



**Addis Ababa University**  
**Addis Ababa Institute of Technology**  
**School of Civil and Environmental Engineering**

**Study on Investigating Causes and Effects of Delay in Addis Ababa 40/60  
Housing Construction: A Case Study on Some Selected Project Sites.**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa University  
in Partial Fulfillment of the Requirements for the Degree of Master of Science in  
Civil Engineering (Construction Technology and Management).**

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Investigating Causes and Effects of Delay in Addis Ababa 40/60 Housing Construction:  
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Addis Ababa University  
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Construction Technology and Management Stream

Study on Investigating Causes and Effects of Delay in Addis Ababa 40/60 Housing  
Construction: A Case Study on Some Selected Project Sites.

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**ABBREVIATIONS**

AAHCPO.....	Addis Ababa Housing Construction Project Office
AASHDE.....	Addis Ababa Saving House Development Enterprise
ANOVA.....	Analysis of Variance
ANS.....	African National Congress
ASC.....	Associated Schools of Construction
BOQ.....	Bill of Quantity
CPI.....	Cost Performance Index
CPM.....	Critical Path Method
DOE.....	Department of Energy
FIDIC.....	Fédération Internationale des Ingénieurs-Conseils (International Federation of Consulting Engineers)
GNP.....	Gross National Product
GRV.....	Goods Receiving Vouchers
GTZ.....	Germany Technical Corporation
HCB.....	Hollow Concrete Block
HDB.....	Housing and Development Board
HOS.....	Home Owner Scheme
IHDP.....	Integrated Housing Development Program
IJESMR.....	International Journal of Engineering Sciences & Management Research
IT.....	Information Technology
LRT.....	Light Rail Transit
MARR.....	Minimum Acceptable Rate of Return
MoUDC.....	Ministry of Urban Development and Construction
MRT.....	Metro/Mass Rail Transit
MSE.....	Micro and Small scale Enterprise
No.....	Number
OPC.....	Ordinary Portland Cement
PBPPE.....	Prefabricated Building Parts Production Enterprise
PERT.....	Program Evaluation and Review Technique
PHP.....	Peoples Housing Process

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PMBOK.....	Project Management Body of Knowledge
PMI.....	Project Management Institute
PMs.....	Project Managers
PP.....	Paper Pages
PPA.....	Public Procurement Agency
PPC.....	Pozolana Portland Cement
PPR.....	Polypropylene Random copolymer plastic
PVC.....	Poly Venile Chloride
SPI.....	Schedule performance index
RDP.....	Reconstruction and Development Program
UAE.....	United Arab Emirates
UN-HABITAT.....	United Nations Human Settlement
USD.....	United States Dollar
USA.....	United States of America

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**ABSTRACT**

A delay in construction projects is a global phenomenon that causes significant losses for resources. Delays and cost overrun are common problems in building construction projects due to several factors, but their frequency of occurrence and degree of severity vary significantly. As a unique nature of construction projects, completion time delay can be minimized when the potential causes and effects are properly identified.

The main objective of this research is to identify the major causes and effects of delay in the construction of Addis Ababa 40/60 housing project. A total of 99 respondents participated that represents client, consultants and contractors in the survey and 20 major causes of delay were identified based on the relative importance index from a list of 70 causes of delay.

The research finding indicates that late delivery of materials by the client, difficulties in financing project by contractors, improper contractor selection, slow decision making by the client and obsolete technology used by contractors were some of the most dominant delay factors. For the top 20 delay factors a number of another root causes are identified for their occurrence. The cumulative effects of those varieties of causes for the incidence of major delay factors contributed a great role on the project timely completion failure and the project is delayed by more than 150%. From the investigated major causes of delay, client sourced and contractor sourced delay factors were the major bottlenecks of progress.

Due to the acute delay of the project, 24 serious effects were also identified and the result shows that cost-overrun, time-overrun, increase unemployment rate, client loses time value of money, the government mistrusted by the people and reduce the quality of construction were some of the most severe effects of delay. To minimize those severe delay problems and inevitable outcomes some recommendations are forwarded.

**Keywords:** Causes of delay, effects of delay, consultants, client, contractors, 40/60 housing project, advance payment, time value of money, construction cost, sources of delay factors.

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## CHAPTER ONE: INTRODUCTION

This chapter deals with background, statement of the problem, objective of the study, significance of the research, scope of the study, limitations of the research, and organization of the thesis.

### 1.1. Background

The construction industry by its nature is unique, very dynamic, intricate, capital intensive and it requires huge sums of money for its realization. Delay in the completion of a construction project is one of the biggest problems facing by the industry. It occurs in every construction project but the degrees of these delays vary much from project to project. The industry demands significant amount of resources like physical resource, financial resource, material resource, human resource and information resources. Due to its dynamic and complex nature it needs the involvement of variety of parties like contractor, consultant, client, regulatory body, financial institutions, suppliers and micro & small enterprises as well as individual efforts. The construction operation is differentiated in technological advancement, execution within unpredictability and complicated environment. As a result, the operation of a construction project is subject to a substantial delay. The consequence of delay has a negative impact on project cost; quality and safety which is directly affect contractors, client as well as end users. The client losses time value of money due to construction delay and thus delayed advance reimbursement. Money can be used to earn more money between the different instances of time. Obviously, one million birr now is worth more than one million birr a year from now even if there is no inflation. The reasons to be returned the advance money immediately are to invest again for similar projects and to generate revenue from investment, to use the money before it lost its purchasing power and to generate income from interest by depositing at the bank. Delay leads to pay additional consultant & security fees and will expense overhead costs. More over the delay causes project unable to serviceable for the desired objective.

