College of Business and Economics
School of Commerce

Determinant Factors Affecting Schedule and Cost Overruns on Water/Sewerage Construction Projects: The Case of AAWSA

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A Thesis Submitted to the Addis Ababa University School of Commerce in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Art in Project Management (MA)

January 2019
Addis Ababa, Ethiopia

ADDIS ABABA UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
SCHOOL OF COMMERCE

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DECLARATION

I declare that this thesis entitled "***Determinant Factors Affecting Schedule and Cost overruns on Water/Sewerage Construction Projects: The Case of AAWSA"*** is my original work. This thesis has not been presented for any other university and is not concurrently submitted in the candidature of any other degree, and that all sources of material used for the thesis have been duly acknowledged.

Candidate:

Name: _Lejalem Mulu Emiru_____Signature: _____Date: _____

Acknowledgments

I would like to take this opportunity to acknowledge the support and contribution I got from various sources particularly from the Addis Ababa Water and Sewerage Authority, various contractor and consultant organizations and other sector governmental offices while working on this research paper.

First and foremost I take this opportunity to thank the almighty God and his beloved mother St. Merry for the usual unlimited support and guidance throughout my life. I sincerely acknowledge with gratefulness the support, guidance and valuable advice from my adviser Dr. Fisseha Affework for his timely and valuable guidance throughout this research project. Most sincerely, I would like to thank my family members for their support, encouragement, prayers, and assistance during my study.

Lastly but not least, I would like to sincerely thank the Addis Ababa University particularly the School of Commerce Academic Staff and also the senior management members for making my dream come true by equipping me with all the required courses, education materials, and dedicated lecturers.

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List of Abbreviations

PMI - Project management Institute

AIPM - Australian Institute of Project Management.

PMBOK - Project Management Body of Knowledge.

RII- Relative Importance Index

WB - World Bank

AAWSA - Addis Ababa Water and Sewerage Authority

PM - Project Management

SPSS- Statistical Package for Social Scientists

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Abstract

The water supply and sewerage construction projects in Addis Ababa city recurrently faced several problems which lead to schedule and cost overruns. The objective of this study was to assess the determinant Factors affecting schedule and cost overruns on water supply and Sewerage construction projects in Addis Ababa City. This research used a descriptive survey design and a combination of both quantitative and qualitative data collections methods to collect primary data as well as secondary data. The research data were collected from primary and secondary sources using structured questionnaires administered to Site Engineers, project managers, consultants, contractors, procurement officers, budget/finance officers, project planning, monitoring and controlling officers, and Internal Auditors. The data collected through a structured questionnaire were analyzed with SPSS version 20.0 software and the Relative Importance Index (RII). Documentary evidence was also reviewed by the researcher for the extent of cost and schedule overruns case analysis. The study has finally pointed out the most important determinant factors that affect schedule delays on water supply and sewerage construction projects in the city as perceived by the three parties (client, consultants, and contractors) are bureaucracy in Government agencies, Government tendering system of choosing the lowest bidder, late delivery of materials, escalation of local material prices, ineffective project planning and scheduling, insufficient estimation of original contract duration, design errors made by designers, slowness in decision making, delay in site delivery, and unexpected surface & subsurface conditions. The findings from the survey result also showed that the top ten determinant factors affecting cost overruns on water supply and sewerage construction projects in Addis Ababa are design change, price escalation of labor and materials, quantity underestimation, contractual claims, such as an extension of time with cost claims, poor Contract management, omissions and errors in the bills of quantities, additional work orders/extra items at owner's request, inadequate project preparation, monitoring, planning, and implementation, scope changes, and wastage/poor financial control on site. Further, the main conclusion was that almost the majority of the water supply and sewerage construction projects in Addis Ababa city experienced extraordinary schedule delay and cost overruns to varying degrees due to the above-mentioned determinant factors. The average rate of schedule overrun is between 7.69% and 1208.89% of the original duration, and the average rate of cost overrun is between 0.72% and 8.11% of the original contract value. The projects were predominantly affected by the three key project players (client, contractor, and consultant). It is therefore, recommended, among other things, that all relevant appropriate measures shall be put in place by the responsible parties (client, contractors, and consultants) to minimize schedule and cost overruns by implementing the general project cost and schedule management practices, functions, procedures, tools, relevant techniques and using latest technology products from the beginning of the project initiation up to the final closure process.

Keywords: Schedule delay, Cost overruns, water supply & Sewerage construction projects.

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

The water supply and sewerage projects in Addis Ababa City are being implemented through the Addis Ababa Water and Sewerage Authority (AAWSA), an organ of the Addis Ababa City government, which carries the sole responsibility of providing potable water and management of sewage sludge to the city residents. The authority is getting its water from surface and groundwater sources by implementing various projects. However, various studies indicated that the construction project management practice in Ethiopia, in general, has not been without problems.

According to Zewdu & Aregaw (2015), the level of construction project management practice in the Ethiopian construction sector in terms of adapting the general project management procedures, time management, project management functions, tools & techniques to be unsatisfactory. A similar study by Flyvbjerg (2003) indicated that nine out of ten projects had the cost overruns from a sample of 258 companies across 20 countries and 5 continents around the world. In the absence of modern project management practice, be it in developed or developing countries delays can occur in every construction project and the extent of these delays varies significantly from project to project and country to country (Wa'el, Mohd. Razali, Azizah and Ernawati, 2007). A study by Enshassi (2009) and Azhar (2008) confirmed that project schedule delays and cost overruns are the most common problems in the construction sector in both developed and developing countries.

In Addis Ababa city, the substandard sanitation provisions as well as the water shortage crisis has been a regular problem up to now as the majority of the water supply and sewerage construction projects have had problems with schedule and cost overruns to complete the projects as planned. In most cases, projects fail or may not be completed as planned and within the allocated budget due to several reasons including poorly defined goals, unrealistic deadlines, unrealistic budget estimates, scope creep, insufficient project team skills, improper communication between the project stakeholders, poor project management leadership, week risk management, and other factors. In light of this driving fact, this research work was essential to identify the determinant Factors affecting schedule and cost overruns on water supply and Sewerage construction projects in Addis Ababa City and wish to make a contribution of what seems to be best practice on the reduction of project schedule slippage and cost overruns.

1.2. Background of the Addis Ababa Water and Sewerage Authority

Addis Ababa is the capital city of Ethiopia established during the era of Emperor Menelik II in 1986. It was since 1900 that piped water service was started in Addis Ababa. In the beginning, the provision of potable water was delegated to the then Ministry of Works. And following the defeat of Fascist Italian invaders in 1934, this responsibility was transferred to the newly re-established Municipal Office. In order to cater to the increasingly growing demand for water and wastewater disposal services there did arise a need for the establishment of an autonomous body that would primarily focus on the provision of the services. Accordingly, according to AAWSA, the Addis Ababa Water and Sewerage Service Authority was set up as per Proclamation No. 68/1963, in 1971 and in 1995 additional powers were invested on the authority while being re-established with a slightly different name, i.e., Addis Ababa Water and Sewerage Authority (AAWSA) (https://aawsa.gov.et/ accessed on 31st December 2018).

The main objectives of the Authority are Supply of safe and adequate water and the provision of wastewater and sludge disposal service for Addis City dwellers. Currently, the authority is structured under water & sewerage board presided by the mayor of the Addis Ababa City administration and the relevant ministries and organization of the federal government as members. The internal structure comprises one General Manager, three deputy G/Ms, nine departments, five services & eight branch offices and a project office in the city. The authority is self- financing and the source of its revenue for the ongoing water and sewerage projects and other miscellaneous costs are being the sale of water, sewerage service, connection fee, other miscellaneous income, foreign grant & loan, and capital subsidy from the Addis Ababa City government (NETWAS, 2002).

1.3. Statement of the Problem

Following the increasing population growth in Addis Ababa city, the Addis Ababa city administration has been struggling to meet the demand of the population in terms of potable water supply and sanitation facilities by implementing various water supply and sewerage construction projects for the last consecutive periods. However, the construction sector in Ethiopia including the Urban Water Supply and Sanitation construction projects (UWSSP) have a serious problem with the construction management and administration as well as limitation of budget, time and resources in general. Some of the main recurrent problems are a failure to complete the projects on schedule and budget due to several factors. A recent study by Bekele (2017) indicated the existence of cost

overruns in AAWSA's Water supply and sanitation projects due to unpleasant project and resource management practices.

Reports of the donor organizations also indicated that the project management practice of the Addis Ababa Water and Sewerage Authority Project Office has not been without problems. Some of the whys and wherefores were largely due to the delay in project preparation, long procurement processes, and limitations in technical, financial, procurement and contract management capacity, and right of way issues in certain projects (World Bank, 2017). As a result, there is a consistent serious concern from the project owners, project beneficiaries, and project sponsors due to the extraordinary delay of projects which leads to schedule delay and cost overruns, regular water shortage and substandard sanitation issues in the city throughout the years.

Another recent study by Tadesse (2016) indicated that the amount of construction project schedule slippage in Ethiopia in general ranges between 61-80% and that of planned costs and other variables such as risk, quality, resources utilization, and safety deviates in the range 21-40% from predetermined requirements or anticipated at the beginning of the project. Additionally, some preliminary investigations were done by different researchers, which indicated the existence of both cost and schedule overruns and the associated rate of cost and schedule overruns on various construction projects in Addis Ababa and in Ethiopia in general (Tadesse, 2016:Fetene, 2008: Zinabu and Getachew,2015; Abubekir, 2015).

However, almost the majority of the previous studies were limited to road and building constructions at the Addis Ababa city level as well as within Ethiopia so that the lack of adequate researches or no empirical evidence that prove the extent of schedule and cost overruns and determinant factors contributing to schedule delay and cost overruns on water supply and sewerage construction projects especially in the Addis Ababa City context has been a major motivation to carry out this study.

In view of the above, this research can be regarded as the first attempt to evaluate the rate of cost and schedule overruns and the determinant Factors affecting schedule and cost overruns on water supply and Sewerage construction projects in Addis Ababa City. Indeed, the findings would have vital importance to have a better understanding of the determinant factors in the Addis Ababa city context.

1.4. Research Questions

In brief, the associated research questions within the Addis Ababa city context, therefore, included the following:

1) What were the determinant Factors Affecting Schedule and Cost Overruns on water and Sewerage Construction projects in Addis Ababa City?
2) Who were the relevant responsible parties (Client/owners, contractors, consultants, and others) for the water and sewerage construction project cost and schedule overruns?
3) What were the extents of Cost and Schedule overruns related to Water supply and sewerage construction projects in Addis Ababa City?

1.5. The objective of the Study

1.5.1. General Objective

The main objective of this research was to identify the determinant factors affecting schedule and cost overruns on water supply and sewerage construction projects in Addis Ababa City.

1.5.2. Specific Objectives

The objectives of this research give special attention to the following specific objectives:

1. To identify and rank the determinant factors affecting schedule delays and cost overruns in water supply and sewerage construction projects in Addis Ababa City.
2. To determine the main responsible parties for the cost and schedule overruns and to classify the associated factors in terms of related categories.
3. To identify the extents of schedule delay and cost overruns of selected completed water supply and sewerage construction projects in Addis Ababa city (the list of selected projects are depicted hereunder on page 46 for the purpose of this study).

1.6. Significance of the Study

This study highlights the determinant factors that contribute to schedule delay and cost overruns on water supply and sewerage construction projects in Addis Ababa City. It will also help to narrow down the knowledge gap with respect to schedule delay and cost overruns related to water supply and sewerage construction projects. The researcher has also hoped that the findings of this study will be

used by various researchers, government organs, project managers, clients, Site Engineers, consultants, contractors and scholars of project management and academic institutions.

Moreover, the result will make the concerned parties be aware of the serious effect that their failure to complete their projects on time and properly have an impact on the socio-economic development of the City as well as in the country in general. The study could be used by the Addis Ababa Water Supply and Sewerage Authority in addressing some of the determinant factors related to project management practices. Additionally, the study will again, let the AAWSA project office realize the need to equip its project team, train and motivate them properly for the efficient working mindset. Finally, the study could be used as an instigator for researchers to conduct further study in this area. The study could be used by the Addis Ababa Water Supply and Sewerage Authority in addressing some of the determinant factors related to project management practices.

1.7. Delimitation of the Study

The delimitations have an effect on generalizing the study findings (Silverman, 2013). The researcher of this study has tried his best to gather very relevant data from all key stakeholders. For the sake of effectiveness and efficiency, and to manage the limited project time and research budget, this study has focused on the assessment of the determinant Factors affecting schedule delays and cost overruns on water supply and Sewerage construction projects in Addis Ababa City and such research has not been done so far in this level. This study included participants from the Addis Ababa Water Supply and Sewerage Authority Project office (Client), contractors and Consultants of the AWSSA only.

1.8. Limitations of the Study

The main constraint of this research is that the research was conducted on the water supply and Sewerage projects of Addis Ababa City only and it doesn't cover other construction project sectors so that the findings may not indicate the general situation of other regional towns of Ethiopia. Further, few staff members were not willing to fill out the questionnaires, time and resource constraints, the unavailability of adequate current literature on this research topic at a national level were also some of the limitations of the study.

1.9. Operational Definitions of Terms

1. **Project:** A project is temporary in that it has a defined beginning and end in time, and therefore defined scope and resources (PMI, 2013); It is a temporary endeavor undertaken to create a unique product, service, or result (Kerzner (1998).
2. **Project management:** PM is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (PMI, 2013).
3. **Schedule overruns (delay):** Schedule overruns refer to situations where the actual project duration exceeds the originally planned and agreed completion period (Kaming et al (1997), Choudhry (2004) and Chan (2001), Mohamad, M.R.B. (2010))
4. **Cost overruns:** Cost Overruns refers to the increase in the amount of project cost required to construct a project over and above the original budgeted amount (Choudhry (2004), Zhu K and Liu L (2004)).

5. **Project Management Body of Knowledge (PMBOK):** PMBOK is a guide that the PMI introduced as a global standard for project managers to conduct good management practices while managing individual projects (PMI, 2013).
6. **Project management office (PMO):** Project Management Office (PMO) is the office responsible for providing support for enhancing timely completion of the projects within the allocated budget (Kaleshovska, 2014).

1.10. Organization of the Study

This research paper consists of five chapters including chapter one, the current chapter, entails the introduction and context of the study, which contained the background of the study, Statement of problem, research questions, objective of the study, significance of the study, the limitations and delimitations of the study. The second chapter is solely on a literature review in project management, schedule delay and cost overrun on water supply and sewerage construction projects. This is basically the review of the literature that has been done relating to the topic under study by other people. Chapter three covers the methodology used in obtaining and analysis of data. Chapter four deals with the analysis and discussions of findings. The last chapter, which is chapter five, comprises the summary, conclusion, and recommendations of the study.

CHAPTER TWO
LITERATURE REVIEW

This chapter reviews published data and research findings relevant to the topic under the subheadings of tridimensional frameworks of theoretical, empirical and conceptual perspectives.

2.1. Theoretical Framework

The theoretical framework for this research was crafted in line with the Game theory, Goal Set Theory, and Project Management Competency Theory, and other concepts which explain why the research problem under study exists and the relevance of each theory to the topic.

2.1.1. Game theory

This theory was developed by Gintis, H. (2000) asserting that it is the process of demonstrating tactical collaboration between two or more players in a situation containing set rules and outcomes. In a construction project, the four key project players who are usually involved in the development of a major project includes the owner of the project /sponsor, the project team, the consultants, and the contractors (Condon, E. & Hartman, F. T, 2004).

In a construction project, each project team members have their own project goals to achieve and responsibilities to perform in contributing to the development of project estimates. Gintis (2000) proposed that individuals come to strategic interactions with a propensity to cooperate, respond to cooperative behavior by maintaining or increasing their level of cooperation and respond to non-cooperative behavior by retaliation, even at a cost to themselves.

Further, a common result of projects which have suffered cost or schedule overruns is that disagreement and finger-pointing can occur amongst the players involved (Floricel & Miller, 2001), leading to the search for new partners or approaches on new projects. In general, this model or theory will help project managers better understand the dynamic forces of the players involved in project development prior to project approval and/or during the project's execution by allocating significant amounts of energy and time into ensuring that cost and schedule baselines are properly set up and integrated within the approved project plan (Hatfield Michael, 2015).

