

**Assessment of Causes of Delay in Water Supply
Construction Projects: The case Study of World Vision
Ethiopia**



By: Teketel Mathiws (GSD/0533/07)

**A Project Work Submitted to AAUSC in Partial Fulfillment
of the Requirements for the Master of Arts Degree in Project
Management**

**ADDIS ABABA UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
SCHOOL OF COMMERCE**

April, 2018

Addis Ababa, Ethiopia

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DECLARATION OF CANDIDATE

I hereby declare that this research project work is my own work and that it has not been submitted anywhere for any approval.

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ACKNOWLEDGEMENTS

First of all my praise and thanks go to my Lord Jesus Christ for his love, help and protection in every aspect of my life.

I would like to thank my advisor Ato. Fisseha Afework (Ass. Prof) for his remarkable advice and guidance in this study.

My deepest gratitude goes to World Vision Ethiopia WASH team for letting me to have access of information required.

My appreciation goes to Ato Eba Taffese for his great support his unreserved support in during questionnaire collection.

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Abstract

Construction delays are common problems in water supply projects in Ethiopia. The delays in construction projects are the major causes of project failure. If the delay is not identified and the corrective project management decision is not taken in time a project may incur extra cost and extension of project time, which gives rise to dissatisfaction to all the parties involved and nowadays it's becoming a major obstruction for their development for developing countries like Ethiopia. The research intended to identify the major causes that are led to project delay. To achieve the objective, the study employed descriptive research approach and both primary and secondary data were used. Questionnaires and desk review was tools used collect the data required. This research first identified 58 factors causing delay in Ethiopian water supply construction sector, and then the most common and critical causes of construction delay were evaluated by the data collected in a survey of program managers, regional coordinators and site engineers. The findings show that the main critical factors that cause construction delays in water supply sector in Ethiopia are: (1) adverse weather condition, (2) delay in approval of documents, (3) equipment Failure, (4) scarcity of material in the market,(5) poor supervision, (6) poor site management, (7) fluctuation of prices of materials, (8) change in subsurface conditions, (9) slowness in decision making process and, (10) low skills of labor.

Chapter 1: Introduction

1.1. Background of the Study

Access to clean water and sanitation is declared as a human right by United Nations in 2010 (UN, 2013). At the beginning of 2000, 1.1 billion people of the world's population were without access to improved water supply. The absence of reliable water supply and sanitation services and inadequacies in these services has been the main cause of death of millions. Government and non-government organizations are carry out several water supply construction projects across the country to reduce such a big problem. However, several studies pointed of that most of construction projects suffer delays. The effects of these delays may be of considerable magnitude on the efficiency of the project. It is possible to reduce these delays through recognition of their real causes (Ashraf and Ghanim, 2016). In Ethiopia, only 8.25% projects have been finished to the original targeted completion date. The remaining 91.75% delayed 352% of its contractual time (Worku and Jah, 2016).

Several studies suggested numerous causes of project delay in construction sector. The most common causes of project delay in construction industry are change orders, time-consuming decision making by the owner, and design errors (Mohammad, 2017). Ashraf and Ghanim, 2016, revealed 55 project delay causes. The top 10 causes of project delay based on the frequency of occurrence, severity and importance are (1) inadequate management and supervision by the contractor, (2) client's changes of the design, (3) inadequate planning and control by the contractor, (4) using lowest bid that lead to low performance, (5) Changes in the extent of the project, (6) errors in design and contract documents, (7) progress payments are not made in time by the client, (8) Rework due to mistakes during construction, (9) changes in the original design and (10) Low level productivity. According to Werku and Jah (2017), the critical factors that cause construction delays in Ethiopia are: (1) Difficulties in financing project by a contractor; (2) Escalation of the materials price; (3) Infective project planning; (4) Scheduling or resource management; (5) Delay in progress payments for completed works, (6) Lack of skilled professionals in the field of construction management in the organization, and (7) Fluctuating labor availability season to season /Seasonal labors availability.

The delay of projects will cause time overrun, cost overrun, disputes, arbitration, litigation and total abandonment. These results are based on frequency of occurrence (Ashraf and Ghanim, 2016).

A research work carried out by Anuruddha, 2010, indicated that inclement weather conditions, contractors' financial difficulties, delays in sub contractors' work, material import delays and ineffective planning and scheduling of project by contractor are among the most important factors causing delay in construction of medium scale water supply projects. Anuruddha also listed time overruns, cost overruns, difficulty and poor relationships with other parties and disputes are among the most important effects due to delay.

Water Aid, an international NGO operating in Ethiopia, explained that 61 million Ethiopians (i.e. over 80%) lack access to safe water. The organization undertook a survey and found that many women and children walk more than three hours to collect water. By the end of the Growth and Transformation Plan-II period in 2020, according to UNICEF's report, government of Ethiopia planned to increase proportion of people using safely managed, adequate and resilient water supply services to 83%. The lack of access to safe water and sanitation, accounts for 70-80% of health problems in Ethiopia. It has also been identified as a major cause of morbidity and mortality (Mengesha 2002).

Realizing the critical importance of supplying potable water, national and regional governments, local and international NGOs, bilateral organizations, UN, AU and others have been investing millions of capitals every year in Ethiopia to tackle the problem through the implementation of water supply projects.

1.2. Statement of the Problem

Ethiopian government allocates its lion share of annual budget for the construction industry in terms of government development program (werku and Jha, 2016). According to werku and Jha, 2016, therefore public construction projects consume an average annual rate of nearly 60% of the government's capital budget. ENA, 2018, reported that Ethiopian Construction Project Management Institute found that completion of the projects within time frame and budget become increasingly difficult due to lack of effective construction management capacity. According to Ethiopian Construction Project Management Institute, 2018, projects budget and time overrun reached 76% and 124% respectively. Lack of capacity in project formulation, certified personnel, and integration and coordination were the reasons put forward. Poor

integration among contractors, consultants, clients, material suppliers and other stake holders is causing delay for many projects (ENA, 2018). Despite lack of empirical evidences specific to the sector, the water supply construction projects also are suffering from a massive delay. Poor nations like Ethiopia can't afford wasting their limited resources just like that. Thus, a careful examination of what is causing the delay and mitigation practices that the implementing organizations applying has to be done in order to minimize the waste and maximize the benefits. Rural water supply construction projects have their own specific characteristics. These projects are meant to be completed within a year or less. They are also constructed in rural areas where human resources, equipment and supplies are severely scarce. Thus, the research intended to identify sector specific problems to influence decision makers to make informed decisions.

This study, therefore, identify the major causes of construction delay in water supply project construction sector and assess mitigation practices that help implementing organizations minimize the incidence. This study identified 58 causes of delay to describe the ones applicable to water supply sector. These causes of delay were grouped into 8 groups such as design-related, material-related, labor-related, equipment-related, finance- related, management-related, contractual-related and external causes.