A construction project is commonly acknowledged as successful, when it is completed within the scheduled time frame and budgeted cost, by satisfying the desired quality and in the safest manner. Currently, Ethiopia has been undertaking several projects ranging from small scale to mega projects. Residential housing is one of the projects. Shelter need is a critical issue in major cities of the country particularly in Addis Ababa. Addis Ababa is challenged with housing scarcity due to the continually increasing population growth and immigration from different corners of the

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country. The ten years (2010-2019) average population growth rate of Addis Ababa is 4.363%. (Data source: United Nation world population prospects, August 2019). Rapid urbanization rate has posed several socio-economic challenges and housing is one of the primary basic needs in the country especially in Addis Ababa.

Housing shortage in Addis Ababa is one of the major concerns for the government. In 2004, Ethiopia began to introduce condominium houses by the name Integrated Housing Development Program (IHDP). The initial goal of the programme was to construct 400,000 condominium units, to create 200,000 jobs, to promote the development of 10,000 micro and small enterprises, to enhance the capacity of the construction sector, to renew inner city slum areas by 50 percent, and to promote homeownership for low income households with in five-years from 2005 to 2010 (UN-HABITAT, 2011). However in Addis Ababa the program was not effective and successful to meet the desired objective. In 2013, the City government launched the Addis Ababa Integrated Housing Development Program (AAIHDP) in a new format to reduce the climax demand of existing shelter need (Ministry of Urban Development and Construction August 2013). The program comprises four different schemes based on percent of saving in advance and down-payment modalities such as 10/90, 20/80, 40/60 and housing association. With this new program, a significant number of housing seekers were registered. The scheme is shown in the following table (table 1.1).

Table 1.1 Schemes of the Addis Ababa Housing Development Program.

<b>Scheme of project</b>	<b>Target population</b>	<b>Advance payment (%)</b>	<b>Mortgage loan (%)</b>
10/90	Low-Income	10	90
20/80	Lower Middle Income	20	80
40/60	Upper Middle Income	40	60
Housing association	Higher Income	100	-

## 1.2. Statement of the problem

As per June-August 2013 Addis Ababa city administration residential housing needs registration, there was more than 900,000 housing units demand in three types of programs, i.e. ( 10/90, 20/80 & 40/60). From the total demand, 40/60 housing program takes a share of 163,000 housing units and 156,932 people were active. Based on the demand, the city government started 39,229 housing

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units for 40/60 type of housing seekers. However construction delay is one of the critical problems in 40/60 mass housing construction project. The original contract period of construction was two years, but in practice it requiring more than twice of original contract time for 100% completion. By the last six years, only 1,292 housing units were fully completed and transferred to the occupants and 18,576 housing units were allocated by lottery scheme (but not handed over) with the status of 70% to 80% completion out of 39,229 housing units that are under construction (Source: Addis Ababa housing development and administration bureau 2020 report).

In order to assist contractors to be financially capable and strong at the beginning stage, the client invested a huge sum of advance money. This significant amount of advance money is not fully returned due to the delay of the project. Even though the advance money is secure through guarantee, it loses time value of money due to delayed reimbursement. Prolonged advance repayment reduces the capacity of owner to invest for other similar projects.

The longer period results in higher overhead costs and expenses. This loss of money has not get emphasis by the concerned bodies. Large amount of money is losing through monthly consultants and site security fees, salaries of client workers, rental cars, fuel cost, spare parts and other overhead costs.

At the current speed of construction, the project might take more time to complete the remaining work and decades to deliver the houses fully to the registered public under the 40/60 housing program. This delay and its outcome were also unable to answer the shelter need of the society on time, the cost of the project is significantly escalated (huge sum of public money getting unnecessary loss) and the desired quality of the houses is compromised. In addition the money saving by the registered public for the housing by deducting from their basic livelihood is tied up in the bank and then becomes lose its purchasing power.

Construction projects delay and inevitable effects can be minimized only when the potential causes and effects are properly identified in a detailed manner.

### **1.3. Objective of the study**

#### **1.3.1. General objective**

The general objective of the research is to investigate the causes and effects of delay in Addis Ababa 40/60 housing construction projects.

#### **1.3.2. Specific Objectives**

The specific objectives of the study are:

- To investigate the major reasons of delay in 40/60 housing construction project.
- To study the effects of delay in 40/60 housing construction project.
- To indicate strategies and methods of minimizing construction delays.

### **1.4. Research questions**

The following basic questions were raised in the research.

- What are the major causes of delay in Addis Ababa 40/60 housing construction project?
- What are the effects of the project delay in Addis Ababa 40/60 housing construction?
- What kinds of remedy shall solve the problem?

### **1.5. Scope of the study**

Currently 40/60 housing construction has eleven project sites that contain 350 building blocks constructing by 164 contractors and nine consultants. Since the scattered location of project sites in some parts of the city and due to the complex nature of the construction project with the significant number of actors in all project sites, it is difficult to address all participants in the project and trying to study more project sites with limited resource and time, would reduce the quality of the research outcome. Owing to this reason the scope of the study is limited to only 40/60 housing construction client viewpoint.

### **1.6. Limitations of the study**

Due to the current Covid-19 worldwide pandemic problem it was difficult to move from place to place and to gather sufficient data through face-to-face interview, existing document scanning as well as observation. As a result more data were collected at three project branches, namely branch-1, branch-2 and branch-3. More over the study was limited and focused on the client perspective.

### **1.7. Significance of the study**

Findings from this study can be used by 40/60 housing construction project top managers for making appropriate decision regarding the project schedule management and also will help them to minimize causes of delay and cost over-run in construction projects. The government officials may use it for policy formulation and to make appropriate guideline in the future. The research can also be used as a reference material for future researchers who will be interested to conduct further study in the project delay of similar projects and in these particular sites.

