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INVESTIGATING THE CAUSES FOR DELAY AND COST OVERRUN IN WATER WORKS CONSTRUCTION PROJECTS OF OROMIA WATER WORKS CONSTRUCTION ENTERPRISE (OWWCE)

A Thesis to be Submitted for the Department of Management in Partial Fulfilment for the Award of Master of Arts (MA) Degree in Project Management

Submitted by: Habtamu Imiru

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Advisor: Dereje Tekelemariam (Ph.D)

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By HABTAMU IMIRU

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BY:

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Declaration

I, the undersigned, declare that this Thesis is my original work prepared under the guidance of Dereje Teklemariam (PhD). All sources of materials used for the Thesis have been acknowledged. I further confirm that this Thesis has not been submitted for any degree.

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May 2020

Endorsement

This Thesis has been submitted to St. Mary's University, School of Graduate Studies for the Examination with an approval as a university advisor.

Dereje Teklemariam (PhD) **15/08/2020**

Advisor Signature Date

Dedication

This work is dedicated primarily to my father, Mr. Imiru Gemechu Korsa and Mother Mrs. Aberash Chacka Feyissa, who had worked hard to educate me while they were not educated for themselves; and Mrs. Margaret and Dr. Harvey Doorenbose who contributed a lot to the realization of my personal dream in education since eighth grade.

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Abstract

It is imperative that construction projects play vital roles in the improvement of the socio-economic growth of any nation. Conversely, the construction industry frequently encounters problems of delay and cost overrun. These problems are also prevalent in the construction industry of Ethiopia in general, in Oromia in particular. Therefore, this thesis focused on investigating the causes for delay and cost overrun in construction projects of Oromia Water Works Construction Enterprise (OWWCE). Data utilized for the study were both from primary and secondary sources. Data collection method and tools employed for this study were survey questionnaires for gathering data from relevant respondents and observation of the researcher for primary data sources; while review of documents from the archive of OWWCE office for the secondary source. Variables of causes of delay and cost overrun were gathered from literatures for preparing questionnaires that were distributed to respondents so that their responses were captured using likert scale of 1 to 5 response scales. The questionnaires for the data collection from responds were designed such that both variables namely delay and cost overrun had 48 and 37 factors respectively. All technical staffs having experience more than one year were provided questionnaires, that is a total of 33 respondents from OWWCE. In order to carry out reliable analysis, all the distributed questionnaires were collected with 100% response rate. Data analysis was carried out using descriptive statistical technique after entering responses of respondents from questionnaires into SPSS v 20. Cronbach's alpha coefficient 0.93 was achieved justifying the reliability of the data gathered for further analysis. Relative importance index (RII) was used to rank the factors while severity index (SvI) was used to categorize the factors into severity level (SvL) ranging no severity to extremely high severity to identify the most sever factors of delay and cost overrun in construction projects of Oromia Water Works Construction Enterprise (OWWCE). Accordingly severity index (SvI) of more than 60% was used for selecting sever factors causing delay and cost overrun in OWWCE construction projects. Accordingly the study identified 35 highly sever factors causing delay among which the top five (5) factors were: underestimate project duration during design stage, consultant makes frequent design changes, consultant makes frequent design changes, consultant makes errors in design that is found after commencement of construction process. Similarly the study identified 27 highly sever factors causing cost overrun in OWWCE construction projects among which the top five (5) factors were: underestimate project duration, delay in payment, lack of coordination and communication at design phase, fluctuation in price of raw materials while significant effects of the two issues were inability to deliver value for money, inability to secure project finance or securing it at higher costs due to added risks arising from bad reputation.

***Key Words**: Construction projects, cost overrun, time overrun*

CHATER 1: INTRODUCTION

1. Introduction

The introduction part is all about the background of the study, statement of the problem, basic questions of the research, general and specific objectives of the study, significance of the study, scope/delimitation of the study, and organization o of the study. In general, this section helps as the backbone of the entire research by issues like how the study was done, the gaps and problems it intended to address, the purpose of the research and the scope of the research.

1.1 Background of the Study

In boosting the economic development of any nation, construction industry plays a great role. It helps to provide both the physical infrastructure that are vital for quality life of citizens and also useful in its linkage with other businesses in the economic system through supplies and inputs for construction projects, having multiplying effect in the economy, Durdyev and Ismail, (2016).

Definition of terms

Delay: in construction industry, delay is used to explain the time overrun of a project beyond the officially agreed completion time the parties in the contract, namely the employer, contractor and the consultant. It is a project spilling over its planned schedule and is considered as a common problem in construction projects. Completing projects on time is the indication of efficiency, however, the processes in construction is subjected to the performances of e ach party, resources availability, environmental conditions, involvement of other parties, and contractual relations (Aibinu and Jagboro, 2002).

As a result of many unforeseen factors before the designing and planning phase, project delay occur during the construction phase that in turn adversely impact project owners, contractors, consultants, beneficiaries/citizens, etc (stakeholders of the project) by inflicting loss of revenue by the owners and project beneficiaries as a result of lacking production facilities, loss of profit by the contractors and suffer short of meeting the needs gained from the projects by the beneficiary/citizens.

The view of causes of delays is sometimes controversial as contractors blame owners or vice versa on its causes. Contractors blame owners while owners blame constructor for causes of the delay, Zack (2001). However, the causes of delay are related to both the clients/owners and the contractors. The problems related to project scope and in adequacy of early project planning is related to clients/owners. Clients, sometimes, interfere in the decision making process by delaying the design or changes the design that in turn leads to making other changes like changes in approval of the designs by authorities. While the contractor is responsible for such delays as: over ambitious estimates and incorrect task assigning leading to delay are related to delaying attributed to lack of task clarity for inexperienced contractor or subcontractor.

The ever increasing demand for social and economic development in Ethiopia calls for construction. According to MoEF (2015), construction industry showed annual growth rate of 12.43% contributing to 5.3% of country's GDP. According to the proclamation of Chaffe Oromiya (highest legislative body of Oromia Regional State), OWWCE is supposed to provide quality service in relation to water works construction projects to the people of the regional states especially for those community living out of the reach of town/urban centres where it is hardly possible to implement using private contractors. So far, the company (OWWCE) had constructed many projects and handed over to the respective users. Among them, many of them were not completed both in time and expected budget outlay or contracted amount of money.

1.2Problem Statement

Occurrences of delay and cost overrun of construction projects vary in magnitude from project to project, that is, some projects vary only few days and small amount of cost while others delay over long years and huge amount of cost overrun. When projects fail to meet targeted time, budgeted costs, design and specifications and specified standard quality, it results in unexpected negative results such as incur additional cost, induce loss of profit, liquidated damage, dissatisfaction of project owners and users, loss of confidence and credibility by owners, weakens the growth of the industry and thereby the economy. From delay point of view, when projects delay two options are there: one is to extend time of completion and delivery second is to accelerate the work to finish it within the agreed time span. However, the former leads to arbitration, litigation, penalties, etc while the later leads to incur additional costs, but both culminates in loss of money. Further accelerating to complete

within time leads to poor quality of output that highly affects the satisfaction of the owner/client and affecting the contractors' reputation (Henderickson and Au., 2003).

Literatures present varying views over the nature of the causes of project cost overrun and delays in construction projects. This variation in view over these two success factors of construction projects variation capacity of implementing firms, nature of the contract, the stability of the economy and contexts in which these projects are carried out. Al-Kaharashi and Skitmore (2009), for instance, identified leading causes of construction delays in Saudi Arabia are clients' suffering shortage of finance to complete the constructions and delays in the payment processes. Haseeb et al. (2011) identified causes like natural disaster, poor planning and poor site management in Pakistan construction industry. Furthermore, Doloi et al. (2012) indicated that lack of commitment, lack of project scope clarity is the major causes of delay in Indian construction industry. Aibinu and Jagboro (2002) identified major causes as: change in construction orders, financial constraints and lack of experience in construction. Other related causes stated by other authors are: poor organizational structure, poor planning, poor site management, delays in payments, construction materials shortage on market, and poor communication were identified as most recurring causes of construction delay (Kagri et al., 2003;Sambasivan and Soon, 2007; Frimpong et al., 2004; Mloof – ud – Dyian and Rabbini, 2011; and Alinaitwe, 2008).

Studies carried out in Ethiopia on construction projects other than water works construction projects showed that causes of cost overrun were included: poor planning, raw materials' price escalation, poor financial control for construction projects, monopoly of suppliers, cost of machinery, high cost of machinery maintenance, shortage of adequate manpower/technical staff (Zewdu Z. T., and Teka G. (2015)). The Federal Democratic Republic of Ethiopia (FDRE) has been investing more than 30% of GDP into Gross Fixed Capital Formation (GFCF) expenditure (majorly focusing on the construction industry) since 2010 so as to make the economy fast growing. According to African Economic Outlook report (2017), construction activities of the nation made 15.9% of GDP at the market prices of the fiscal year 2015/16. Thus, this trend necessitates the need for studying the issues around the industry, construction, to ensure that issues affecting the effectiveness and efficiencies of the industry are understood to make viable recommendations so that pertinent policy makers and decision makers work on its improvement to ensure intended economic development of the nation is realized.

Furthermore, conducting such studies in Ethiopia, specifically in Oromia region, on the water works related constructions is critically felt need as most of the resources of the construction companies/operators is spent in trying to address the causes of delays and cost overruns based on the identified causes and remedial recommendations suggested from literatures that are based on experiences of other countries that hardly reflect the contexts of our country. Moreover, identification of few numbers of causes has paramount positive effect in helping the company (OWWCE) to allocate resources in addressing the will-be identified most priority causes for achievement of optimum and effective results. Therefore, the purpose of this study is to fill the gap in the knowledge area by identifying (assessing) the various causes of delay and cost overrun in the water works construction of Oromia region.

1.3 Research Questions

The research questions to be addressed in this study are the following:

1. What does the situation of water works construction projects of OWWCE in terms of meeting schedule and cost agreed look like?
2. What are the most critical factors causing construction delay and cost overrun in Oromia Water Works Construction Enterprise (OWWCE)?
3. What are the external factors causing construction delay and cost overrun in Oromia Water Works Construction Enterprise (OWWCE)?

1.4 Objective of the Study

1.4.1 General Objectives

The main objective of the study is to assess the major causes of delay and cost overrun in Oromia Water Works Construction Enterprise (OWWCE).

1.4.2 Specific Objectives

The specific objectives of this study include the following ones.

1. To understand the current situation of the water works construction projects of OWWCE in terms of factors causing delay and cost overrun
2. To identify the sever causes of delay and cost overrun in OWWCE construction projects
3. To identify the causes of delay and cost overrun related to parties responsible for undertaking OWWCE construction projects.

1.5 Significance of the Study

Successes of construction projects are majorly expressed in terms of completion of projects within the predetermined budgeted cost, scheduled time and quality and desired outcomes. Thus, the findings of the study are expected to have importance to the following: to study the will identify factors that cause delay and cost overrun in water works construction projects that helps management to device strategic guidance and formulation of policies for addressing the issues, helps management to plan means of mitigation for the issues, helps other researchers as spring board for further investigations and adds some knowledge on water works construction projects especially in the setting of public enterprises having similar characteristics with that of Oromia Water Works Construction Enterprise (OWWDSE).

1.6 Scope of the Study

The study focused on cost overrun and delay of water works construction in particular context of the Oromia Water Works Construction Enterprise (OWWDSE). There are obvious problems of timely and within planned budgeted cost completion of water works construction projects that is complained by stakeholders and public of Oromia Regional State. Thus, the issue is demanding to undertake study on the causes of problems contributing failures in these success factors, namely delay and cost overrun. The place of the study is Oromia Regional State and the office implementing constructions of water works in different zones is located in Addis Ababa.

The planned research design for this study is descriptive as the research will focus understand the causes and impacts of cost overrun and delay by identifying extent of delay and cost overrun, their main variables and their overall effects on delay and cost overrun and variations resulted comparing the completed and planned delay and cost overruns. The length of time the research took was 4 months namely from February to May 2020.

1.7 Limitations of the Study

It is undeniable that any research papers from its initiation to completion perhaps encounter a limitation. Limitations of the time allotted and budget were bottlenecks to carry out the study by including respondents from clients and consultants so to reach at the best conclusion of the issue under investigation from different perspective. The level of analysis and interpretation for generalizability is limited to the scope and context of Oromia Water Works Construction

Enterprise (OWWCE) that it does not comprehensively represent to conclude the works of other companies involved in similar works. The data gathered is only limited to this company as its population that does not represent others outside of this population except giving some clue for getting lessons. Furthermore, the analysis is based on descriptive statistics that other method of investigation may result in varying conclusions about the issue under study. The focus of the research is mainly on critical performance measures, such as cost and time.

