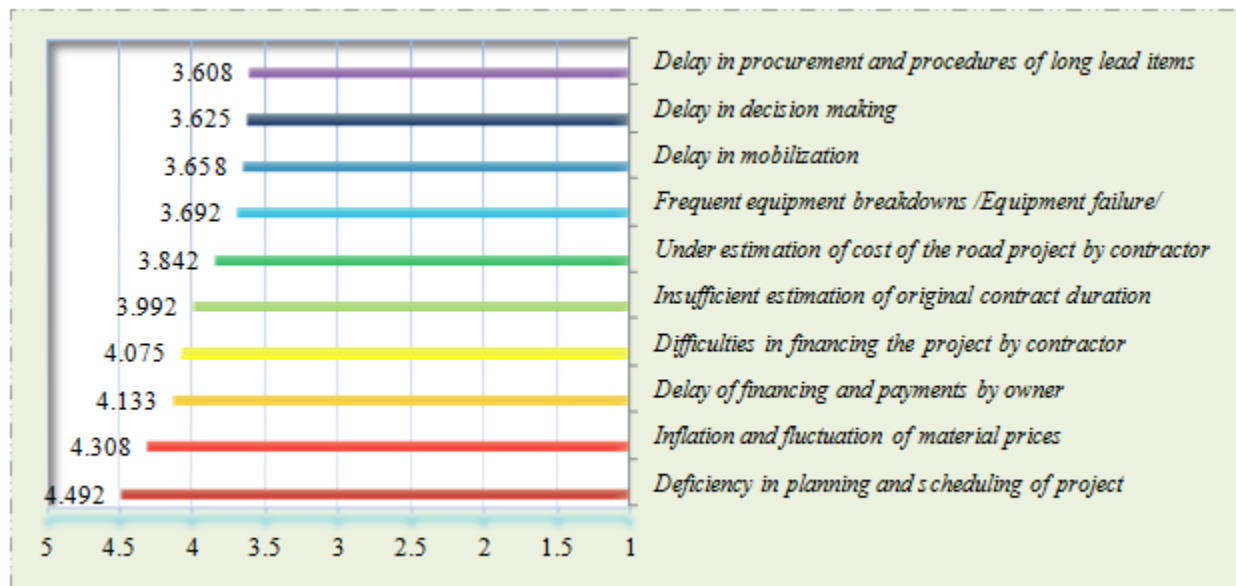


Figure 4.3 Top 10 Delay Causes

The survey results presented on figure 4.3 and previous Tables 4.4, 4.5, 4.6 and 4.7 show that, when the causes were ranked overall, the top ten most influential causes of delay are identified as: Deficiencies in planning and scheduling of projects with mean value equals to 4.492 or (RII=0.898), Inflation and escalation of material prices with mean value of 4.308 or (RII=0.862), Delay of financing and payments by owners with mean value of 4.133 or (RII=0.827), Difficulties in financing the project by contractor with mean value of 4.075 or (RII=0.815), Insufficient estimation of original contract duration (RII=0.798), Under estimation of cost of the project by contractor (RII=0.768), Frequent equipment breakdown/equipment failure/ (RII=0.738), Delay in mobilization (RII=0.732), Delay in decision making (RII=0.725), and Delay in procurement and procedures of long lead items (RII=0.722).

The survey result also revealed that out of the total 61 delay attributes which are categorized under the four major groups (clients, consultants, contractor and external related factors) ten (10) of them had minimal influence on causing delays and they include; Culture in public holidays (RII=0.385), Personal conflicts among labor (RII=0.408), Accident during construction (RII=0.423), Unfavorable contract clauses (RII=0.425), Changes in government regulations and laws (RII=0.430), Delay by owner in handing over process or approval of completed work (RII=0.463), Force Majeure (earthquake, etc.) (RII=0.482), and Rework due to errors during construction (RII=0.485), Problem with nearby structure or facilities (Disturbance to public activities, effect of social and cultural factors) (RII=490), and Lack of site utilities or services such as (water, electricity, etc.) (RII=495) since their RII was below 0.50.