2.1.2. Goal Set Theory

Edwin Locke (1960) stated that the Goal Set Theory was essentially linked to task-specific and performance. It refers to the effects of setting goals on subsequent performance. Locke (2010) stated

that individuals who set specific, difficult goals performed better than those who set general, easy goals. With this understanding, it is one of the most effective methods to motivate the project team members and also to set goals for the individual project team members in the construction sector. However, the type and quality of goals set by the individual project team members affect how well they will work. The simple act of setting a well-defined goal gives a better chance of realizing that goal.

2.1.3. Project Management Competency Theory

The project management competency theory, as defined by existing standards such as the PMBOK® Guide and Australian National Competency Standards for Project Management, has been developed on the basis of a view of project management influenced by well-resourced and well defined major projects (Crawford, Lynn., 2018)). They are primarily directed at providing guidance to project managers in the management of discrete projects

Chen and Partington (2006) presented the PM competency in the United Kingdom in three hierarchical levels. The first level was for planning and control tasks. The second level was organizing the project activities, including coordinating stages and interfaces of the project. The third level was examining and managing problems. Chen and Partington argued that the third level managers are the most competent whereas first level managers have the least competency among the three discussed levels in construction project management.

Chen and Partington considered the standards used to assess and develop project management competence as the point of departure for the knowledge areas presented as competencies. Chen and Partington highlighted the need to train those managers who lacked attributes for any of the three hierarchical levels to achieve effective PM competence.

Furthermore, below are the theoretical frameworks of cost overruns and schedule delay (time overrun) which are relevant to construction project management and are very essential to solve the problems of schedule delays and cost overruns.

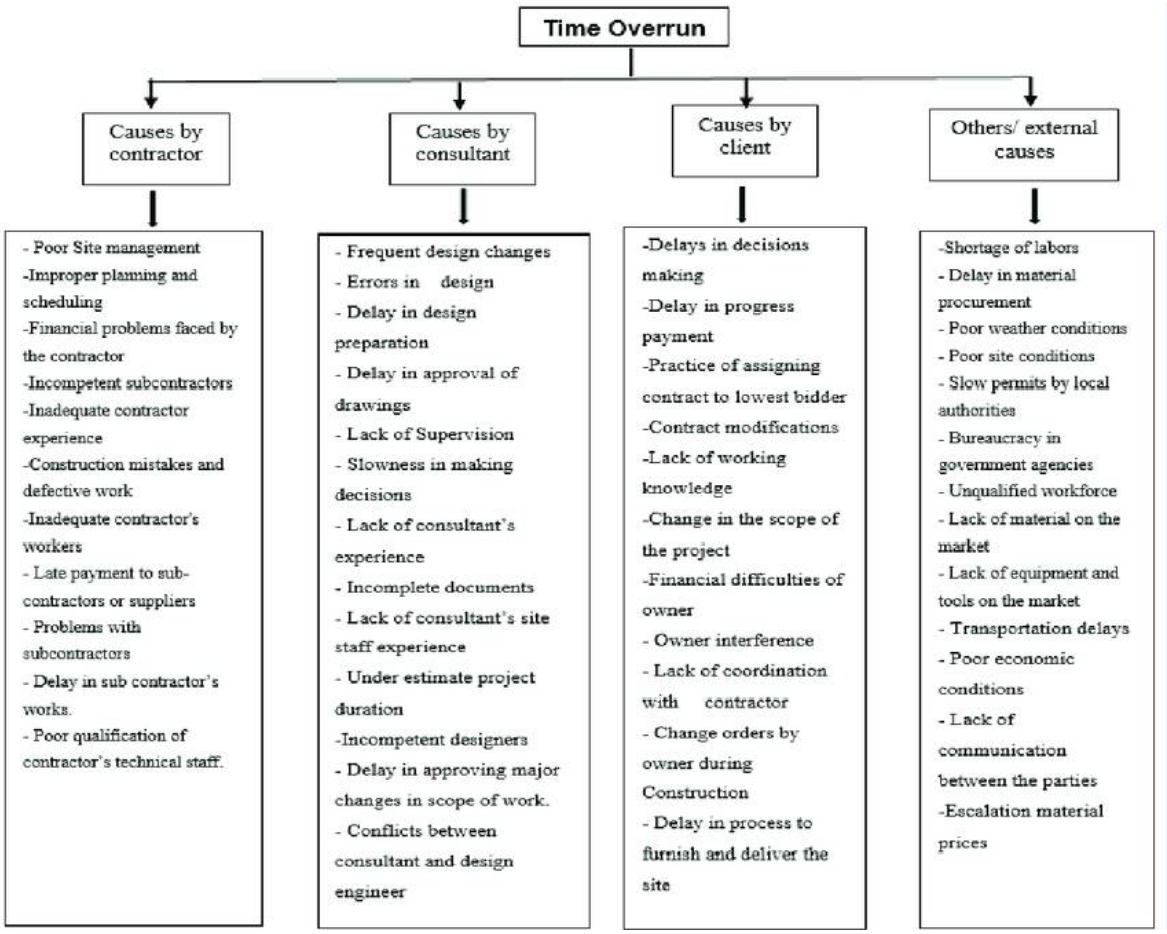


Figure 2.1. A theoretical framework for construction time overrun (adapted from K Ullah et al, 2017)

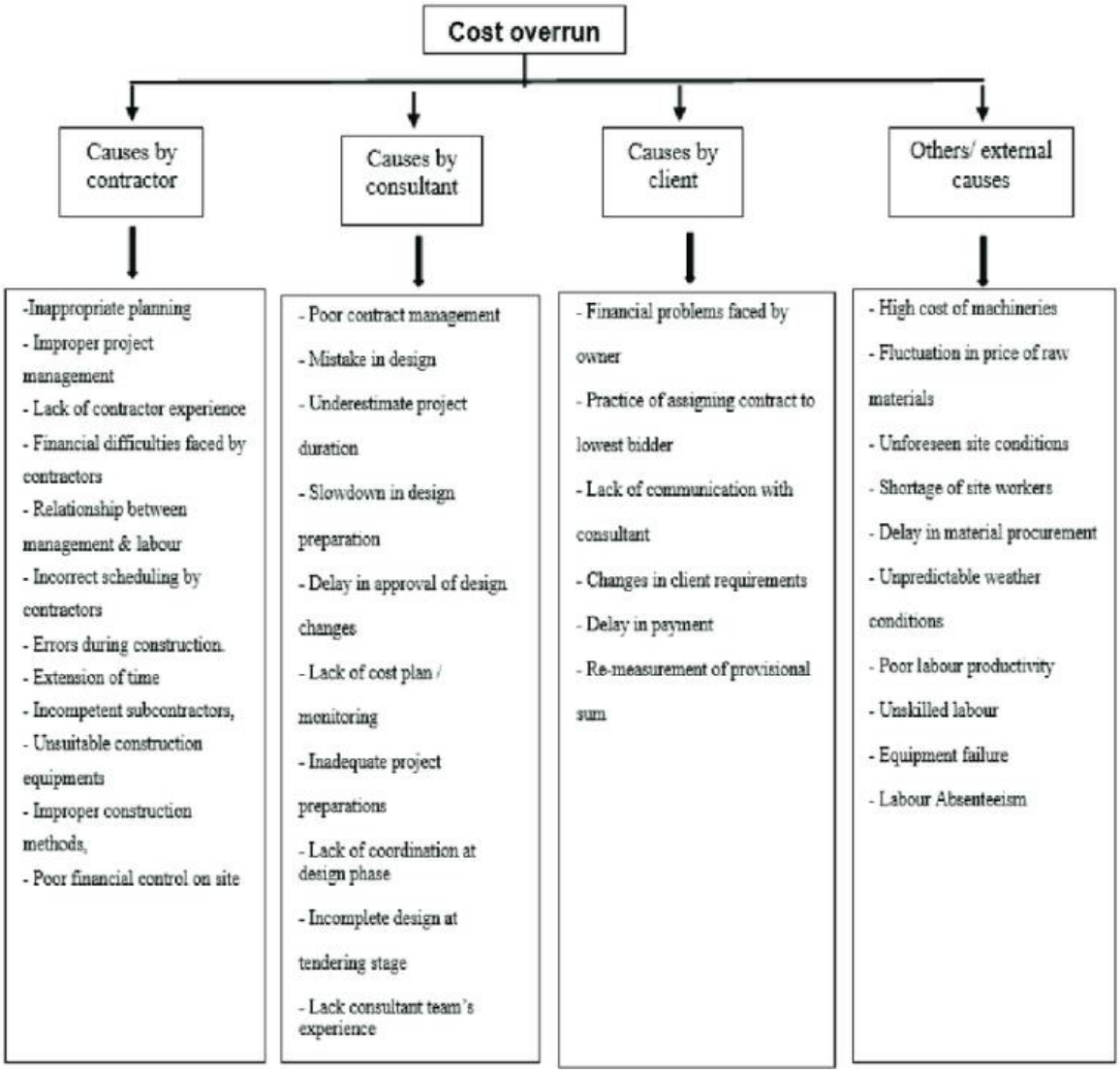


Figure 2.2. A theoretical framework for construction cost overrun (Reprinted from K Ullah et al, 2017).

2.2. Empirical Literature Review on Cost and Schedule Overruns

This subsection reviews some empirical studies on determinant factors affecting schedule and cost overruns on water and sewerage construction projects, and also on other similar construction projects.

2.2.1. Determinant Factors affecting schedule and Cost Overruns on construction projects

Adano Boru (2016) carried out a study on the topic "determinants of delay and cost overruns in Kenya's public sector construction projects: A case of Meru county, Kenya." aimed at identifying the

determinants of delay and cost overruns in Kenya's public sector construction projects. It was survey research by which he adopted the use of a questionnaire for data generation. The outcome of his research showed that public sector construction projects were frequently faced by delay and cost overruns due to rising contractual issues, changes in project financing, lack of qualified labor and modern equipment in use, changes in project scheduling and irregular changes in project design and documentation. In his research findings, it was concluded that project delay and cost overruns can be reduced if their causes are critically examined before commencing any project. He further recommended that the selection of capable contractors to be assessed properly before the project commencement; proper documentation also to be maintained prior to project commencement, ensuring the presence of proper monitoring and evaluation tools, techniques including proper financing as well as deployment of the right equipment and experienced manpower is very essential for the success of the project implementation. He also advised the stakeholders should understand the contractual issues which might cause delays and cost overruns during the life cycle of the projects.

In another similar study carried out by Enshassi et al., (2010) in a study of significant Factors Causing Time and Cost Overruns in Construction Projects in the Gaza Strip (Contractors' Perspective) indicated that the most significant causes of time delay include strikes, border closures, lack of materials in markets, shortage of construction materials at site, delay of material delivery to site, cash-flow problems during construction, and poor site management. He further indicated that the most significant causes of cost overruns includes increase in material prices due to continuous border closures, delay in construction, supply of raw materials and equipment by contractors, fluctuations in the cost of building materials, project materials monopoly by suppliers, instability of the local currency in relation to dollar value, low commitment of supporters to compensate any negative outcomes attributable to the poor economic and political situation, and donor policy in awarding tenders to the lowest bidder. Better project management procedures and the inclusion of an appropriate contingency allowance in the pre-contract estimate were recommended as a means of minimizing the adverse effect of construction delays.

Similarly, Abdul Rahman et al., (2013) on the topic "Significant Factors Causing Cost Overruns in Large Construction Projects in Malaysia" aimed at to identify the significant factors causing cost overrun in large construction projects in Malaysia. The study adopted survey research and used a questionnaire to generate data. The researcher administered questionnaires on 35 common factors of

cost overrun identified from literature work. The researcher used a Relative importance index method to analyze the hierarchal assessment of factors and found that the top 3 most significant factors of cost overrun are a fluctuation of prices of material, cash flow and financial difficulties faced by contractors and poor site management and supervision. These factors belong to two categories i.e., contractor's site management and financial management category, thus improvements in these categories were recommended as a solution for cost overrun controlling in construction projects. Another research conducted by Al-kharash and Skitmore (2009) indicated a survey result on the schedule delay in Saudi Arabian public sector construction project which showed that there are five causative factors that have the greatest effect on delay. These causes include slow decision making by a client, lack of finance to complete the work by the client, difficulties in obtaining work permits, Suspension of work by owner, and Non-payment of contractor claim.

Further, Ndungu Rosemary Wangari (2014) of Kenya conducted a study to investigate on factors influencing completion time of water projects in Water Service Boards in Kenya from contractor, client, and consultants‟ perspectives during the construction phase. His findings indicated that the level of financing of a project's construction activities and its timeliness was found to be a determinant of its completion time and that effective monitoring partially depends on the adequacy of supervisory personnel as well as timeliness in decision making and taking of actions to alleviate significant project target deviations that exist. Further, the contractor's incompetence attributed to inadequate equipment and personnel with required skills as well as financial difficulties among others is a key factor contributing to time overruns in the water projects, while contract variations are common among the water projects and they impact negatively on the projects‟ completion time.

On the other hand, Jomah Mohammed Al-Najjar (2008) on a study topic "Factors Influencing Time and Cost Overruns on Construction Projects in the Gaza Strip) found out that "Strikes, Israeli attacks, and border closures" were the most critical factor that influence project delay. The result also indicated that "material- related factors" occupied the second rank in importance, where "the lack of materials in markets" and "delay in materials delivered to the site" were among the most important factors affecting schedule delay. The researchers indicated that the prices fluctuations of constructions materials as well as prices inflation highly contributes to cost overrun.

Terna et al., (2017) in their study titled “Effects of Infrastructure Project Cost Overruns and Schedule Delays in Sub-Saharan Africa” on the economic impact of project cost overruns and schedule delays on infrastructure said that cost overrun and schedule delay in infrastructure procurement could bring a destructive economic effect ranging from productive incompetence of scarce resources management, further delays, contractual disputes, claims, and litigation to project failure and total abandonment. Their study also recommends project management on capacity-building for infrastructure developers, project managers as well as a number of innovative control mechanisms such as reference class forecasting, public-private partnership and computer-aided cost estimating tools including artificial neural networks, data mining, building information modelling as well as fuzzy neural inference model, genetic algorithms, and stochastic simulation to curb the risk of economic influence associated with schedule delay and cost overruns.

A study by Abbas Niazi et al., (2017) on the topic “Significant Factors Causing Cost Overruns in the Construction Industry in Afghanistan”. The aim of the research was to identify the significant factors that lead to construction cost overruns in Afghanistan. The study adopted survey research and used 75 sets of questionnaires from a captured group of selected clients, contractors, and consultants, with 51 valid returns received and analyzed. A relative importance index method was employed to rank the causes of cost overrun. The researcher found out that that the key critical causes that potentially result in construction cost overruns in Afghanistan are: corruption, delay in progress payment by owner, difficulties in financing project by contractors, security, change the order by the owner during construction and market inflation. In their research findings, it was concluded that project cost overrun is a significant challenge for the construction industry in Afghanistan.

Further, a study by Edwin et al., (2016) was conducted to investigate factors that influence completion of water projects in Kenya using Kakamega County and the result indicated that the main factors that were associated with client included financial capacity, owner interference, the imposition of contract duration, decision-making ability, and change in project scope which had a positive relationship with project completion. They further elaborated that the contractor-related factors influencing completion of water projects were financial capacity, equipment availability and quality, skilled workforce, site supervision ability, material availability, and control over subcontractors which had a positive relationship with project completion. They concluded that both client-related and contractor-related factors had a significant relationship with project completion.

2.2.2. Categories of Factors Affecting Schedule Delay on Construction projects

Various studies have been carried out across the world with regard to the responsible parties and categories of factors affecting schedule delay and cost overruns for a number of years. Some of the research findings used four categories schedule delays for analysis, namely Client-related Schedule factors, contractor-related Schedule factors, Consultant-related Schedule factors, and others/External-related Schedule factors (Alaghbari et al., 2007).