1.8 Ethical Considerations

The researcher upheld values and norms such as respecting and protecting the rights and dignity of participants and providing guarantee to become liable as a result of respondents participation in the study data provision process. Furthermore, respondents' right to withdraw from participating in the responding to study enquiry process will be respected the anytime they feel unhappy.

1.9 Organization of the Study

This research is organized into five chapters. Chapter one contains background of the study, statement of the problem, basic research questions, research objectives, scope and delimitations of the study, and significance of the study. Chapter two provides a literature review informing the reader of what is already known in this area of study. Chapter three discussions on the methodology utilized in the study, including, research design, sample size and sampling techniques, data source and collection method, procedure of data collection and method of data analysis. Chapter four is about the data analysis and discussion of the results. Finally chapter five contains conclusion and recommendations.

CHATER 2: LITERATURE REVIEW

2.1 Theoretical Review

In reviewing the literatures for this study, concepts and theories on the following issues were dealt with: definition of project delay and cost overrun, types, causes, effects, who is responsible for project delay, what project time and cost are and their managements, mitigation actions to control delay and cost overruns, and impacts of project delay and cost overrun on socio-economy of the nation, carrying data analysis and conclusions carried out from the assessment of literature.

Even though the extent of the problem of project delay and cost overrun varies from nation to nation, it has a pervasive nature across all the construction industry globally (Al-Najjar, 2008). The variations of its prevalence are attributed to the economic and the environment in which constructions are carried out. Overruns generally encompass factors/variables like time or schedule, cost, quality in fulfilling the needs of the clients/owners/beneficiaries and scope. Each piece of activity in a project has its own time and cost estimates along with its unique processes of completion that in turn contributes to the overall completion of the entire project. Each activity has its own unique and varying types of risk factors impacting other activities which are either carried out in sequential/preceding/succeeding that surely affects the execution of another activity finally impacting the entire project. Thus, success in project is defined as achieving project goals and objectives as predetermined in the project management plan. The goal and objectives achievement can be interpreted as: completion within the required technical requirement, within planned budget and time schedule (Frimpong, Oluwoye and Crawford, 2003). Major problems identified in construction industry are project delay and cost overrun. Even though scholars advocate that project management has grown, these two variables are remained the top challenges and recurring problems in the construction industry nowadays. The effects of overruns in construction projects are economic and political problems in a nation because less work is performed but more budget is spent and mission/objective of the projects are not realized as expected (Mustafa, 2015).

The problems of construction projects in terms of delay and cost overrun in developing countries like Ethiopia is aggravated due to many factors namely the economic and political conditions (Odediran, Abeyinka and Eghenure, n.d), growth and complexity of construction

industry (size and complexity) owing to low level of proficiency in project management, poor planning and budgeting, variations resulting from poor scope and requirement definitions and specification during the initial project planning and design stage, shortage of technical staffs in exhaustively handling the design and planning, prevalence of unforeseen conditions demanding changes in projects, and the likes. Thus, it is critically vital to define the actual causes of time and cost overruns related to specific situations (companies, industry, projects, etc) so as to either minimize or totally eliminate delays and cost overruns in the process of executing any construction project. The subsequent sections are allocated to discuss the fundamental concepts related to project delay and cost overruns.

2.1.1 Definitions of time and cost overruns

2.1.1.1 Definitions of Time Overruns

One of the most important problems in the construction industry is time overrun. Time overrun occur in every construction project and the magnitude of these delays varies considerably from project to project. So it is essential to define the actual causes of time overrun in order to minimize and avoid delays in any construction project. Construction works that are not completed on time are referred to as projects that have undergone time overrun. Time overrun is defined as the extension of time beyond planned completion dates traceable to the contractors (Naveenkumar and Prabhu, 2016). Further they defined time overrun as the difference between the actual completion time and the estimated completion time. It was measured in number of days. Time overrun occur when projects is not completed within the time the project plan specifies. Raykar and Ghadge (2016) represented time overrun mathematically as follows in Equations 2.1 and 2.2.

Net duration = Date of project commencement – Date of project approval for its completion
…… Equation 2.1

Time overrun = Net duration – Project duration …… Equation 2.2

2.1.1.2 Definitions of Cost Overruns

Cost overruns are very common in the construction Industry. Hardly few projects get completed within original cost. Cost overrun is the amount by which actual costs exceed the baseline or approved costs. Cost overrun is defined as excess of actual cost budget – it is sometimes called as cost escalation, cost increase, or budget overrun (Shanmugapriya and

Subramanian, 2013). Cost overrun is defined as the positive difference between the final or actual cost of a construction project at completion and the contract amount agreed by the client and the contractor during signing of the contract (Mustafa, 2015). Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation, cost increase, or budget overrun. Cost overrun is defined as the change in contract amount divided by the original contract award amount (Al-Najjar, 2008). According to AL-Najjar(2008) the cost overruns is expressed mathematically in this formula and calculation can be converted to a percentage for ease of comparison as indicated in equation 2.3.

Cost overrun = (Final Contract Amount – Original Contract Amount)/ Original Contract Amount X 100 …… equation 2.3

2.1.2 Types of Delay

Delays in construction projects are categorized into two major classes namely: concurrent and non-concurrent delays. These two are further divided into six groups: excusable and non-excusable based on condition of liability, critical and non-critical based on its impact based on the critical path steps; and compensable and non-compensable delays as seen in Figure 2.1 adopted from Raykar and Ghadge (2016) and Vidalis *et al*. (2002). These types of delays occur mainly due to either internal or external environment affecting project processes. Delays due to internal sources initiate from the client/owner, designers, contractors, consultants while the external sources of delays emanate from institutions responsible for utilities, government bodies, subcontractors, suppliers, trade unions, natural disasters and the like (Raykar and Ghadge 2016).

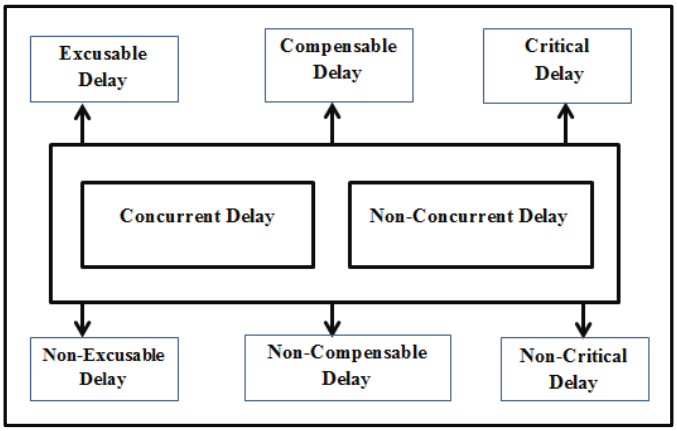

Figure 2 1:Type of Delays in Construction Projects

Source: Prepared by Researcher as learned from Literature

2.1.2.1 Concurrent and non-concurrent

A condition in which more than one factor/variable delays of the project in an overlapping (simultaneous) periods of time it the delay is said to be concurrent delay (Alaghabari et al, 2007). Such delay happened in condition where both the owner and the contractor are responsible for the factors of delay. For example, if harsh weather condition prohibits the contractor from working of the project for two weeks and at the same time the client prohibits the contractor from project site for three weeks, then the concurrent delay of the project is two weeks while non-concurrent delay is for one week. Thus, contractor for the damage of two weeks as bad weather is not taken as cause of delay and is compensable delay (Mustafa, 2015).

2.1.2.2 Delays Compensable and non-compensable delays

Excusable delays are classified into compensable and non-compensable delays. If the contractor is not responsible for the delay of the project it is said to be compensable delay as it occurred due to unforeseeable and beyond the control of contractor. Thus case, the contractor has right for claiming both compensation and time extensions. Such delays happen due to the government, direct work changes, work suspension, constructive changes and failure of client to provide access to site on time, work scope change (Raykar and Ghadge, 2016). However, non-compensable delays are conditions where an excusable delay happened, but the contractor is not is subject to claim compensation due to the excusable delay. Thus, in non-compensable delay, neither the client nor the contractor is liable for the delay – but the contractor is granted for time extension while not compensated for monetary damage. Such delays occur such as due to severe weather and natural disaster (Raykar and Ghadge, 2016).

2.1.2.3 Critical and non-critical delays

Delays are said to be critical delays when the delays have negative effect on the progress, schedule, and cost implications. However, in non-critical delays there is not negative effect in terms of the completion date of the project. In non-critical delays, subsequent activities are not on the critical path that their delays will not affect the schedule (Abdul-Rahman et al, 2006).

2.1.2.4 Excusable and non-excusable delays

Every delay can either be categorized under excusable or non-excusable. Unforeseen events causing delays that contractor or sub-contractors would not control are said to be an

excusable delay. Such delays are further divided into compensable or non-compensable delays. Compensable delays result in the entitlement of contractor for financial compensation and additional time. However, non-compensated excusable delays result in compensation of extra time for the contractor but no addition of monetary value is provided to complete the work. In contracts of construction projects, excusable delays (categorized as non-compensable delays) are also called as "force majeure" delays, or said to be "acts of God" the delays are not caused due to fault of any party in the contract, thus allowing additional time due to the excusable delays, while no any extra money entitlement. Mustafa (2008) found out the causes of excusable delay as: general labour strikes, fires, acts of God/natural problems (floods, landslides, volcanic eruptions, …), client/owner-directed changes, variation in site conditions, harsh weather conditions, intervention by external bodies, untimely action by government bodies, such as building inspection.

On the other hand, non-excusable delays are events causing delays which can be controlled or planned ahead of time. Such delays include: late performance of sub-contractors, delays in delivery from suppliers, rectifications causing delay due to fault in poor workmanship of either the contractor or sub-contractors, project-specific labour strike caused by faults of the contractor/sub-contractor in timely resolving labour related issues (Al- Gahtani and Mohan, 2007).

2.1.3 Causes of Project Delay and Cost Overruns

2.1.3.1 Causes of Project Delays

Causes of delay are variables or factors that affect completion of construction projects as per the contract specified scheduled time. Studies identified several causes of delays resulting in failure of project success in terms of time, cost, quality, and safety (Sweis G.J., 2013). Based on investigation carried out in Jordan on the two aspects of project delays namely contractor and consultants, Odeh and Battaineh (2002) identified the causes of project delays. The study result revealed that contractors believed that 'poor labour productivity', 'owner interference' and 'inadequate contractor experience' were the three major significant causes of delays, while consultant indicated 'inadequate contractor experience', 'late payment of completed work' and 'poor subcontracting' to be the three significant causes of delay. The problem identified namely 'late payment of completed work' as a cause for delay was defined as late payment for completed project activities, in which case contractors are forced to halt the

work in case payment for completed work were not processed after the agreed due date. Further, the studies also revealed that the prominently high ranked causes of delays concentrated around owner/client actions that include: 'incomplete designs', 'design changes', 'slow decision-making' and 'late issue of instructions'. While causes of delay attributed to contractor (contractor category) are: 'shortage of skills' were identified as the most significant delay factor, followed by 'poor planning' and 'labour problems'. Moreover, most significant cause of delay attributed to external factor was 'unforeseen soil conditions' (Baloyi and Bekker, 2011).

According to certain study, the top listed causes of delays in time of construction projects were: 'inadequate fund for the project', 'inadequate planning of project before take-off', 'inadequate tools and equipment', 'delay in delivery of materials', 'subcontractors' incompetency' and 'design changes during project execution' (Ameh and Osegbo, 2011). According to a study carried out in Kuwait three major causes of delays were: change orders, owners' financial constraints, and owners' shortage of experience. Lot of delay factors under the control of consultants were also included factors under the control of owners/clients that include: design changes, poor labour productivity, inadequate planning and resource shortages are major factors influencing delays. Time overruns result from both internal and external factors, in which case, internal factors are those happening due the three parties involved in the construction project, namely project owner/client, consultant and contractors. On the other hand, external factors happen outside of the three parties namely: government's act, material suppliers, harsh weather conditions, etc. Moreover, special constraints are additionally occurring from the side of contractors working in developing economies namely: poor technological and skilled manpower compared to those in developed countries attributing to delays (Koushki et al., 2005).