### **1.8. Organization of the study**

The thesis is organized in to five chapters. Chapter one presents the “Introduction” that explains the problem, objective of the study, significance of the study, scope of the study, limitations of the study, organization of the study and procedures of the investigation in general and gives direction.

Chapter two deals the “Literature review”. Here, the concepts and related theories have discussed thoroughly and the major topic areas are introduction, project time management, legal backgrounds about construction delay, classification delay types, identifying causes of delay from previous studies, advance payment and effects of delay.

Chapter three presents the “Methodology” and it discusses the methods and techniques employed for the investigation. Under this chapter, data collection techniques, sampling & sample size determination methods, data quality assurance techniques, data analysis & interpretation methods are explained.

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Chapter four provides the data analysis and discussion portion. In this portion, all the collected raw data is presented, analyzed and interpreted in the detailed manner.

The last chapter (Chapter five) presents “Conclusions and Recommendations”. This summarizes the data sequentially with the research questions to prove that they are properly answered with the actual data and makes concluding remarks. In the final section of this last chapter the study forwards some recommendations.

## CHAPTER TWO: LITERATURE REVIEW

The objective of this chapter is to identify the applicability of past studies on the factors causing delays and to the undertaking of this research by review various literatures related to mass housing construction projects and project completion delay.

### 2.1. Introduction

Many researchers were study construction delays for several years. The term delay is described by numerous researchers in various ways as it's an extra time taken to complete the specific task or a project. According to definition of Oxford dictionary it is late or postponed period of time to deliver a task or project (Imtiaz Ali Bhatti et al, 2018). Construction delay means a time overrun either beyond the contract date or beyond the date that the parties have agreed upon for the delivery of the project (Mohamed M. Marzouk, Tarek I. El-Rasas, 2013). So the proper description of delay for this study is failure to complete a project or milestone of activities as planned schedule because of various causative factors.

A delay in construction projects is a global problem that causes considerable losses for many economies. Due to the complexities in standardizing construction projects, efforts to mitigate risks of delay have not been adequately successful. A basic step to prevent delays involves identifying the main potential causes, which may be different in each region (Mohammadsoroush Tafazzoli et al, 2017). Construction delays and cost overrun are common problems in building construction projects and are more severe to developing countries. There are numerous factors causing delays and cost overrun in building projects, but their frequency of occurrence and degree of severity vary considerably (Valentine G.M. Luvara et al., 2018). Completion time is one of the yardsticks for measuring the level of project success in the construction industry. Thus, timely completion of construction projects is of great concern to construction projects participants (Dele Samuel et al, 2015).

Over the last two decades the Ethiopian construction sector has shown a remarkable growth. Many public construction projects have been undertaken throughout the country as part of the government's national development plans with significant amount of public expenditure.

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However, numerous defects are being noted in the sector that needs immediate action. One of the critical problems concerning these projects is the frequent and lengthy delay that occur.

Addis Ababa 40/60 housing construction is one of public construction projects. The major aim of the project was to minimize the climax housing scarcity of the city and to improve the living standard of middle and higher income citizens of the city by provisions of affordable houses and through the creation of employment opportunities for lower income citizens. The immediate objectives of the program were also developing saving culture of citizens, regenerating the slum areas of the inner city, increasing the land delivery amount in the inner city as a process of densification and vertical growth, promotion of MSEs, promotion of cost effective housing construction technology, empowering citizens of the city through ownership of houses and tenure security and to change the image of the city (source: 40/60 consultant agreement, 2015).

Since the foundation of Addis Ababa 40/60 housing construction program, project sites were started in three different phases and it has been under construction in four project branch offices namely Branch one project office which comprises Bole Bulbula project site, Ehil Nigd project site, Hintsa Akrabi project site, Tourist project site and Asko project sites. Senga Tera and Crown sites were also administered under branch one but these project sites are completed and transferred to the dwellers. Branch-two project office contains Bole Ayat-1 and Meri Loke sites. Branch-three project office has a responsibility to administer only Bole Beshale project site and Branch-four project office has been administer Semmit project sites, Bole Ayat-2 project site-1 and site-2.

In order to share contractors financial burden for mobilization of personnel, purchase of equipment & delivery of material at the beginning stage, the client invested advance payment at the rate of 20% of the contract sum and the amount of money given in advance was about three billion birr and it was given to them once a time without disbursement. The entire budget allocated for the project is gained from the Commercial Bank of Ethiopia by the annual coupon bond interest rate of 9.5% simple interest modality. The city government of Addis Ababa will repay the bonds from the sales proceeds of the constructed houses or from its own or other sources. The maturity period of the bond is three years inclusive the grace period of two years from the date of issuance of the bond certificate. Bond value not redeemed on the maturity date shall earn the agreed up on interest rate plus default rate of 3% per annum to be calculated from day one after the maturity date.

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However, the advance payment given to contractors is free from any interest (source: bond indenture agreement Commercial Bank of Ethiopia and City Government of Addis Ababa, 2015).

Main construction materials like reinforcement bar, cement both OPC & PPC, ceramic and porcelain tiles & skirting, electrical installation materials like conduits, different sizes of wires, sanitary installation materials like PPR pipes, PVC pipes are supplied by the client. Different sizes of wall making and ribbed floor slab HCB which produced by MSEs are also provided by the client. Handrails and guardrails are supplied and fixed by MSEs whereas the aluminum windows and doors are supplied and fixed by B&C Aluminum works P.L.C (source: 40/60 contractors contract document, 2015).