1.3. Basic Research Questions

The study was guided by the following research questions:

- i. What are the major causes for the delay in the water supply construction projects in Ethiopia?
- ii. What are the practices that the implementing organization undertaking to minimize the occurrence of the delay and its effects?

1.4. Objective of Study

The main objective of this study was to identify the major causes of delays of water supply construction projects. The specific objectives of the study are to:

- Identify the major causes of delay in the construction of water supply projects in Ethiopia.
- Assess the practices that the organization undertaking to minimize the occurrence of the delay and its effects.

1.5. Significance of the Study

Researches were conducted on causes of delay in construction sector in general. However, no study was undertaken up until now specific to water supply construction sector. The study identifies the main causes of delay in water supply construction sector. Thus, the subject matter of this research and the resulting lessons drawn from the analysis are likely to benefit implementing organizations. This study will be significant for its contribution to:

- The study sheds light on the causes of project delay specific to water supply sector
- The study's findings and recommendations are highly important to management of the project implementing organizations because it draws their attention to some of the points where corrective actions are necessary and enable them to make such corrections
- The research could be used to establish a framework for subsequent studies that can work with more comprehensive data sets. Furthermore, it could stimulate further research.
- The findings and recommendations of the study are highly important to policy makers because it draws their attention to some of the points that need corrective measures on their side.

1.6. Scope and limitations of the Study

Werku and Jha, 2016, explained that construction delays are occurring in every phase of a construction project and are common problems in all construction projects in Ethiopia. Findings from assessing the construction industry as a whole would have given a good picture to users of this study. However, this research focused on assessment of causes and effects delay of water supply construction projects due to limitation of time. The study also picked projects that are owned by one organization, World Vision Ethiopia, as a case to show the trend elsewhere. This study does not consider projects completed in the past because it would be difficult to access the personnel and even contractors sometimes who managed them. Thus, only those projects that are currently active will be covered with the study. This study also didn't consider relationships between variables. Thus no correlation or regression analysis is used due to time limitation. The study also is limited to opinion of implementing organization because the organization carryout most construction in its own. However, it invites contractors where the need may be.

1.7. Definition of Terms

Project Delay: A project that is requiring any time more than what is actually needed to complete a project is considered as a delayed project (Fugar and Agyakwah-Baah, 2010).

Effects of delay: Any consequence directly attributed to the project delay based on the perception of the clients, contractors and consultants is taken as effect of delay (Werku and Jha 2016).

Water supply projects: Water supply projects in this study context refer to projects that are built by World Vision Ethiopia for community services.

1.8. Organization of the research

The study is structured in five chapters. Chapter one dealt with background of the study, statement of the problem, basic research questions, objectives of the study, definition of terms, significance of the study, and scope & limitations of the study. Chapter two was all about literature review to discussing overview causes of delay, effects of delay other empirical facts of construction industry. Chapter three presented sources data, the data collection tools/instruments, data collection procedure and methods of data analysis. Chapter four summarized the findings of the study, and interpreted and discussed the findings. Finally, Chapter five presented the summary of findings, conclusion and recommendation.

Chapter 2: Literature Review

This chapter presents review of various literatures, both theoretical and empirical, to assess causes of delay in projects, its effect on the performance and mitigation alternatives to the projects in construction sector. Academic studies, websites of implementing organization and the like are considered to be sources of data. It shall also put forward a conceptual framework of the study based on the review.

2.1. Theoretical review

2.1.1. Classification of Project Delay

Syed and Ahmed, 2003, explained three types of construction delay. They classified delays into non-excusable delays, excusable delays and concurrent delays.

A. Excusable delays

According to Syed and Ahmed, 2003, excusable delay is defined as a delay that is due to an unforeseeable event beyond the contractor's or the subcontractor's control. Usually, based on common general provisions in public agency specifications, delay resulting from the following events would be considered excusable such as fires, floods, owner-directed changes, errors and omissions in the contract drawing, unusually severe weather and etc. Excusable delays can be further classified into excusable with compensation and excusable without compensation.

B. Excusable with compensation

Compensation delays are caused by the owner or the owner's agents. An example of this would be the drawings late release from the owner's architect. An excusable, compensable delay normally leads to a schedule extension and exposes the owner to financial damages claimed by the contractor. In this scenario, the contractor incurs additional indirect costs for both extended field office and home office overhead and unabsorbed home office overhead (Syed and Ahmed ,2003).

C. Excusable delays without compensation

Non-compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. Examples typically include unusual weather, strikes, fires, acts of government in its sovereign capacity, etc. In this case, the contractor is normally entitled to claim extension of time but no compensation for delay damages (Syed and Ahmed, 2003).

D. Non-excusable delays

According to Fugar and Agyakwah, 2010, non-excusable delays are caused by lack of performance of the contractor on the construction project. This delay can be caused by underestimates of productivity, improper project planning and scheduling, poor site management and supervision, wrong construction methods, equipment breakdowns, unreliable subcontractors or suppliers. Therefore, it is contractor responsibilities to continue their work with no entitlement to claim for extension of time or delay damages until they completed the project. For instance, a contractor failure to provide an adequate material to completed their job.

E. Concurrent Delay

Concurrent delay is a problem that is happening on most of the construction industry project. This issue arises when two or more delaying event at the same time in a project cannot complete on time. In this situation, both owner and contractor are responsible for the delay (Fugar and Agyakwah, 2010). Commonly concurrent delays which involve any two or more excusable delays result in extension of time. When excusable with compensation and non-excusable delays are concurrent, an extension of time can be issued or the delay can be distribution between the owner and the contractor. Concurrent delay can be categories in three types of delays:

- If excusable and non-excusable delays occur concurrently, the contractor only to allow claim for extension of time:
- If excusable with compensation and excusable without compensation delays occur concurrently, the contractor is entitle to claim extension of time but no delay damages:
- If two excusable with compensation delays occur concurrently, the contractor is entitled to claim extension of time and delay damages.

For instance, a concurrent delay would be if the owner fails to give more detail regarding either using ceramic tile or homogeneous tile for toilet floor finishes. But at the same time contractor made with own decision and using ceramic tile for toilet floor finishes but actually owner plan using homogeneous tile. In this situation, the contractor cannot claim for damages. It is because contractor is not follow owner instruction but he can claim for extension of time with owner failure to give more detail of drawing.

2.1.2. Causes of Project Delay

According to Fugar and Agyakwah, 2010, construction delays are occurring in every phase of a construction project and are common problems in construction projects. The actors in the

industry (i.e. consultants, clients and contractors) have their own share in the process. There are also other factors that are external to these parties. Studies on the causes of delay in project are reviewed and discussed below.

2.1.2.1. Classification of Delay Causes

Researchers did classify causes of project delay in different ways. Some tried to categorize them by creating a sort of group that happen to share similar characteristics while others did it based on the parties who contributed for the causes happen.