In another study Aibinu and Jagboro (2002) conducted to identify and assess the impacts of delays on the delivery of 61 construction projects in Nigeria, time and cost overruns were found to be frequent effects of delay. Similarly, Shanmugapriya and Subramanian (2013) found five most significant factors causing time overruns in an Indian context namely: material market rate, contract modification, high level of quality requirements, project location and experiences of contractors. Furthermore, Naveennkumar and Prabhu (2016) studied to identify the factors influencing time and cost overruns in construction projects in India and found out that "low productivity of labour" was ranked first in the contractor's role

and responsibility. Thus, this study revealed importance of production for the progress of project. On the other hand "slowness in giving instruction" was ranked first factor in the role and responsibilities of consultant. Thus, this result was helpful in indicating the high importance of each party to perform its respective required work. Respondents involved in the study revealed the following factor in their study: delay factor identified as role and responsibility of owners/clients ranking first was "Delaying in bill settlement", indicating on time payments completion was used as means of delay of freeing contractor payments, it will affect contractor's financial obligations. “Poor materials procurement plan” was ranked first factor under category of materials, while “shortage of equipment maintenance” was ranked first under category of Equipment and Labour. Furthermore, “Strikes, riots and other external forces" was ranked first under the category of external. Thus, the delay in the construction project is of great concern to all the concerned parties: clients/owners, professionals and other stakeholders. Certain study conducted in Nigeria (Odediraa, Abeyinka and Eghenure, n.d.) showed that the factors with highest significant influence over project delay were: non-readiness of site conditions, change in scope of projects, un-timeliness of progress payments for the executed activities and poor planning. Factors like: poor project design and implementation, project cost underestimation, inadequacy of allocated funds for the projects, harsh weather conditions, lack of integration between owner/client and contractor in their relationship for that work. Another study carried out in Jordan on public construction projects also showed three major factors of project delay namely: selection and assignment of unqualified consultants, staffs and engineers; contractors’ poor planning and scheduling and harsh weather conditions (Sweis, 2013).

2.1.3.2 Causes of Project Cost Overruns

Studies revealed that the causes and effects of construction projects cost overruns vary from project to project and country to country. According to Shnmugapriya and Subramanian (2013) causes of cost overruns were: high materials’ transportation costs, change in material specification, and materials’’ price escalation, reworks, frequent idleness in construction equipment’s and plants due to breakdown. Shreenaath, Arunmozhi and Sivagamasundari (2014) identified the first 12 major factors affecting cost overruns. These were: material’s price escalation, supply unreliability and poor materials quality, poorly managed and supervised project sites, shortage of qualified/experienced workers, slow mobilization and shortage construction equipment, unrealistic project suspension due to owners, delay in

progress payment, delay caused by natural disasters like flood, rain; and contractors' poor planning and scheduling of works, changes of working drawing during construction period, poor construction methods undertaken by contractors, conflict between consultant and engineers, and delay in acquiring permits from municipality.

In another study conducted in Malaysia (Abdul Rahman, Memon and Abd.Karim, 2013) the first three ranking most significant from the list of factors causing cost overruns in large construction were: materials' price variation, contractors faced difficulties in cash flow and finances and poor site supervision and management. Another study conducted in Nigerian on telecommunication projects, (Ameh, Soyingbe and Odusami, 2010), showed predominant factors of cost overrun were: unplanned design changes, fraudulent practices and kickbacks, too much variation works, poor contract management, labour unavailability, inadequacy of duration for contract period and unqualified contractual procedures. In another study based on the perceptions of respondents involved in the inquiry, Ramabodu and Verster (2010) indicated three categories of factors affecting cost overruns in construction projects as: the first five factors in the list of factors were very critical factors, the next four factors were moderately critical and the last five factors were considered to be less critical. They indicated the first five ranking factors under the very critical causes of cost overruns in public construction projects were: project scope changes, incomplete design documents during tender process, unnecessary claim of time and cost claim (contractual claim), poor planning and monitoring fund utilizations; and delays approving variation result in cost and additional works.

According to studies carried out by Nega (2008) in Ethiopian Construction Industry, parties involved in the construction projects blamed one another for the cost escalations that encountered in projects under their responsibilities. Thus, he suggested that importance of identification of the stakeholders responsible for causing cost overruns in public building construction projects for taking sound corrective measures. The factors causing cost overruns as he reported were clients claiming redesign, specifications and contract documentation. In study conducted in South African construction context, Baloyi and Bekker (2011) identified the causes of cost overrun for construction and refurbishment of stadia projects for the 2010 FIFA World Cup. The study forwarded top ten causes in ranking of their significance as: materials cost escalation, materials inaccurate estimations, shortage of skilled labour, late contract award by client/owner, complexity of the projects, variation estimated in labour cost,

poorly and inaccurate estimation of bill of quantity (BOQ), variation bid amount and consultants' estimates, orders initiated by clients for changing the original work after commencement of construction, and shortage of professional.

In another study conducted in Czech Republic, Ahmed, Dlask and Hasan (2014) reported top 10 factors that caused cost overruns of projects namely: owners' unplanned work change orders, price escalations, constructions projects offered to lowest bid offers, shortage of critical construction materials, poor estimation of bill of quantities, poor construction management, delay in progress payments, projects may be complex, inadequate planning and change functional programme. Another study in India, Pune region, Tejale, Khandekar and Patil, (2015) identified causes of cost overrun in construction projects were: shortage of construction materials, shortage of labour, untimely equipment and materials delivery from suppliers, shortage of professional and competent staffs, level of productivity of labour low, poor materials and equipment quality. Study conducted in two phases in Mara, Memon et al, (2010), on large projects revealed 24 most recurring factors affecting the constructions in its first phase of study based on literature review. In the second phase of the study, a survey by involving 18 senior personnel as respondents was carried out to verify and rank the factors. The study result revealed that contractors' shortage of cash and finance, poor project site supervision and management of contractors, shortage of experience in the construction business, shortage of labourers, poor planning and scheduling of contractors were found to be the most significant factors that affected construction cost overruns.

In their study, Olawale and Sun (2010) revealed 21 most frequent factors causing cost overruns were: design changes, unmanaged risk and uncertainty related to construction projects, poor estimation of cost and time required for projects, poor performances of subcontractors, project works of complex in nature, poorly handled conflicts among project parties, misunderstandings and conflicts in contract documentation, disagreement in the interpretation of contract and specification, materials' price escalation, untimely payment of completed activities and financial problems of contractors, poor project management techniques and skills, shortage of skilled manpower, unfavourable weather conditions, unavailability of imported materials, low technological adoption (software), high interest rates, currency/exchange rate fluctuations, poor regulation and control systems, problems of fraud and corruption and unstable government policies on projects. A study conducted in India by Shanmugapriya and Subramanian (2013) on large constructions revealed five most

significant factors causing cost overrun are: high transportation cost, frequent change in specification material, price escalation of construction material, frequent idealness of equipment and plants of construction due to breakage and rework. In another study on construction projects conducted by Naveenkumar and Prabhu (2016), the most recurring 10 causes of cost overrun have been identified in the order their rank. 1) project site handover delay for commencement, 2) wrong construction site selection, 3) poor project preparation, 4) materials' prices due escalations to frequent/continuous closures of working days, 5) shortage of resources, 6) harsh weather conditions, 7) variations in the cost of building materials, 8) allocation problems of equipment, 9) shortage cost records for planning/monitoring, and 10) changes in construction design. As studied and reported by Al-Najjar (2008) total of 42 factors causing cost overruns were identified and of which ten of most frequently occurring causes were: staffs problems of technical competence, poorly structured project organization and failures of the enterprises to give attention to projects, shortage of cost reports during construction stage, inadequacy of preparations of projects, planning and implementation, information delivery and issuance delays to the contractor for timely actions, design phase lacks coordination, project scope change or changes in policies of government, manoeuvrings of tendering by contractors (such as front- loading of rates), use incomplete design documents for processing of tender, improper assignments of labour on the construction site, and delays in decisions requiring issues. In another survey conducted in Indonesian context on the 22 building projects Wiguna and Scott (2005) reported that the most critical risk factors that were identified affecting both time and cost overruns of construction projects were: unforeseen high price escalations, owners' unplanned design changes, poorly designed and defective project design used to process tender, delay in interim/progress payments for contractors, bad weather condition.

2.1.3.3 External factors of cost and time overrun

External factors triggering time and cost overruns are: shortage of construction materials on market, shortage of tools and equipment on market, bad weather conditions, unfavourable project site conditions (location, ground, etc.), economic problems of the nation (currency, inflation rate, etc.), changes in laws and regulations affecting the progress of the project, problems of transportation system for delivery of materials and equipment to the site on time and required amount, and external conditions of public agencies in providing services such as roads, utilities and public services (poor bureaucracy) (Alghbari et al, 2007).

2.1.4 Factors of Delay and Cost Overrun Owing to Executions of Responsible Parties

Owing to continues growth of construction industry both in size and complexity, associated problems challenging on the effectiveness and efficiency of the projects also increase over time. Many researches showed it is not uncommon that construction projects are not completed in the stipulated time and their planned budgets majorly owing to various interest groups who play roles and have stakes in the construction projects (Mahamid I, et al., 2012; Shah R.K. 2016). The major interest groups include: owner/client of project, contractors, consultants, financers/funding agent, suppliers, project end-users, government and others. Thus, taking the three parties (owners, consultant and contractor) as a system, internal causes of delay emanates from the three parties involved in the project. Other delays, not attributable to these three parties are categorized as external causes of construction project delay. The parties causing delay in construction considered as the external parties are: suppliers of construction materials, government bodies, financers/funding agents and weather condition. Thus, customarily, most researchers categorized the causes of project delays as internal and external factors caused by various construction project stakeholders.

2.1.4.1 Owner's Responsibility

The client/owner is the individual or organization for whom a project is to be built under the conditions of contracts. Generally speaking, public sector owner is poorly concerned encouraging project progress compared to that of the private sector owner. The major problem with public sector owners is shortage of skills in managing and controlling construction projects and undesirable bureaucracy are the most undesirable characteristics of public sector project owners inducing delay. In addition, it works with lots other governmental departments that are responsible for endorsing changes when it is required that it causes delay. Thus, factors related to owner's responsibility are: lack of working knowledge, sluggish in making decisions, poor coordination with contractors, frequent changes of contract (removing and adding new works to the project and change in specification), and problems of cash and finance like delays in requested progress payments, difficulties encountered in financial issues, and economic problems of the nation) (Al-Najjar, 2008).

2.1.4.3 Consultant's Responsibility

Construction project consultant is defined as a type of organization, mostly known to be firm that includes both designer/Architect and supervisor engineering. An Architect is the planner

and designer of buildings and their related landscaping. In most cases, an Engineer is referred to an individual who is engaged in the design and/or other work associated with the designing or construction of building projects. Therefore, it is obvious that consultant who engaged in a building project surely affects the progress of construction works through monitoring activities like issuing certificates and endorsing the fulfilment of certain required compliance procedures of construction process. Consultants are granted the authority to approve the fulfilment of certain requirement such as designing, piling, steel fixing, the quality of key materials, before the construction proceeds forward. As a result, the factors mostly related to the responsibility of consultant causing delay in construction projects are: absence of consultant's staff from the site, shortage of desired experience from the part of the consultant, lack of experience of staff assigned by consultant - (managerial and supervisory personnel), untimely, delayed and slow supervisions carried out for timely decision-making, incomplete documents, sluggish and slow in giving instructions, and provision of insufficient or incorrect design data (Al-Najjar, 2008). Thus, it is obvious that delay in progress of construction project occurs when the above listed monitoring requirements are not fulfilled as at the expected level.

2.1.4.3 Contractor's Responsibility

By definition, contractor is any legal entity or person that can enter into a contract with a client for the execution of works or part of the work (Windapo, 2013). Thus, the contractor is expected to implement or building the project. Contractor's performance can delay a construction project in different ways. For instance the main contractors can enter into disputes with subcontractors and suppliers of construction materials that can lead to major delays, mostly considered the leading cause of delay from contractor's responsibility point of view. Other factors are insufficient financial capacity contractors, errors or wrongs committed in decision-making of controlling progress and the poor competency in project management functions are the possible reasons for leading to project delays. Thus, factors of delay related to contractor's responsibility are: untimely delivery of construction materials to site, construction materials' shortage on site, wrong and defective work, poor skills and experience of labourers, shortage of ample number of labourers and the site, low productivity of labour, monetary and financial problems of the contractor, problem of coordination with others parties, skills shortage from the subcontractors side, shortage of required number of staffs on site from the contractor's staffs, poor site management, and shortage of tools and equipment on site at the required time (Al-Najjar, 2008).

2.1.4.4 External Factors of Time and Cost Overruns

Various literatures such as Alghbari et al (2007); Mahamid I, et al., (2012 and Shah R.K. (2016 stressed the vitality of external bodies/environment in causing project delay and cost overrun. The factors related to external factors were identified as: shortage of construction materials on market, shortage of tools and equipment on market, bad weather conditions, unfavourable project site conditions (location, ground, etc.), economic problems of the nation (currency, inflation rate, etc.), changes in laws and regulations affecting the progress of the project, problems of transportation system for delivery of materials and equipment to the site on time and required amount, and external conditions of public agencies in providing services such as roads, utilities and public services (poor bureaucracy).