4.10 Discussions

The relative importance index rank presented in Table 4.8 above shows that contractor group of causes are the most contributing factors to project delay with the grand mean value equals to 3.196 or relative importance index value (RII=0.639). This result is consistent with the findings of Werku and Jha (2016), and Aziz (2013), even though Aziz (2013) grouped delay causes in to nine major groups. The consultant related causes (RII=0.631) ranked second, followed by client related causes (RII=0.617). The external factor related delay causes category demonstrated the least aggregated relative importance index of (RII=0.541).

The result of ranking order of group causes in this study almost consistent with the ranking of Werku and Jha (2016). They ranked groups based on their order of importance as: (1) Contractor's related, (2) Material related, (3) Labour related, (4) Designer's related, (5) Consultants/supervisors related, (6) Client related, (7) External related factors. In this study delay attributes re-categorized under four major groups (Clients, consultants, contractors and external) related causes. Most of material and labour related causes are categorized under contractor related causes; and designer related factors under consultant related causes. Therefore according to this categorization, contractor related causes placed on the first place, followed by consultant related, and then client related, finally external related causes.

However, the overall ranking of group causes may not consistent with other studies as Sambasivan and Soon (2007) stated that, "The effects of delays in construction projects can be country specific" none of the studies is comparable to any other and each study has different rankings for the causes of delay and the groups as project characteristics are unique and may even be region specific. As project is unique endeavor, delay attributes to projects and their ranking may differ from country to country, region to region, even project

to project. Therefore the ranking of the causes and groups in this study also does not compare with other studies. Ahmed *et al.*, (1999), reinforced this issue by making statement like this; Construction projects vary in terms of complexity in nature, location, type of contract, communication between parties.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Summary of major findings

From overall results it was found Deficiencies in planning and scheduling of projects was considered the first cause affecting delay in road projects. Generally respondents from the three major stakeholders agreed that out of a total of 61 delay attributes; Inflation and escalation of material prices, Delay of financing and payments by owners, Difficulties in financing the project by contractor, Insufficient estimation of original contract duration, Under estimation of cost of the project by contractor, Frequent equipment breakdown/equipment failure/, Delay in decision making, Delay in mobilization, and shortage of equipment are considered as the most prominent delay causes of road projects.

The relative importance index rank presented in previous Table 4.8 above shows that contractor group of causes are the most contributing factors to project delay with the relative importance index value (RII= 0.639) or grand mean value equals to 3.196. The consultant related causes ranked second next to contractor related causes with the grand mean values of 3.157 or (RII=0.631), followed by client related causes with the grand mean values equals to 3.082 or (RII=0.617). The external factor related delay causes category demonstrated the least aggregated relative importance index of (RII=0.541) or grand mean values equals to 2.707.

5.2 Conclusion

Project delay is still happening and will continue to happen in the construction for various reasons. Delays are inevitable; however, they can be avoided or minimized when their causes are effectively identified and analyzed. The objective of this research was to identify the main causes of delay that affect road construction projects. A literature review and expert interviews were conducted to identify the causes of delay. A compiled list of 61 delay attributes were identified and categorized into four groups of consultant related delay factors, contractor related delay factors, client related delay factors and external related delay factors and listed on the questionnaire for further quantitative evaluation in a questionnaire survey to confirm the causes and to identify the most important causes of road construction project delay. The most important causes of delay identified by the survey through questionnaire and the results were analyzed for the overall view and for each of the three major parties in construction who participated in the questionnaire (clients/owner, consultants, and contractors) separately to make an overall view of the causes of delay in road projects.

The above mentioned Sixty one (61) delay attributes were categorized into four major groups (clients, consultants, contractors, and external factors) and were ranked using relative importance indices (RII). The results show that the average results of respondents from the three major groups indicated that the contractor group of delay factors was the most prominent delay factor. Consultants related factors were considered the second most influential causes of delay in road construction projects followed by client's related causes of delay, and then external factors related causes of project delay placed in the last stage.

5.3 Recommendation

Road construction project will be successful when the construction project activities are done by proper planning and scheduling, within the allocated budget and specified quality, under specified timeframe and by the satisfaction of the stakeholders. Delays are a part of the construction projects, however, they can be avoided or minimized when their causes are effectively identified and analyzed. Based on the above mentioned results and findings of this study, the following points can be recommended as ways to minimized and control delay in road construction projects.