In this project, the first original design for Senga Tera and Crown was made by ETG Designers and Consulting P.L.C and approved by MoWUD and the second original design was made by Acute designers and ETG. In the design review, contract administration and supervision, nine class-1 consulting firms have participated. A total of 164 Grade-1 up to grade-3 local contractors have been participated in the operation of major construction works. Micro and small enterprises have also participated in the production of prefabricated elements like HCB and precast beam, steel structure works like hand rail and guard rail, loading & unloading, and electrical and sanitary installation works, site works like cobble stone laying on car parking place and walkway, concrete curve stone works. Moreover, financial institutions like banks and insurance companies are participated by providing required loan and advance guarantee and performance bonds, construction material suppliers participated in the project. Service giving organizations like Ethiopian electric service Organization, Addis Ababa Water and Sanitation Authority and Addis Ababa Road Authority are also project participants.

However, the project sites in this program are substantially affected by extreme delay. In order to improve the situation, it is first necessary to identify the major causes involved and associated inevitable effects.

## **2.2. Project Time Management**

A project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end (PMBOK Guide Fourth Edition, 2008). Project time has been defined as duration of the project on the date stated in the contract, or provisional completion dates required for phases of the work (Clough et al., 2000). It is the period of time schedule that needed to complete all the project work. “Duration” is the time, usually in days, taken to complete the entire project, from starting the first task to finishing the last activity.

According to PMBOK’s (2008) project time management is the processes required to manage timely completion of the project that includes planning, scheduling and controlling of activities. Project time management was changed to project schedule management to reflect that the project schedule is defined and managed during the project, whereas time is not managed (PMBOK’s, 2017).

## **2.3. The Legal Background Regarding Construction Delays**

There are declarations related to construction delay in local and international standard documents. FIDIC, MoWUD, PPA (2011) and 1960 Ethiopian Civil Code are some of the standard documents that comprises rights and obligations of each party relating to construction delay in a concise and precise statements.

### **2.3.1. Delay related Articles in the 1960 Ethiopian Civil Code**

The 1960 Ethiopian Civil Code (ECC) consist of some articles that address the nature, effect, and treatment of construction delays as discussed hereunder.

Article 1771: A contractual party is allowed to require enforcement of the contract or cancellation of the contract and damage caused to him by delay to be made good when the other party does not carry out his obligations under the contract. However, Article 1791 states that “If the party fails to perform his obligations, shall be liable to pay damages unless he can show that performance was prevented by force majeure”.

Article 1792: Force majeure results from an unforeseeable occurrence which absolutely prevents the contractor from performing his obligations. Examples of force majeure are presented under Article 1793 and which include the unforeseeable act of a third party for whom the contractor is not responsible, an official prohibition preventing the performance of the contract, a natural disaster such as an earthquake, lightning or flood, international or civil war and the death or a serious accident or unexpected serious illness of the contractor.

Article 1794: unless otherwise expressly agreed, Force majeure shall not consider in the following circumstances: strike or lock-out taking place in the undertaking of a party or affecting the branch of business in which he carries out his activities; or an increase or reduction in the price of raw materials necessary for the performance of the contract; or the enactment of new legislation which makes the performance of the contract more onerous

Article 2618: When contractor delays the carrying out of his task, the client may fix him a reasonable time limit to begin the execution of the task. In case, the contractor, after this time limit, has not begun the task or has interrupted it in bad faith, the client may cancel the contract without waiting for the expiry of the period laid down for the completion of the task. Where appropriate, the client may also claim damages from the contractor.

### **2.3.2. Delay related Clauses in the MoWUD Standard Document**

Ministry of Works and Urban Development (MoWUD) standard condition of contract is incorporated in the general condition of contract for Addis Ababa 40/60 housing construction. The delay related clauses in this standard document are the following.

Clause 44: The contractor is entitled to an extension of completion time if he notifies the client within 28 days when there is extra or additional work or exceptional adverse climatic conditions, or other special circumstances without his fault. The Engineer, after due consultation with the Employer, determine the amount of such extension and shall notify the Employer and the Contractor accordingly.

Clause 46: Provided that the rate of progress of the project Works is too slow to ensure completion by the prescribed time or extended time, the contractor shall take acceleration steps without any compensation.

Clause 47: In case, the contractor fails to achieve completion of the Works within the agreed time, then he shall pay to the client 1/1000 of the contract price per day as liquidated damages for the time elapse between the contract time and the date of certified completion of the works, but the liquidated damage for delay shall be effected for only the part of work not certified after the project completion date. The maximum limit of the liquidated damage shall be 20% of the Contract Price.

### **2.3.3. Delay related Clauses in the FIDIC Standard Document**

FIDIC form of standard condition of contract is one of the famous and internationally recognized standard forms of contract and used in international contracts when the contractual parties are from diverse countries. In the FIDIC (1987) forms of contract document the following delay related provisions are specified.

Clauses 42.2: If the Contractor suffers delay and/or incurs costs from failure on the part of the client to give possession of site, the Contractor is entitled to extension of time and compensated for the incurred costs. However, Clause 44.1: The Contractor will be entitled to only an extension of time in such events: extra or additional work, adverse climatic conditions, impediment or prevention by the client, or other special circumstances without his fault. Furthermore, according to Clause 44.2, the contractor even will not be entitled to the extension of time unless he notifies the detailed particulars within 28 days.

Clause 44.3: When an event has a continuing effect, the Contractor shall submit interim particulars not exceeding 28 days interval and final particulars within 28 days of the end of the effects to get extension of time.

Clause 46.1: If the rate of project progress is too slow to meet the desired completion date, the contractor shall take acceleration steps without any compensation.

Clause 47.1: The client is entitled to liquidated damages for every day after the project completion date, but Clause 47.2 specifies that the liquidated damages for delay shall be effected only for the remainder of the Works, non- certified portion of works.