2.2 Empirical review

In most cases, project success is measured in terms of time performance, cost performance, quality standards, achieving safety and health, etc. According to Atkinson (1999) project performances such as evaluated in terms of cost, time and quality known to be Iron Triangle for any project success. Other studies, (Frimpong et al., 2003; Olawale& Sun, 2010) advocated cost performance as the most important indicator of project success. They defended that performance of project in terms of cost represents not only the firm's profitability but also the productivity of organizations at any point during the construction processes. That is why in most cases, project cost is evaluated easily from the project account and is thus chose to measure project performance against the estimated target.

Unluckily, most research findings reveal that construction industry in most cases experiences poor cost performance, meaning unable to complete projects within its planned budget. World Bank (its Report of 1990) notified that project inability of completing construction projects is the chronic problem affecting the industry worldwide and critically affecting the economy of nations. Research report (as cited by Ameh et al., 2010; Zujo et al., 2010) showed that that 63% of the 1778 World Bank financed construction projects faced poor cost performance (cost overrun) against its planned budget with an average of 40%. Flyvbjerg et al. (2003) conducted a study for worldwide scenario on 258 projects in 20 nations with approximately US$90 billion worth of project with size ranging from US$1.5 million to $8.5 billion. The research finding revealed that cost overrun was caused majorly due to cost escalation that manifested to almost 9 out of 10 projects with an average increase of forecasted cost by 28%. The conclusion of the study was that the issue of cost performance

has not improved over years and its magnitude has not changed for the past 70 years. The problem of cost overrun is pervasive and common issue in both developing and developed countries (Angelo & Reina, 2002) However, it is more severe in developing countries where actual cost exceeded 100% of the anticipated cost of the projects (Azhar et al., 2008). In the following section one empirical finding on cost overrun both for developed and developing countries will be reviewed as studied by various researchers.

2.2.1 Empirical Finding on Cost Overrun in Developed Countries

Execution of construction projects in developed countries goes through project failure described in terms of delay and cost overruns as revealed by olawale& son (2010) as seen in the list below for countries and types of projects:

1. Case of USA: As a study conducted by Frame (1997) on 8000 construction projects in 1994 revealed, only 16% of them fulfilled the three success criteria of projects: completed in time, planned budget and the stipulated quality. In addition, a study conducted on projects contracted based on cost plus fixed fee agreement, change (2002) performed case study on four projects and found out that cost overrun was in a range of 12.3% to 51.3% of their original contract amount. Another study conducted by Cantarelli et al. (2010) on highway projects showed cost overrun was 77%.
2. Case of The Netherlands: Cantarelli's (2009) investigation on 87 projects depicted the projects were completed with overspending of average 10.3% of initial projects cost showing that cost overrun to be major problem..
3. Case of Norway: Odeck (2004) showed that cost overrun was a major bottleneck for project failures that amounted cost overrun ranging between -59% to 183%.
4. Case of UK: As studied by Barrick (1995) nearly one third of the clients in UK complained suffering cost overrun problems of their projects they were carrying out. In addition, report from a project ran by Department of Environment, Transport and the Regions (DETR) (2000) showed nearly 55% of construction projects faced cost overrun problem accounting for enormous amount of money as it was cited by Jackson (2002). Further, a construction project that was owned by British library was challenged by over spending in more than three times of the initial contracted amount while a project managed by Guy's house (NAO, 1998) suffered overspending worth valued at £152 million which was almost double of the budget committed initially for the project. In addition study on project performance report of parliamentary office building in London Wheeler (1998) showed it was completed at cost of £250 million, which was almost

double of its original planned budget. Fairs (2001) in his study on Holy road project located in Glasgow was completed in an amount of £230 million that was much greater than the original planned budget of £90 million..

2.2.2 Findings of Empirical Studies on Cost Overrun in Developing Countries

Olawale& son (2010) and cited by Aftab (2013) revealed that most of the construction projects situated in most of the developing countries that includes Ethiopia were affected by problem cost overrun especially with regards to public construction. Some are listed below:

1. Case of Bosnia and Herzegovina: A study carried out on 177 projects of structures showed that about 41.23 % of the structures completed above their contracted prices. In another investigation carried out on 53 building projects (29 new construction while 24 reconstruction projects) depicted that cost overrun on average base in reconstruction projects was 9.23% while 6.84% for new construction projects (Zujo et al., 2010; Zujo& Car, 2008).
2. Case of Ghana: Frimpong et al. (2003) studied cost performance of water drilling projects and found that 38 of total of 47 investigated projects (at a rate of 75%) were facing cost overrun whereas only 25% were completed within the budget.
3. Case of Zambia: A study carried out by Kaliba *et al*. (2009) on road construction projects showed that the projects were completed with value of worth U$542.7 million in which more than 50% of these projects suffered cost overrun.
4. Case of Ethiopia: A study carried out by Fetene (2008) showed that 67 out of 70 public construction projects (95.7%) had been completed with issues of cost overrun. Their actual completion costs were over within a range of 0 to 126% of their contract prices.
5. Case of Uganda: Apolot *et al.* (2011) study report revealed that a by-pass project in Kampala was completed with cost overrun amounted more than 100% of its original contract prices while their another study on 30 projects attested that 53% of these projects were completed with cost overruns.

2.2.3 Gaps in Previous Studies on Causes of Delay and Overrun and Conclusion

Review of previous studies on the causes of delay and cost overrun in the context of Ethiopia showed gaps in the knowledge pertaining to the factors causing delay and cost overrun in water works construction projects. Thus, this study will factors causing delay and cost overruns as suggested in the study findings of other researchers to test in the case of water works construction projects in the context of Ethiopia particularly Oromia Region. The

investigations of the cases of developing countries such as: Indonesia, Ghana, Ethiopia, Vietnam and Ugandan will be used.

The following list depicts the list of ranked factors causing delay and cost overrun in construction projects as in the investigation reports of countries such as Indonesia, Ghana, Ethiopia, Vietnam and Ugandan contexts.

i. Top seven factors reported to be causes of delay and cost overrun as indicated in the study conducted in Indonesia by Kaming et al., (1997) on high rising buildings were: 1. Rise in material cost due to inflation, 2. Inaccurate estimation of bill of quantities, 3. Increase in labor cost due to environmental restriction, 4. Lack of knowledge of conditions of project location 5. Shortage of knowledge and experience of the project type, 6. Uncertainty in weather conditions, and 7. Shortage in understanding of the local regulation.
ii. Top five factors reported to be causes of cost overrun as indicated in the study conducted in Ghana by Frimpong, *et al*., (2003) on ground water drilling projects were: 1. Inability to get progress payment, 2. Poor contract management, 3. Problems of procurement related issues 4. Materials' price escalation due to inflation, 5. Contractors' financial shortage.
iii. Top four factors reported to be causes of delay and cost overrun as indicated in the study conducted in Ethiopia by Nega (2008) on public construction projects in general were: 1. Escalation in price of construction materials, 2. Poor coordination and planning, 3. Initiated change orders for requirement change as desired by client, and 4. Poor in estimation of bill of quantities causing excess quantity during construction.
iv. Top five factors reported to be causes of cost overrun as indicated in the study conducted in Vietnams by Long le- hoai, *et al*., (2008) on construction projects in general were: 1. Poorly management and supervision of sites, 2. Low assistance provided by project management, 3. Owners' financial shortage, 4. Contractors financial shortage, and 5. Changes in Design after contract award.
v. Top five factors reported to be causes of cost overrun as indicated in the study conducted in Uganda by Alinaitwe et al., (2013 on public sector construction projects in general were: 1. Work scope change after contract award, 2. Escalation in price of materials and rise in interest rate, 3. Poor system of monitoring and control, 4. Delayed progress payments to contractors, and 5. Shortage of fuel in the local market.

The result of research reviews as shown above helps to conclude that the rank of factors causing delay and cost overruns vary from one nation to nation. Escalation in prices of materials due to inflation in contexts of Ethiopia and Indonesia were number 1 priority factors, while in Ghana this factor ranked the fourth in the list, and while still in Vietnam and Uganda this causative factor (price escalation due to inflation) is not even in the top five factors. In addition, this particular factor (materials price escalation due to inflation) across developing countries varies based on types of executed projects. In the case of Ghana, for example, ground water drilling projects, the first five causative factors in the list were different from that of Indonesia the top four factors ranked in its list. Observing the top factors causing delay and overruns in projects of the two countries (Ghana and Indonesia), the common factor is only inflation (causing price escalation of materials and equipment's). Thus, this gap (meaning research result in one company or country does not necessarly hold true for the other company or country) attracting the attention of the researcher to investigate and respond to the major question of this research, "What are the factors causing delay and cost overrun in water works construction projects of Oromia Water Works Construction Enterprise (OWWDSE)?". In the research process it is expected that the causes of delay and cost overrun, the pertinent parties will respond to address the root causes of each factor both under their responsibility and share the remaining to respective stakeholders responsible for addressing the causative factors – recommendation that will be expected from the study.

2.3 Conceptual Framework

In the preceding sections, theoretical and empirical studies reviews indicated various factors causing delay and cost overrun in various construction projects. It was also indicated that contributory factors of delay and cost rise of project varies both based on project types and country to county. Accordingly, the current research uses the summary of investigations identified from these previous studies theoretically declaring as the main factors causing delay and cost overrun in water works construction projects of Oromia as shown in the following conceptual model relating causes and sources of causes projects ineffectiveness and inefficiencies. Figure 2.2 depicts the conceptual framework depicting the system making up the study namely: the sources of factors were categorized into four namely: causes attributed to contractor, causes attributed consultant, causes attributed owner/client, and causes attributed other/external factors where as the ineffectiveness and inefficiencies of projects categorized into delay and cost overruns.

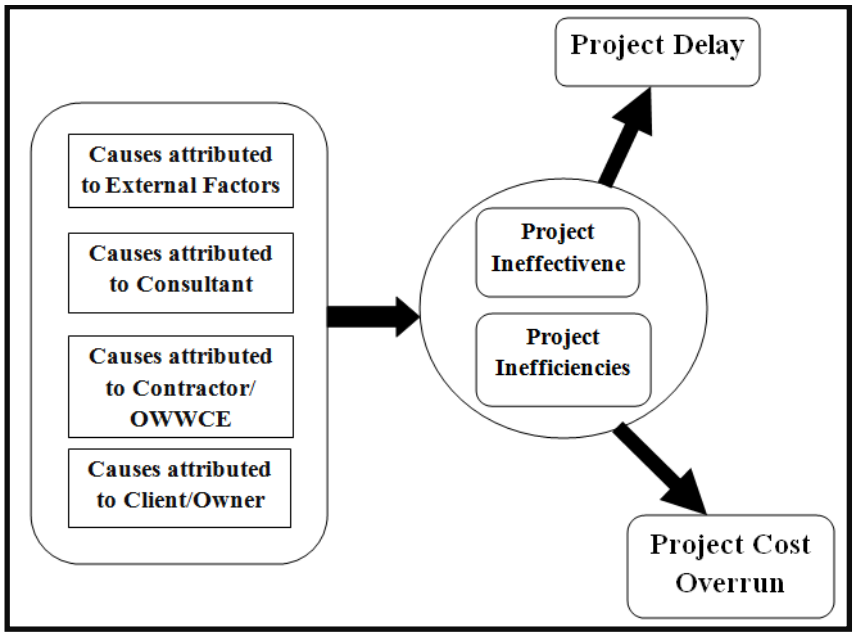

Figure 2 2: Conceptual Framework of Current Study

Source: Summarized and prepared from Literature by the researcher

Table 2: 1 Factors Causing Delays in construction Projects

FACTORS CAUSING CONSTRUCTION PROJECT DELAYS			
Factors caused by Contractors	**Factors caused by Consultants**	**Factors caused by Clients/Owners**	**Factors caused by Externals/Others**
Poor site management	Frequent design changes	Delay in decision making	Shortage of labors
Improper planning and scheduling	Errors in design	Delay in progress payment	Delay in material procurement
Financial problems faced by contractors	Delay in design preparation	Practice of assigning contract to lowest bidder	Poor weather conditions
Incompetent subcontractors	Delay in approval of drawings	Contract modifications	Poor site conditions
Inadequate contractor's experience	Lack of supervision	Lack of working knowledge	Slow permits by local authorities
Construction mistakes and defective works	Slowness in making decision	Change in the scope of the project	Bureaucracy in government agencies
Inadequate contractor's workers	Lack of consultant's experience	Financial difficulties of the owner	Unqualified workforce
Late payments to subcontractors or suppliers	Incomplete documents	Owner interference	Lack of material on the market
Problems with subcontractors	Lack of consultant's site staff experience	Lack of coordination with contractor	Lack of equipment and tools on the market
Delay in subcontractors' works	Underestimate project duration	change orders by owners during construction	Transportation delays
Poor qualification of contractor's technical staff	Incompetent designers	Delay in process to furnish and deliver the site	Poor economic conditions
	Delay in approving major changes in scope of work		Lack of communication between the parties
	Conflicts between consultant and design engineer		Materials' price escalation