2.1.2.1.1. Classification Based on Delay Categories

Fugar, 2010, categorized 32 causes of delay into nine major areas. The classifications are: materials, manpower, equipment, financing, environment, changes, government action, contractual relationships, and scheduling and controlling techniques. Table 1 summarized Fugar's delay causes classification.

Table 1. Fugar's delay causes classification

1. Material • Shortages of materials on site or market • Late delivery of material	2. Manpower • Shortage of unskilled labor • Shortage of skilled labor
3. Equipment • Equipment failure or breakdown • Unskilled equipment operators	4. Financing • Delay in honoring payment certificates • Difficulties in assessing credit • Fluctuation of prices
5. Environmental • Bad weather conditions • Unfavorable site conditions	6. Changes • Client initiated variations • Necessary variations • Mistakes in soil investigation • Poor design • Foundation conditions encountered in site
7. Government action	8. Contractual relations

• Delays in obtaining permit from municipality • Public holidays • Discrepancy between design specification and building code	• Legal disputes • Insufficient communication between parties • Poor professional management • Delay in instructions from consultants • Delay by subcontractors
9. Scheduling and controlling techniques • Poor site management • Poor supervision • Lack of program of works • Accidents during construction • Construction methods • Underestimation of costs of projects • Underestimation of complexity of projects • Underestimation of time of completion	

Fugar further analyzed to identify the top ten most important factors causing delay in Ghana are:

- Delay in honoring certificates
- Underestimation of the cost of project
- Underestimation of complexity of project
- Difficulty in accessing bank credit
- Poor supervision
- Underestimation of time for completion of projects by contractors
- Shortage of materials
- Poor professional management
- Fluctuation of prices/rising cost of materials
- Poor site management

Based on the different groups of delay, the study revealed that the top three groups of delay are financial, materials and scheduling and control.

- Financial: Financial difficulties have also been identified as the first major factor causing delay in construction projects. The inability of clients (building owners) to honor

payments on time was determined by all respondents under the financial group of delays as the first major factor that causes delays in building construction projects in Ghana. Failure to provide adequate funding resources to contractors will make it impossible for contractors to meet project objectives

- Materials: shortage of material on the market, the availability of materials on site at the right time and in the right quantities is directly related to the ability of the client to honor certificates as and when they are due. Liquidity problems make it difficult for contractors to procure materials.
- Scheduling and control: Contractors, clients, and consultants together ranked scheduling and controlling of work as the third most crucial factor in the delay of building construction projects.

2.1.2.1.2. Classification Based on Major Actors Involved in Construction Sector

Emeka, 2016, Worku and Jah, 2016, and others categorized causes of delay based on the major actors (contractors, clients, consultants) involved in the construction industry and factors external to these parties.

A. Consultants' Related Causes

Causes related to consultants are lack of consultant site engineer, lack of adequate knowledge on the part of the consultant, inexperience on the part of the consultant site staff, delayed in making decisions, insufficient documents, slowness in passing information, contract administration, planning and endorsement of structural drawings and quality control (Emeka, 2016). From consultants/supervisors point of view top 10 construction delay factors are: difficulties in financing project by contractor, ineffective project planning, scheduling or resource management, low productivity of labour, escalation of materials price, supplying poor quality material by contractor, lack of skilled professional in construction PM(project management) in the organization, poor coordination and communication with other parties, fluctuating labor availability season to season/seasonal labor availability, price fluctuations, and late delivery of materials (Worku and Jah,2016).

B. Contractors' Related Causes

Emeka, 2016, listed contractors related delays which are, delay in conveying materials to site, materials shortage on site, structural flaw and substandard work, poor skills and inexperience of

workers, lack of site labour, poor skills of labour, financial difficulties, supervision problems with labour, lack of subcontractor's skills, lack of site contractor's staff, poor site management, and shortage of construction equipment, poor site management, inappropriate planning of project, contractors incompetency, construction flaw and unsuitable construction techniques. Werku, 2016, on other hand listed delay in progress payments for completed works, fluctuating labours availability season to season/Seasonal labours availability, late delivery of materials, difficulties in financing project by contractor, type of project bidding and award i.e. negotiation, lowest bidder, bureaucracy (excessively complicated administrative procedure), escalation of materials price, unclear and inadequate details in drawings, poor quality of construction materials, and preparing incomplete/un detailed BOQ as causes of project delay.

C. Clients' Related Causes

Worku, 2016, listed top ten delay causes from clients' point of view. The most frequent and most critical delay factors listed by client/owner organizations are escalation of materials price, difficulties in financing project by contractor, insufficient data collection and survey before design, supplying poor quality material by contractor, lack of skilled professional in construction project management in the organization, infective project planning, scheduling or resource management, poor site management and supervision, preparing incomplete/un detailed BOQ, unqualified/inadequate experienced labour, and shortage of equipment in their order.

D. Causes of Delay due to External Factors

Ashraf, 2016, listed seven causes of delay external to clients, consultants and contractors. These factors are: bureaucracy and change in government regulations, other public works on site, effect of local community, changes in the cost of resources, unforeseen site conditions, problems with local community and weather conditions.

2.1.3. Major causes of Project Delay in Ethiopia

Worku and Jah, 2016, discussed five most significant factors that cause delays in Ethiopian public building construction according to their finding.

A. Contractor's' Financial Difficulties

Failure to release payments for executed work on time is one of the problems that contractors faced. This problem is leading to financial difficulties to contractors and the pitfalls on the progress of the projects. Therefore the owners should have to release payments on time based on

contract agreement and prepare sufficient fund in advance to avoid delay in progress payments for executed work and contractor's financial difficulties.

B. Escalation of Materials

Escalation of material price is another key factor affecting time performance of most construction projects in Ethiopia. Poor cost estimation that failed to predict inflation appropriately is leading to higher cost of construction materials, tools, labors, equipment etc. during construction period. Escalation is causing such negative impacts as delayed projects, lack of firm price quotes, higher project costs, a significant rise in the incidence of jobsite construction materials theft. Some of the more severe impacts can be managed by cooperative efforts to minimize, manage and share risks through proactive changes in project methods and contracts.

C. Ineffective Planning and Scheduling by Contractors

Planning and scheduling is the basic for every construction work. Ineffective planning and scheduling has a significant impact on construction delays. It should be developed from the start of the project until completion of a project. The reasons why contractors are not able to follow the planning and scheduling effectively may be due to inexperience staff and shortage of workers at the site, financial problem, and poor site management. Ineffective planning and scheduling by contractors is the significant causes of delay in construction project.

D. Delay in Progress Payments for Completed Works

Delayed payments of work done by clients on construction projects in the Ethiopian construction industry are considered to be a factor that causes delay. It causes severe cash-flow problems to contractors and this can have a devastating effect down the contractual payment chain. Regular monthly payment to contractors for work done removed constraints which otherwise may have impeded project progress to cause delay and cost overruns. Failure to provide adequate funding resources to contractors for the job done will make it difficult for the contractors to meet project objectives. Delay in progress payments for completed works was found to be one of the major factors that causes schedule overrun.