2.2.2.1. Client-related Schedule delay factors

A recent critical literature review on main factors of delay in construction projects by Daba and Pitroda (2018) indicated that the client/owner-related schedule delay factors include corruption ,intermittent termination of variation while project is ongoing, less on-time payment for developers, variation of specifications and material type during construction work, delay in checking contract document, variation of project scope, poor coordination with other stakeholders, slow decision-making ,inadequate information during project feasibility study ,delay in site delivery, lack of motivations for contractor to finish ahead of schedule ,ineffective representative, poor experience, interference during actual project work, joint-owners disagreement, improper feasibility study ,poor coordination and communication, interruption of work ,slow document approve ,nature bidding and award ,impractical contract duration ,and unrealistic delay penalties.

The study by Aibinu and Odeyinka (2006) identified Client-related Schedule delay factors which include the owner's cash flow problems, variation orders and slowness and delay in decision making. Similarly, Chan and Kumaraswamy (1997) identified Client-related schedule delay factors on construction projects which are the low speed of decision making, unrealistic duration of the contract, and owner-initiated variations. Contract modifications (replacement and addition of new work to the project and change in specifications); lack of working knowledge; lack of coordination with contractors; delayed decisions; and financial problems (delayed payments, financial difficulties, and economic problems) are also client-related Schedule delay factors (Enshassi et al., (2010).

Furthermore, Assaf and Al-Hejji (2006) carried out a similar study on the topic "Causes of delay in large construction projects". The researchers found out that Client-related Schedule delay factors affecting schedule delay are: Lack of incentives for contractor for finishing ahead of schedule and suspension of work by owner, delay in payment for the work, delay to deliver the site to the

contractor, changing and modify orders during work, delay in revising and approving design documents, bad communication and coordination between the client and the other parties, slowness in decision making, suspension of the work and conflicts between joint-ownership of the project.

2.2.2.2. Contractor-related Schedule delay Factors

Aibinu and Odeyinka (2006) identified several factors as the main contributors to contractor-related factors for Schedule delay. These include planning and scheduling problems, financial shortage problems, equipment fault, shortage of equipment and materials, slow mobilization, equipment maintenance problems and a shortage of labors. Chan and Kumaraswamy (1997) also identified that factors affecting schedule delay are poor site management and supervision, insufficient project planning and scheduling.

A more recent study on cost overruns by Enshassi et al., (2010) on the topic "Significant Factors Causing Time and Cost Overruns in Construction Projects in the Gaza Strip" factors related to contractor-related Schedule delay are: financial problems; delay in delivery of materials to site; shortage of materials on site; construction mistakes and defective work; poor skills and experience of labour; low productivity of labour; coordination problems with others; lack of subcontractor's skills; lack of site contractor's staff; poor site management; shortage of site labour; and equipment and tool shortages on site.

Another recent critical literature review on main factors of delay in Construction projects by Daba and Pitroda (2018) indicated that the contractor-related schedule delay factors are "dishonesty/problems in funding by contractor, ineffective site supervision, ineffective scheduling ,revise due to mistakes during work ,sub-contractors work related delay, poor experience of the contractor, delay in site arrangement, delay in preparation of working drawing and sample of material, delay in payment of executed work for a contractor by the owner, slow decision-making ,late approving design documents ,variation by owner, delay in procurement of materials, mistakes in design documents, recurrent changing of subcontractors, poor methods of construction, unskilled project crew, poor technology, poor coordination and communication between them, ineffective contractor's policies, unskilled sub-contractors, ineffective economic control on site, inadequate procurement of construction materials, improper equipment, frequent equipment breakdowns ,shortage of equipment, subcontractor turn-over ,lack of labour, slow mobilization of labour, ineffective equipment ,slow equipment deliver, materials damage, strike, conflict between labor and client".

2.2.2.3. Consultant -related Schedule delay Factors

The study by Aibinu and Odeyinka (2006) revealed that incomplete drawings, late issuance of instructions and inadequate supervision are some of the consultant -related Schedule delay Factors. Similarly, Enshassi et al., (2010) concluded that lack of experience on the part of the consultant; absence of consultant's site staff; lack of managerial as well as supervisory experience on the part of the consultant's site staff; incomplete documents; delayed and slow supervision in making decisions; and delayed instructions are also some of the factors. Al-Khalil and Al-Ghafly (1999) stated that inadequate site supervision by the consultant staff was the major cause of schedule delay.

In the construction sector, delay in approving major changes in the scope of work by consultant, delay in performing inspection and testing by consultant, stubbornness of consultant, late review and approval of design documents by consultants, poor communication and coordination between consultant and other parties, conflicts between consultant and design engineer, insufficient work experience of consultant, design errors made by designers, changes in types and specifications during construction, insufficient communication between owner and consultant during design stage were consultant -related Schedule delay Factors (Assaf et al., 1995).

Additionally, a recent critical literature review on main cause of delay in construction projects by Daba and Pitroda (2018) indicated that the consultant-related Schedule delay Factors are "lack of experience ,disagreement with a design engineer ,delay in approving project scope ,delay in performing inspection and testing, poor site investigation, unskilled project management assistance, delay in approving and checking design documents, inadequate coordination and communication between project holders and developers, recurrent change of contractors and sub-contractors, kind of project award and bidding ,variation during construction by owners, unfavorable weather condition during construction work, poor experience of consultant and contractors, delay in checking working drawing, error in design documents and discrepancies, less brief specifications in drawings ,quality pledge".

2.2.2.4. Others/external -related Schedule delay Factors

Various researchers have identified others/external -related Schedule delay factors category as one of the groups of factors affecting schedule delays in construction project management. These include price escalation, inclement weather, labour disputes and strikes, government regulations, slow permit by the government, civil disturbances and acts of God (Aibinu and Odeyinka, 2006).

In a separate studies by several authors have concluded that poor procurement of material topped, shortage of materials in the market as a factor causing delay, poor quality of materials, escalation of material prices, and late delivery of materials, lack of equipment and tools on the market; adverse weather conditions; poor site conditions (location, ground, etc.); poor economic conditions (currency, inflation rate, etc.); changes in laws and regulations; equipment breakdowns, shortage of equipment; transportation delays; and external work due to public agencies (roads, utilities, and public services are external -related Schedule delay Factors (Assaf and Al-Hejji (2006); Chan and Kumaraswamy (1997); Kumaraswamy et al (1998); Alghbari et al. (2007)).

A study by Assaf and Al-Hejji (2006) on the topic "Causes of delay in large construction projects". Their findings indicated that the external/ others related delay factors as; unfavorable weather conditions, delay in obtaining permits from municipality ;effects of subsurface conditions (e.g. soil, high water table, etc.), hot weather effect on construction activities, rain effect on construction activities, unavailability of utilities in site (such as, water, electricity, telephone, etc.), effect of social and cultural factors, traffic control and restriction at job site, accident during construction, differing site (ground) conditions, changes in government regulations and laws, delay in providing services from utilities (such as water, electricity), delay in performing final inspection and certification by a third party. The same author stated that shortage of construction materials in the market, legal disputes and ineffective delay penalties, and delay in manufacturing special building materials and others as causative factors that contributed to schedule delays.

Findings from a recent study done by Aziz (2013) of Egypt in his study also showed that the main and highest factor affecting delays in construction projects in Egypt is a financial problem (funding problem) and identified the top ten factors include different type of bribes, shortage of equipment
Ineffective project planning and scheduling, poor site management and supervision, poor financial control on site, rework due to errors, selecting inappropriate contractors, sudden failures actions and inadequate planning.

Moreover a study by Shibani, Dr Abdussalam (2015) on a study topic "Time and Cost Overrun in Construction Projects in Egypt" conclude that the most five (5) factors affecting schedule delay (time overruns) in construction projects from the perspective of importance were: (1) "low productivity of labours", (2) "poor communication and coordination between parties", (3) "different ways of bribes",

(4) “financing delay of the project”, (5) “change orders during work” and “unskilled labours”. The result also indicates that the most five (5) factors affecting cost overrun (increasing of the cost) include additional works by the owner, inaccurate review of the plans and contract document, poor feasibility planning and cost control during work, resources constraints such as (financial budget, lack of reserved resources for the contractors and fluctuation of materials prices. His study also recommends that the owners, contractors, and consultants were advised to be more responsible about their work and their responsibility to prevent any schedule delay or cost increases which could be achieved by encouraging the labours by giving rewards to increase their productivity, good management, improve the communication and coordination among them.

2.2.3. Factors affecting Cost Overruns on water and Sewerage Construction Projects

Schedule delay and cost overruns can occur commonly due to several factors on different types of construction projects including water supply and sewerage construction projects. When the actual construction project costs or schedules exceed their planned targets, client satisfaction could be compromised and as a result, the total cost may no longer match with the initial prearranged cost (budget) and further schedule slippage could result (Alinaitwe, H. et al., 2013).

In a study conducted by Frimpongs et al. (2003) identified 26 factors affecting cost overruns in the construction of groundwater projects in Ghana. The researchers administered 55 questionnaires to owners, 40 to contractors and 30 to consultants, and as a result, their findings indicated that monthly payments difficulties from agencies were the most important cost overruns factor according to the contractors and consultants whereas the client/owners ranked poor contractor management as the most important factor. Further, their conclusions revealed that the major factors that cause cost overruns on groundwater project in developing countries are monthly payment difficulties from agencies, poor contractor management, monthly payment difficulties from agencies, material procurement, escalation of material prices, and poor technical performance.

According to Morris et al., (2005) in his research mentioned the factors prompting cost overruns in construction projects. These factors are Inadequate project preparation, Inadequate planning/scheduling, and implementation, Delay in construction, Supply of raw material and equipment by contractor, Change in the scope of the project, Delay in decisions making by

government or project owner, Unclear coordinating bodies, Inappropriate choice of site, Technical incompetence/unskilled project team, Poor organizational structure, labour unrest, natural calamities, restiveness, war and lack of experience of technical consultants.

On the other hand, findings from a study done by Kaming et al. (1997) on the topic "Factors influencing construction time and cost overruns on high-rise projects in Indonesia" also indicated that some of the common factors are complexity of projects, change in material rates, inaccurate estimation of cost,, contractors less experience about the site geography, contractor less experience about the project, weather condition, and non-familiarity with local regulations. He also identified the four main factors that affect the cost overrun in construction projects are an increase in material cost, incorrect management of quantity take-off, the productivity of labor and the increase of labor wages in markets.

Another research by Iyer and Jha (2005) point out that the 10 significant factors result in construction project cost overrun include nonexistence of cooperation, aggressive competition at tender stage; conflict among project participants, presence of poor project specific attributes, hostile socio-economic, climatic conditions, reluctance in timely decision, and short bid preparation time, ignorance and lack of knowledge, and others. Kaliba, Muya, and Mumba (2009) in their research confirmed that cost escalation of construction projects in Zambia was caused by factors such as inclement weather, scope changes, environmental protection and mitigation costs, schedule delays, strikes, technical challenges, and inflation.

Chimwaso (2001) also discovered in his study that the nine factors include additional work at owner's request, poor soil conditions at site, incomplete design at the time of tender, changes in owner brief, adjustment of prime cost and provisional sums, lack of cost planning and monitoring during pre and post contract stages, re-measurement of provisional works, lack of cost reports during construction stage, and excessive logistics costs due to site location. Moreover, a study by Bubshait and Al-Juwait (2002) pointed out that the factors that caused cost overruns on construction projects in Saudi Arabia include the number of projects going on at the same time, social and cultural impacts, a lack of productivity standards in Saudi Arabia, the level of competitors, supplier manipulation, the project location, economic stability, inadequate production of raw materials by the country, the effects of weather and the absence of construction cost management.

In a similar water supply project study by Frimpong et al., (2003) on the topic "Significant factors causing delay and cost overruns in the construction of groundwater projects in Ghana" and aimed at to examine and evaluate the relative importance of the main factors that cause delay and cost overruns in groundwater construction projects. The study adopted survey research and used a questionnaire to generate data from professionals involved in groundwater construction projects in Ghana. The researchers analyzed and ranked the data using relative importance weights and based on the profession of the respondents and their roles in the industry (i.e. owners, contractors, and consultants). The results indicated that: (1) the surveyed groups generally agreed that the project financing category is the main reason for groundwater construction delay and cost overruns, whereas the labour category is the least; (2) owners, consultants and contractors substantially agree on the ranking of the major categories of delay and cost overruns factors. The researchers further conclude that all the three groups felt that project financing, natural conditions, micro-economics, and materials factor categories play a predominant role in causing schedule delay and cost overruns to groundwater construction projects.

In general, schedule delay and cost Overruns can occur in many aspects. The researcher has made an in-depth empirical literature review and identified nighty three (93) factors affecting project schedule delay and cost overruns in Ethiopia context and grouped them into 4 major categories such as contractor related, consultant related and client related and others/External related (Chan and Kumaraswamy (1996, 2002), (Ogunlana et al. 1996), (Kaming et al 1997), (Alwi and Hampson 2003), (Elinwa and Joshua 2001), (Ahmed et al. 2003), (Odeh et al. 2002),(Enshassi et al. 2003), (Abudul-Rahman et al. 2006), (Alaghbari et al. 2007), (Aziz (2013), (Abudul-Rahman et al. 2008), (Morris et al. 1990), (Chimwaso ,2001). The details of the common factors and categories from the literature review are discussed hereunder and summarized in Table 2.1.

Table 2.1. Common factors affecting Schedule delay and cost overruns on construction projects

S.N	Factors Affecting Schedule Delay	Category
1	Delay in assessing/evaluating major changes in the scope of work	Consultant
2	Design errors made by designers	Consultant
3	Inadequate site investigation	Consultant
4	Unclear and inadequate details in drawings	Consultant
5	Delay in preparing interim payment certificates	Consultant
6	Delay in reviewing and approving design changes	Consultant
7	The complexity of the project	Consultant
8	Poor qualification of engineer's staff assigned to the project	Consultant
9	Late approval of contractor submissions by the consultant	Consultant
10	Delay in inspection, performing and testing by the consultant	Consultant
11	Late response from the consultant to contractor inquiries	Consultant
12	Delay in correcting mistakes and reconciling discrepancies in the contract document	Consultant
13	Late instructions by the consultant/ engineer	Consultant
14	Lack of experience of consultant in construction projects	Consultant
15	Conflicts between consultants	Consultant
16	Insufficient data collection and survey before design	Consultant
17	Poor communication and coordination with other parties	Consultant
18	Misunderstanding of the owner's requirements	Consultant
19	Insufficient estimation of original contract duration	Consultant
20	Poor use of advanced design software	Consultant
21	Financial indiscipline/dishonesty	Contractor
22	Inadequate contractor experience	Contractor
23	Incompetent project team	Contractor
24	Poor site management and supervision	Contractor
25	Poor procurement of construction materials	Contractor
26	Absenteeism	Contractor
27	Ineffective project planning and scheduling	Contractor
28	Late delivery of materials	Contractor
29	Rework due to errors	Contractor
30	Poor communication and coordination with other parties	Contractor
31	Unqualified / inadequate experienced labour	Contractor
32	Low motivation and morale of labour	Contractor
33	Low productivity of labour	Contractor
34	Improper equipment	Contractor
35	Obsolete technology	Contractor
36	Frequent equipment breakdowns	Contractor
37	Unreliable subcontractors	Contractor
38	Shortage of equipment	Contractor
39	Poor quality of construction materials	Contractor
40	Subcontractor turn-over	Contractor
41	Shortage of labour	Contractor
42	Slow mobilization of labour	Contractor
43	Low efficiency of equipment	Contractor
44	Slow mobilization of equipment	Contractor
45	Damage of materials	Contractor
46	Strike	Contractor
47	Personal conflicts among labour	Contractor