Source: K Ullah *et al.*, 2017

Table 2: 2 Factors Causing Cost Overruns in Construction Projects

FACTORS CAUSING CONSTRUCTION PROJECT COST OVERRUNS			
Factors caused by Contractors	**Factors caused by Consultants**	**Factors caused by Clients/Owners**	**Factors caused by Externals/Others**
Inappropriate planning	Poor contract management	Financial problems faced by owner	High cost of machineries
Improper project management	Mistake in design	Practice of assigning contract to lowest bidder	Fluctuation in price of raw materials
Lack of contractor's experience	Underestimate project duration	Lack of communication with consultant	Unforeseen site condition
Financial Difficulties experienced by contractor	Slowdown in design preparation	Changes in client's requirement	Shortage of site workers
Relationship between management and laborers	Delay in approval of design changes	Delay in payment	Delay in material procurement
Incorrect scheduling by contractors	Lack of cost plan/monitoring	Re-measurement of provisional sum	Unpredictable weather conditions
Errors during construction	Inadequate project preparation		Poor labor productivity
Extension of time	Lack of coordination at design phase		Unskilled labor
Incompetent subcontractors	Incomplete design at tendering stage		Equipment failure
Unsuitable construction equipment	Lack of consultant's team experience		Labor absenteeism
Improper construction methods			
Poor financial control on time			

Source: K Ullah *et al.*, 2017

CHATER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discussed the general outline of this study in acquiring relevant data, analysis, interpretation, presentation that helps for reaching at conclusion and forwarding viable recommendation. Specifically emphasis is given to issues related to research approach and design, target population and sample, data collection method and tools, data analysis and presentation

3.2 Research Approach and Design

Deductive research strategy was used to make inquiry for this current research. Issues were seen from basic premises stipulated as causes of delay and cost overrun concepts to reach at the conclusion of the issues under investigation. The study followed quantitative research approach in order to collect and analyze data to derive understanding of the research problem. The nature of the research is descriptive research type that employees descriptive statistical techniques. Furthermore, quantitative research method was planned to be utilized to achieve the objective of the study. The research is developed from the observation of practical problems on the construction projects that have been carried out using budget allocated by government but have suffered the problems of delay and cost overrun. The research questions focused to investigate the major causes of project delay and cost overrun of OWWCE construction projects. Therefore, the research design, namely descriptive method, was designed to coherently and logically incorporate different components of the study. Descriptive statistical techniques employed for this study focuses on in-depth investigation of the practical reasons of delays and cost overrun through identifying the major variables causing delay, cost overrun their general effects on the company (OWWCE) and also to show the rate of discrepancy between the contract amount and the actual cost at completion.

3.3 Data collection and measurement

3.3.1 Data collection and measurement

The major sources of data for this study were primary and review of secondary data sources in Oromia Water Works Construction Enterprise (OWWCE). The review of selected office documentations such as contract agreement and other relevant data deemed useful for this

study. Primary data was collected through distribution of close ended structured questionnaires to selected respondents from the contractors namely Oromia Water Works Construction Enterprise (OWWCE). The respondents were asked to acquire information on the construction projects which are related to OWWCE undertakings in Oromia Region.

Generally, the survey questionnaires will help to obtain the following major information:

a. Respondents' personal characteristics such as age, education level and gender, etc.
b. Information regarding major causes of delay and cost overrun of the projects.
c. Information on the overall effects of delay and cost overrun.
d. Information regarding the responsible parties for the causes of delays and cost overrun.

The major information obtained through the review of existing office documentation include: information on each project contract agreement, estimated budget, actual cost at completion, projects duration, project location, services provided by the projects, project design and site, etc.

Hypothesis on the variables of delay and cost overrun were constructed from literature review on the general construction projects that helped to craft questionnaires that the respondents are asked about their agreement on significance of these variables of causing delays and cost overrun in the case of water works construction projects. In order to carry through this, five point likert-scale of 1 to 5 were adopted to assess the consensus level of the respondents on the factors listed as causes of delays and cost overrun in study construction projects that was helpful to rank them using their respective mean values, frequencies and relative importance index and severity indices .

Considering that the determined of factors of delay and cost overrun, the respondents were asked to rank the significance level of factor affecting water works construction projects' delay and cost. In similar fashion, a five point likert- scale ranging from 1 to 5, where, 5=extremely significant (ES), 4= very significant (VS), 3= moderately significant (MS), 2= slightly significant (SS), and 1= not significant (NS) were adopted to assess the degree of significance.

3.3.2 Data Source

The data sources for the current study were majorly primary and secondary data sources. The primary data sources were collected by using questionnaires, and researcher's personal observations when visiting sites and office. The sources of secondary data were from the unpublished document of the company (from company's document review) and published documents such as related books, research papers, Journal articles, reports of projects which are both in progress and already completed from recognized websites for references, and thesis documents.

3.4 Target Population and Sample

3.4.1 Target Population

Major activities performed in the various functions and divisions of OWWCE are contract administration, construction of procured or contracted projects, project construction raw materials procurement, human resources development, and financial and resources management for the proper operation and implementation of the construction projects. The target population of this research were, therefore, selected from relevant function or divisions namely from construction and contract administration departments. The selection of respondents for the questionnaires was based on the predetermined criteria namely their current role and duties (designations), profession/field of studies and experiences of the staffs so that required knowledge, attitude and perception on the questions presented in the questionnaires were responded to the required level for generalizability of the result of the analysis. Therefore, census technique was employed for this study to acquired desired data for analysis and interpretations.

3.4.2 Census Technique

According to Calleam Consulting Ltd (2012), a census technique is the study of every unit, or everyone or everything in a population under study. It is applicable in the situation where the entire population is less than 100. Its advantage is that it provides a true measure of the population compared to the sampling method, gives benchmark view for more detailed scrutiny in the future; detailed information about each sub-group/unit/function within the population is available in most cases.

After discussing with the key personnel of OWWCE, the pertinent population for the study were identified. As the study is related to construction projects and its key management

activities, the criteria that were used to select were majorly their current role and duties (designations), profession/field of studies and experiences of the staffs was considered as criteria for selection of respondents. Accordingly departmental wise the two units namely construction and contract administration units were selected. Profession/field wise all staffs employed and assigned to take the role and responsibilities of engineering activities were included regarding the experience of the staff, those having not less than 12 months' (1 year) time in the company were considered and selected to be included in the respondents category Accordingly, the total technical staffs in the two departments were 35 out of which 33 (thirty three) staffs were identified to be viable for providing information that would be used for this study.

3.5 Data Collection Methods and Tools

A survey design provides tools helpful to collect data that is useful to generalization about the populations using quantitative or numeric description of trends, attitudes, or opinions of a population (Creswell, 2009). Data collection methods and tools that were helpful to achieve the desired objectives as set in this thesis were questionnaires survey designed. Further, collection of data for this research was survey questions and reviewing of secondary document and researcher's observations. Factors affecting delays and cost overruns in water works construction in Oromia Region were identified from relevant literature reviews prior to development of questionnaires for the survey and reference of secondary documents. Then questionnaires having five-point Likert's scale were used for the survey data collection method. Each method of measurement addressed specific types of issues so as to make the measurement accurate and efficient. The variables supposed to be addressed in the questionnaires were ordinal measurements that were helpful to answer the questionnaire based on Likert's scale of five point's to capture the respondents' feeling and attitudes towards the statements based on their level of agreement varying from 1 for "not significant" to 5 for "extremely significant". Adopting simple scale facilitated simplification during both answers provision process by respondents and the evaluation and analysis process of the collected data by the researcher. The rating scales on the Likert's scale was, therefore, indicated how closely the feelings of the respondents matched with the tone of the questions or statements provided. Further, the questionnaires contained both open ended and close ended questions that respondents get opportunity to answer in case some issues were not considered in the questionnaires.

3.6 Data Analysis and Presentation

3.6.1 Data analysis

Method of data analysis for the collected data followed descriptive statistics. Analysis relay on both primary and secondary data (gather through questionnaires, review of reports and literature and observation). This study used data measurement type of ordinal scales that utilizes integer values in descending order for factors/variables data collected using questionnaires. Questionnaires were collected and analysed with the help of statistical software package, SPSS v 20. A five point scale Likert's scale helped to enter data into SPSS defining:"5" as "extremely significant", "4" "very significant", "3" moderately significant", "2" "slightly significant" and "1" "not significant". If the variable result earns a rating of "4" and "5", it was interpreted as a significant contributor of construction delay and cost overruns, where as if the rating earns values of "1" and "2", it was interpreted as insignificant contributor of delay and cost overruns. If the variable earned rating of "3", it was interpreted as uncertain about the variable/factor. The results obtain was used to compare the opinions of the key respondents of OWWCE about the factors affecting delay and cost overruns in the construction projects.

Based on the responses of respondents towards the level of significances of each the identified causative factor, analysis of severity of each factor was carried out by calculating the severity index (SvI) using equation 1 Then the result for each causative factor was evaluated against the criteria shown in Table 3.1.

$$\mathbf{SvI} = \left[\frac{\sum(\mathbf{1}*\boldsymbol{NS})+(\mathbf{2}*\boldsymbol{SS})+(\mathbf{3}*\boldsymbol{MS})+(\mathbf{4}*\boldsymbol{VS})+(\mathbf{5}*\boldsymbol{ES})}{(\mathbf{5}*\boldsymbol{Nr})}\right] * \mathbf{100} \qquad \text{Equation 1}$$

where; SvI = Severity index, NS = proportion of respondents' frequency for "not sever", VLS = proportion of respondents' frequency for "very low sever" , LS = proportion of respondents' frequency for "low sever", MS = proportion of respondents' frequency for "moderately sever", HS = proportion of respondents' frequency for " highly sever" and VHS = proportion of respondents' frequency for " very high sever".

Table 3: 1Severity Index Scale and Corresponding Level of Severity

Severity Range (%)	Level of Severity (LSv)
0	Not Sever (NS)
0 - 20	Very Low Sever (VLS)
20 - 40	Low Sever (LS)
40 - 60	Moderate Sever (MS)
60 - 80	Highly Sever (HS)
80 - 100	Very High Sever (VHS)

Source: Mahamid, et. al., 2012

Relative importance index (RII) is also another descriptive statistical technique useful to extract factors which are key or critically affecting the other variable from many factors (Shah R. K.,2016; Davoodi T. and Daglı.U. U., 2019). Based on the responses of respondents towards the level of significances of each the identified causative factor, analysis of importance of each factor in affecting delay and cost overrun was carried out by Relative importance index (RII) using equation 2. It is used for ranking the factors.

$$\mathbf{RII} = \left[\frac{\sum(\mathbf{1}*\boldsymbol{NS})+(\mathbf{2}*\boldsymbol{SS})+(\mathbf{3}*\boldsymbol{MS})+(\mathbf{4}*\boldsymbol{VS})+(\mathbf{5}*\boldsymbol{ES})}{(\mathbf{5}*\boldsymbol{Nr})}\right] \quad \text{Equation 2}$$

where; RII = Severity index, NS = Number of respondents for "Not Significant", SS = Number of respondents for "Slightly Significant", Number of respondents for "Moderately Significant", Number of respondents for "Very Significant", Number of respondents for "Extremely Significant".

Cronbach's alpha coefficient was used to test the reliability of the collected data. Values of Cronbach's alpha ranges from 0 to 1, with value of 0.7 considered as acceptable minimum value to come to decision for utilizing the gathered data for further analysis.

3.6.2 Data Presentation

After completing the analysis of the collected data, concise and clear presentation with various methods followed and then discussed the findings in narration by interpreting the presented data linking to the conceptual and theoretical backgrounds of the researched factors to extract viable and sound conclusion. The study employed various data presentation methods like tables, graphs, bar charts and pie charts will be utilized for the presentation of data.

CHAPTER 4:RESULTS AND DISCUSSION

This part of the research dealt with the analysis and discussion of the data gathered from questionnaire survey and document review. The investigation of Questionnaires survey comprised indicating the significances of the identified causes of delay and cost overrun, and the effects of the variables of delays and cost overrun. Document review was used to identify information such as contract amount, contract time, actual cost at completion, actual completion time at completion of the project. This helps to understand the variation rate of cost overrun and contract amount OWWCE construction project for which complete data were available.