E. Lack of Skilled Professional in Construction Project Management in Contractor Organization

Shortage of talent in the construction sector is a long-term problem and will continue to push up project time and costs. The education and training capacity given through various higher

institutions, organizations etc. are clearly inadequate to meet the need of the large percentage of skilled workers in the Ethiopian construction sector. The education system is often not delivering the required number of specialists across project management, engineering, surveying, contract management and the skilled/semi-skilled labor.

2.1.4. Mitigating the Effects of Construction Delay

Unless an immediate action is taken to mitigate the effects of construction delay, the project suffer a huge set back (CPM, 2016). Effective job site management requires the ability to understand the importance of these delays, evaluate the impacts they may have, and readjust the timeline in a responsible manner. The following actions are recommended by CPM for mitigating the effects of construction delay:

A. Anticipate

Experienced personnel have the ability to anticipate where and when delays may occur. Anticipating potential obstacles is a proactive way of preparing your team and client so that everyone can respond with quick, effective action in the case that a delay arises. It removes the shock and panic factor of delay, and as a result allows you to make allowances with a clear mind, unclouded by an emotional response.

B. Prioritize planning

Professional construction planning lays out a project's timeline from start to finish, allowing managers to stay within budget, anticipate potential hazards, and make the necessary timeline adjustments in the moment. Prioritize accurate time estimates, cost estimates, and resource allocation from day one in order to avoid embarking on an unrealistic schedule.

C. Avoid Acceleration

Acceleration, according to CPM, refers to the owner or general contractor's choice to speed up the progress of a project to make up for lost time or accomplish an early completion. Accelerating to compensate to recuperate lost time might be required but doing so is likely to put the project outcome in jeopardy. Instead, taking the time to formally readjust schedules and accommodate for whatever delay has taken place would be preferable.

D. Communicate down the chain of command

If a timeline has been adjusted or expectations have been altered in any way, communicate with team members, subcontractors, and third party vendors so that the new timeline is clearly understood and all are in agreement to move forward with the revised plan. Maintaining a well-

informed, multidisciplinary, competent project team is a vital element to ensuring a positive outcome for all involved.

2.2. Empirical review

The construction industry globally has been faced with the criticisms of delays, which have an extremely negative effect on construction projects. More than 40 per cent of projects globally experienced delay. Governmental organizations, academics and practitioners across the globe are among criticized for poor management of construction projects (KPMG, 2015). According to George and Andrew, 2017, 52 per cent of projects in the UK overrun on time and 70 per cent of the UK public projects exceeded their time estimates. Moura and Teixeira, 2007, stated that time delay in Portuguese construction industry is 40% on average. Developing countries invest about US\$200 billion a year on new infrastructure, and this constitutes 4% of their national output and a fifth of their total investment (World Bank 1994).

Owners or client organizations continue to experience project failures. 53% of clients suffered one or more underperforming projects in a year. Only 31% Projects came within 10% of projects budget and 25% of projects came within 10% of their original deadlines in the past 3 years (KPMG, 2015).

The two main reasons for the delay in Portuguese construction industry owner and design responsibility, 62% and 61% respectively, followed by project specifics, contractor responsibility and external factors, 45% 39% 36% respectively (Moura and Teixeira, 2007). Abinayasri et. al., 2017, assessed 40 causes of delay in construction industry in India and categorized them under 9 groups such as design, equipment, personal, manpower, experience, government, material, finance, and owner. The study summarized projects experienced delay in one or more of the above nine categories. Owner related causes, finance related causes and material related causes were the three categories on the top of the list with 69%, 66% and 63% respectively followed by government related causes and experience related causes with 58% and 53% respectively. The sixth and seventh highest causes in the list were personal related causes and Manpower related causes which accounted for 48% and 42% respectively. Projects that experienced design related causes and Equipment related causes rated as 28% and 39% respectively.

Werku and Jah, 2017, outlined the top 10 critical factors that cause construction delays in Ethiopia based on importance index. These factors are: (1) Difficulties in financing project by a contractor with 68.75; (2) Escalation of the materials price with 65.57; (3) Infective project

planning with 64.53; (4) Scheduling or resource management with 63.05; (5) Delay in progress payments for completed works with 62.57; (6) Lack of skilled professionals in the field of construction management in the organization 60.59; (7) Fluctuating labor availability season to season /Seasonal labors availability with 58.46, (8) Low productivity of labour with 54.93; (9) Unqualified/inadequate experienced labour with 46.89; and (10) Insufficient data collection and survey before design with 46.85.

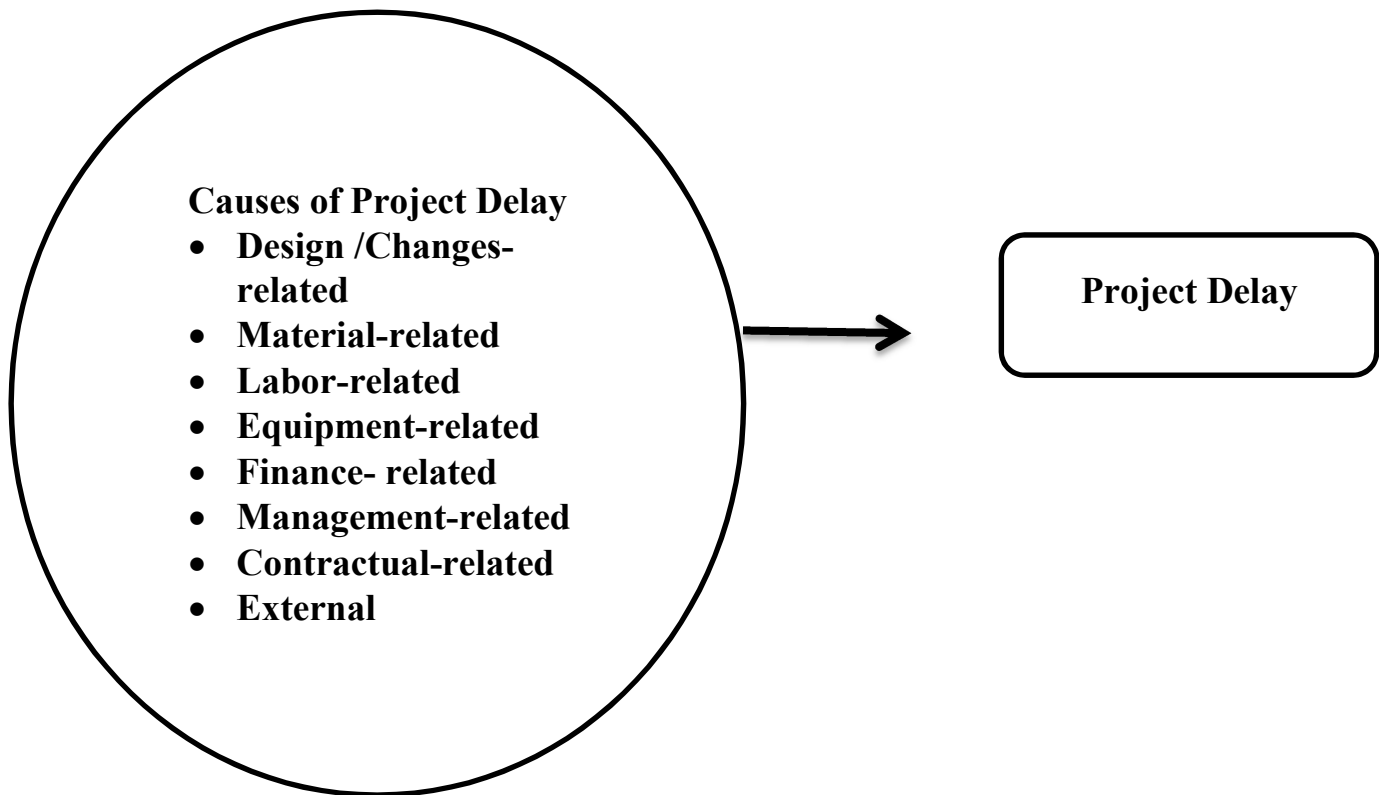
Ashraf, 2016, listed cost overrun, disputes arbitration, total abandonment and litigation as the six effects of delay causes on project performance construction projects based on the frequency of occurrence of the effects of construction delays on project delivery. According to him, time overrun appeared to be on the top of the list with 94.62 followed by cost overrun with 88.50. Disputes, arbitration and total abandonment were the next three effects with 73.37, 64.33 and 58.21 respectively. Litigation also is ranked from 6th with 55.67 frequency of occurrence.