#### **2.4. Causes of Delay during Pre-construction Stage**

According to Montana (2000) cited by Michael, pre-construction stage is defined as all activities required taking a project from proposal through to advertisement for construction contract letting. The pre-construction process includes all the activities required to develop a project in to the detailed plan specifications and estimates that are used by contractors as their construction plan. This is a very complex process performed by several management units that involves many different engineering disciplines and functional areas of expertise.

The causes of delay and cost over runs arising from pre-construction stage that lead to claims and disputes result due to the existence of high uncertainty during the early phase of a project, which possess the most probable influencing power on the project (Wubshet Jekale 2020). The major events that may result in delay arising from pre-construction stage are: Contract document preparation, Design preparation, Tender document preparation, Process of tendering and Contract negotiation process (Construction Change Management, 2003).

#### **2.5. Causes of Delays during Construction Stage**

##### **2.5.1. General**

Factors that cause delay during implementation stage may result in additional cost to both the client and the contractor. The loss of benefit that could have been gained if the project was completed on time, consultant fees which ,cost associated with head office support of the project are among the costs to be cited as the major ones incurred by the employer. Similarly, the additional cost to be incurred by the contractors include: additional overhead costs, costs of extension of various bonds such as performance bond and bank guarantee, operational and maintenance cost of facilities (Girmay Kahssay, 2003).

## **2.5.2. Types of Construction Delays**

According to Theodore Trauner (2009) there are four basic ways to categorize delays. These are: (1) Critical or Noncritical delays, (2) Excusable or Non-excusable delays, (3) Compensable or Non-compensable delays and (4) Concurrent or Non-concurrent.

### **2.5.2.1. Critical Versus Noncritical Delays**

In any analysis of delays to a project, the primary focus is on delays that affect the progress of the entire project (the project end date or milestone date) or that are critical to the project completion. However, many delays occur that do not delay the project completion date or a milestone date. Delays that affect the project completion or in some cases a milestone date are considered critical delays, and delays that do not affect the project completion, or a milestone date, are noncritical delays. The concept of “critical” delays emanates from critical path method (CPM) scheduling (Theodore Trauner, 2009).

### **2.5.2.2. Excusable Versus Non-excusable Delays**

All delays are either excusable or non-excusable. An excusable delay, in general, is a delay that is due to an unforeseeable event beyond the contractor’s or the subcontractor’s control. Normally delays resulting from the events general labor strikes, fires, floods, acts of God, owner-directed changes, errors and omissions in the plans and specifications, differing site conditions or concealed conditions, unusually severe weather, intervention by outside agencies and lack of action by government bodies, such as building inspection would be considered excusable. These conditions may be reasonably unforeseeable and not within the Contractor’s control (Theodore Trauner, 2009).

Decisions concerning delays must be made within the context of the specific contract. The Contract should clearly define the factors that are considered valid delays to the project that justify time extensions to the contract completion date. For example, some contracts may not allow for any time extensions caused by weather conditions, regardless of how unusual, unexpected, or severe (Theodore Trauner, 2009).

Non-excusable delays are events that are within the contractor's control or that are foreseeable. Late performance of subcontractors, untimely performance by suppliers, faulty workmanship by the contractor or subcontractors and a project-specific labor strike caused by either the contractor's unwillingness to meet with labor representatives or by unfair labor practices are some examples of non-excusable delays. Again, the contract is the controlling document that determines if a delay would be considered non-excusable (Theodore Trauner, 2009).

### **2.5.2.3. Compensable Versus Non-compensable Delays**

A compensable delay is a delay where the contractor is entitled to a time extension and to additional compensation. Relating back to the excusable and non-excusable delays, only excusable delays can be compensable. A non-compensable delay means that although an excusable delay may have occurred, the contractor is not entitled to any added compensation resulting from the excusable delay. Thus, the question of whether a delay is compensable must be answered. Additionally, a non-excusable delay warrants neither additional compensation nor a time extension (Theodore Trauner, 2009).

Whether or not a delay is compensable depends primarily on the terms of the contract. In most cases, a contract specifically notes the kinds of delays that are non-compensable, for which the contractor does not receive any additional money but may be allowed a time extension. Contracts distinguish between compensable and non-compensable delays in many ways, some of which are described in the following paragraphs. Federal government contracts normally define strikes, floods, fires, acts of God, and unusually severe weather as excusable but non-compensable delays. Other forms of excusable delays are compensable, such as differing site conditions, Owner-directed changes, and constructive changes that may cause a delay (Theodore Trauner, 2009).

### **2.5.2.4. Concurrent Delays**

Concurrent delay is defined as two or more delays that occur at the same time, either of which would cause project delay (William et al, 2011). The concept of concurrent delay has become a very common presentation as part of some analyses of construction delays. The concurrency argument is not just from the standpoint of determining the project's critical delays but from the standpoint of assigning responsibility for damages associated with delays to the critical path.

Owners will often cite concurrent delays by the contractor as a reason for issuing a time extension without additional compensation. Contractors will often cite concurrent delays by the owner as a reason why liquidated damages should not be assessed for its delays. Simply stated, concurrent delays are separate delays to the critical path that occur at the same time (Theodore Trauner, 2009).

### **2.5.3. Sources of Delay**

Construction delays are usually caused by either the contractual parties such as client, contractor and consultant or external factors that beyond the control of the parties or force majeure (Alhaji & Danladi, 2012).

#### **2.5.3.1. Delays caused by the client**

Delays are caused by the client's actions originating from his need or inactions contrary to provisions specified in the contract. Examples include late material delivery, late payment to the contractor, change order, differing site condition, interference, late decision making, etc. In this case, the contractor will be entitled to claim for time extension and financial compensation (Saeed, 2012).