48	Corruption tendencies	Client
49	Intermittent stoppage of work due to cash flow constraints	Client
50	Change orders	Client
51	Delay in payments	Client
52	Changes in material types and specifications during construction	Client
53	Delay in approving design documents	Client
54	Design changes by the owner or his agent during construction	Client
55	Poor communication and coordination with other parties	Client
56	Slowness in decision making	Client
57	Conflicts between joint-owners	Client
58	Inadequate information during project feasibility study	Client
59	Delay in site delivery	Client
60	Lack of incentives for the contractor to finish ahead of schedule	Client
61	Lack of capable representative	Client
62	Lack of experience of the owner in construction projects	Client
63	Unfavorable weather conditions	Others/External
64	Legal disputes between project participants	Others/External
65	Shortage of construction materials	Others/External
66	Unexpected surface & subsurface conditions (such as soil, high water table)	Others/External
67	Delay in manufacturing materials	Others/External
68	Accidents during construction	Others/External
69	Environmental and social factors	Others/External
70	Geopolitical and regional stability	Others/External
71	Escalation of local material prices	Others/External
72	Government tendering system of choosing the lowest bidder	Others/External
73	Bureaucracy in Government agencies	Others/External
	Factors Affecting Cost Overruns	
74	Design change	Consultant
75	Quantity underestimation	Consultant
76	Price escalation (Labor/Materials)	Others/External
77	Corruption	Others/External
78	Lack of quality	Contractor
79	The high cost of transportation	Others/External
80	Poor Contract management	Client
81	Scope changes	Client
82	Lack of coordination between construction parties	Contractor
83	Mistake during construction	Contractor
84	Force Majeure	Others/External
85	Contractual claims, such as an extension of time with cost claims	Contractor
86	Wastage/ Poor financial control on site	Client
87	Cash flow and financial difficulties faced by contractors	Contractor
88	Financial difficulties of owner	Client
89	Additional work/extra items at owner's request	Client
90	Site/poor soil conditions	Others/External
91	Technical omissions at the design stage	Consultant
92	Omissions and errors in the bills of quantities	Consultant
93	Inadequate project preparation, monitoring, planning, and implementation	Client

2.2.4. Factors Affecting schedule and cost overruns on the construction projects in Ethiopia

Abubeker Jemal Mustefa (2015) carried out research to get evidence on the factors that cause time and cost overrun during construction and their effects on road construction projects in Addis Ababa. He used questionnaire surveys together with desk review to collect data on time and cost overruns. The researcher collected a total of 94 questionnaires from the client, consultants, and contractors and did a desk review of 10 completed road construction projects in Addis Ababa. According to his findings, almost 100% of the road construction projects suffered both time and cost overrun. The rate of time overrun was between 25% and 264.38% of the original duration and the rate of cost overrun was between 4.11% and 135.06% of the original contract amount. His findings also indicated that the most important causes of time overrun were delayed to furnish and deliver the site (Right of way problem), financial problems and improper planning. Further, the most common causes of cost overrun were found to be a delay in construction, inadequate supply of raw materials and equipment by contractors, design changes, supplementary agreement, adversarial relations among stakeholders, and a budget shortfall of project owner's, and incomplete design at the time of tender.

Similarly, Zelele, Tadesse. (2016) concluded that the level of construction project management practice in Ethiopia in terms of adapting general project management procedures, project management functions, tools & techniques including the level of practice in terms of safety, risk and time management was found to be to be inadequate. The amount of schedule slippage ranges between 61-80% and that of planned costs and other variables such as risk, quality, resources utilization, and safety deviates in the range 21-40% from predetermined requirements or anticipated at the beginning of the project (Tadesse, 2016).

In another recent study by Tsegay Gebrehiwet and Hanbin Luo (2017) concluded that the highest rank of the cause of delay in Ethiopian construction is corruption. Also unavailability of services (utilities) at the site, inflation, less quality material, late design and design documents, less speed of material supply, late in agreement of contract and receiving of completed project work, poor site management and performance, late release budget/ funds, and unsuccessful project preparation and scheduling. The result of their research indicated that the critical effects of delay investigated are cost overruns, time overrun, and termination of a contract, arbitration, and litigation sequentially.

On the other hand, a recent study by Zinabu Tebeje Zewdu and Getachew Teka (2015) indicated a different result with respect to cost overruns that 'the top five factors that cause cost overrun of

construction projects were from medium to high as per the contractor' response. On the other hand, the top five factors as per the response of consultants and clients ranged between high to very high'. The contractors indicated the top five factors affecting cost overruns in construction projects are poor planning, fluctuation of the price of materials, poor productivity, inflationary pressure, and project financing in descending order.

2.3. Conceptual Framework

The conceptual framework for this research was in line with the theories of Project Management. Kerzner (1998), one of the specialists of Project management, characterizes a project as having a specific objective to be completed within certain specifications, with defined start and end dates, funding limits, and which consume resources (i.e. money, people, equipment). Similarly, Gaddis (1959) underscored that an important goal in the field of project management is to complete the project within the allocated time and budget.

In 1916, Fayol was the first pioneer to introduce the managerial thinking concept based on his experience in the early 1900s. He familiarized the main function of management including planning, organizing, staffing, and controlling. Further, project management (PM) theory is a collection of confirmed effective work practices for managing projects (Engwall, 1998). With this conceptual understanding, it is deemed that the construction management sector across the world, in general, has been established with proper planning of a project by identifying the suitable resources to finish the project on time, with the allocated budget and at the required level of quality. The three main important goals of any construction projects are cost, time and quality which are linked together as shown in figure 2.3 "Iron triangle". Majority of the successful construction projects have been achieved by accomplishing the project deliverables and objectives within the specified time, cost and quality by bringing together the project activities and resources necessary to that. However, mostly construction projects including water supply and sewerage construction projects face schedule and cost overruns due to several determinant factors.

Figure 2.3: The Iron Triangle

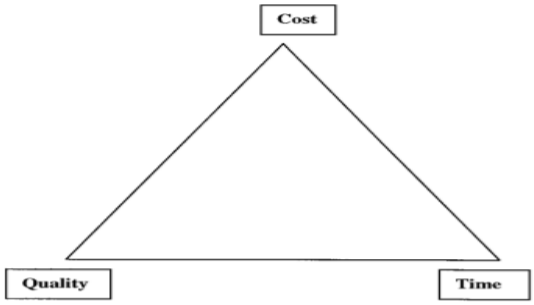


Figure 2.3. The Iron Triangle

The Project Management Triangle (Iron Triangle) is prototypical of the constraints of project management. Even though its origins are unclear, it has been used since at least the 1950s. It deals with that the quality of work is constrained by the project's budget, deadlines, and scope (features). Further, it indicated that changes in one constraint necessitate changes in others to compensate or quality will be compromised. The project could be completed faster by increasing the budget (cost) or cutting scope. On the other hand, the increasing scope may require equivalent escalations in the cost /budget and schedule, which leads to cost overruns and schedule delay respectively. On the other hand, cutting the budget without adjusting schedule or scope will lead to a lower quality so that there is a need to have proper project management practices to avoid schedule and cost overruns as well as substandard quality issues.

Further, the Project management Institute (PMI) introduced a guide to the PMBOK with which project managers can apply the process groups to meet the project objective and avoid the common problem of construction project schedule delay and cost overruns. The five groups of the PM process include (a) initiation process group, (b) planning process group, (c) executing process group, (d) monitoring and controlling process group, and (e) closing process group (PMI, 2013; Wysocki, 2014). The five process groups have one or more of the 10 knowledge areas as introduced in a matrix illustrated hereunder on which PMI elaborated in Table 3.1 of the PMBOK (5th ed.; PMI, 2013).

Knowledge Areas	Project Management Process Groups				
	Initiating	Planning	Executing	Monitoring and Controlling	Closing
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

Figure 2.4. PM process groups and knowledge area mapping (adapted from Project Management Body of Knowledge (PMBOK®; 6th ed.; p. 61.

Accordingly, managing a project activities comprises, but is not limited to: identifying requirements, addressing the various needs, concerns, and expectations of the stakeholders in planning and executing the project, setting up, maintaining, and carrying out communications among stakeholders that are active, effective, and collaborative in nature; managing stakeholders towards meeting project requirements and creating project deliverables and also balancing the competing project constraints, which include, but are not limited to: Scope management, activity scheduling (time management), Quality management, cost and resource management, and risk management (PMI,2013).

2.3.1. Definition of schedule delay and cost overruns

2.3.1.1. Cost overruns

Choudhry (2004) defined the cost overruns as the difference between the original cost estimate of the project and actual construction cost on completion of works of a commercial sector construction project. Cost overrun is defined as the change in contract amount divided by the original contract award amount.

Zhu K and Liu L (2004) also defined Cost overrun as a budget overrun, cost increase, or cost escalation. Cost overrun is a variance between initially estimated or projected cost and final cost at the completion of the project. Cost overrun is the difference between the actual cost and the initially projected (i.e. expected) cost of the projects. The actual costs become known only at the time of completion, the projected costs are the estimated costs when a project is planned (Adano Boru, 2016).

2.3.1.2. Schedule delay

According to Kaming et al (1997), as cited by Adano Boru (2016), the delay is the extension of time beyond planned completion dates noticeable to the contractors. Whereas schedule overrun is an extra time required to finish a given construction project beyond its original planned duration, whether compensated for or not (Alkhathami, 2004). Similarly, Choudhry (2004) and Chan (2001), Mohamad, M.R.B. (2010) defined the schedule overruns as the difference between the actual completion time and the estimated completion time. The schedule overruns are measured in a number of days. From the above definition, Schedule overrun is defined as the schedule slippage beyond the date that the parties agreed upon for delivery of a project due to several factors delineated the project.

2.3.2. Types of Schedule Delays in Construction Projects

According to Theodore J. Trauner Jr (2009) as cited by Ahmed, Twana. (2015), schedule delays in construction projects have been put in various classifications by several authors but the four categories of delays as explained by various authors have a lot in common in terms of their fundamentals. These includes Excusable delay, Concurrent delay, Compensable delay, and Critical delay (Abdul-Rahman et al. (2008), Kumaraswamy and Chan (1995), Ahmed et al. (2003), Vidalis et al (2002), Ahmed et al (2003), Alaghabri et al (2007) and Al- Gahtani and Mohan (2007)) as cited by Jomah Mohammed Al-Najjar (2008)). Even though the various types of delays have been put in several studies, they are somewhat linked to one another. These classifications have been elaborated hereunder.

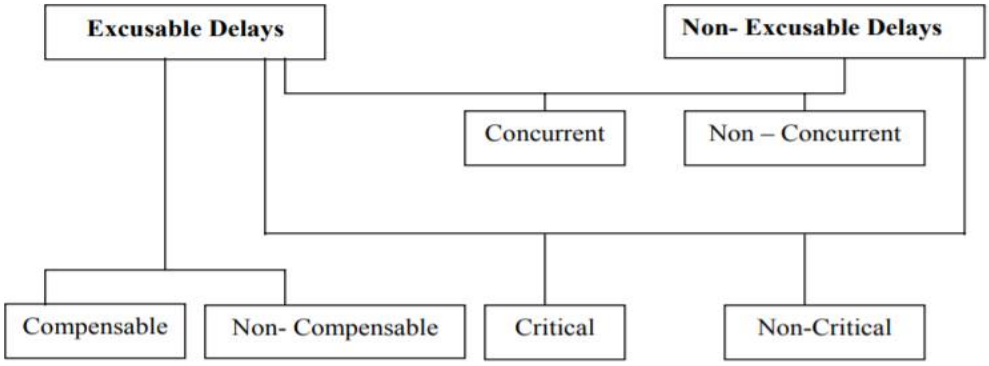


Figure 2.5: Sequential relationships of various categories of delays (adapted from Vidalis et al, 2002)

2.3.2.1. Excusable or Non Excusable

Alaghbari et al 2007 stated that Excusable Delay is a delay that is due to an unforeseeable event beyond the contractors or the subcontractor's control. Normally, based on common general provisions in public agency specifications, delay resulting from the following events would be considered excusable: General labor strikes, Fires, Floods, Acts of God, Owner- directed changes, Errors & omissions in the plans and specifications, Differing site conditions or concealed conditions, usually sever weathers, Intervention by outside agencies, and Lack of action by government bodies, such as building inspection. Before the analyst concludes that a delay is excusable based solely on the preceding definition, he or she must refer to the construction contract documents. A decision concerning delays must be made within the context of the specific contract. the contract should clearly define the factors that are considered valid delays to the project that justify time extensions to the contract completion date, for example, some contracts may not allow for any time extension caused by weather conditions, regardless of how unusual, unexpected, or sever. Most contracts allow the contractor to obtain an extension of time for excusable delays, but no additional money (Alaghbari et al 2007). None excusable delays are events that are within the contractor's control or that are foreseeable. These are some examples of none excusable delays: Late performance of subcontractors, the untimely performance by suppliers, Faulty workmanship by the contractor and subcontractors, a project-specific labour strike caused by either the contractor's unwillingness to meet with labour representatives or by unfair labour practices.

2.3.2.2. Compensable or Non Compensable

Alaghbari et al (2007) indicated that a compensable delay is a delay where the Contractor is entitled to a time extension and to additional compensation. The most common form of compensable delay is

inadequate drawings and specifications, but compensable delays can also arise from the owner's failure to respond in a timely fashion to requests for information or shop drawings, owner's changes in design or materials, and owner's disruption and/or change in the sequence of the work (Jomah Mohammed Al-Najjar, 2008). On the other hand, a non-compensable delay means that although an excusable delay may have occurred, the contractor is not entitled to any added compensation resulting from the excusable delay. Thus, the question of wheatear a delay is compensable must be answered. Additionally, a non-excusable delay warrants neither additional compensation nor a time extension. Whether or not a delay is compensable depends primarily on the terms of the contract. In most cases, a contract specifically notes the kinds of delays that are non-compensable, for which the contractor does not receive any additional money but may be allowed a time extension (Al-Gahtani and Mohan, 2007).

2.3.2.3. Concurrent or Non Concurrent

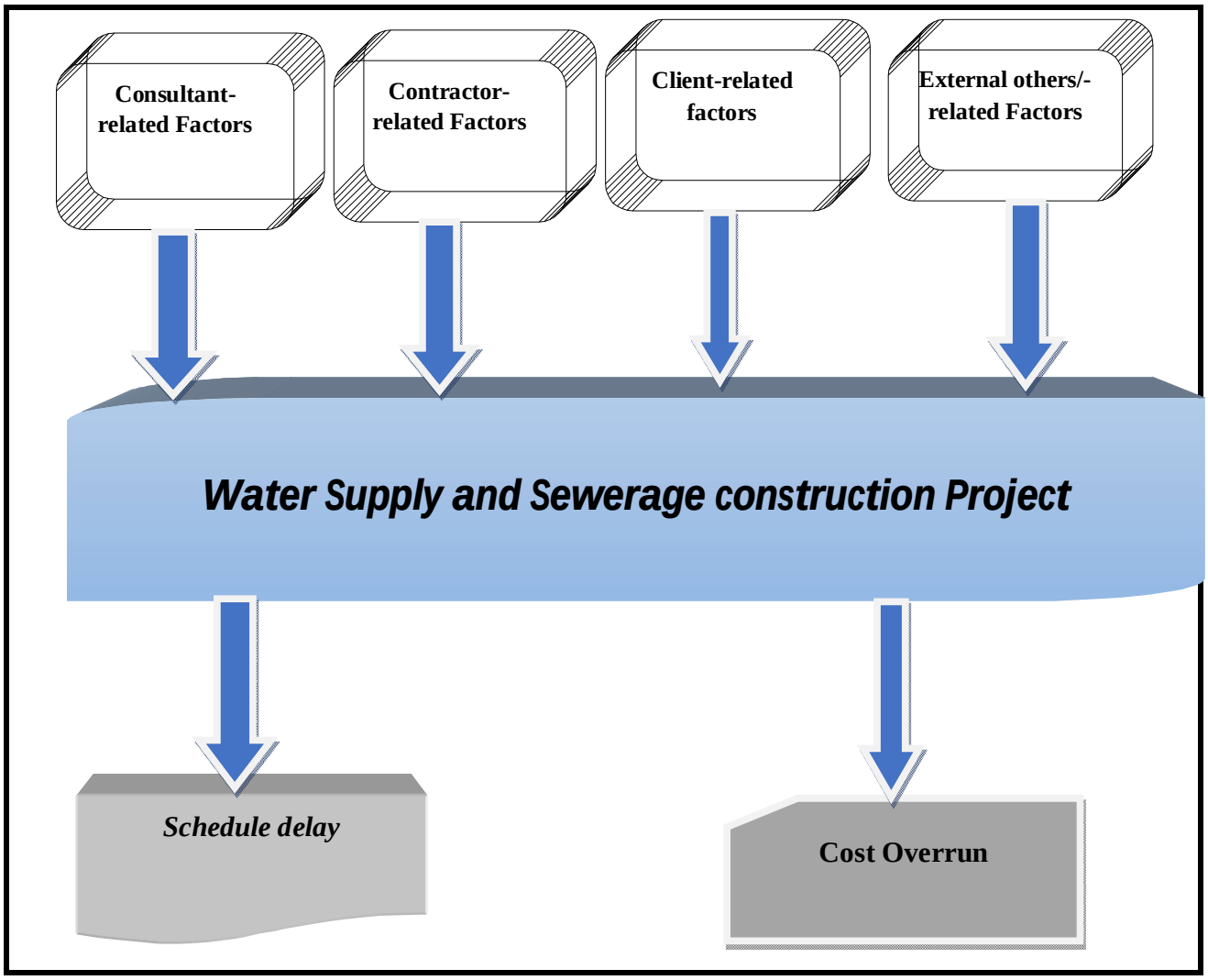
Concurrent delay mostly refers to the situation where two or more delay activities occur at different times but the impact is felt (in whole or in part) at the same time (Alaghbari et al 2007). It occurs when both parties to the construction contract (owner and contractor) delay the project during an excusable but non-compensable delay (such as severe weather conditions). Such delays do not necessarily have to occur simultaneously but can be on two parallel critical path chains. Concurrent delays may also be an excusable delay with compensation which may grant some reliefs to the contractor in the form of an extension of time, remission of liquidated damages and sometimes a potential delay of damages subject to the given circumstance and the contractual agreement. In the same vein, a concurrent delay may also be inexcusable where the delay of the contractor, though concurrent with that of the owner, had a more severe impact on the finishing date. Concurrent delays could be caused by the delaying effects of events that were either excusable (i.e. the events for which the employer takes the risk of time and for which extensions of time should be granted to the contractor.