2.3. Conceptual framework

There are several causes that which have a potential to affect the performance of projects negatively or positively. If the performance of projects affected negatively the project would fall in to delay.

The causes of project delay are listed in 8 categories for this specific study. The categories are: design /changes-related, material-related, labor-related, equipment-related, finance- related, management-related, contractual-related and external factors. If one or more of these causes may occur the chance it affects the project performance with time overrun, cost overrun, disputes, arbitration, litigation and/or total abandonment would be very high. These effects in turn leads project into delay. The project manager could apply mitigation exercise but still the delay would be highly likely.

Fig. 1.1 Conceptual framework



Chapter 3: Research Methodology

3.1. Description of the Study Area

World Vision, an international NGO, started its operation in Ethiopia in 1970. Increasing access to safe water is one of the pillars of its program. The organization constructed several water supply systems that have benefited over 2 million people in the past five years. It has 60 active rural water projects all over the country funded by seven different donors in 2018. The total budget allotted for these projects is USD 16,801,494.00. These projects are meant to serve over 1.5 million rural communities. World Vision Ethiopia has been endured several challenges while executing these projects said Ato Mebratu G/egziabher, WASH Division Monitoring and Evaluation Advisor . According to him, project delay is very common problem that the organization encounters year after year. He explained that availability and capacity of contractors, price escalation, poor commitment from the government side and inadequate study and design are the main reasons for the delay. This study targeted all the 60 water supply construction projects that World Vision Ethiopia is implementing across all regions in the country. Reasons for projects delay is assessed both at the field level and program coordination office level across all the projects. The research design, sampling procedures, method of data collection and their source are discussed below.

3.2. Research Approach

A combination of both quantitative and qualitative research methods was employed in this study. The qualitative aspect of the study provided an in-depth analysis of the factors responsible for delay and their impact on the construction projects whereas quantitative design provided consistent results of the collected data as the data gathered was quantified using statistical tools.

3.3. Research Design

The research design of this study was descriptive design in which data was collected from respondents with questionnaire. Major causes of project delay in water supply construction projects were identified from implanting organization perspective.

3.4. Population and Sample

The study targeted all the 60 water supply construction projects being implemented by World Vision Ethiopia. Sixty-seven people who are working directly on the projects (i.e. one program

manager, 6 regional coordinators and 60 site engineers & officers) were made part of the research population.

3.5. Data Sources and types

Both primary and secondary data sources are used. Primary data involve collection of data for the first time from the key respondents of the research. A questionnaire was designed to assess the opinion of the program manager, regional coordinators and site engineers on the causes of delay in construction of WSPs in Ethiopia. Secondary data from related researches and annual reports of the organization were also used to strengthen the reliability of the research data and supplement the missing data from questionnaire survey.

3.6. Data collection methods and tools

The research is conducted mainly on primary data. Structured Questionnaires were distributed to 67 respondents (managers, regional coordinators and site engineers & officers) in person and via email based on convenience. Desk review was conducted to collect secondary sources. The validity and reliability of the data gathered was triangulated.

3.7. Ethical Considerations

While assessing the information, the respondent's perception was respected. The participants' consents were solicited and they are told that their personal answers would be kept confidential. Moreover, the responsibility on scientific research was maintained to the level best possible

3.8. Data Analysis Plan

The study presented the findings through descriptive statistics method. Tables, frequencies, graphs and percentages were used to present the findings. Thus, a statistical tool, SPSS and Microsoft Excel were used to analyze the findings from the questionnaires. The statistical result of the data collected for this study was ranked according to their significance using the relative importance index (RII).

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

Where

RII= relative importance index

W= weight of each attribute

Σw = summation of all weight of each attribute

A= is highest score e.g. 5

N= total number of respondents i.e. 48

Chapter 4: Data Presentation and Analysis

4.1. Introduction

This chapter accounts for the analysis on information obtained from the questionnaires. This data was used to achieve the objective of this study by the application of the above methodology. The data was collected through a survey questionnaire which was administered to 60 respondents but had a feedback of 48 respondents. The data analysis method used in this chapter present the statistical analysis of the responses given by the different stakeholders from the survey questions as explained in the research methodology.

4.2. Background of the respondents

This part comprises of the analysis of all question in section A of the questionnaire it deals with the different stakeholders involve in this study, their familiarity to construction delay, their level of involvement in building projects that was delay, their length of experience in construction industry, the length of time the project was delayed, and the type of construction delay they experienced.

4.2.1. Respondents position in the Organization

Project managers, engineers, and regional coordinators took part in the survey. 43. 8% of the respondents were field level engineers followed by project officer (29.2%) who engage in a daily routine of the projects. Project staff at every hierarchical level was engaged. Thus, views were captured from every corner to see the big picture across the board.

Table 4.1. Respondents position in the organization

What is your position in the organization	Frequency	Percent	Valid Percent	Cumulative Percent
Program Manger	1	2.1	2.1	2.1
Project Engineer	21	43.8	43.8	45.8
Project Manager	6	12.5	12.5	58.3
Project Officer	14	29.2	29.2	87.5
Regional Coordinator	6	12.5	12.5	100.0
Total	48	100.0	100.0	

4.2.2. Familiarity with Construction Delay

All respondents were familiar with construction delay. They responded that that all encountered project delay. This shows that project delay is a common phenomenon that requires attention.