#### **2.5.3.2. Delays caused by the contractor**

Delays are also caused by the contractor's non-performance of activities due to his own problem or problems within his control which finally result in time overrun and cost overrun. Examples include inadequate experience, poor site management, problems related to subcontractors and suppliers, shortage of material, labor and finance, improper project planning, mistakes during construction, etc. In this case, the contractor will not be entitled to time extension and financial compensation, rather pay liquidated damage or actual damage to the client.

#### **2.5.3.3. Delays caused by the consultant**

In fact, delays may result from consultant problems which include design errors, late approval of tests and drawings, poor project administration etc. In this case, the contractor will be entitled to claim for time extension or/and financial compensation whereas the client will not be entitled to claim for liquidated damage as the consultant is the representative and within control of the client.

#### **2.5.3.4. Delays caused by External Factors**

Delays are caused by force majeure, which are beyond the control and without the fault of the client or the contractor. Examples include the unforeseeable act of a third party for whom the contractor is not responsible, an official prohibition preventing the performance of the contract, a natural catastrophe such as an earthquake, lightning or flood, international or civil war and the death or a serious accident or unexpected serious illness of the contractor. In this case, the contractor shall not be entitled to financial compensation, but extension of time to complete the project. In addition, the contractor shall not pay liquidated damage to the client (ECC, 1960)

#### **2.5.4. Nature of Delay**

Based on their time of incidence nature, construction delays are classified into three categories such as independent delay, serial delay and concurrent delay (Arditi & Robinson, 1995).

##### **2.5.4.1. Independent delays**

An independent delay is defined as a particular delay occurring only and without concurrency with other delays (Arditi & Robinson, 1995). Analyzing this type of delay is simple and the effect can be identified easily by imposing the delay on the project schedule, but independent delay may cause serial delays. Example is when a contractor fails to supply material solely.

##### **2.5.4.2. Serial Delays**

Serial delay is a series of sequential, non-overlapping delays that are linked together (Arditi & Robinson, 1995). It is caused by the action or inaction of one of the parties (Raid et al., 1991). Example: when client fails to pay the contractor and then the contractor fails to supply material sequentially (Arditi & Robinson, 1995).

##### **2.5.4.3. Concurrent Delays**

Concurrent delay is defined as two or more delays that occur at the same time, either of which would cause project delay (William et al, 2011). Concurrent delays can be caused by a combination of delays as follows (Kraeim, 1987):

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- I. Excusable delay and non-excusable delay. Example is when adverse weather condition occurs and contractor fails to supply material at the same time. In such a case, contractor should be entitled to time extension, but not financial compensation.
- II. Excusable delay and compensable delay. Example is when severe weather occurs and client fails to pay the contractor at the same time. In such a case, contractor should be entitled to time extension, but not financial compensation.
- III. Excusable delay, non-excusable delay, and compensable delay at the same time. Example: when severe weather occurs, it is excusable delay, when contractor fails to supply material, it is non-excusable delay and when client fails to pay the contractor, the delay will be compensable delay.
- IV. Non excusable delay and compensable delay. Example is when contractor fails to supply material and client fails to pay the contractor at the same time. In such a case, contractor should be entitled to time extension, but not financial compensation.

For concurrent delays the owner and the contractor are both responsible for delays in completing the work.

#### **2.5.5. Responsible Body for Delay**

Based on responsibilities, delays are classified in to client responsible, contractor responsible, both parties responsible and neither party responsible so as to identify the party entitled for compensation as discussed hereunder, Ahmed et al. (2002).

##### **2.5.5.1. Client Responsible**

Such delays occur when the client is responsible for the occurrence of delay, then Contractor will be granted time extension and financial compensation and client will not be entitled to claim for liquidated or actual damages. Examples include change order, failure to pay the contractor, differing site condition etc.

##### **2.5.5.2. Contractor Responsible**

Such delays occur when the contractor is responsible for the occurrence of delay; client will be entitled to claim for liquidated or actual damages. Contractor will not be granted time extension

and financial compensation. Examples include failure to deliver material and equipment, low productivity of workers, failure of equipment etc.

#### **2.5.5.3.Both party responsible**

Such delays occur when a delay occurs due to both parties concurrently, Contractor will get time extension to complete the project but not financial compensation and client will not be entitled to claim for liquidated or actual damages. Example include concurrent delays like contractor fails to supply material and the client fails to pay the contractor at the same time.

#### **2.5.5.4.Neither Party Responsible**

Such delays occur due to force majeure, neither party is responsible. However, Contractor will get time extension to complete the project but not financial compensation and client will not be entitled to claim for liquidated or actual damages. Examples include civil war, occurrence of a natural disaster such as earthquake, flood etc.

### **2.6. Occurrence of Construction Delay**

According to Jonathan Jingsheng Shi, et al, (2001) a project consists of collections of activities. An activity's completion may be delayed due to a delayed start or extended activity duration. An activity's start may be delayed due to certain reasons; its duration may be extended due to some other reasons. An activity's delayed completion may cause delays in the succeeding activities, which in turn can cause a delay in the project completion. Delays can occur in any and all activities, and these delays can concurrently or simultaneously cause delays in the project completion. In other words, a project delay is the accumulated effect of the delays in individual activities.

### **2.7.International and local practices in mass housing construction**

According to world economic forum report (2019), most cities around the world are facing major challenges in providing safe and adequate housing for their people, especially cities that are growing rapidly and where the affordable housing options are limited. However the degree of severity is varied between developed and developing countries due to their economic status and technological advancement. The construction sector in developed countries is highly advanced in technology and can solve such kind of problems in a short period of time. However such problem

is aggravated in developing countries particularly in Ethiopia. The local and international residential mass housing construction practices are discussed hereunder.