2.3.2.4. Critical or Non Critical delays

Jomah Mohammed Al-Najjar (2008) highlighted that Critical delays are delays which prevent the contractor from finishing the work on the scheduled completion date as agreed upon in the contract whereas the noncritical delays do not affect the completion date of the project. This indicates that non-critical delays can be seen as those delays that do not impact the completion date of the project but in a way, affect the progress of the work. It can, therefore, be said that both excusable and non-

excusable delays are all critical delays. This leaves non-critical delays as a standalone delay classification.

Figure 2.6: A Suggestive Conceptual framework of the determinant factor groups affecting schedule delay and cost overruns in water supply and Sewerage Construction projects.



CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. Research Design

This research used a descriptive survey design and a combination of both quantitative and qualitative data collections approaches to identify the determinant factors affecting schedule delays and cost overruns on water supply and sewerage construction projects within the Addis Ababa City. Such kind of research method has become a common practice in recent years research work for a better understanding and validation of the research results (Saunders et al, 2011; Bryman, 2006). The research methodology includes questionnaire designing, selection of participants using purposive sampling, identifying the source of data and target population, data collection using a questionnaire survey and interview, determining the data collection instruments and data analysis tools, reviewing secondary data through desk review, and lastly identifying and ranking the determinant factors affecting schedule and cost overruns.

3.2. Source of Data

The research used both qualitative and quantitative data which included secondary data review and the use of a structured questionnaire which was considered to be the most appropriate tool to reach the population of the study with limited time and resource. Accordingly, the survey was designed based on the factors extracted from the recent literature and organized in three parts which include questions related to respondents profile, cost overrun related factors, and delay-related factors in the construction industry in general. The secondary data were also collected from books, the internet (i.e. e-journals, web articles), manuals, annual reports, and periodical progress reports.

3.3. Population and Sample

The target populations for this research work included the staff members of the client (project owners), consultants, and contractors based on their direct exposure to the Water supply and Sewerage construction projects of the AAWSA. The research population composition included Project managers, architects, civil/site engineers, site supervisors, quantity surveyors, electro-mechanical engineers, planning, monitoring, and evaluation officers, including some key support staff of the client who are actively participating in the project management process especially in the resource administration and contract administration duties like the procurement officers,

budget/Finance officers, and Internal Auditors. Participants from the client (project owners of AAWSA), Contractors, and Consultant firms were selected on the basis of knowledge of the research problem and direct work experience in water supply and construction project activities. Accordingly, the sample has been selected purposely to allow selection of appropriate participants for inclusion in the sample. Purposive sampling is very suitable for such kind of research to answer the research questions and also to have the required information from the experts of construction (contractors, consultants, project managers, and client's construction team members) with regard to the research objectives (Mugenda and Mugenda, 2003). The available selected participants had practical project management experience in the construction of water supply and sewerage projects. Their knowledge and experience helped as a suitable indication of the determinant factors affecting schedule and Cost overruns on water and sewerage construction projects from owners, contractors and consultants point of view. Of the three different organizations namely client, consultants and contractors, Eighty-one (81) available participants (45 from the Client, 12 from the contractor, and 24 from the consultants) were invited and taken as a sample. Thus, it was appropriate and convenient to take all these respondents as a sample.

3.4. Instruments of Data Collection

Considering Addis Ababa City as a research ground for this study, a total of ninety-three (93) factors were identified based on the literature review and experts advice and then designed to be a structured closed-ended questionnaire and an additional three (3) self-explanatory open-ended questions, and finally grouped them under four (4) broad categories of determinant factors causing schedule delays and cost overruns by the researcher (Contractor-related factors, Consultant related factors, Client-related factors and others/ External related factors (see Annex 1 for further info).

Accordingly, respondents (the client staff members, consultants of the AAWSA, and Contractors of AAWSA) were requested to indicate the determinant factors using a structured questionnaire on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree), and open-ended questions. The scale was leveled as: "Strongly Agree", "Agree", "Neither agree nor Disagree", "Disagree", and "Strongly Disagree"; the higher the number, the greater determinant factor on the cost overruns and schedule delays of water Supply and sewerage construction projects in Addis Ababa city context. Moreover, an interview was conducted with the key officials of the AAWSA, consulting firms and construction companies. Some relevant documents were also reviewed at the AAWSA project office

to identify the rate of schedule delay and cost overruns for some selected water supply and sewerage construction projects.

3.5. Data Analysis Procedures and Presentation

The data gathered through primary and secondary data collection methods were analyzed using both mixed data analysis methods. The data collected in the course of the questionnaire were examined and presented using Statistical Package for Social Scientists (SPSS) version 20.0 application software, descriptive statistics, and Relative important of the index (RII) in order to analyze the data generated by the research questions. RII helps in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables (Johnson and LeBreton (2004). The same method is used in this research within various groups category (i.e. client, consultants, contractors) to rate the identified factor on a five-point Likert scale (1, for the strongly disagree to and 5, for the strongly agree). Based on the survey response, an RII was tabulated using the following equation (1):

$$RII = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n}{5\,N}$$

Where W is the weighting given to each factor by the respondent, ranging from 1 to 5, (n1 = number of respondents that strongly disagree, n2 = number of respondents that disagree, n3 = number of respondents that are neutral, n4 = number of respondents that agree, n5 = number of respondents for strongly agree). “A” is the highest weight (i.e. 5 in the study) and N is the total number of samples. The relative importance index ranges from 0 to 1.

The literature review entirely depended on secondary sources whereas; the analysis part relied on primary data that has been collected through structured questionnaires, and face to face interview. It also depends on secondary data collection (desk review exercises) from the sources indicated above in 3.2 (Annual reports, Monitoring, and evaluation reports, planning documents, etc.).

3.6. Pilot Study

A pilot study was conducted to ensure the validity and reliability of the questionnaire used for the research and the design of the questionnaire started with the development of a sample questionnaire with an intensive review of the literature to confirm the clarity, completeness, validity, and

applicability of the questionnaire. Experts were also consulted to examine its contents in relation to its ability to achieve the stated objectives of the research, the level of coverage, how logical and how suitable they are for the prospective respondents from different perceptions (client, consultant, and contractors).

In addition, the reliability test was conducted using Cronbach's alpha coefficient of internal consistency and reliability test was also used. As a result, the survey presents ninety-three (93) factors generated on the basis of recent related research works on schedule delay and cost overruns on construction projects. The results as presented in table 1 shows a coefficient of 0.876 and 0.944 for the cost overruns and schedule delay respectively, implying that the data are reliable and internally consistent and therefore accepted as depicted in table 3.2.

Factors	Cronbach's alpha	N of item
Schedule delay	**0.944**	**73**
Cost Overruns	**0.876**	**20**

Table 3.2: SPSS Cronbach's alpha Computation based on field Survey Data, 2018.

According to Reynold and Santos (1999), a Cronbach's alpha value greater than 0.7 implies that the instrument is acceptable. Therefore, based on the above results, the questionnaire was judged to be reliable.

3.7. Ethical considerations

The ethical issues related to this academic research has been protected by upholding high-level confidentiality of the information given by the research participants and the information is only for academic purpose. Thus, the respondent's ideas and comments were provided voluntarily and kept confidentially in order to create a conducive environment for their free and genuine responses. Further, the names of the participants were not a requirement on the questionnaire and limited to basic general information only. An official authorization was also granted from the AAWSA Manager and the consultants and contractors to collect data from the respondents, and a self-explanatory letter of introduction to respondents was also attached to each questionnaire.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSIONS

The findings in this chapter portray based on the research objectives and research questions as stated in the introduction part. In analyzing the data on the assessment of the determinant factors affecting schedule delay and cost Overruns on water supply and sewerage projects of Addis Ababa City, both the primary and secondary data gotten were linked for better understanding and analyzing the research outputs.

4.1. Questionnaire Response Rate

The study targeted a sample of 81 respondents from the client, contractors and consultant's offices & out of which 64 filled out and returned the questionnaires giving a response rate of 79%.

Table 4.3. Summary of Questionnaire distribution and response rate

Organization type	Total # of Questionnaire distributed	Total #of Questionnaire Returned	Response rate (%age)
Client	45	38	84%
Contractor	12	9	75%
Consultant	24	17	71%
Total	81	64	79%

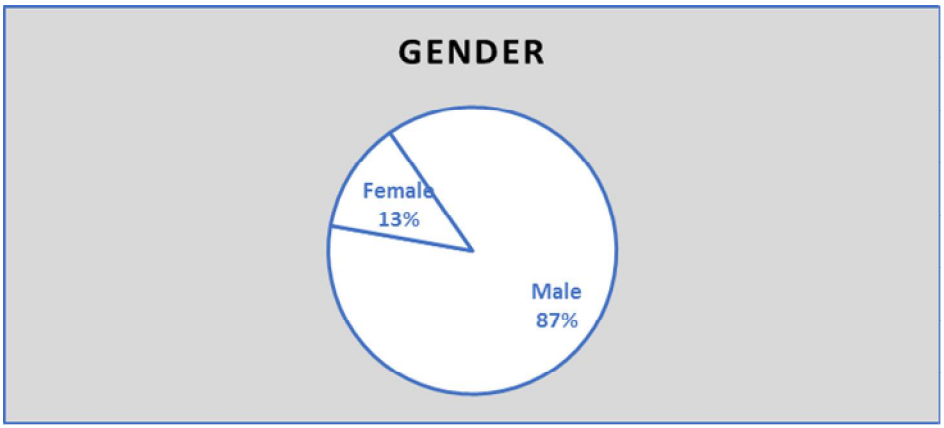
Source: Field survey Data, 2018

This response was good enough and representative of the population and conforms to Mugenda and Mugenda (1999) stipulation that a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and above is excellent.

4.2. Respondents Demographic Statistics

The study sought to establish the gender distribution, age, education level, designation, work experience of the respondents and other parameters as discussed in the table hereunder. Findings from the returned questionnaires revealed that the males made the majority of the respondents at 87% and the females at 13% as shown in figure 4.7 below.

Figure 4.7: Gender distribution

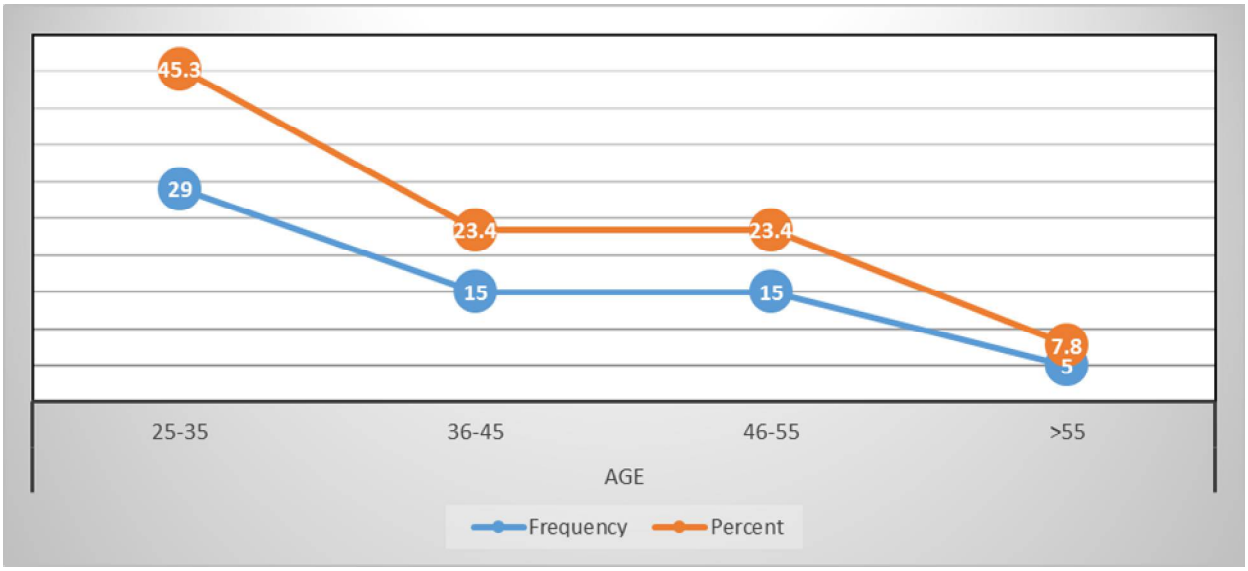


Source: Field survey Data, 2018

The numbers of female employees are very less compared to males since the gender party proportion is still not fulfilled in all organizational types in Ethiopia.

As shown in figure 4.8 hereunder, results from the survey report indicated that 45% of the respondents were in the age group of 25-35 years old, 23.4% of the respondents in the age group of 36 - 45 years old; 23.4% of the respondents were in the age group of 36-55 years old, and 7.8% of the respondents were above 55 years old. In general, above 54.69% of the respondents are relatively mature in terms of age and It seems that the organizations were equipped with more moderate matured technical staff.

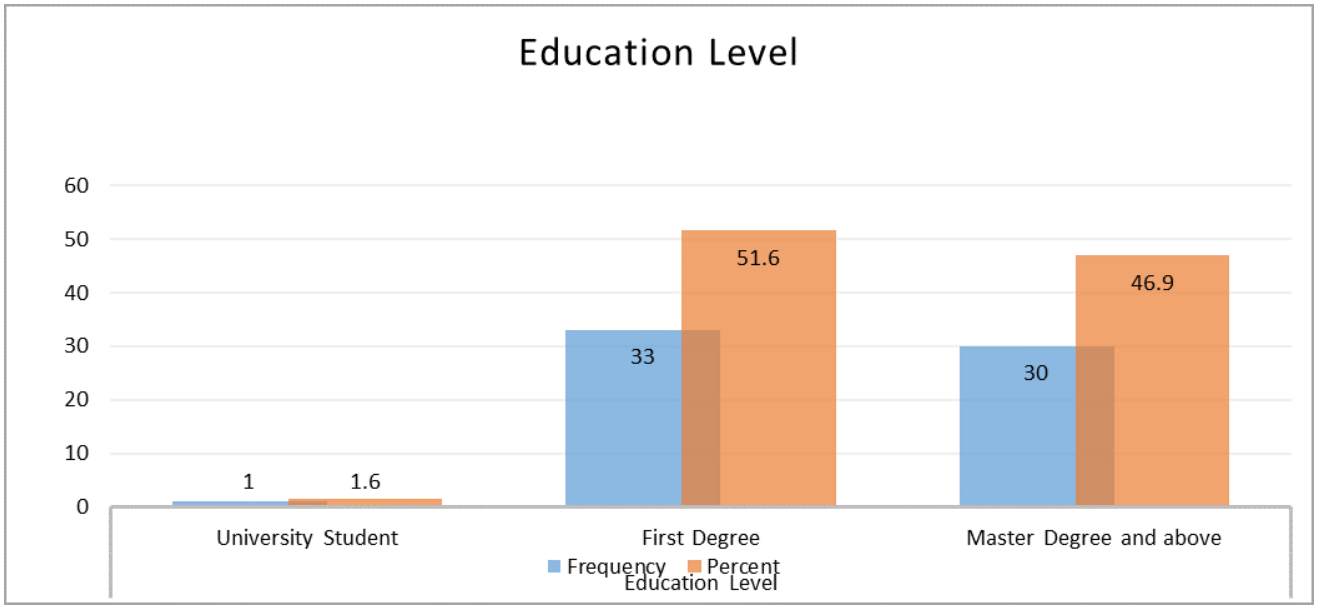
Figure 4.8: The range of Respondents age distribution.