Table 4.2. Respondents familiarity with project delay

Have you been involved in projects that were delayed		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	48	100.0	100.0	100.0

4.2.3. Length of time the projects was delayed

Small scale water supply project construction is meant to be completed in one fiscal year. However, the survey shows projects were delayed 4 months on average.

Table 4.3. Length of project delay

	N	Minimum	Maximum	Mean	Std. Deviation
How long was the project delayed	48	1.00	12.00	4.2708	1.95415

4.2.4. Length of Experience in water supply projects Construction

The large percentage (i.e. 59%) of respondents have experience five years and above in the sector. Such an experience considered to be good enough to give the respondents to handle issues and challenges of any magnitude in construction or be able to find alternative ways to approach challenging situation

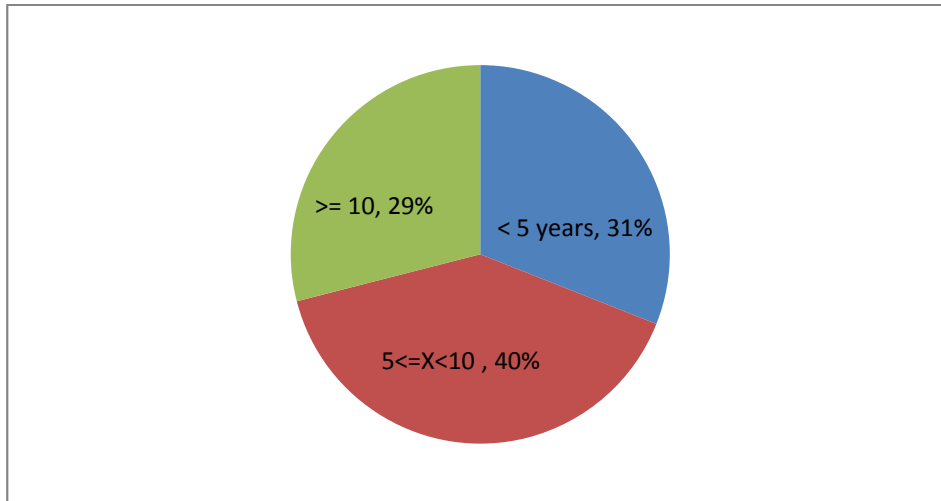


Figure 4.1. Length of experience in water supply projects construction

4.3. Causes of project delay

The survey data consisting of 58 causes of delay were analyzed and grouped into eight major areas: design, material, labor, equipment, management, finance, contractual and external related.

A. Design /Changes-related

1. Design Change order
2. Design change in drawing
3. Change in specification
4. Incomplete contract document
5. Decision during development stage
6. Design Development
7. Delay due to shop drawing approval
8. Mistake and discrepancy in design document
9. Change in subsurface conditions
10. Change in scope
11. Variation

E. Finance- related

21. Delayed payments to contractors
22. Delayed payments to suppliers and

B. Material-related

12. Quality of material
13. Late material supply
14. Scarcity of material in the market

C. Labor-related

15. Shortage of labors
16. Low productivity level of labors
17. Inadequate contractor experience

D. Equipment-related

18. Improper equipment
19. Equipment unavailability
20. Equipment Failure

F. Management-related

28. Organizational changes
29. Old technology

- subcontractors
- 23. Client's finance shortage
- 24. Financial difficulties faced by the contractor
- 25. Difficulty in accessing credit
- 26. Ill-financed project
- 27. Fluctuation of prices/rising cost of materials

G. Contractual-related

- 43. Non utilization of professional construction/Contractual management
- 44. Delay in delivering site project to contractor
- 45. Delay in approval of documents
- 46. Unsmooth internal and external communications
- 47. Lack of communication between parties
- 48. Slowness in giving instruction
- 49. Slowness in decision making process
- 50. Duration of inspection procedure
- 51. Nomination of sub-contractors and suppliers
- 52. Delay in performance of subcontractors
- 53. Problems with subcontractors

- 30. Poor supervision
- 31. Poor site management
- 32. Mistakes in construction
- 33. Unrealistic contract duration
- 34. Inaccurate cost estimation
- 35. Not Preparing the method statements
- 36. Inappropriate organization management
- 37. Less emphasis to planning
- 38. Ineffective planning and scheduling of project
- 39. Low skills of labor
- 40. Inadequate consultant experience
- 41. Underestimation of the complexity of the project
- 42. Many Provisional Sums and Prime

H. External

- 54. Regulatory changes
- 55. Laws – regulations
- 56. Building Permits Approval
- 57. Adverse weather condition
- 58. Natural disasters

This study presented the mean and standard deviation of the client related causes and the calculation of the relative importance index (RII) of the statistical data and ranking of clients related causes of construction delays. The relative important index of the data shows the level of significant the factors are to construction delay. The data were rearranged according to their level of ranking for better understanding of the result and analysis. The ranking were determined by the highest value of the RII.

The study revealed (refer table 4.4) the top 10 causes of project delay in water supply sector are:

- Adverse weather condition
- Delay in approval of documents

- Equipment Failure
- Scarcity of material in the market
- Poor supervision
- Poor site management
- Fluctuation of prices/rising cost of materials
- Change in subsurface conditions
- Slowness in decision making process
- Low skills of labor

Table 4.4. Index and Rank of Causes of Projects Delay

Causes of Delay	N	Sum	Mean	St. D	A	RII	Rank
Adverse weather condition	48	196	4.08	.767	5	0.8167	1
Delay in approval of documents	48	176	3.67	.781	5	0.7333	2
Equipment Failure	47	166	3.53	.905	5	0.7064	3
Scarcity of material in the market	47	166	3.53	.687	5	0.7064	4
Poor supervision	47	162	3.45	.829	5	0.6894	5
Poor site management	47	162	3.45	.829	5	0.6894	6
Fluctuation of prices/rising cost of materials	48	161	3.35	.838	5	0.6708	7
Change in subsurface conditions	46	152	3.30	.756	5	0.6609	8
Slowness in decision making process	48	157	3.27	.869	5	0.6542	9
Low skills of labor	47	153	3.26	.943	5	0.6511	10
Equipment unavailability	46	149	3.24	.794	5	0.6478	11
Late material supply	48	155	3.23	.928	5	0.6458	12
Inadequate contractor experience	47	143	3.04	.721	5	0.6085	13
Improper equipment	47	142	3.02	.872	5	0.6043	14
Underestimation of the complexity of the project	47	138	2.94	.942	5	0.5872	15
Shortage of labors	47	133	2.83	.842	5	0.5660	16
Design Development	47	131	2.79	1.020	5	0.5574	17
Delay in delivering site project to contractor	45	121	2.69	.733	5	0.5378	18