- During planning of the project, stakeholders (clients, consultants and contractors) must give considerations for unforeseen events which may lead to project delay.
- Clients must ensure that effective planning of project costs to determine adequate budget/ funds are available for the project in order to avoid intermittent stoppage of works as a result of funding constraints and ensure interim payments are paid in time within the stipulated time-frame.
- Stakeholders should practice transparency to avoid acts of corruption at the time of bidding and during construction.
- Clients can make timely and prompt decisions
- Clients and consultants should also promptly respond to contractors enquires in revising and approving documents (design, drawings, submittals, sample materials etc.) without delay.
- Client shall deliver/handover the site to contractors immediately after contract agreement has signed.
- Clients must ensure that the demand for design changes during construction have no adverse effects on the critical activities that leads to project delay.
- Clients and consultants can take in to account of proper estimate of the original cost and duration of the project pre-contract and bidding period.

- Consultant must undertake adequate site investigation and supervision and must assign competent and well experienced representative.
- Consultants shall ensure that the documents or design & specifications issued by consultants to contractors are free from mistakes or discrepancies and any design error must be rectified immediately to avoid delay in the progress of project works.
- Contractor shall ensure proper planning and scheduling of projects and proper site management and supervision in order to run the project on specified time frame/ schedule.
- Contractors shall ensure proper estimate of the project cost and duration and determine to finance the project with sufficient amount of budget and desist from practice of diverting particular project budget/funds to non project activities or to other projects to avoid project cash flow constraint.
- Contractors shall mobilize resources without delay.
- Contractors must also allocate adequate construction equipments and ensure to avoid frequent equipment breakdown.

Finally, Commitment to project can be evident from all stakeholders; similar studies can also be conducted in this area and stakeholders in construction also take in to account such issues and utilize the findings of such studies. I also suggest that future studies can focus on the magnitude of effects of causes on projects (the extent of delay and the contribution of each cause to delay).

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Causes of Delay in Road Construction Projects (Questionnaire)

Dear Sir/ Madam,

My name is Berhane Bekele, a graduate student of Addis Ababa University. I am conducting a research about "*Causes of Delay in Road Construction Projects*", which I had chosen as a topic to conduct research on it for my master's project.

The aim of the research is to study the various delay factors with regards to the Construction environment. I kindly invite you to be a part of this research and request you to assist me in completing the brief questionnaire. I would kindly request your participation, and cooperation of your construction personnel and project managers in providing the required information in the questionnaire, as well as to thank you for your valuable time and efforts.

The information provided will only be used for research on an academic platform. Your kind assistance in this regard is highly appreciated. Thank You for your time and attention. I look forward to hearing from you,

Yours Sincerely,
Berhane Bekele
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Addis Ababa University
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Advisor: Wubeshet B. (PhD)

1. General Information

Please check which most accurately describes:

All information, including all results and personal information from participating individuals will be kept strictly confidential and be used only for research purposes.

1.1. Organization type

- ☐ Owner
- ☐ Contractor
- ☐ Consultant

1.2. Respondent gender

- ☐ Male
- ☐ Female

1.3. Age

- ☐ 21-30 years
- ☐ 31-40 years
- ☐ 41-50 Ears
- ☐ >51 years

1.4. Educational Background

- ☐ TVET/ Diploma
- ☐ 1st Degree
- ☐ 2nd Degree
- ☐ PhD

1.5. Experience in Road construction (in years)

- ☐ 1-5
- ☐ 6-10
- ☐ 11-15
- ☐ 16+

1.6. Job Designation

- ☐ Project Manager
- ☐ Resident Engineer
- ☐ Project Office Engineer
- ☐ Surveyor
- ☐ Supervisor

Other, Specify_____

2. Ranking Causes of Delay

Please evaluate the following attributes based on:

Importance (the delay impact on construction project) and; Frequency (How often the attribute is implemented or considered) on a rating scale of 1 - 5 as shown below:

Rating Scale	Very Low	Low	Moderate	High	Very High
	1	2	3	4	5

For an example, for the first Cause of Delay factors “*Delay in decision making*”, the respondent was asked to evaluate the:

- Importance: What is the Severity of “*Delay in decision making*” on construction projects?
- Frequency: How often is “*Delay in decision making*” considered or does it occurs in construction projects?