Source: Field survey Data, 2018

Findings vis-à-vis respondent's educational qualification, the majority of the respondents (51.6%) had bachelor's Degree followed by those who had a Master's degree and above were 46.9%, and 1.6% of the respondents were attending a University education as depicted hereunder in Figure 4.9.

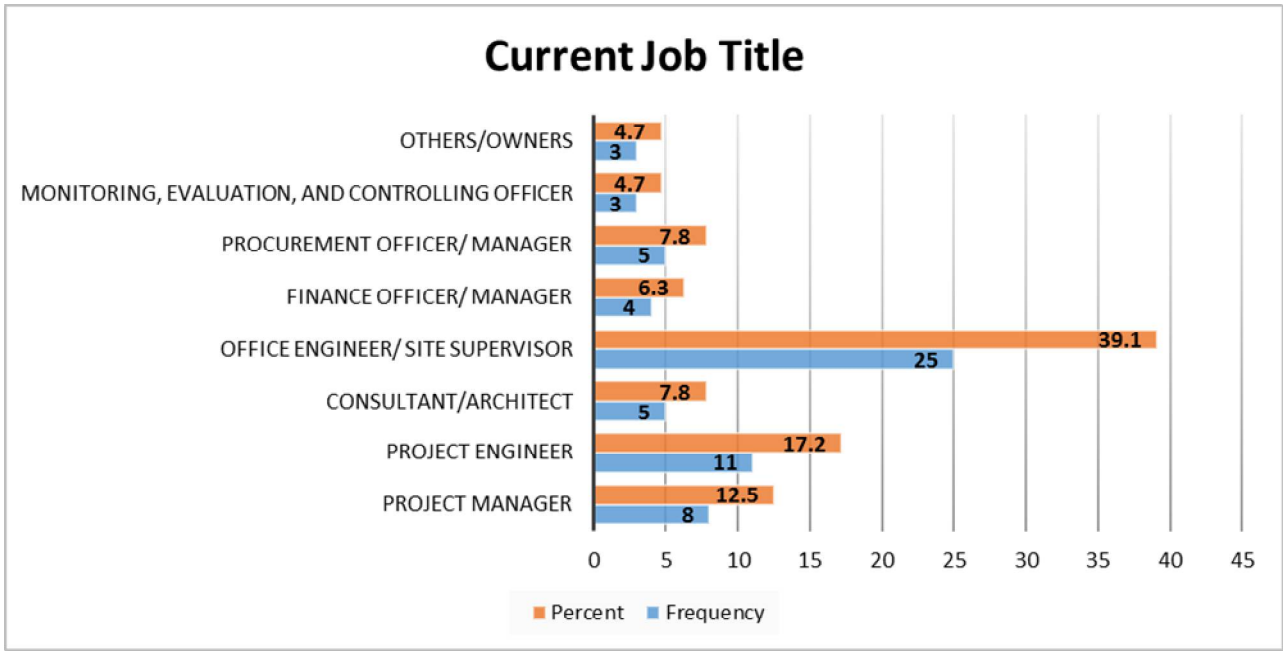
Figure 4.9: Respondents' distribution in terms of Educational qualification



Source: Field survey Data, 2018

According to the findings as indicated in figure 4.10, above 95% of the participants were working in more moderate and senior positions so that the data collected from each post holder has been very relatable to analyze the views and perceptions of the participants in the area of the study. Furthermore, about 12.5% of the respondents were project managers, 17.2% of the respondents were project engineers, 7.8% were working as Project consultant/Architect, 39.1% were office Engineers/ Site Supervisors, 6.3% and 7.8% of the respondents were finance officers and procurement officers respectively, and 4.7% of the respondents were project monitoring, evaluation and control officers. In addition, 4.7% of the respondents were owners of the construction companies.

Figure 4.10: The Job title of respondents



Source: Field survey Data, 2018

Findings also indicated that the respondents that participated in this survey had very good working experience in executing different water supply and sewerage construction projects. Table 4.2 below shows that 59.4% of the respondents were employees of the client, 26.6% of the respondents were employees of the consultant firms and, 14.1% of the respondents were employed by the contractors. Fifty of the sixty-four respondents also indicated that their employers have above 10 years of work experience in the industry. Furthermore, it seems that the client, consultant, and contractors organizations were occupied with more educated staff members and with adequate work experience.

Table 4.4: Respondents' distribution in terms of Respondents experience, organization type, types of project, the category of the organization and experience of the organizations in the Water & sewerage construction project.

Characteristics of Respondents	Parameters	Frequency	Percent	Cumulative Percent
Years of your organization involved in the Water and sewerage construction project	< 5 years	14	21.9	21.9
	5 - 10 years	13	20.3	42.2
	> 10 Years	37	57.8	100.0
Years of work experience in the organization	Below 1 Year	5	7.8	7.8
	1-5 Years	23	35.9	43.8

	5-10 Years	21	32.8	76.6
	11-15 Years	9	14.1	90.6
	16 -20 Years	3	4.7	95.3
	Above 20 Years	3	4.7	100.0
Type of organization	Client	38	59.4	59.4
	Contractor	9	14.1	73.4
	Consultant	17	26.6	100.0
Type of construction projects your organization has been participating	Water/Sewerage	63	98.4	98.4
	Office building	1	1.6	100.0
Category/ class of Your organization	Governmental/ Public organization	39	60.9	60.9
	Private Limited company (PLC)	17	26.6	87.5
	Corporation	8	12.5	100.0
Total		**64**		

Source: Field survey Data, 2018

Above 92% of the respondents had above 5 years of work experience related to the 98.4% of the water supply and sewerage projects so that the numbers of qualified employee's participation in this assessment study is very reasonable and acceptable to get the required research data for analysis. Further, the majority of the respondents were from the governmental/ Public organization (60.9%), 26.6% of the participants from Private limited company (PLC), and 12.5% of the respondents were from the corporations.

4.3. Analysis of determinant factors affecting Schedule Delay and cost Overruns based on the Relative Importance Index (RII).

4.3.1. Determinant Factors Affecting Schedule Delay on water supply and sewerage construction projects

The relative importance index was used to rank the determinant factors affecting schedule delay on the water supply and sewerage construction projects in Addis Ababa. The RII value was calculated for each group of the respondents, including the clients, contractors, and consultants. The survey results revealed that the top ten determinant factors affecting schedule delay as perceived by the three parties (client, consultants, and contractors) are (1) Bureaucracy in Government agencies (RII=0.8469), (2) Government tendering system of choosing the lowest bidder (RII=0.8313) , (3) Late delivery of materials (RII=0.8281), (4) Escalation of local material prices (RII= 0.7938), (5)

Ineffective project planning and scheduling (RII=0.7813), (6) Insufficient estimation of original contract duration (RII=0.7719); (7) Design errors made by designers (RII=0.7688), (8) Slowness in decision making (RII=0.7594), (9) Delay in site delivery (RII=0.7469), (10) Unexpected surface & subsurface conditions (such as soil, high water table) (RII=0.7469). Table 4.5 shows the top ten determinant factors affecting Schedule Delay with their RII value, which was ranked by the groups of respondents.

Table 4.5. Top ten determinant factors affecting Schedule Delay in water supply & sewerage projects.

Factors Affecting Schedule Delay	RII	Rank
Bureaucracy in Government agencies	0.8469	1
Government tendering system of choosing the lowest bidder	0.8313	2
Late delivery of materials	0.8281	3
Escalation of local material prices	0.7938	4
Ineffective project planning and scheduling	0.7813	5
Insufficient estimation of original contract duration	0.7719	6
Design errors made by designers	0.7688	7
Slowness in decision making	0.7594	8
Delay in site delivery	0.7469	9
Unexpected surface & subsurface conditions (such as soil, high water table)	0.7469	10

Source: Field survey Data, 2018

The findings indicated that they are in partial agreement with the study of Chan and Kumaraswamy (1996, 2002), Ogunlana et al. (1996), Kaming et al (1997), Alwi and Hampson (2003), Elinwa and Joshua (2001), (Ahmed et al. (2003), Odeh et al. (2002), Enshassi et al. (2003), Abudul-Rahman et al. (2006), Alaghbari et al. (2007), Aziz (2013), Abudul-Rahman et al. (2008), Morris et al. (1990), and Chimwaso (2001) who also pointed out the significant factors for schedule delay in various types of construction projects. However, the findings were not in agreement with the study of Frimpong et al., (2003) who showed that the three groups felt that project financing, natural conditions, micro-economics, and materials factor categories play a predominant role in causing schedule delay and cost overruns to groundwater construction projects. Further, the findings of this research were also

not similar to the results identified by Abubeker Jemal Mustefa (2015) and Tsegay Gebrehiwet and Hanbin Luo (2017) of Ethiopia.

4.3.2. Determinant Factors Affecting Cost Overruns on water supply and sewerage construction projects

The relative importance index was used to rank the determinant factors affecting Cost overruns on the water supply and sewerage construction projects in Addis Ababa. The RII value was calculated for each group of the respondents, including the clients, contractors, and consultants. The findings indicated that the top ten determinant factors affecting cost overruns as perceived by the three parties (client, consultants, and contractors) include (1) design change (RII=0.7969), (2) Price escalation (Labor/Materials)(RII=0.7906), (3) Quantity underestimation (RII=0.7844), (4) Contractual claims, such as an extension of time with cost claims (RII=0.7750), (5) Poor Contract management (RII=0.7531), (6) Omissions and errors in the bills of quantities (RII= 0.7438), (7) Additional work/extra items at owner's request (RII=0.7406), (8) Inadequate project preparation, monitoring, planning, and implementation (RII=0.7406), (9) Scope changes (RII=0.7344), and (10) wastage/ Poor financial control on site (RII=0.7063). Table 4.6 displays the relevant determinant factors affecting Cost overruns with their RII value which were ranked by the groups of respondents.

Table 4.6. Ranking of the top ten determinant factors affecting Cost overruns on water supply & sewerage projects in Addis Ababa City

Factors Affecting Cost overruns	RII	Rank
Design change	0.7969	1
Price escalation (Labor/Materials)	0.7906	2
Quantity underestimation	0.7844	3
Contractual claims, such as an extension of time with cost claims	0.7750	4
Poor Contract management	0.7531	5
Omissions and errors in the bills of quantities	0.7438	6
Additional work/extra items at the owner's request	0.7406	7
Inadequate project preparation, monitoring, planning, and implementation	0.7406	8
Scope changes	0.7344	9

Wastage/ Poor financial control on site	0.7063	10

Source: Field survey Data, 2018

The findings on the determinant factors affecting Cost overruns on water supply & sewerage projects in Addis Ababa City conforms with the studies of Frimpongs et al. (2003), Morris et al., (2005), Kaming et al. (1997), Kaliba, Muya, and Mumba (2009), Chimwaso (2001), Zinabu Tebeje Zewdu and Getachew Teka (2015), and Abubeker Jemal Mustefa (2015) regardless of the geographical location of the research, development level, or the nature of the organizations or environment. The possible justification for this agreement that their findings indicated the following factors affecting cost overruns on various construction projects including the water supply and sewerage construction projects: poor contractor management, Inadequate project preparation, planning/scheduling, and implementation, change in the scope of the project, an increase in material cost, incomplete design at the time of tender, changes in owner brief, adjustment of prime cost and provisional sums, design changes, additional work/extra items at owner's request, and incomplete design at the time of tender.

In general, the client and contractors as well as the consultant related group of schedule and cost overruns factors were the most determinant factors causing cost overruns on water supply and sewerage construction projects due to the low level of construction project management practice in Ethiopia in terms of adapting general project management procedures, project management functions, tools & techniques including the level of practice in terms of safety, risk and time management (Tadesse, 2016).

4.4. Categories of Schedule delay Factors with respect to Responsible parties on water supply and sewerage construction projects

The categories of schedule delay factors with respect to responsible parties are analyzed and ranked based on the relative importance index (RII) results. The list of factors affecting schedule delay categorized into four main groups, which includes Client-related Schedule delay factors, Consultant-related Schedule delay factors, Contractor-related Schedule delay factors, and External/others-related Schedule delay factors. Table 4.7 shows the categories of factors affecting schedule delay with their RII value, which was ranked by the four groups of respondents.

Table 4.7: Categories of factors affecting Schedule Delay with their RII value which was ranked by the four groups of respondents.

Factors Affecting Schedule Delay	RII	Rank	Related Category
Bureaucracy in Government agencies	0.8469	1	Others/External
Government tendering system of choosing the lowest bidder	0.8313	2	Others/External
Late delivery of materials	0.8281	3	Contractor
Escalation of local material prices	0.7938	4	Others/External
Ineffective project planning and scheduling	0.7813	5	Contractor
Insufficient estimation of original contract duration	0.7719	6	Consultant
Design errors made by designers	0.7688	7	Consultant
Slowness in decision making	0.7594	8	Client
Delay in site delivery	0.7469	9	Client
Unexpected surface & subsurface conditions (such as soil, high water table)	0.7469	10	Others/External
Delay in manufacturing materials	0.7438	11	Others/External
Poor communication and coordination with other parties	0.7406	12	Contractor
Delay in assessing/evaluating major changes in the scope of work	0.7375	13	Consultant
Inadequate information during the project feasibility study	0.7375	14	Client
Insufficient data collection and survey before design	0.7313	15	Consultant
Unreliable subcontractors	0.7313	16	Contractor
Delay in reviewing and approving design changes	0.7219	17	Consultant
Design changes by the owner or his agent during construction	0.7219	18	Client
Environmental and social factors	0.7219	19	Others/External
Geopolitical and regional stability	0.7219	20	Others/External
Inadequate site investigation	0.7188	21	Consultant
Poor site management and supervision	0.7156	22	Contractor
Poor communication and coordination with other parties	0.7125	23	Consultant
Incompetent project team	0.7125	24	Contractor
Low efficiency of equipment	0.7125	25	Contractor
Poor communication and coordination with other parties	0.7125	26	Client
Inadequate contractor experience	0.7063	27	Contractor
Rework due to errors	0.7063	28	Contractor
Improper equipment	0.7031	29	Contractor
Slow mobilization of equipment	0.7031	30	Contractor
Low productivity of labour	0.7	31	Contractor
Shortage of equipment	0.7	32	Contractor
Unclear and inadequate details in drawings	0.6938	33	Consultant
Poor use of advanced design software	0.6906	34	Consultant

Lack of incentives for the contractor to finish ahead of schedule	0.6906	35	Client
Low motivation and morale of labour	0.6875	36	Contractor
Delay in approving design documents	0.6875	37	Client
Legal disputes between project participants	0.6781	38	Others/External
Delay in payments	0.675	39	Client
Frequent equipment breakdowns	0.6719	40	Contractor
Change orders	0.6719	41	Client
Changes in material types and specifications during construction	0.6719	42	Client

Source: Field survey Data, 2018

4.4.1. Client-related Schedule delay factors

As presented in Table 4.7 above, the main Schedule delay factors attributed to the client's action were slowness in decision making (RII= 0.7594), delay in site delivery (RII= 0.7469), inadequate information during project feasibility study (RII= 0.7375), design changes by the owner or his agent during construction (RII=0.7219), poor communication and coordination with other parties (RII= 0.7125), lack of incentives for the contractor to finish ahead of schedule (RII= 0.6906), delay in approving design documents (RII= 0.6875), delay in payments (RII= 0.6750), change orders (0.6719), and changes in material types and specifications during construction (RII=0.6719). The findings are in general agreement with the study of Assaf and Al-Hejji (2006), Daba and Pitroda (2018), and Aibinu and Odeyinka (2006 who also pointed out delay in site delivery, slowness in the decision making, inadequate information during project feasibility study, poor coordination and communication by the client / owner as the major factors affecting schedule delay on construction projects.