4.1 Demographics of the Respondents

The demographics of the respondents that were participated in the survey are summarized as follows:

Table 4: 1Summary of Respondents' Personal Data

Respondents' Personal Data	**Frequency**	**Percent (%)**
Gender		
Male	27	82%
Female	6	18%
Total	33	100%
Respondent's Designation		
Project Manager	4	12%
Project Coordinator	6	18%
Project Engineer	6	18%
Site Engineer	6	18%
Other	11	33%
Total	33	100%
Respondents' Educational level		
PhD	0	0%
Master's Degree	6	18%
B.Sc.	27	82%
Diploma	0	0%
Total	33	100%
Respondents' Field of study		
Civil engineering	17	52%
Hydraulic/Water Engineer	10	30%
*Others	6	18%
Total	33	100%
Relevant Work Experience (in years)		
1-4	1	3%
4-8	9	27%
8-12	15	45%
>12	8	24%
Total	33	100%

*Source: Survey Result, 2020, Note: *Others were specified in the survey as Irrigation Engineer and Contract Administration and others*

The majority of respondents who participated in the survey were male (82%) while female were only 18% as depicted in Table 4.1. Furthermore, Table 4.1 showed 12% (4) were project managers, while project coordinators, project engineer site engineers were each comprised 18% (6) of the respondents involved in the survey. This clearly showed that the respondents involved in the survey were from pertinent professional areas eligible in providing the desired information for this study. Similarly, Table 4.1 revealed the educational level of the respondents comprised of 18% (6) and 82 % (27) of the respondents were Master's and B.Sc. degree holders respectively.

The respondents' field of study were shown in Table 4.1 as 52% and 30% were civil engineering and Hydraulic and water resources engineering respectively. Similarly, 27%, 46%, and 24% of the respondents had 4 to 8, 8 to 12 and more than 12 years respectively of related work experience revealing the company has high employee retention in its human resources management which is helpful for the advancement and effectiveness of the company. Furthermore, the respondents were also fit and appropriate in proving their wealthy experience generated knowledge to be reflected in the survey.

4.2 Causes of Delay in the Construction Projects of OWWCE

Questionnaires for survey were prepared after identifying the factors that caused the construction delays from recent literatures. As a result 48 factors agreed upon by contemporary scholars were sorted them into four different responsible agencies namely contractors, consultants, clients/owners and external factors. The analysis using SPSS software helped to compute the descriptive statistics of the responses of respondents that explain about the factors causing delays using mean, standard deviation and frequency of respondents' scores. After that excel program was used to compute the frequency indexes/reliability importance index that was utilized to rank the factors according to their decreasing orders as shown in Table 4.2. As the nature of construction projects involve many stakeholders who do have influence and interests, the ranking of the factors were carried out at each party level rather than considering all at OWWCE level. This study used relative importance index (RII) technique for ranking and sorting the critical variables causing construction delay in OWWCE as the technique is widely used in quantitative analysis, especially in construction industry as seen in the preceding section as seen in Table 4.2. The

high severely causing factors on the basis of each responsible party in OWWCE construction projects namely client, consultant and contractors were identified as presented in Table 4.3.

Table 4: 2: Factors Causing Time Overrun (Delays) in Construction Projects

Delays Factors	NS	SS	MS	VS	ES	RII	Rank	SvI (%)	LS vI
Underestimate project duration during design stage		4	10	6	13	0.77	1	77	HS
Consultant makes frequent design changes	3	1	9	7	13	0.76	2	76	HS
Consultant makes errors in design that is found after commencement of construction process	1	3	8	11	10	0.76	2	76	HS
Incomplete documents are submitted by consultant	1	3	6	16	7	0.75	4	75	HS
Materials' price escalation (increase in price of construction materials and equipment over the construction period)	2	2	8	13	8	0.74	5	74	HS
Poor site management	2	2	11	8	10	0.73	6	73	HS
Client's delay in decision making		4	12	8	9	0.73	6	73	HS
Client's delay in progress payment (not paying the requested payments for executed works		3	11	13	6	0.73	6	73	HS
Improper planning and scheduling	2	1	10	14	6	0.73	9	73	HS
Financial difficulties of the owner (shortage of budget encounters the client)	1	5	7	14	6	0.72	10	72	HS
Incompetent designers are involved in designing of construction projects	2	3	14	5	9	0.70	11	70	HS
Manpower and equipment shortage	3	2	12	9	7	0.69	12	69	HS
Poor coordination and communication among construction project parties (client, contractor, consultant and key stakeholders)	1	7	10	6	9	0.69	12	69	HS
Slowness in making decision by consultant		4	13	14	2	0.69	14	68	HS
Delay in process to furnish and deliver the site	1	3	13	13	3	0.69	14	68	HS
Delay in material procurement due to shortage of supplies from the market	2	3	13	9	6	0.69	14	68	HS
Project size	4	5	7	8	9	0.68	17	68	HS
Delay in design preparation by consultant	2	4	9	11	6	0.67	18	67	HS
When scope changes are required by the client, the consultant delays in approving major changes required for the work	2	3	13	13	2	0.66	19	66	HS
Financial problems faced by contractors	1	5	12	14	1	0.66	20	65	HS
Bureaucracy in government agencies	1	7	11	10	4	0.66	20	65	HS
Delay in approval of drawings by consultant	4	3	12	9	5	0.65	22	65	HS
Lack of consultant's experience in carrying out consulting construction firms	1	9	10	7	6	0.65	22	65	HS
Slow permits by local authorities	1	8	10	10	4	0.65	22	65	HS
Unfavorable weather conditions		8	12	11	2	0.64	25	64	HS
Project location	4	4	11	10	4	0.64	26	64	HS
Change orders by owners during construction	1	7	13	9	3	0.64	26	64	HS
Project scope definition	5	6	6	11	5	0.63	28	63	HS
Practice of assigning contract to lowest bidder	1	10	10	7	5	0.63	28	63	HS
Client makes change in the scope of the project	1	9	10	10	3	0.63	28	63	HS
Lack of supervision during construction process	3	6	12	9	3	0.62	31	62	HS

Delays Factors	NS	SS	MS	VS	ES	RII	Rank	SvI (%)	LS vI
Poor economic conditions	2	10	9	9	3	0.61	32	61	HS
Client makes contract modifications	2	9	10	11	1	0.60	33	60	HS
Client's shown lack of working knowledge	4	7	11	7	4	0.60	33	60	HS
Unqualified workforce exist in labor market	1	8	15	8	1	0.60	33	60	HS
Poor site conditions	4	8	12	5	4	0.58	36	58	MS
Lack of material on the market	2	14	7	5	5	0.58	36	58	MS
Lack of coordination with contractor	5	7	7	10	3	0.58	38	58	MS
Poor qualification of contractor's technical staff	7	6	8	10	2	0.56	39	56	MS
Lack of equipment and tools on the market	5	9	10	7	2	0.55	40	55	MS
Construction mistakes and defective works	3	11	13	5	1	0.54	41	54	MS
Client/Owner makes interference	6	7	13	5	2	0.54	41	54	MS
Inadequate contractor's experience	5	11	11	3	3	0.53	43	53	MS
Inadequate number of contractor's workers	6	9	11	6	1	0.52	44	52	MS
Shortage of labors	4	13	9	6	1	0.52	44	52	MS
Transportation delays	5	13	9	3	3	0.52	46	52	MS
Conflicts between consultant and design engineer	5	13	10	4	1	0.50	47	50	MS
Lack of consultant's site staff experience	9	8	12	4		0.47	48	47	MS

Source: Survey and SPSS V.20 Result. Note: SvI (%) = severity Index in %, LSvl = Level of Severity

Analysis of the surveyed data from respondents shown in Table 4.2 indicated that from the 48 identified variables deemed to cause delay in construction projects as taken from literatures, and arranged in ranks of their respective RII and SvI (%) values after analysing the severity of the variables based on the responses of respondents involved in the survey from OWWCE. Calculation of the relative importance index (RII) result of responses from the respondents for each cause was found out as indicated in the Table 4.2 ranging from 0.77 to 0.47 while severity index ranged from 77% to 47%. Out of the 48 factors of delay 35 of them gained severity index (SvI) values ranging from 77% to 60% while 13 of the delay factors achieved severity index (SvI) of 58% to 47% as seen in Table 4..4. The top ranked 5 causes of delay are underestimate project duration, delay in payment, lack of coordination and communication at design phase (between client, consultant and key stakeholders), fluctuation in price of raw materials (prices increase from that was planned during the design stage) and incomplete design at tendering stage categorized as very sever levels. The list of all the 35 factors of causes of delay identified with very sever level of indices are referred in Table 4.1.2.

On the other hand, from the 48 listed causes of delay the least ranked delay factors are lack of consultant's site staff experience, conflicts between consultant and design engineer, transportation delays, shortage of labors, inadequate number of contractor's workers,

inadequate contractor's experience, client/owner makes interference, construction mistakes and defective works, lack of equipment and tools on the market, poor qualification of contractor's technical staff, and lack of coordination with contractor were the least significant/important causative factors in OWWCE construction projects according to the analysis of respondents view as shown in Table 4.2.

4.3 Factors Causing Delay by Responsible Party

The survey result depicted that all the parties involved in the construction projects of OWWCE namely the contractor, consultant, client/owner and external bodies were playing in contributing delay factors as shown in Table 4.3. According to the respondents view as seen in the Table 4.3, relative importance index (RII) and severity indices for each party namely contractor (OWWCE), consultant, client/owners, and external bodies were indicated with its respective ranks. According to the analysis of severity index shown in Table 4.3, all the four factors related to project (project size, project location, project scope definition and manpower and equipment shortage) gained 63% to 69% which means all are sever in terms of the level severity. On the other hand. out of the seven (7) identified delay factors attributed to contractor, only three factors namely poor site management and improper planning and scheduling and Financial problems faced by contractors attained severity index ranging from 66% to 73% indicating they were severely contributing to the delay of OWWCE projects. The rest four factors achieved severity index ranging from 52% to 56 % showing their moderately sever factors affecting the construction delay in OWWCE.

Furthermore, out of the 13 identified factors of delay attributed to consultants 11 factors achieved severity index ranging from 62% to 77% showing high severity level while two factors achieved 47% to 50% indicating moderate severity level as seen in Table 4.3. Out of the 12 delay factors attributed to client/owner, 9 of them attained severity index of ranging from 60 % to 73 % indicating high severity while 3 of them ranging from 52% to 58% showing moderate severity level as seen in Table 4.3. Moreover, out of the 12 factors proposed to attribute to external factors for the delay of construction projects in OWWCE, 8 factor gained severity index ranging from 60% to 74% that proved their high level of severity while 4 of the remaining factors achieved severity index ranging from 51% to 58% showing their moderate sever level as seen in Table 4.3.

Table 4: 3: Factors Causing Delay by Responsible Party

S/N	Delay Factors	RII	SvI (%)	LSv
	Project Related Factors			
1	Project size	0.68	68	HS
2	Project location	0.64	64	HS
3	Project scope definition	0.63	63	HS
4	Manpower and equipment shortage	0.69	69	HS
	Factors caused due to Contractors			
5	Poor site management	0.73	73	HS
6	Improper planning and scheduling	0.73	73	HS
7	Financial problems faced by contractors	0.65	65	HS
8	Inadequate contractor's experience	0.53	53	MS
9	Construction mistakes and defective works	0.54	54	MS
10	Inadequate number of contractor's workers	0.52	52	MS
11	Poor qualification of contractor's technical staff	0.56	56	MS
	Factors caused due to Consultants			
12	Consultant makes frequent design changes	0.76	76	HS
13	Consultant makes errors in design that is found after commencement of construction process	0.76	76	HS
14	Delay in design preparation by consultant	0.67	67	HS
15	Delay in approval of drawings by consultant	0.65	65	HS
16	Lack of supervision during construction process	0.62	62	HS
17	Slowness in making decision by consultant	0.68	68	HS
18	Lack of consultant's experience in carrying out consulting construction firms	0.65	65	HS
19	Incomplete documents are submitted by consultant	0.75	75	HS
20	Lack of consultant's site staff experience	0.47	47	MS
21	Underestimate project duration during design stage	0.77	77	HS
22	Incompetent designers are involved in designing of construction projects	0.70	70	HS
23	When scope changes are required by the client, the consultant delays in approving major changes required for the work	0.66	66	HS
24	Conflicts between consultant and design engineer	0.50	50	MS
	Factors caused due to Clients/Owners			
25	Client's delay in decision making	0.73	73	HS
26	Client's delay in progress payment (not paying the requested payments for executed works	0.73	73	HS
27	Practice of assigning contract to lowest bidder	0.63	63	HS
28	Client makes contract modifications	0.60	60	HS
29	Client's shown lack of working knowledge	0.60	60	HS
30	Client makes change in the scope of the project	0.63	63	HS
31	Financial difficulties of the owner (shortage of budget encounters the client)	0.72	72	HS
32	Client/Owner makes interference	0.54	54	MS
33	Lack of coordination with contractor	0.58	58	MS
34	Change orders by owners during construction	0.64	64	HS
35	Delay in process to furnish and deliver the site	0.68	68	HS
36	Shortage of labors	0.52	52	MS
	Factors caused due to Externals/Others			
37	Delay in material procurement due to shortage of supplies from the market	0.68	68	HS
38	Unfavorable weather conditions	0.64	64	HS
39	Poor site conditions	0.58	58	MS
40	Slow permits by local authorities	0.65	65	HS
41	Bureaucracy in government agencies	0.65	65	HS
42	Unqualified workforce exist in labor market	0.60	60	HS
43	Lack of material on the market	0.58	58	MS
44	Lack of equipment and tools on the market	0.55	55	MS