S. N	Causes of delay	Severity					Frequency				
		1	2	3	4	5	1	2	3	4	5
1	Delay in decision making										
2	Suspension of work										
3	Delay in revising and approving documents (design, drawings, submittals, sample materials etc.) by owner										
4	Delay in site delivery to the contractor										
5	Delay of financing and payments by owner										
6	Corruption tendencies										
7	Design changes by owner or his agent during construction										
8	Intermittent stoppage of work due to cash flow constraints										
9	Poor communication and coordination with other parties										
10	Unrealistic enforced contract duration										
11	Delay by owner in handing over process or approval of completed work										
12	Unfavorable contract clauses										
13	Bureaucracy (Excessively complicated administrative procedure)										
14	Lack of experience of owner in road construction projects										
15	Lack of experience of consultants										
16	Delay in preparing interim payment certificates										
17	Delay in performing inspection and testing										
18	Mistakes or discrepancies in documents or design & specifications issued by consultants										
19	Unclear and inadequate details in drawings										
20	Inadequate site investigation										
21	Insufficient estimation of original contract duration										
22	Slow response to contractor inquiries										
23	Delay in mobilization										
24	Difficulties in financing the project by contractor										
25	Poor site management and supervision										
26	Deficiency in planning and scheduling of project										
27	Rework due to errors during construction										
28	Delays related to sub-contractors work										
29	Inadequate contractor experience										
30	Incompetent project team										
31	Under estimation of cost of the road project by contractor										

32	Under estimation of complexity of the road projects																		
33	Inappropriate construction methods																		
34	Unreliable subcontractors																		
35	Unsafe practice at site (Poor safety conditions on site)																		
36	Difficulty in accessing Bank (Credit, LC etc)																		
37	Centralization with Top Management																		
38	Shortage of construction materials																		
39	Delay in procurement and procedures of long lead items																		
40	Delays due to material delivery																		
41	Changes in material types and specifications during construction																		
42	Inflation and escalation of material prices																		
43	Shortage of labors																		
44	Unqualified workforce																		
45	Low productivity of labor																		
46	Personal conflicts among labour																		
47	Shortage of equipment																		
48	Frequent equipment breakdowns /Equipment failure/																		
49	Equipment allocation problem																		
50	Unforeseen site conditions (Unexpected subsurface conditions e.g. Soil type, Utility line, high water table, etc.)																		
51	Restriction at job site (Poor site access, traffic congestion)																		
52	Lack of site utilities or services such as (water, electricity, etc.)																		
53	Accident during construction																		
54	Problem with nearby structure or facilities (Disturbance to public activities, effect of social and cultural factors)																		
55	Unforeseen Weather conditions (rains)																		
56	Changes in government regulations and laws																		
57	Delay in performing final inspection and certification by a third party																		
58	Global financial crisis																		
59	Geopolitical and regional stability																		
60	Force Majeure (earthquake, etc.)																		
61	Culture in public holidays																		

3. Other (please specify)

Please mention rates of Severity and Frequency next to each cause of delay

4. Mitigation Measures

Please suggest your recommendation to minimize project delay. What you recommend for clients, consultants, and contractors in order to minimize or control causes of delay to projects.

1. What are expected from clients to minimize project delay?
2. What are expected from consultants?
3. What should contractor do to minimize project delay?