Causes of Delay	N	Sum	Mean	St. D	A	RII	Rank
Problems with subcontractors	46	123	2.67	.762	5	0.5348	19
Delay in performance of subcontractors	46	122	2.65	.737	5	0.5304	20
Slowness in giving instruction	47	122	2.60	.742	5	0.5191	21
Less emphasis to planning	47	116	2.47	.747	5	0.4936	22
Mistakes in construction	47	110	2.34	.600	5	0.4681	23
Inappropriate organization management	47	109	2.32	.837	5	0.4638	24
Decision during development stage	44	102	2.32	1.095	5	0.4636	25
Low productivity level of labors	46	104	2.26	.828	5	0.4522	26
Financial difficulties faced by the contractor	48	103	2.15	.684	5	0.4292	27
Ineffective planning and scheduling of project	46	92	2.00	.667	5	0.4000	28
Nomination of sub-contractors and suppliers	47	87	1.85	.625	5	0.3702	29
Client's finance shortage	47	84	1.79	.657	5	0.3574	30
Change in scope	48	85	1.77	.905	5	0.3542	31
Natural disasters	46	79	1.72	.688	5	0.3435	32
Duration of inspection procedure	47	77	1.64	.705	5	0.3277	33
Lack of communication between parties	47	77	1.64	.486	5	0.3277	34
Delayed payments to contractors	47	76	1.62	.768	5	0.3234	35
Inaccurate cost estimation	47	75	1.60	.496	5	0.3191	36
Unrealistic contract duration	47	74	1.57	.617	5	0.3149	37
Unsmooth internal and external communications	47	73	1.55	.583	5	0.3106	38
Non utilization of professional construction/Contractual management	47	72	1.53	.584	5	0.3064	39
Many Provisional Sums and Prime	47	71	1.51	.505	5	0.3021	40
Variation	48	71	1.48	.799	5	0.2958	41
Delayed payments to suppliers and subcontractors	47	66	1.40	.496	5	0.2809	42

Causes of Delay	N	Sum	Mean	St. D	A	RII	Rank
Organizational changes	47	65	1.38	.677	5	0.2766	43
Change in specification	44	59	1.34	.713	5	0.2682	44
Quality of material	47	63	1.34	.562	5	0.2681	45
Design change in drawing	47	62	1.32	.629	5	0.2638	46
Regulatory changes	47	58	1.23	.598	5	0.2468	47
Laws – regulations	46	54	1.17	.437	5	0.2348	48
Old technology	47	55	1.17	.380	5	0.2340	49
Difficulty in accessing credit	46	53	1.15	.363	5	0.2304	50
Ill-financed project	46	53	1.15	.363	5	0.2304	51
Design Change order	47	54	1.15	.416	5	0.2298	52
Mistake and discrepancy in design document	44	48	1.09	.291	5	0.2182	53
Delay due to shop drawing approval	45	49	1.09	.358	5	0.2178	54
Incomplete contract document	46	49	1.07	.250	5	0.2130	55
Inadequate consultant experience	47	50	1.06	.438	5	0.2128	56
Not Preparing the method statements	46	47	1.02	.147	5	0.2043	57
Building Permits Approval	46	46	1.00	.000	5	0.2000	58

Table 4.4 shows that adverse weather condition had the highest RII of 0.8167 and was ranked first which indicate that the respondents considered adverse weather condition as the most significant factor among all the causes of delay of project. This implies most projects were pushed to rainy season which affected the projects to delay. Delay in approval of documents was considered to be significant by the respondents with RII of 0.7333 and was ranked second. His shows that it takes considerable amount of time to approve project documents. Equipment failure was also considered significant by respondents with RII of 0.7064 and was ranked third. Scarcity of material in the market, poor supervision and poor site management were ranked 4th, 5th, and 6th with RII of 0.7064, 0.6894, and 0.6894 respectively. The cause ranked 7th by the respondents is fluctuation of prices/rising cost of materials with RII of 0.6708. Change in subsurface conditions, slowness in decision making process and low skills of labor were ranked 8th, 9th, and 10th with RII of 0.6609, 0.6542, and 0.6511 respectively.

4.4. Causes of Groups of Delay

The relative importance index for all the delay of causes also was calculated for each group/category. The aim of the analysis was to establish the relative importance of the various factors identified as responsible for construction delay. Based on the above analysis the top three groups are ranked as:

- External related
- Contractual related
- Equipment related

External related

Based on the above analysis the most significant cause of project delay in water supply sector is external related. Adverse weather condition appeared to be a significant factor in this group with RII of 0.8167. All the rest have a weak RII.

Table 4.5. Index and Rank of External Related Causes of Delay

Causes delay	N	Sum	Mean	Std. D	A	RII	Rank
Regulatory changes	47	58	1.23	0.60	5	0.2468	3
Laws – regulations	46	54	1.17	0.44	5	0.2348	4
Building Permits Approval	46	46	1.00	0.00	5	0.2000	5
Adverse weather condition	48	196	4.08	0.77	5	0.8167	1
Natural disasters	46	79	1.72	0.69	5	0.3435	2

Contractual related

The RII calculated for contractual related factors show that delay in approval of documents ranked first with 0.7333 followed by slowness in decision making process.

Table 4.6. Index and Rank of Contractual Related Causes of Delay

Causes delay	N	Sum	Mean	Std. D	A	RII	Rank
Non utilization of professional construction/Contractual management	47	72	1.53	0.58	5	0.3064	11

Delay in delivering site project to contractor	45	121	2.69	0.73	5	0.5378	3
Delay in approval of documents	48	176	3.67	0.78	5	0.7333	1
Unsmooth internal and external communications	47	73	1.55	0.58	5	0.3106	10
Lack of communication between parties	47	77	1.64	0.49	5	0.3277	8
Slowness in giving instruction	47	122	2.60	0.74	5	0.5191	6
Slowness in decision making process	48	157	3.27	0.87	5	0.6542	2
Duration of inspection procedure	47	77	1.64	0.70	5	0.3277	9
Nomination of sub-contractors and suppliers	47	87	1.85	0.62	5	0.3702	7
Delay in performance of subcontractors	46	122	2.65	0.74	5	0.5304	5
Problems with subcontractors	46	123	2.67	0.76	5	0.5348	4

Equipment related

Among causes under equipment related category, equipment failure happened to be ranked the first with RII of 0.7064. The other two also are significant based on RII.

Table 4.7. Index and Rank of Equipment Related Causes of Delay

Causes delay	N	Sum	Mean	Std. D	A	RII	Rank
Improper equipment	47	142	3.02	0.87	5	0.6043	3
Equipment unavailability	46	149	3.24	0.79	5	0.6478	2
Equipment Failure	47	166	3.53	0.91	5	0.7064	1

Chapter 5: Summary, Conclusion and Suggestion

This chapter discourse the key findings in this research, conclusion and recommendations based on analysis of responses from all respondents participated in the survey.