### **2.7.1. International practice in mass residential housing construction**

In international practice Brazilian social housing development practice, Indonesian mass housing practice, China's experience especially Anju project practice, South African practice, Hong Kong experience, Brazil and Singapore practice are discussed hereunder.

#### **2.7.1.1.Indonesia's practice**

Indonesia has undertaken One Million Houses program for low-income people. The program has been implementing since 2015 to achieve an ambitious target of building 10 million houses. The proportion of the housing is 70 percent for low-income people and 30 percent for non-low-income people. This program is a joint movement between the central government, regional governments, real estate developers and the community. The program is targeted to reach one million housing units annually. In 2015, about 700,000 homes were built, increasing to approximately 805,000 in 2016 and around 904,000 by the end of 2017 (thejakartapost.com, 2019).

#### **2.7.1.2.China's practice**

China, in 1995, the "Housing Project for Low Income Households" (Anju Project) was introduced in order to help low and mid-low income groups to buy houses. It was considered part of the social security schemes. The targeted group was the people suffering from housing difficulties (Bingqin Li, 2013). Under the Anju Scheme, with the approval from the central government, commercial banks provide construction loans and the local government provide free serviced land for developing low cost housing construction. The completed housing (Anju housing) was sold without profit to the middle and lower income families. The households with poor housing conditions would get preferential rights to buy Anju housing (Hongyu Liu, 1998). By the end of 1997, about 6.5 million people benefited from the Anju project (Bingqin Li, 2013). There were 163 cities carrying out the Anju Scheme as a pilot projects. Approximately 26.65 million m<sup>2</sup> of Anju housing were being constructed in 1997. The target of the Anju scheme was to construct 150 million m<sup>2</sup> of housing from 1995 to 2000 (Hongyu Liu, 1998). However, due to its high subsidizations Anju scheme project was replaced by the economical and comfortable housing

project known as Jingji Shiyong Fang in 1998. This policy was suggested that the state wanted to stop people from depending on heavy state subsidies. Between 1999 and 2008, about 4.5 million flats (60-100 sq. m. each) were constructed under the Jingji Shiyong Fang scheme project (Bingqin Li, 2013).

### **2.7.1.3.South African practice**

The human settlement issue in South Africa has posed a great challenge to the post-apartheid government. As a result of the policies and political turbulence of the apartheid era, the housing market inherited by the new South African government in 1994 was hindered by severe problems. The newly elected ANC government's commitment to addressing these housing issues can be traced to the 1994 Reconstruction and Development Programme (RDP). The programme was the ANC's election manifesto for a post-apartheid South Africa. The RDP was committed to meeting the basic needs of all South Africans. RDP housing was a package involving secure tenure, land, a top structure and the supply of water, sanitation and electricity. On taking up office in 1994, the newly democratic government of South Africa made a substantive commitment to addressing the need for housing with a large-scale capital subsidy programme.

A sub-programme, the People's Housing Process (PHP), was launched in 1998. A response to self-build initiatives across the nation, the PHP sought to support co-production between the state and civil society by providing funds to groups that wanted to self-organize and develop their own housing. The many acknowledged merits of this programme included the strengthening of civil society and empowerment of the urban poor (Walter Fieuw & Diana Mitlin, 2018).

Between 1994 and 2004, the South African government invested R27.6 billion in housing. More than 1.3 million houses were delivered, affecting the lives of 6.5 million people (Bokang Ramashamole). Despite these achievements however, the urban housing backlog increased from 1.5 million housing units needed between 1996 and 2013. By 2015, over 3.2 million dwellings (including new builds, individual tenure titles, and transfer of housing stock) had been provided to low-income households. (Walter Fieuw & Diana Mitlin, 2018).

#### **2.7.1.4.Hong Kong practice**

Hong Kong Public Housing development process passes three stages. That process can conclude the changing as from setting the temporary place for the huge immigrants to take more comprehensive the housing policies and construction program, from only provided the rental housing to subsidize household became homeownership, and from built low level housing to construct modernization public housing.

1970s, was turning point of Hong Kong Public Housing development. In 1973, Hong Kong Housing Authority was established to responsible for the Home Ownership Scheme, Occupants Purchase Scheme, Sandwich Class Housing Scheme and Interim Housing. (Sandwich Class' is considered that the income of this group is between higher income groups to lower income groups in social class). Since then, Hong Kong government introduced a series of housing policies to standardization the housing market, construction market and the subsidy funded sector.

The government took full implementation of the 'Home Ownership Scheme' to speed up the public housing construction schedule. As a result more rural housing had rebuilt to be urban concrete construction, living standard and environment been obviously improved and the quality of public housing are good as commercial housing because government allowed developers and investors to participate in public housing program. The successful of Hong Kong public housing model was 1) Legitimate formed a housing authority as the independence and non-profit housing agency, 2) Effective financial and governor arrangement, and 3) Clear housing policies system.

The Hong Kong sixth annual policy in 2010 announced a home purchase scheme in which the governments will subsidies middle-income earners to buy their own homes. The target was to build 5000 units under the scheme and if demand proves to be high, the government could allocate more plots to build more flats. The government also promised that units under the new scheme would be affordable. But the emphases of the scheme was the no-frills, small and medium-sized flats only for these 'sandwich class' households, if they can spend 45 to 50 percent of their income on rental and also on saving with the added protection of rental non-adjustment. The government recommended that the new program is more flexible than home ownership scheme, as tenants would be reimbursed half of their net rental payments for up to five years to help them purchase a

flat. He was confident that this new scheme would make it easier for middle-income earners to purchase their own home.