4.4.2. Consultant -related Schedule delay factors

According to the findings indicated on table 4.7 above, the most determinant schedule delays factors caused by the consultant action were insufficient estimation of original contract duration (RII=0.7719), design errors made by designers (RII=0.7688), delay in assessing/evaluating major changes in the scope of work (RII=0.7375), Insufficient data collection and survey before design (RII=0.7313),delay in reviewing and approving design changes (RII=0.7219), Inadequate site investigation(RII=0.7188),poor communication and coordination with other parties (RII= 0.7125). Consultants are responsible for all consultant related factors. The results revealed that they were similar with the study by Assaf et al., (1995) where design errors made by designers, changes in

types and specifications during construction, insufficient communication between owner and consultant during design stage were considered as consultant -related Schedule delay Factors. Furthermore, the findings were partially in agreement with the study by Aibinu and Odeyinka (2006) who revealed that incomplete drawings, late issuance of instructions and inadequate supervision were some of the consultant -related Schedule delay Factors.

4.4.3. Contractor-related Schedule delay factors

From the findings on table 4.7 above, it was noted that the factors that affects schedule delay on water supply and sewerage projects in Addis Ababa city government includes late delivery of materials (RII= 0.8281), ineffective project planning and scheduling (RII= 0.7813), poor communication and coordination with other parties (RII= 0.7406), unreliable subcontractors (RII= 0.7313), poor site management and supervision (RII= 0.7156), incompetent project team (RII:0.7125), and Low efficiency of equipment (RII= 0.7125), inadequate contractor experience (RII=0.7063), Rework due to errors (RII= 0.7063), improper equipment (RII= 0.7031), slow mobilization of equipment (RII= 0.7031), Low productivity of labour (RII= 0.7000) and Shortage of equipment (RII= 0.7000).

The findings in connection with contractor -related Schedule delay factors were in agreement with the study by Enshassi et al., (2010) where delay in delivery of materials to site; financial problems; shortage of materials on site; construction mistakes and defective work; poor skills and experience of labour; low productivity of labour; coordination problems with others; lack of subcontractor's skills; lack of site contractor's staff; poor site management; shortage of site labour; and equipment and tool shortages on site by the contractor were identified as the major factors of contractor related schedule overruns.

4.4.4. Others/External-related Schedule delay factors

As perceived by the three parties (client, consultants, and contractors), the external/others-related schedule delay factors are bureaucracy in Government agencies (RII=0.8469), Government tendering system of choosing the lowest bidder (RII= 0.8313), escalation of local material prices (RII= 0.7938), unexpected surface & subsurface conditions (such as soil, high water table)(RII= 0.7469), delay in manufacturing materials (RII= 0.7438), environmental and social factors (RII= 0.7219), and Geopolitical and regional stability (RII= 0.7219) according to table 4.7 above. Some of the results were in agreement with the study by of Assaf and Al-Hejji (2006) that their findings indicated that the external/ others related delay factors as; changes in government regulations and laws, delay in obtaining permits from municipality

;effects of subsurface conditions (e.g. soil, high water table, etc.), hot weather effect on construction activities, rain effect on construction activities, delay in manufacturing special building materials and others as causative factors that contributed to schedule delays.

4.5. The extent of schedule delay and cost overruns for selected water supply and sewerage construction projects in Addis Ababa City

For the extent of schedule delay and cost overruns analysis, the AAWSA project office database was used to source historic water supply and sewerage construction projects. According to the findings, the average rate of schedule overrun is between 7.69% and 1208.89% of the original duration, and the average rate of cost overrun is between 0.72% and 8.11% of the original cost.

These results are in general agreement with the study of Abubeker Jemal Mustefa (2015) of Ethiopia who also pointed out the rate of time overrun on road construction projects in Addis Ababa was between 25% and 264.38% of the original duration and the average cost overrun rate was between 4.11% and 135.06% of the original contract value. Another recent study by Tadesse A. et al. (2016) also indicated that the amount of construction project schedule slippage in Ethiopia was between 61-80% and that of planned costs and other variables such as risk, quality, resources utilization, and safety deviates in the range 21-40% from predetermined requirements or anticipated at the beginning of the project. The findings of the case analysis indicated the presence of project schedule delay and cost overruns on water supply and sewerage projects in Addis Ababa city as depicted in table 4.8 below.

Source: Field survey Data, 2018

	The extent of schedule delay and cost overruns for eight (8) sample complete water supply and sewerage construction projects in Addis Ababa City (2011 -2018 G.C)						
No	Selected Addis Ababa Water and Sewerage projects name	Contract time (Months)	Actual completed time (Months)	The rate of schedule Overruns (%)	Contract Amount (ETH. Birr)	Actual completed Cost (ETH. Birr)	The rate of Cost Overruns (%)
1	Koyefeche water supply project	52.00	56	7.69%	1,022,341,705.00	1,046,503,982.47	2.36%
2	Legedadi phase II water project	12.00	18	50.00%	181,531,710.00	182,845,200.50	0.72%
3	Legedadi Deep wells water project	36.00	49	36.11%	1,607,989,008.00	1,620,335,524.00	0.77%
4	Soft loan deep well water project	24.00	32	33.33%	1,475,000,000.00	1,490,000,000.00	1.02%
5	Project 1 (#9 deep wells) around the Irrigation dams	23.80	39.3	65.13%	47,841,344.00	47,841,344.00	0.00%
6	Legedadi Water Treatment Plant Expansion Project	6.00	78.53	1208.89%	864,673,136.23	899,530,007.46	4.03%
7	Legedadi Deep wells water development projects (total)	42.20	67.3	59.48%	1,518,299,541.50	1,543,350,606.80	1.65%
7.1	10 Deep wells water digging project (Lot 1)	10.17	38.67	280.33%	46,851,193.00	46,851,193.00	0.00%
7.2	10 Deep wells water digging project (Lot 2)	10.17	18.87	85.57%	42,504,805.00	42,504,805.00	0.00%
7.3	water line expansion and associated civil works	12.00	14.77	23.06%	663,586,843.09	675,933,359.39	1.86%
7.4	Electromechanical supply and installation cost	12.00	37.27	210.56%	765,356,700.40	778,061,249.40	1.66%
8	New Water supply Institutions construction projects (Phase 3A)	59.23	77.67	31.12%	959,912,620.38	1,037,768,169.68	8.11%

Table 4.8. The extent of schedule delay and cost overruns for eight (8) sample complete water supply and sewerage construction projects in Addis Ababa City (2011 -2018 G.C).

CHAPTER FIVE:

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.1. SUMMARY OF FINDINGS AND CONCLUSIONS

As it has been clearly stated in the introduction part, the objective of this research was to assess the determinant Factors affecting schedule delays and cost overruns on water supply and Sewerage construction projects in Addis Ababa City and rank them in order of importance. Accordingly, the objectives of the research were fully achieved and the findings of this research are partially in agreement with the earlier studies in developing countries.

According to the research findings, the top ten determinant factors affecting schedule delay on water supply and sewerage construction projects in Addis Ababa as perceived by the three parties (client, consultants, and contractors) are bureaucracy in Government agencies, Government tendering system of choosing the lowest bidder, late delivery of materials, escalation of local material prices, ineffective project planning and scheduling, insufficient estimation of original contract duration, design errors made by designers, slowness in decision making, delay in site delivery, and unexpected surface & subsurface conditions.

Additionally, the findings from the survey showed that the top ten determinant factors affecting Cost overruns on water supply and sewerage construction projects in Addis Ababa as agreed by the three parties (client, consultants, and contractors) are design change, price escalation (Labor/Materials), quantity underestimation, contractual claims, such as an extension of time with cost claims, poor Contract management, omissions and errors in the bills of quantities, additional work/extra items at the owner's request, inadequate project preparation, monitoring, planning, and implementation, scope changes, and wastage/ poor financial control on site. The categories of factors with respect to responsible parties were also identified and ranked into four main categories (client-related factors, contractor-related factors, consultant-related factors, and others/external –related factors).

The survey result also indicated that almost the majority of the water supply and sewerage construction projects in Addis Ababa city experienced extraordinary schedule delay and cost overruns to varying degrees. The rate of schedule overrun is between 7.69% and 1208.89% of the original duration and the average rate of cost overrun is between 0.72% and 8.11% of the original cost. Further, the main conclusion was that schedule slippage and cost overruns are almost common problems in all kinds of construction projects in developing countries due to the low level of project

management practice, skills, knowledge, competencies, technology and also due to various determinant factors.

5.2. RECOMMENDATION

Based on the findings of the study, the following recommendations are made to the following responsible parties:

1) It is recommended that the design work as well as the bill of quantities shall be managed by the consultants. It is also good to avoid omissions and design errors on the bills of quantities, insufficient estimation of original contract duration; and quantity underestimation for labor and materials requirement. There is also a need to review the quality of designs continuously so as to avoid design change and other mistakes that could lead to rework of activities and finally schedule delay and cost overruns.
2) It is also suggested that having an adequate warehouse for the purpose of bulk construction materials management is good to avoid late delivery of materials, escalation of local material prices and as a result to avoid schedule delay and cost overruns. Contractors should have qualified project team members with appropriate knowledge, skills, and experience to manage various technical and managerial aspects of the project.
3) It is recommended that the client or the owner of the project shall work more on project planning, project cost and schedule management. This will help to avoid slow decision making, delay in site delivery, poor contract management practices, bringing additional work/extra items (scope changes) at a later stage and wastage/ poor financial control on site and other associated problems which can lead to schedule delay and cost overruns. Further, the client is also advised to review its procurement rules and regulations in connection with construction project related procurements especially the tendering system of choosing the lowest bidder.
4) It is recommended that all the responsible parties (client and contractors) shall arrange a training for their team particularly on project cost and schedule management. Furthermore, it is also recommended that frequent site coordination meetings and harmonized communication between the three project players (contractor, consultant, and client) should be arranged at appropriate intervals in order to solve all kinds of project related problems on time including minimizing unnecessary bureaucracy, which leads to schedule and cost overruns.

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Appendix 1- Questionnaire

Addis Ababa University

No	Question	**Response**

College of Business & Economics
School of Commerce, Graduate Studies
Department of Project Management

***D*ear Respondents:-**

I am a Project Management student at the Addis Ababa University, School of Commerce in Ethiopia, and now I am interested to use the Addis Ababa Water and Sewerage Authority platform as a research ground to fulfill the required academic paper. The research I wish to conduct for my Master's thesis is on the topic "Assessment of Determinant Factors Affecting Schedule Delays and Cost Overruns on Water supply and Sewerage Construction projects: The case of Addis Ababa Water and Sewerage Authority".

This research is aimed to examine the problems why most Water and Sewerage construction projects within the Addis Ababa City Government are delayed beyond their time for completion and require additional cost than agreed contract prices. Identifying the determinant factors that contribute to schedule delays and cost overruns in Water and Sewerage construction projects in the Addis Ababa City and rank them in their order of severity have paramount importance to conduct the analysis and subsequent recommendations of the possible solutions towards minimizing the problems.

To successfully undertake this research it is mandatory to look into the issues from different perspectives by involving professionals who have experience in the Water and Sewerage construction sector within the Addis Ababa City Water and Sewerage Authority. In this respect, you are the one who can give the correct and necessary information. Hence, I kindly request you to complete the accompanying questionnaire. I would like to express my sincere appreciation and thanks in advance for your generous time and truthful responses.

The questioner has three parts.

Part I. Respondents Profile
Part II. Rating close ended questions
Part III. Open ended questions

Please **circle** your choice for the **part I** and put a tick **"✓" M**ark for **part II** of the questioners (i.e. close-ended questions). Also please write your short and precise answers for those followed by blank spaces (i.e. open-ended questions). Your valuable support in responding to the questions raised is very important to the success of the study. Hence, I ask you in all regard to filling the questionnaires carefully and at your best knowledge. The quality and quantity of information you provide determine the ultimate reliability of the study. Furthermore, I want to assure you that this research is only for academic purpose. Thus, your ideas and comments are highly honored and kept confidentially. To create a conducive environment for your free and genuine responses, you are not required to write your name. If you have any additional comments or ideas, please feel free to use a blank paper.

Thank you very much for your time and cooperation, and looking forward to receiving your response.

Yours Sincerely,

Lejalem Mulu
Addis Ababa University
College of Business & Economics, School of Commerce

1	Gender	1- Male
		2- Female
2	Age	1- Below 25
		2- 25 -35
		3- 36 -45
		4- 46-55
		5- Above 55
3	Educational Level	1- Below High school
		2- 12 Complete
		3- University Student
		4- Diploma
		5- First Degree
		6- Masters and Above
4	Position in your organization: (Please describe your current job/position)	1. Project manager
		2. Project Officer/ Engineer
		3. Consultant/Architect
		4. Engineer/Site supervisor
		5. Finance officer/ manager
		6. Procurement officer/Manager
		7. Monitoring, evaluation & controlling officer
		8. Other (Please specify)_____
5	Years of your organization involved in Wash and sewerage construction project	1) < 5 years 2) 5 – 10 years 3) > 10 years
6	Years of work experience in the organization	1) ≤1 year 2) 1-5 years 3) 5 - 10years 4) 10- 15 years 5) 15-20 years 6) > 20 Years
7	Type of organization	1. Client 2. Contractor 3. Consultant 4. Other (Please specify)
8	Type of construction projects your organization has been participating:	1) Water/Sewerage 2) Office building 3) Other (Please specify)_____
9	Category/ class of Your organization:	1) Governmental/ Public organization 2) Private Limited company (PLC) 3) Partnership organization 4) Corporation 5) None Governmental Organization (NGO) 6) Other (Please specify)_____

Part I: Respondents Profile

Part II: Determinant Factors affecting Schedule Delay (Close-ended Questions)

S.N	Schedule Delay Factors	Options				
		Strongly Disagree (1)	**Disagree (2)**	**Neither agree nor Disagree (3)**	**Agree (4)**	**Strongly Agree (5)**
	Consultant Related Category					
1	Delay in assessing/evaluating major changes in the scope of work					
2	Design errors made by designers					
3	Inadequate site investigation					
4	Unclear and inadequate details in drawings					
5	Delay in preparing interim payment certificates					
6	Delay in reviewing and approving design changes					
7	The complexity of the project					
8	Poor qualification of engineer's staff assigned to the project					
9	Late approval of contractor submissions by the consultant					
10	Delay in inspection, performing and testing by the consultant					
11	Late response from the consultant to contractor inquiries					
12	Delay in correcting mistakes and reconciling discrepancies in the contract document					
13	Late instructions by the consultant/ engineer					
14	Lack of experience of consultant in construction projects					
15	Conflicts between consultants					
16	Insufficient data collection and survey before design					
17	Poor communication and coordination with other parties					
18	Misunderstanding of the owner's requirements					
19	Insufficient estimation of original contract duration					
20	Poor use of advanced design software					
	Contractor Related Factors					
21	Financial indiscipline/dishonesty					
22	Inadequate contractor experience					
23	Incompetent project team					
24	Poor site management and supervision					
25	Poor procurement of construction materials					