Annex 2. Overall ranking of delay causes using RII

S. N	Causes of Delay	Clients			Consultants			Contractors			Average		
		Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank	Mean	RII	Rank
1	Deficiency in planning and scheduling of project	4.7	0.94	1	4.6	0.92	3	4.175	0.835	1	4.492	0.898	1
2	Inflation and fluctuation of material prices	4.3	0.86	2	4.5	0.90	4	4.125	0.825	3	4.308	0.862	2
3	Delay of financing and payments by owner	3.55	0.71	7	4.7	0.94	2	4.15	0.83	2	4.133	0.827	3
4	Difficulties in financing the project by contractor	3.9	0.78	4	4.8	0.96	1	3.525	0.705	9	4.075	0.815	4
5	Insufficient estimation of original contract duration	4.15	0.83	3	4.25	0.85	7	3.575	0.715	6	3.992	0.798	5
6	Under estimation of cost of the road project by contractor	3.8	0.76	5	4.45	0.89	6	3.275	0.655	19	3.842	0.768	6
7	Frequent equipment breakdowns /Equipment failure/	3.15	0.63	19	4.5	0.90	4	3.425	0.685	12	3.692	0.738	7
8	Delay in mobilization	3.45	0.69	13	4.1	0.82	10	3.425	0.685	12	3.658	0.732	8
9	Delay in decision making	3.3	0.66	16	4.0	0.80	11	3.575	0.715	6	3.625	0.725	9
10	Delay in procurement and procedures of long lead items	3.5	0.70	10	4.15	0.83	9	3.175	0.635	25	3.608	0.722	10
11	Delay in revising and approving documents (design, drawings, submittals, sample materials etc.)	3.5	0.70	10	3.8	0.76	16	3.375	0.675	16	3.558	0.712	11
12	Intermittent stoppage of work due to cash flow constraints	3.3	0.66	16	3.9	0.78	14	3.275	0.655	19	3.492	0.698	12
13	Shortage of equipment	2.8	0.56	34	4.0	0.80	11	3.65	0.73	4	3.483	0.697	13
14	Delay in site delivery to the contractor	2.95	0.59	25	4.2	0.84	8	3.275	0.655	19	3.475	0.695	14
15	Delays due to material delivery	3.15	0.63	19	3.7	0.74	18	3.475	0.695	10	3.442	0.688	15
16	Poor site management and supervision	3.55	0.71	7	3.7	0.74	18	3.075	0.615	31	3.442	0.688	15
17	Unforeseen site conditions (Unexpected subsurface conditions e.g. Soil type, Utility line, high water table, etc.)	3.55	0.71	7	3.35	0.67	24	3.175	0.635	25	3.358	0.672	17
18	Unforeseen Weather conditions (rain)	2.9	0.58	28	3.95	0.79	13	3.025	0.605	36	3.292	0.658	18
19	Inadequate site investigation	3.6	0.72	6	2.85	0.57	34	3.4	0.68	15	3.283	0.657	19
20	Inappropriate construction methods	3.1	0.62	22	3.25	0.65	28	3.35	0.67	17	3.233	0.647	20
21	Shortage of construction materials	2.65	0.53	40	3.8	0.76	16	3.2	0.64	23	3.217	0.643	21
22	Design changes by owner or his agent during construction	2.7	0.54	39	3.35	0.67	24	3.575	0.715	6	3.208	0.642	22
23	Corruption tendencies	2.5	0.50	44	3.5	0.70	23	3.6	0.72	5	3.2	0.640	23
24	Lack of experience of consultants	3.05	0.61	23	3.1	0.62	30	3.45	0.69	11	3.2	0.640	23
25	Low productivity of labor	2.55	0.51	41	3.55	0.71	21	3.425	0.685	12	3.175	0.635	25
26	Difficulty in accessing Bank (Credit, LC etc)	2.85	0.57	31	3.65	0.73	20	2.975	0.595	38	3.158	0.632	26
27	Incompetent project team	2.5	0.50	44	3.9	0.78	14	3.05	0.61	34	3.15	0.630	27
28	Suspension of work	2.95	0.59	25	3.35	0.67	24	3.125	0.625	29	3.142	0.628	28
29	Mistakes or discrepancies in documents or design & specifications issued by consultants	3.5	0.70	10	2.8	0.56	35	3.075	0.615	31	3.125	0.625	29
30	Unsafe practice at site (Poor safety conditions on site)	3.4	0.68	14	3.05	0.61	32	2.85	0.57	44	3.1	0.620	30
31	Poor communication and coordination with other parties	2.8	0.56	34	3.1	0.62	30	3.25	0.65	22	3.05	0.610	31
32	Delay in performing inspection and testing	3.4	0.68	14	2.75	0.55	38	2.975	0.595	38	3.042	0.608	32
33	Centralization with Top Management	3.2	0.64	18	2.6	0.52	46	3.125	0.625	29	2.975	0.595	33