5.1. Summary of Key Findings

- All respondents indicated that they experienced a project delay.
- Water supply projects planned to be carried out in a fiscal year by the organization delayed four months on average.
- This study identified 58 causes of delay. These causes of delay were grouped into 8 groups such as design-related, material-related, labor-related, equipment-related, finance-related, management-related, contractual-related and external. The results revealed that the top 10 causes of project delay in water supply sector in their descending order are: adverse weather condition, delay in approval of documents, equipment Failure, scarcity of material in the market, poor supervision, poor site management, fluctuation of prices of materials, change in subsurface conditions, slowness in decision making process and low skills of labor. The results further revealed that the three most important categories of delay were external related, contractual related and equipment related.
- Respondents were unable to point out mitigation practices required to minimize the occurrence and effect of causes of project delay.

5.2. Conclusion

- Projects are delaying in the organization mainly because of adverse weather condition. The favorable season for construction was wasted while documents approval process, insufficient equipment care and maintenance, lack of solid monitoring exercise and other external factors such as price fluctuations. Also, poor supervision and site handling contributed to delay of projects. Thus, it can be concluded that the organization has poor monitoring, evaluation and learning systems.
- Projects also delay due to delay in approval of documents. The system in place is not favoring timely approval of design documents and budgets for the projects to proceed.
- Equipment failure is the other cause contributed to delay in project. The organization doesn't have a system that enables to swiftly act when breakage happen.
- Poor inventory system also was causing scarcity of material in the market.

- Poor supervision, poor site management, fluctuation of prices of materials, change in subsurface conditions, slowness in decision making process and low skills of labor are also causes of project delay.
- The fact that respondents were unable put forward what mitigation mechanism that they are adopting to minimize the occurrence and effect of causes of project delay indicates that the organization doesn't have a no good mitigation practice documented and shared among its staff.

5.3. Recommendation

- A good mitigation practice to dealing with causes of delay is required to minimize the occurrence of the delay and its effect on the performance of the project. There should be an effective job site management that requires the ability to understand the importance of these delays, evaluate the impacts they might have, and readjust the timeline in a responsible manner. Ability to anticipate where and when delays may occur, professional construction planning lays out a project's timeline from start to finish, and communicating any change with team members, subcontractors, and third party vendors are required.
- The organization should ensure that projects are executed on time before the onset of the rain. Project planning, contractor and supplies selection, project documents approval and other office based project management practices should be finalized even before the fiscal year begin for long term programs or in the very first few weeks of the new and one year long projects.
- The organization should delegate responsibility to lower level authorities depending on the size of the project to avoid delay in approval of documents. Alternatively, it should cut the hierarchy and find a way for the project manager go straight to final approval after proper documentation is finalized.
- The organization should solid equipment monitoring and maintenance procedure to avoid frequent equipment failure.
- The organization should always aim to finish their project few weeks before the stipulated date to enable them take care of any lapses.

- Good financial planning and cash flow net is required to enable any contracting firm to meet up with project deadline.
- The organization should always take inventory of the materials on site to have sufficient amount at hand to avoid scarcity of material and price fluctuation in the market whenever possible.
- The organization should put good project monitoring, evaluation and learning system to properly execute projects, learn from the process and ensure accountability.

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Appendix

Questionnaire

The aim of this questionnaire is to gather information about the Assessment of Causes of Delay in Construction of Water Supply Projects and its Effects on the performance of the projects. This questionnaire is required to be filled with exact relevant facts as much as possible. All data included in this questionnaire will be used only for academic research and will be strictly confidential. After all questionnaires are collected and analyzed, interested participants of this study will be given feedback on the overall research results. Please respond to each question by adding a tick in the appropriate response or filling in the relevant information

SECTION A- Background and Knowledge of Respondents on construction delay

1. What is the Name of the Project Site? _____
2. Which of the stakeholder are you? (Please choose one).
☐ Contractor ☐ Consultant ☐ Client
3. What is your position in the organization? _____
4. What is your length of experience in construction of water supply projects? _____
5. Have you been involved in projects that were delayed? _____
6. How long was the project delayed? _____

SECTION B – Causes of construction delay

Please tick the causes of the delay on the performance of the project you have been working on.

Using the following scale: 1 very low; 2 Low; 3 Average; 4 High and 5 very high.

Category of Causes of delay	Main causes of delay	Very low	low	average	high	very high
1.Design /Changes-related	Change order					
	Changes in drawings					
	Changes in specifications					
	Incomplete contract documents					
	Decision during development stage					
	Design Development					

Category of Causes of delay	Main causes of delay	Very low	low	average	high	very high
	Shop drawings approval					
	Mistakes and discrepancies in design documents					
	Change in subsurface conditions					
	Change in the scope of the project					
	Variations					
2. Material-related	Quality of material					
	Late material supply					
	Scarcity of material in the market					
3. Labor-related	Shortage of labors					
	Low productivity level of labors					
	Low skills of labor					
4. Equipment-related	Improper equipment					
	Equipment unavailability					
	Equipment Failure					
Finance- related	Delayed payments to contractors					
	Delayed payments to suppliers and subcontractors					
	Client's finance shortage					
	Financial difficulties faced by the contractor					
	Difficulty in accessing credit					
	Ill-financed project					
	Fluctuation of prices/rising cost of materials					
Management-related	Organizational changes					
	Old technology					
	Poor supervision					
	Poor site management					
	Mistakes in construction					
	Unrealistic contract duration					

Category of Causes of delay	Main causes of delay	Very low	low	average	high	very high
	Inaccurate cost estimation					
	Not Preparing the method statements					
	Inappropriate organization management					
	Less emphasis to planning					
	Ineffective planning and scheduling of project					
	Inadequate contractor experience					
	Inadequate consultant experience					
	Underestimation of the complexity of the project					
	Many Provisional Sums and Prime					
7. Contractual-related	Non utilization of professional construction/Contractual management					
	Delay in delivering site project to contractor					
	Delay in approval of documents					
	Unsmooth internal and external communications					
	Lack of communication between parties					
	Slowness in giving instruction					
	Slowness in decision making process					
	Duration of inspection procedure					
	Nomination of sub-contractors and suppliers					
	Delay in performance of subcontractors					
	Problems with subcontractors					
8. External	Regulatory changes					
	Laws – regulations					
	Building Permits Approval					
	Adverse weather condition					

Category of Causes of delay	Main causes of delay	Very low	low	average	high	very high
	Natural disasters					

SECTION C – The effects of the delay on the performance of the project

Please tick the effects of the delay on the performance of the project you have been working on.

Using the following scale: 1 very low; 2 Low; 3 Average; 4 High and 5 very high

S/N	Effects of delays on the project	Very low	low	average	high	very high
a.	Time overrun					
b.	Cost overrun					
c.	disputes					
d.	arbitration					
e.	litigation					
f.	Total abandonment.					

SECTION D – Practices to minimize the effects of delay

Please list the practices that your organization is undertaking to minimize delay on the performance of the project you have been working on. Using the following scale: 1 very low; 2 Low; 3 Average; 4 High and 5 very high

S/N	Practices that your organization is undertaking to minimize delay	Very low	low	average	high	very high
a.						
b.						
c.						