26	Absenteeism					
27	Ineffective project planning and scheduling					
28	Late delivery of materials					
29	Rework due to errors					
30	Poor communication and coordination with other parties					
31	Unqualified / inadequate experienced labour					
32	Low motivation and morale of labour					
33	Low productivity of labour					
34	Improper equipment					
35	Obsolete technology					
36	Frequent equipment breakdowns					
37	Unreliable subcontractors					
38	Shortage of equipment					
39	Poor quality of construction materials					
40	Subcontractor turn-over					
41	Shortage of labour					
42	Slow mobilization of labour					
43	Low efficiency of equipment					
44	Slow mobilization of equipment					
45	Damage of materials					
46	Strike					
47	Personal conflicts among labour					
	Client Related Factors					
48	Corruption tendencies					
49	Intermittent stoppage of work due to cash flow constraints					
50	Change orders					
51	Delay in payments					
52	Changes in material types and specifications during construction					
53	Delay in approving design documents					
54	Design changes by the owner or his agent during construction					
55	Poor communication and coordination with other parties					
56	Slowness in decision making					
57	Conflicts between joint-owners					
58	Inadequate information during project feasibility study					
59	Delay in site delivery					
60	Lack of incentives for the contractor to finish ahead of schedule					
61	Lack of capable representative					

62	Lack of experience of the owner in construction projects					
	External related factors					
63	Unfavorable weather conditions					
64	Legal disputes between project participants					
65	Shortage of construction materials					
66	Unexpected surface & subsurface conditions (such as soil, high water table)					
67	Delay in manufacturing materials					
68	Accidents during construction					
69	Environmental and social factors					
70	Geopolitical and regional stability					
71	Escalation of local material prices					
72	Government tendering system of choosing the lowest bidder					
73	Bureaucracy in Government agencies					
Part II: Determinant Factors affecting Cost Overruns (Close-ended Questions)						
S.N	Cost Overruns Factors	**Options**				
		Strongly Disagree (1)	**Disagree (2)**	**Neither agree nor Disagree (3)**	**Agree (4)**	**Strongly Agree (5)**
1	Design change					
2	Quantity underestimation					
3	Price escalation (Labor/Materials)					
4	Corruption					
5	Lack of quality					
6	The high cost of transportation					
7	Poor Contract management					
8	Scope changes					
9	Lack of coordination between construction parties					
10	Mistake during construction					
11	Force Majeure					
12	Contractual claims, such as an extension of time with cost claims					
13	Wastage/ Poor financial control on site					
14	Cash flow and financial difficulties faced by contractors					
15	Financial difficulties of owner					
16	Additional work/extra items at owner's request					
17	Site/poor soil conditions					
18	Technical omissions at the design stage					
19	Omissions and errors in the bills of quantities					

20	Inadequate project preparation, monitoring, planning, and implementation					

Part III. Open-Ended questions

1) In your opinion, what are the determinant factors that affect **Cost Overruns** in the Addis Ababa Water and Sewerage Authority Water and sewerage construction projects?

a) **……**
b) **……**
c) **……**
d) **……**
e) **……**

2) In your opinion, what are the determinant Factors that affect **Schedule Delays** in the Addis Ababa Water and Sewerage Authority Water and sewerage construction projects?

a. **……**
b. **……**
c. **……**
d. **……**
e. **……**

3) Please highlight your possible recommendation to minimize and to control schedule delay and cost Overrun problems encountered in Water and Sewerage construction projects in Addis Ababa City Government Administration.

I ***would appreciate it if you could make sure that you haven't skipped any of the questions in all sections?***

Appendix 2 – Categories of Factors with respect to responsible parties Affecting schedule delay.

Factors Affecting Schedule Delay	RII	Rank	Category

Bureaucracy in Government agencies	0.8469	1	Others/External
Government tendering system of choosing the lowest bidder	0.8313	2	Others/External
Late delivery of materials	0.8281	3	Contractor
Escalation of local material prices	0.7938	4	Others/External
Ineffective project planning and scheduling	0.7813	5	Contractor
Insufficient estimation of original contract duration	0.7719	6	Consultant
Design errors made by designers	0.7688	7	Consultant
Slowness in decision making	0.7594	8	Client
Delay in site delivery	0.7469	9	Client
Unexpected surface & subsurface conditions (such as soil, high water table)	0.7469	10	Others/External
Delay in manufacturing materials	0.7438	11	Others/External
Poor communication and coordination with other parties	0.7406	12	Contractor
Delay in assessing/evaluating major changes in the scope of work	0.7375	13	Consultant
Inadequate information during project feasibility study	0.7375	14	Client
Insufficient data collection and survey before design	0.7313	15	Consultant
Unreliable subcontractors	0.7313	16	Contractor
Delay in reviewing and approving design changes	0.7219	17	Consultant
Design changes by the owner or his agent during construction	0.7219	18	Client
Environmental and social factors	0.7219	19	Others/External
Geopolitical and regional stability	0.7219	20	Others/External
Inadequate site investigation	0.7188	21	Consultant
Poor site management and supervision	0.7156	22	Contractor
Poor communication and coordination with other parties	0.7125	23	Consultant
Incompetent project team	0.7125	24	Contractor
Low efficiency of equipment	0.7125	25	Contractor
Poor communication and coordination with other parties	0.7125	26	Client
Inadequate contractor experience	0.7063	27	Contractor
Rework due to errors	0.7063	28	Contractor
Improper equipment	0.7031	29	Contractor
Slow mobilization of equipment	0.7031	30	Contractor
Low productivity of labour	0.7000	31	Contractor
Shortage of equipment	0.7000	32	Contractor
Unclear and inadequate details in drawings	0.6938	33	Consultant
Poor use of advanced design software	0.6906	34	Consultant

Lack of incentives for the contractor to finish ahead of schedule	0.6906	35	Client
Low motivation and morale of labour	0.6875	36	Contractor
Delay in approving design documents	0.6875	37	Client
Legal disputes between project participants	0.6781	38	Others/External
Delay in payments	0.6750	39	Client
Frequent equipment breakdowns	0.6719	40	Contractor
Change orders	0.6719	41	Client
Changes in material types and specifications during construction	0.6719	42	Client
Unfavourable weather conditions	0.6719	43	Others/External
Poor procurement of construction materials	0.6688	44	Contractor
Obsolete technology	0.6656	45	Contractor
Unqualified / inadequate experienced labour	0.6625	46	Contractor
Lack of capable representative	0.6625	47	Client
Late approval of contractor submissions by the consultant	0.6594	48	Consultant
Late response from the consultant to contractor inquiries	0.6500	49	Consultant
Poor quality of construction materials	0.6500	50	Contractor
Shortage of construction materials	0.6500	51	Others/External
Misunderstanding of the owner's requirements	0.6406	52	Consultant
The complexity of the project	0.6375	53	Consultant
Slow mobilization of labour	0.6375	54	Contractor
Lack of experience of the owner in construction projects	0.6375	55	Client
Late instructions by the consultant/ engineer	0.6219	56	Consultant
Financial indiscipline/dishonesty	0.6219	57	Contractor
Conflicts between joint-owners	0.6156	58	Client
Delay in correcting mistakes and reconciling discrepancies in the contract document	0.6125	59	Consultant
Absenteeism	0.6094	60	Contractor
Damage of materials	0.6031	61	Contractor
Delay in preparing interim payment certificates	0.6000	62	Consultant
Poor qualification of engineer's staff assigned to the project	0.5969	63	Consultant
Delay in inspection, performing and testing by the consultant	0.5969	64	Consultant
Corruption tendencies	0.5906	65	Client
Accidents during construction	0.5875	66	Others/External
Subcontractor turn-over	0.5844	67	Contractor
Intermittent stoppage of work due to cash flow constraints	0.5625	68	Client
Shortage of labour	0.5531	69	Contractor

Lack of experience of consultant in construction projects	0.5188	70	Consultant
Conflicts between consultants	0.5031	71	Consultant
Strike	0.4938	72	Contractor
Personal conflicts among labour	0.4781	73	Contractor

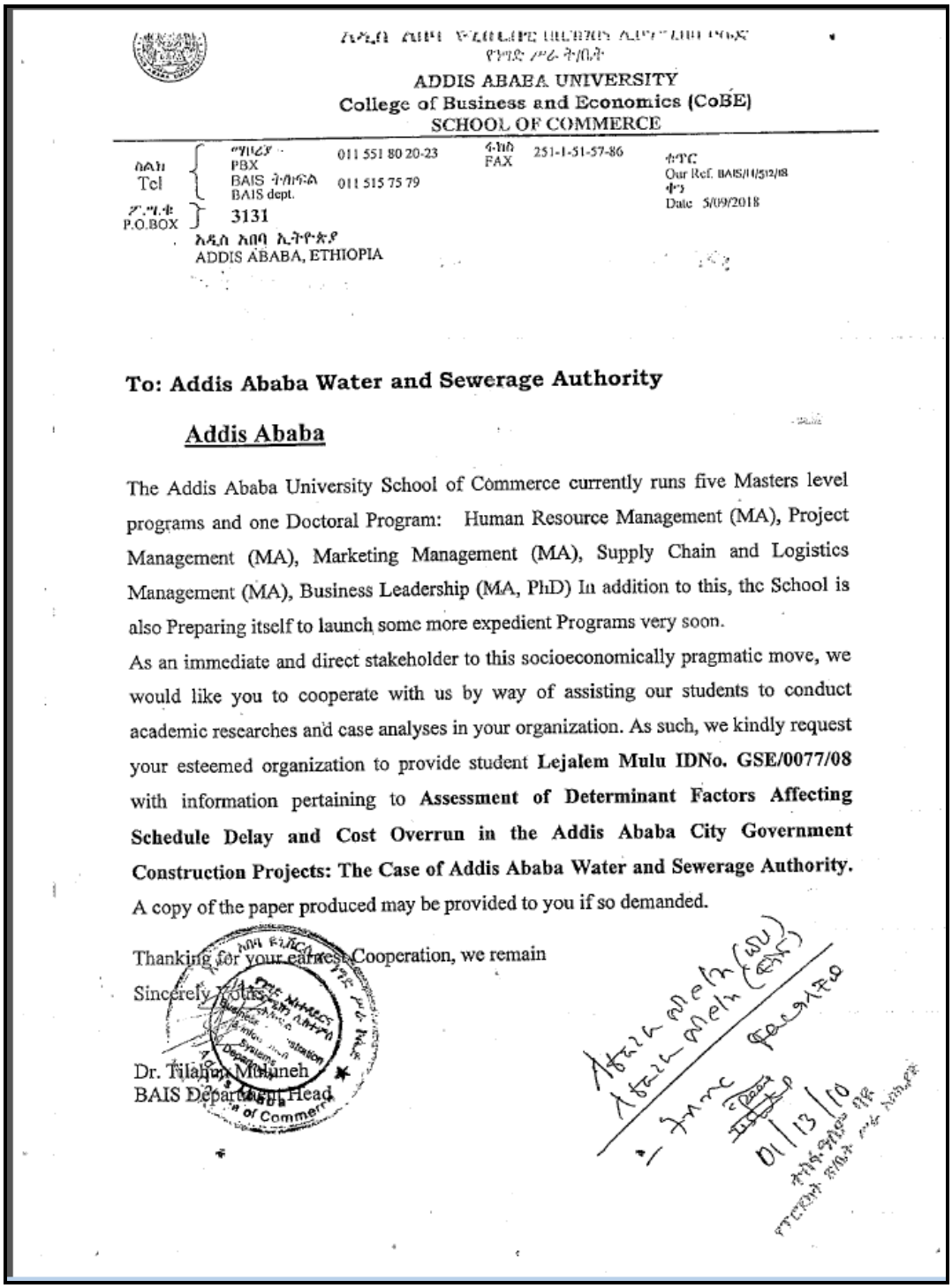
Appendix 3 – List of Determinant Factors Affecting Cost Overruns

Factors Affecting Schedule Delay	**RII**	**Rank**	**Category**
Design change	0.7969	1	Consultant
Price escalation (Labor/Materials)	0.7906	2	Others/External
Quantity underestimation	0.7844	3	Consultant
Contractual claims, such as an extension of time with cost claims	0.7750	4	Contractor
Poor Contract management	0.7531	5	Client
Omissions and errors in the bills of quantities	0.7438	6	Consultant
Additional work/extra items at owner's request	0.7406	7	Client
Inadequate project preparation, monitoring, planning, and implementation	0.7406	8	Client
Scope changes	0.7344	9	Client
Wastage/ Poor financial control on site	0.7063	10	Client
Cash flow and financial difficulties faced by contractors	0.7000	11	Contractor
Lack of quality	0.6844	12	Contractor
Technical omissions at the design stage	0.6844	13	Consultant
Lack of coordination between construction parties	0.6806	14	Contractor
Mistake during construction	0.6750	15	Contractor
Force Majeure	0.6719	16	Others/External
Financial difficulties of owner	0.6719	17	Client
Site/poor soil conditions	0.6563	18	Others/External
Corruption	0.6156	19	Others/External
The high cost of transportation	0.5875	20	Others/External

Appendix 4 – Characteristics of Respondents

Characteristics of Respondents	Parameters	Frequency	Percent	Cumulative Percent
Gender	Male	56	87.5	87.5
	Female	8	12.5	100.0
Age	25-35	29	45.3	45.3
	36-45	15	23.4	68.8
	46-55	15	23.4	92.2
	>55	5	7.8	100.0
Education Level	University Student	1	1.6	1.6
	Degree	33	51.6	53.1
	Master Degree And Above	30	46.9	100.0
Job Position (current job position)	Project manager	8	12.5	12.5
	Project Engineer	11	17.2	29.7
	Consultant/Architect	5	7.8	37.5
	Office Engineer/ Site Supervisor	25	39.1	76.6
	Finance Officer/ Manager	4	6.3	82.8
	Procurement Officer/ manager	5	7.8	90.6
	Monitoring, evaluation and Controlling officer	3	4.7	95.3
	Others/owners	3	4.7	100.0
Years of your organization involved in Wash and sewerage construction project	< 5 years	14	21.9	21.9
	5 - 10 years	13	20.3	42.2
	> 10 Years	37	57.8	100.0
	Total	64	100.0	
Years of work experience in the organization	Below 1 Year	5	7.8	7.8
	1-5 Years	23	35.9	43.8
	5-10 Years	21	32.8	76.6
	11-15 Years	9	14.1	90.6
	16 -20 Years	3	4.7	95.3
	Above 20 Years	3	4.7	100.0
Type of organization	Client	38	59.4	59.4
	Contractor	9	14.1	73.4
	Consultant	17	26.6	100.0
Type of construction projects your organization has been participating	Water/Sewerage	63	98.4	98.4
	Office building	1	1.6	100.0
Category/ class of Your organization	Governmental/ Public organization	39	60.9	60.9
	Private Limited company (PLC)	17	26.6	87.5
	Corporation	8	12.5	100.0
Total		**64**		

Appendix 5 – Letter of Permission to Conduct Academic Research on AAWSA project office



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ADDIS ABABA UNIVERSITY
College of Business and Economics (CoBE)
SCHOOL OF COMMERCE

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ፋክስ FAX 251-1-51-57-86
ቁጥር Our Ref. BAIS/11/512/18
ቀን Date 5/09/2018
ፖ.ሣ.ቁ P.O.BOX 3131
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ADDIS ABABA, ETHIOPIA

To: Addis Ababa Water and Sewerage Authority

Addis Ababa

The Addis Ababa University School of Commerce currently runs five Masters level programs and one Doctoral Program: Human Resource Management (MA), Project Management (MA), Marketing Management (MA), Supply Chain and Logistics Management (MA), Business Leadership (MA, PhD) In addition to this, the School is also Preparing itself to launch some more expedient Programs very soon.

As an immediate and direct stakeholder to this socioeconomically pragmatic move, we would like you to cooperate with us by way of assisting our students to conduct academic researches and case analyses in your organization. As such, we kindly request your esteemed organization to provide student **Lejalem Mulu IDNo. GSE/0077/08** with information pertaining to **Assessment of Determinant Factors Affecting Schedule Delay and Cost Overrun in the Addis Ababa City Government Construction Projects: The Case of Addis Ababa Water and Sewerage Authority.** A copy of the paper produced may be provided to you if so demanded.

Thanking for your earnest Cooperation, we remain

Sincerely Yours,

Dr. Tilahun Muluneh
BAIS Department Head