S/N	Delay Factors	RII	SvI (%)	LSv
45	Transportation delays	0.52	52	MS
46	Poor economic conditions	0.61	61	HS
47	Poor coordination and communication among construction project parties (client, contractor, consultant and key stakeholders)	0.69	69	HS
48	Materials' price escalation (increase in price of construction materials and equipment over the construction period)	0.74	74	HS

Source: Survey and SPSS V.20 Result. Note: SvI (%) = severity Index in %, LSvl = Level of Severity

4.4 Causes of Cost Overrun in the Construction Projects of OWWCE

The survey was conducted to identify the causes of construction cost overruns in OWWCE based on the 37 factors identified from current literatures. Calculation of the relative importance index (RII) score result of responses from the respondents for each cause was found out as indicated in the Table 4.4 ranging from 0.78 (ranked 1st) to 0.44 while severity index ranged from 78% to 44% (ranked 37th) for Delay in payment and Re-measurement of provisional sum (repeated payments for those activities already activities already paid in the previous interim payments) respectively as seen in Table 4.4. Out of the 37 factors of cost overrun 35 of them gained severity index (SvI) values ranging from 78% to 61% while 11 of the cost overrun factors achieved severity index (SvI) of 59% to 44% as seen in Table 4.4. To mention the top ranked 5 causes of cost overrun factors: delay in payment, lack of coordination and communication at design phase (between client, consultant and key stakeholders), fluctuation in price of raw materials (Prices increase from that was planned during the design stage), incomplete design at tendering stage, lack of cost plan/monitoring, and financial problems faced by owner. The analysis of the responses of OWWCE respondents who participated in the survey revealed that these high ranked factors were highly sever in causing cost overrun in OWWCE construction projects. The least ranked cost overrun factors in OWWCE were re-measurement of provisional sum (repeated payments for those activities already activities already paid in the previous interim payments), labor absenteeism, lack of contractor's experience, contractor used unsuitable construction equipment and forced to change it later, and relationship between management and laborers ranking from 33 to 37 in ranks as seen in Table 4.4.. The analysis of the response of the respondents depicted that these factors (least ranked) were moderately severe.

Table 4: 4: Factors Causing Cost Overrun in Construction Projects

FACTORS CAUSING COST OVERRUNS	NS	SS	MS	VS	ES	RII	Rank	SvI (%)	LSv
Delay in payment		5	6	10	12	0.78	1	78	HS
Lack of coordination and communication at design phase (between client, consultant and key stakeholders)		4	9	8	12	0.77	2	77	HS
Fluctuation in price of raw materials (Prices		3	9	11	10	0.77	2	77	HS

FACTORS CAUSING COST OVERRUNS	NS	SS	MS	VS	ES	RII	Rank	SvI (%)	LSv
increase from that was planned during the design stage)									
Incomplete design at tendering stage		3	14	6	10	0.74	4	74	HS
Lack of cost plan/monitoring		5	11	7	10	0.73	5	73	HS
Financial problems faced by owner		4	13	6	10	0.73	5	73	HS
Lack of consultant's team experience (Fresh and incompetent staffs are used by the consultant)		4	10	13	6	0.73	7	73	HS
Unforeseen site condition (conditions not seen during design stage encounter during construction)		4	11	11	7	0.73	7	73	HS
Delay in approval of design changes	1	2	13	10	7	0.72	9	72	HS
Inadequate project preparation (Some of the desired components of project scope are missed)	1	3	12	10	7	0.72	10	72	HS
High cost of machineries (cost more than that was planned during design stage)	2	2	12	9	8	0.72	10	72	HS
Consultant makes mistakes in design during design stage	2	7	4	11	9	0.71	12	71	HS
Consultant undertakes poor contract management	1	4	12	10	6	0.70	13	70	HS
Lack of communication with consultant and other key stakeholders		8	9	10	6	0.68	14	68	HS
Delay in material procurement	3	2	10	14	4	0.68	14	68	HS
Incorrect scheduling by contractors	2	4	13	10	4	0.66	16	66	HS
Improper project management	2	5	12	10	4	0.65	17	65	HS
Poor financial control on time (The contractor do not follow regular financial control to make adjustment on time)	3	5	12	7	6	0.65	18	65	HS
Slowdown in design preparation	2	5	13	9	4	0.65	18	65	HS
The contractor inappropriate planning process	2	5	14	9	3	0.64	20	64	HS
Financial difficulties experienced by contractor	2	6	14	7	4	0.63	21	63	HS
Unpredictable weather conditions	1	9	11	8	4	0.63	21	63	HS
Extension of time requested for original contracted works of the project (where no additional work or scope of project was changed)	2	8	12	6	5	0.62	23	62	HS
Poor labor productivity	2	7	14	6	4	0.62	24	62	HS
Practice of assigning contract to lowest bidder	3	8	11	6	5	0.61	25	61	HS
Unskilled labor (employed workers may not have the required level of skills for the project works)	3	7	13	6	4	0.61	26	61	HS
Equipment failure	5	3	13	10	2	0.61	26	61	HS
Changes in client's requirement	1	9	15	7	1	0.59	28	59	MS
Underestimate project duration	5	7	8	13	0	0.58	29	58	MS
Shortage of site workers (Unavailability of skilled and unskilled workers for the projects)	2	9	16	5	1	0.56	30	56	MS
Errors during construction causing extra cost for corrections	3	12	10	5	3	0.56	31	56	MS
Contractor follows improper construction methods and forced to change later	5	11	7	8	2	0.55	32	55	MS
Relationship between management and	5	11	9	6	2	0.53	33	53	MS

FACTORS CAUSING COST OVERRUNS	NS	SS	MS	VS	ES	RII	Rank	SvI (%)	LSv
laborers									
Contractor used unsuitable construction equipment and forced to change it later	7	8	10	8		0.52	34	52	MS
Lack of contractor's experience	7	13	6	4	3	0.50	35	50	MS
Labor absenteeism	7	10	12	2	2	0.49	36	49	MS
Re-measurement of provisional sum (repeated payments for those activities already activities already paid in the previous interim payments)	8	15	6	4		0.44	37	44	MS

Source: Survey and SPSS V.20 Result. Note: SvI (%) = severity Index in %, LSv = Level of Severity, MS = Moderate Severity, HS = High Severity

4.5 Factors Causing Cost overrun by Responsibility

The analysis of responses of respondents on factors causing cost overrun in OWWCE construction projects segregated into the respective factors attributed to each party (contractor, consultant, client/owner and external bodies) directly contributing to the construction projects is indicated in Table 4. 5. Accordingly the impact of each factor was investigated using relative importance index (RII) and severity index (SvI in %). Analysis based on severity index (SvI) of contractor (OWWCE) revealed that from 11 factors causing cost overrun 6 were categorized as highly sever in causing cost overrun (SvI ranged from 62% to 66% while RII ranged from 0.62 to 0.66) while the remaining 5 factors were moderately severe (SvI ranged from 50% to 56% while RII ranged from 0.50 to 0.56) as seen in Table 4.5, The highly sever factors were: incorrect scheduling by contractors, improper project management, poor financial control on time (the contractor do not follow regular financial control to make adjustment on time), the contractor inappropriate planning process, financial difficulties experienced by contractor, and extension of time requested for original contracted works of the project (where no additional work or scope of project was changed).

Furthermore the analysis based on factors attributed to consultant revealed that from 10 factors causing cost overrun 9 were categorized as highly sever in causing cost overrun (SvI ranged from 65% to 77% while RII ranged from 0.65 to 0.77) while the remaining 1 factor was moderately severe (earning SvI 58% while RII ranged 0.58) as seen in Table 4.5, The highly sever factors were: lack of coordination and communication at design phase (between client, consultant and key stakeholders), incomplete design at tendering stage, lack of consultant's team experience (Fresh and incompetent staffs are used by the consultant), lack of cost plan/monitoring, inadequate project preparation (Some of the desired components of

project scope are missed), delay in approval of design changes, consultant makes mistakes in design during design stage, consultant undertakes poor contract management, and slowdown in design preparation as depicted in Table 4.5.

On the other hand the analysis based on factors attributed to clients/owners revealed that from 6 factors causing cost overrun 4 were categorized as highly sever in causing cost overrun (SvI ranged from 61% to 78% while RII ranged from 0.61 to 0.78) while the remaining 2 factors were moderately severe (earning SvI 44% and 59% while RII ranged 0.44 and 0.59) as seen in Table 4.5, The highly sever factors were: delay in payment, financial problems faced by owner, lack of communication with consultant and other key stakeholders, and practice of assigning contract to lowest bidder as depicted in Table 4.5.

Moreover the analysis based on factors attributed to externals/others revealed that from 10 factors causing cost overrun 8 were categorized as highly sever in causing cost overrun (SvI ranged from 61% to 77% while RII ranged from 0.61 to 0.77) while the remaining 2 factors were moderately severe (earning SvI 49% and 56% while RII ranged 0.49 and 0.56) as seen in Table 4.5, The highly sever factors were: fluctuation in price of raw materials, unforeseen site condition (conditions not seen during design stage encounter during construction). high cost of machineries (cost more than that was planned during design stage), delay in material procurement, Unpredictable weather conditions, Poor labour productivity. Unskilled labour and Equipment failure as depicted in Table 4.5.

Table 4: 5: Factors Causing Cost Overrun by Responsibility

FACTORS CAUSING COST OVERRUNS	RII	Rank	SvI (%)	SvI
Factors caused by Contractors				
The contractor inappropriate planning process	0.64	20	63.64	HS
Improper project management	0.65	17	65.45	HS
Lack of contractor's experience	0.50	35	49.70	MS
Financial difficulties experienced by contractor	0.63	21	63.03	HS
Relationship between management and laborers	0.53	33	53.33	MS
Incorrect scheduling by contractors	0.66	16	66.06	HS
Errors during construction causing extra cost for corrections	0.56	31	55.76	MS
Extension of time requested for original contracted works of the project (where no additional work or scope of project was changed)	0.62	23	62.42	HS
Contractor used unsuitable construction equipment and forced to change it later	0.52	34	51.52	MS
Contractor follows improper construction methods and forced to change later	0.55	32	54.55	MS
Poor financial control on time (The contractor do not follow regular financial control to make adjustment on time)	0.65	18	64.85	HS
Factors caused by Consultants				
Consultant undertakes poor contract management	0.70	13	69.70	HS
Consultant makes mistakes in design during design stage	0.71	12	70.91	HS

FACTORS CAUSING COST OVERRUNS	RII	Rank	SvI (%)	SvI
Underestimate project duration	1.58	29	57.58	MS
Slowdown in design preparation	0.65	18	64.85	HS
Delay in approval of design changes	0.72	9	72.12	HS
Lack of cost plan/monitoring	0.73	5	73.33	HS
Inadequate project preparation (Some of the desired components of project scope are missed)	0.72	10	71.52	HS
Lack of coordination and communication at design phase (between client, consultant and key stakeholders)	0.77	2	76.97	HS
Incomplete design at tendering stage	0.74	4	73.94	HS
Lack of consultant's team experience (Fresh and incompetent staffs are used by the consultant)	0.73	7	72.73	HS
Factors caused due to Clients/Owners				
Financial problems faced by owner	0.73	5	73.33	HS
Lack of communication with consultant and other key stakeholders	0.68	14	68.48	HS
Practice of assigning contract to lowest bidder	0.61	25	61.21	HS
Changes in client's requirement	0.59	28	58.79	MS
Delay in payment	0.78	1	77.58	HS
Re-measurement of provisional sum (repeated payments for those activities already activities already paid in the previous interim payments)	0.44	37	43.64	MS
Factors caused due to Externals/Others				
High cost of machineries (cost more than that was planned during design stage)	0.72	10	71.52	HS
Fluctuation in price of raw materials (Prices increase from that was planned during the design stage)	0.77	2	76.97	HS
Unforeseen site condition (conditions not seen during design stage encounter during construction)	0.73	7	72.73	HS
Shortage of site workers (Unavailability of skilled and unskilled workers for the projects)	0.56	30	56.36	MS
Delay in material procurement	0.68	14	68.48	HS
Unpredictable weather conditions	0.63	21	63.03	HS
Poor labor productivity	0.62	24	61.82	HS
Unskilled labor (employed workers may not have the required level of skills for the project works)	0.61	26	60.61	HS
Equipment failure	0.61	26	60.61	HS
Labor absenteeism	0.49	36	49.09	MS

Source: Survey and SPSS V.20 Result. Note: SvI (%) = severity Index in %, LSvl = Level of Severity

4.6 Document Review On Performances of OWWCE Projects

The review of document for nine (9) construction projects of OWWCE on time and cost performance as seen in Table 4.6 indicated that all the projects suffered time overrun (delay) ranging from 117% to 911%. These figures show that time overrun is the most significant issues in OWWCE. Cost performance wise, three projects were completed below the agreed project contact prices with 23.04%, 30.05% and -41.75% (the negative sign indicating the projects completed below the agreed contract price) while the rest of six projects showed cost overruns ranging from 1% to 57.81% as seen in Table 4.6. Generally speaking, the delay and cost overruns as revealed through document review supports the results found from the analysis of responses of respondents involved in the survey of this study shown in the preceding sections.