34	Inadequate contractor experience	2.4	0.48	48	3.55	0.71	21	2.95	0.59	40	2.967	0.593	34
35	Unreliable subcontractors	2.95	0.59	25	2.75	0.55	38	3.15	0.63	27	2.95	0.590	35
36	Under estimation of complexity of the road projects	2.4	0.48	48	3.2	0.64	29	3.2	0.64	23	2.933	0.587	36
37	Slow response to contractor inquiries	2.9	0.58	28	2.55	0.51	50	3.325	0.665	18	2.925	0.585	37
38	Geopolitical and regional stability	3.05	0.61	23	2.8	0.56	35	2.85	0.57	44	2.9	0.580	38
39	Equipment allocation problem	2.55	0.51	41	3.05	0.61	32	3.05	0.61	34	2.883	0.577	39
40	Lack of experience of owner in road construction projects	2.85	0.57	31	2.75	0.55	38	3.0	0.60	37	2.867	0.573	40
41	Unqualified workforce	2.25	0.45	54	3.35	0.67	24	2.875	0.575	42	2.825	0.565	41
42	Delay in preparing interim payment certificates	2.4	0.48	48	2.75	0.55	38	3.075	0.615	31	2.742	0.548	42
43	Bureaucracy (Excessively complicated administrative procedure)	2.45	0.49	46	2.6	0.52	46	3.15	0.63	27	2.733	0.547	43
44	Delays related to sub-contractors work	2.8	0.56	34	2.6	0.52	46	2.775	0.555	48	2.725	0.545	44
45	Global financial crisis	3.15	0.63	19	2.15	0.43	54	2.725	0.545	50	2.675	0.535	45
46	Changes in material types and specifications during construction	2.3	0.46	53	2.8	0.56	35	2.9	0.58	41	2.667	0.533	46
47	Unrealistic enforced contract duration	2.9	0.58	28	2.65	0.53	45	2.375	0.475	59	2.642	0.528	47
48	Unclear and inadequate details in drawings	2.75	0.55	37	2.35	0.47	52	2.75	0.55	49	2.617	0.523	48
49	Restriction at job site (Poor site access, traffic congestion)	2.75	0.55	37	2.35	0.47	52	2.65	0.53	51	2.583	0.517	49
50	Shortage of labors	2.4	0.48	48	2.7	0.54	43	2.55	0.51	54	2.55	0.510	50
51	Delay in performing final inspection and certification by a third party	2.55	0.51	41	2.6	0.52	46	2.5	0.50	56	2.55	0.510	50
52	Lack of site utilities or services such as (water, electricity, etc.)	1.85	0.37	59	2.7	0.54	43	2.875	0.575	42	2.475	0.495	52
53	Problem with nearby structure or facilities (Disturbance to public activities, effect of social and cultural factors)	2.85	0.57	31	1.65	0.33	59	2.85	0.57	44	2.45	0.490	53
54	Rework due to errors during construction	2.2	0.44	56	2.55	0.51	50	2.525	0.505	55	2.425	0.485	54
55	Force Majeure (earthquake, etc.)	2.45	0.49	46	2.75	0.55	38	2.025	0.405	61	2.408	0.482	55
56	Delay by owner in handing over process or approval of completed work	2.4	0.48	48	2.15	0.43	54	2.4	0.48	58	2.317	0.463	56
57	Changes in government regulations and laws	2.05	0.41	57	2.15	0.43	54	2.25	0.45	60	2.15	0.430	57
58	Unfavorable contract clauses	2.0	0.40	58	1.75	0.35	58	2.625	0.525	52	2.125	0.425	58
59	Accident during construction	2.25	0.45	54	1.5	0.30	60	2.6	0.52	53	2.117	0.423	59
60	Personal conflicts among labor	1.85	0.37	59	1.45	0.29	61	2.825	0.565	47	2.042	0.408	60
61	Culture in public holidays	1.4	0.28	61	1.9	0.38	57	2.475	0.495	57	1.925	0.385	61