Table 4: 6:Time and Cost Performances of OWWCE Projects

Location	Contracted Amount (Birr)	Contract Date (GC)	Contract Duration (in days)	Agreed Completion Date (GC)	Actual cost incurred to complete (Birr)	Actual Completion Date in (GC)	Actual completion Durations (Days)	% Time Overrun	% Cost Overrun
East Hararhge	32,983,955.00	22-May-09	730	21 May-11	33,313,794.00	8-Jul-16	2605	257%	1.00%
Nekemte	192,172,364.97	29-Mar-10	1460	27-Mar-14	134,427,412.30	11-Apr-19	3666	151%	-30.05%
West Arsi	60,834,993.00	16-May-07	365	14-May-08	69,146,930.00	22-May-17	3691	911%	13.66%
Ilu Ababor	78,459,822.00	27-May-10	730	25-May-12	60,384,141.00	7-Jul-17	2599	256%	-23.04%
Arsi	202,164,008.00	29-Jun-10	1095	27-Jun-13	117,755,248.00	30-Dec-16	2377	117%	-41.75%
E/Showa	150,590,613.29	20-Mar-10	730	18-Mar-12	237,639,919.74	7-Jul-19	3397	365%	57.81%
Bale	29,303,745.39	15-May-17	270	8-Feb-18	44,166,790.17	7-Jul-19	784	190%	50.72%
East Wallagaa	107,136,607.00	29-Jun-08	1095	28-Jun-11	111,986,405.00	8-Apr-17	3205	193%	4.53%
E/Showa	107,654,856.00	29-Jun-12	365	28-Jun-13	110,964,065.00	14-Mar-19	2450	571%	3.07%

Source: OWWCE 2020

CHAPTER 5:CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Given the low economic development of the Oromia Regional State and thus high developmental need and that financial resources are scarce, OWWCE as company was established to undertake the region's construction projects especially where other private companies are not willing to involve and address the need of the public. Thus, it is justifiable to investigate the causes of delays and cost overruns in the projects of OWWCE construction projects so as to show the critical issues to be managed through OWWCE along with the other responsible parties. Identification of causes of delay and cost overrun are prerequisite to plan the measures of mitigations to minimize or to avoid these two project success criteria namely delay and cost overrun in OWWCE construction projects. This study was carried out to investigate the critical causes of project delay and cost overrun of OWWCE projects. The study used both primary and secondary method of data sources to make analysis, interpretation and conclusion of the stated issues. With respect to means of acquiring data from primary data sources, questionnaire survey was also used to identify the main causes delay and cost overrun in OWWCE projects. Prior to preparation of structured questionnaires for the survey, 48 and 37 causes of delay and cost overrun respectively were identified and gathered from contemporary literature. Respondents from OWWCE were asked to identify the significance or importance of variables of delay and cost overrun that were critically identified and gathered from current literatures and relevant to OWWCE construction projects. The analysis of the results from the close ended part of the questionnaires was carried out using descriptive statistical techniques.

With regards to secondary data source for acquiring data for the analysis of this study, document review was undertaken to review the performances of nine (9) construction projects for which full data were available to understand the extent of delay and cost overrun. Thus, the results of the analysis of survey through responses of respondents involved in the study and document review revealed the following conclusions:

I. Highly sever delay factors of OWWCE construction projects

1. The need to justify the existence and significance of causes of delay and cost overrun of projects is vital for any construction company prior to commencement of addressing the causes of delay and cost overrun in projects. This study, therefore, identified 35 and 27 highly sever causes of delay and time overrun respectively in

OWWCE construction projects in their execution. This was attested by document review of nine already completed construction projects showing delay (time overrun) ranging from 117% to 911% (for all the nine projects) while cost overrun (increased cost of construction) ranging from 1% to 50.85% (for six projects out of the nine projects) compared to the contract agreement.

2. The respondents were asked to show the significance of each factor in OWWCE construction projects' context. The most significant causes of delay and cost overrun were identified by the research based on the ranking of the rate of relative importance index (RII) and severity index (SvI). Accordingly 35 and 27 factors out of the 48 and 37 factors found highly sever in causing of delay and cost overrun respectively in OWWCE construction projects were listed and availed in tabulation..
3. The study result also identified the responsible parties involved in OWWCE construction projects in terms of the significant variables with high severity in causing delay and cost overruns. Accordingly factors with high severity causing delay with respect to each pary were:

- Contractor was responsible for three (3) factors such as poor site management; improper planning and scheduling and Financial problems faced by contractors
- Consultant was responsible for the 11 factors such as underestimate project duration during design stage, consultant makes frequent design changes, consultant makes errors in design that is found after commencement of construction process, delay in design preparation by consultant, delay in approval of drawings by consultant, lack of supervision during construction process, slowness in making decision by consultant, lack of consultant's experience in carrying out consulting construction firms, incomplete documents are submitted by consultant, underestimate project duration during design stage, incompetent designers are involved in designing of construction projects and when scope changes are required by the client, and the consultant delays in approving major changes required for the work
- Client/owner was responsible for nine (9) factors namely client's delay in decision making, client's delay in progress payment (not paying the requested payments for executed works and financial difficulties of the owner (shortage of budget encounters the client), practice of assigning contract to lowest bidder, client makes contract modifications, client's shown lack of working knowledge, client makes change in the scope of the project, financial difficulties of the owner (shortage of budget encounters

the client), change orders by owners during construction and delay in process to furnish and deliver the site

- External factors were responsible for eight (8) factors namely: Delay in material procurement due to shortage of supplies from the market, unfavourable weather conditions, Slow permits by local authorities, Bureaucracy in government agencies, Unqualified workforce exist in labor market, Poor economic conditions, Poor coordination and communication among construction project parties (client, contractor, consultant and key stakeholders), and materials' price escalation (increase in price of construction materials and equipment over the construction period).

II. Highly sever cost overrun factors of OWWCE construction project

- Contractor was responsible for six (6) factors namely The contractor inappropriate planning process, Improper project management, Financial difficulties experienced by contractor, Incorrect scheduling by contractors, Extension of time requested for original contracted works of the project (where no additional work or scope of project was changed), and Poor financial control on time (The contractor do not follow regular financial control to make adjustment on time).
- Consultant was responsible for the nine (9) factors namely consultant undertakes poor contract management, consultant makes mistakes in design during design stage, slowdown in design preparation, delay in approval of design changes, lack of cost plan/monitoring, inadequate project preparation (some of the desired components of project scope are missed), lack of coordination and communication at design phase (among client, consultant and key stakeholders), incomplete design at tendering stage, and lack of consultant's team experience (fresh and incompetent staffs are used by the consultant).
- Client/owner was responsible for four (4) factors namely financial problems faced by owner, lack of communication with consultant and other key stakeholders, practice of assigning contract to lowest bidder, and delay in progress payment.
- External factors were responsible for eight (8) factors namely high cost of machineries (cost more than that was planned during design stage), fluctuation in price of raw materials (prices increase from that was planned during the design stage), unforeseen site condition (conditions not seen during design stage encounter during construction), and delay in material procurement, unpredictable weather conditions, poor labour productivity, unskilled labour (employed workers may not have the required level of skills for the project works), and equipment failure.

5.2 Recommendation

Based on the findings of this study, the following recommendations were suggested.

1. As goal owner, OWWCE is expected to create understanding and lobby for the identified issues so that each party involved in the OWWCE construction projects take the share of its respective responsibility in order to plan for addressing the causes to mitigate the negative impacts of the delay and cost overrun.
2. Carry out identifications of factors for causes of delay and cost overrun and then identify the significance and importance of each of the identified the most sever causes prior to planning to address these causes for effectiveness.
3. Future study on the causes of delay and cost overrun in the company should focus on survey that includes the respondents from client and consultant for considering their view and attitude over the issue under study.

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APPENDICES

Appendix Table 1: Research Questionnaires.

MARY'S UNIVERSITY SCHOOL OF GRADUATE STUDIES FACULTY OF BUSINESS

Dear respondents,

The purpose of this study is to obtain information from key informants regarding factors that cause project delay and cost overruns in water works construction projects in Oromia Water Works Construction Enterprise (OWWCE), its effects and suggested recommendations for mitigating the causes of delay and cost overrun in the process of managing such projects. Your sincere willingness in providing accurate and reliable information is necessary for the success of this study. The provided information will be kept confidential and the researcher will be liable for any harms or injury occurred due to your participation.

Thank you for your participation

Sincerely,

Habtamu Imiru,

FACTORS AFFECTING TIME AND COST OVERRUNS

SECTION A: DEMOGRAPHIC CHARACTERISTICS AND ORGANIZATIONAL RELATED INFORMATION

1. State respondent organization/company type.

Client ☐ Contractor ☐ Consultant ☐

2. Respondent's sex: Male ☐ Female ☐

3. Respondent's designation:

Project manager ☐ Project coordinator ☐ Project engineer ☐

Resident engineer ☐ Site Engineer ☐ Other Specify ☐

4. Respondents' educational level

PhD ☐ Master's Degree ☐ Bachelor Degree ☐

Diploma ☐

5. Respondents' field of study

Civil engineering ☐ Architecture ☐ Other Specify ☐

6. Relevant work experience (Years)

1 - 4 ☐ 4 – 8 ☐ 8 – 12 ☐ > 12 ☐

7. Do you use software packages for project planning and time control?

Yes ☐ No ☐

If yes mention the name(s):

_____

_____

8. Do you use software packages for project cost control?

Yes ☐ No ☐

If yes mention the name(s):

_____

_____

SECTION B: FACTORS INFLUENCING TIME OVERRUNS OF WATER WORKS CONSTRUCTION PROJECTS IN OROMIA WATER WORKS CONSTRUCTION PROJECTS IN OROMIA REGIONAL REGION.

NOTE: E.S. = EXTREMELY SIGNIFICANT (5); V.S. = VERY SIGNIFICANT (4); M.S. = MODERATELY SIGNIFICANT (3); S.S. = SLIGHTLY SIGNIFICANT (2); N.S. = NOT SIGNIFICANT (1)

No.	Time overrun factors	E.S. (5)	V.S. (4)	M.S. (3)	S.S. (2)	N.S. (1)
	Project Related Factors					
1	Project size					
2	Project location					
3	Project scope definition					
4	Manpower and equipment shortage					
	Owner's Related Factors					
5	Inadequate funding of project or financial constraints					
6	Frequent design change					
7	Increase in project scope					
8	Subcontractors' incompetents					
9	Delays in delivery of materials					
10	Inadequate managerial skills and experiences					
11	Slowness of decision making process					
12	Delays in payment for completed works					
13	Delays in contractors' claim settlements 14					
14	Poor communication and coordination systems					
15	Owner interference					
	Contractors related Factors					
16	Financial or cash problems during constriction					
17	Unstable interest rate and inflationary increase in material prices					
18	Poor site management					
19	Inadequate planning and scheduling					
20	Poor performances of subcontractors					

No.	Time overrun factors	E.S. (5)	V.S. (4)	M.S. (3)	S.S. (2)	N.S. (1)
21	Delay in work progress and poor labour productivity					
22	Shortage and low skilled labour force					
23	Mistake during construction/ reworks					
24	Inadequate contractors experiences					
25	Poor communication and misunderstandings					
26	Unethical behaviour					
	Consultants related Factors					
27	Incomplete drawings and documents					
28	Slowness in giving instructions					
29	Depends on the fresher's to bear the whole responsibility					
30	Under-estimation of costs					
31	Unrealistic contract duration or project time estimation					
32	Inadequate quality control procedures					
33	Poor contract management					
34	Luck of communication and coordination					
35	Delays payment preparations					
36	Delays in material approval					
	External Factors					
37	Unavailability or insufficient of water and electricity					
38	Unpredictable weather conditions					
39	Government regulations and control					
40	Bad site conditions (location, soil, etc)					
41	Labour strikes					

For your additional comments:

_____

_____

_____

_____