These 5000 flats would be built under “my home purchase” plan to help the so-called sandwich class buy their own homes. The idea was that they will rent their homes until they can save enough to buy them. First stage of this new scheme, 1000 flats were provided by 2014, those who qualify for the scheme can rent the flat at a fixed rent for up to five years. They can choose to buy within a specified time frame the flat they rent or another flat under the plan at prevailing market price, or a different unit in the private market. To help them with the down payment, they can get a subsidy equivalent to half of the net rental they have paid during the tenancy period. The idea is to give renters time to think whether or not to join the housing market without being concerned by the ups and downs of housing prices.

Hong Kong has the similar housing scheme as the public housing scheme in Singapore that so called ‘Home Ownership Scheme’ (HOS). HOS is a ‘subsidized-sale’ housing program which was launched in 1970s for the purpose to give the poor a chance to buy or rent a low cost housing to make their life more stable and better. Under the HOS, all residents who belong to the ‘low definition’ low-income group can buy the house through government housing program with about 30 to 40 percent price discount.

#### **2.7.1.5. Brazilian practice**

The Brazilian federal government's social housing program was launched in March 2009 with a budget of 18 billion USD to build one million homes. The second stage of the program included within the government Growth Acceleration Program was announced in March 2010. This stage forecasted the construction of a further two million housing units. All funds for this project were provided by the Brazilian public bank. The bank financed development and provided mortgages for qualifying families. As of September 2018, 4.5 million homes were built and distributed to the population. The project has been criticized for its placement and quality of the houses. Houses are built far from the city center to reduce housing costs which consequently reduces access to the labor market (Mercator & Fortaleza, 2017).

### **2.7.1.6.Singapore practice**

When we talk about the construction of mass housing project, Singapore comes first. Public housing in Singapore is managed by the state Housing and Development Board (HDB) under a 99-year lease. The majority of the residential housing developments in Singapore are publicly governed and developed, and home to approximately 78.7% of the resident population. These flats are located in housing estates, which are self-contained satellite towns with well-maintained schools, supermarkets, malls, community hospitals, clinics, hawker Centre's (food court) and sports and recreational facilities. Every housing estate includes metro rail transport (MRT) stations and bus stops that link residents to other parts of the city-state. Some estates are also complemented by smaller light rail transport (LRT) stations which act as a feeder service to the MRT.

There is a large variety of flat types and layouts which cater to various housing budgets. HDB flats were built primarily to provide affordable housing and their purchase can be financially aided by the Central Provident Fund. Due to changing demands, HDB introduced the Design, Build and Sell Scheme to produce up-market public housing developments.

New public housing flats are strictly only eligible for purchase towards Singaporean citizens. The housing schemes and grants available to finance the purchase of a flat are also only extended to households owned by Singaporeans, while permanent residents do not get any housing grants or subsidies from the Singaporean government and could only purchase resale flats from the secondary market at a market price. Such policies have helped Singapore reach a home-ownership rate of 91%, one of the highest in the world. As cited by Jingchun Lin (2011) More than 850,000 housing units in 23 new towns have been constructed. To catchup such success in mass housing construction, Singapore was supported by Standardized, modularized or prefabricated components.

Productivity in construction could receive a substantial improvement from standardization, modularization and prefabrication. The standardization of components brings many benefits, including a reduction in construction costs, fewer interface and tolerance problems, greater certainty over outcomes, reduced maintenance costs for end-users, and more scope for recycling.

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Modularization adds to the advantages of standardization, by increasing the possibilities for customization and flexibility, and helping to realize the potential of prefabrication in a factory-like environment. Prefabrication would increase construction efficiency, enable better sequencing in the construction process and reduce weather-related holdups; by such means, it becomes possible to reduce a project's delivery times and construction costs relative to traditional construction methods, and also to create safer working environments. Prefabrication can be applied in a wide variety of project types, ranging from residential housing to large-scale industrial plants. The various systems can be distinguished by their degree of prefabrication: at the simpler end are the mostly two-dimensional building components, such as walls, ceilings or truss elements; then there are modular structures, comprising larger volumetric elements like entire rooms or story's; and, finally, there are entirely prefabricated assets.

In 2015 Chinese company, BROAD Group, can built a 57-story building (207m height) within 19 days using prefab elements and modular structures. It is a multifunctional building with offices, different service facilities, 800 apartments and 19 halls of 10m height. The construction rate was 3 floors per day. It is to be noted that before the construction started, 2736 modules had been produced at the plant within four months and a half (Elena M. Generalova et al).

The prefab and modular construction practice have many advantages over traditional construction with respect to cost, quality, time, safety, environment, flexibility and sustainability. According to Nick Bertram et al (2019) modular construction can cut schedule by 20–50 percent and costs by 20 percent.

The time efficiency of prefab and modular construction is due to high degree of organization and mechanization of work to replace manual labor, erecting of prefab building elements at every weather condition, reduction of formwork preparation period and reduction of concrete curing period. As a result, the reduction in construction time can significantly save on construction costs.

Since prefab and modular components are produced in a controlled manufacturing environment and follows specified standards, the components would have uniform desired quality. The controlled environment of a factory allows for more accurate construction, tighter joints and better air filtration, which in turn allows for better wall insulation and an increase in energy efficiency.

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Construction site-built structures are dependent upon varying skill levels and the schedules of independent contractors. These all contribute to the workmanship and overall quality of given structure. With prefabrication, each sub-assembly is built by an experienced crew in a weather-resistant factory, with several quality checks throughout the entire process. Some components of the building are constructed using precise machine equipment to ensure conformity to building code.

Safety is another important parameter to choose prefab and modular construction. Since sub-assemblies are created in a factory-controlled environment utilizing dry materials, there is less risk for problems associated with moisture, environmental hazards and dirt. This ensures that those on the construction site, as well as a project's eventual occupants are less likely to be exposed to weather-related health risks. Also, an indoor construction environment presents considerably fewer risks for accidents and other liabilities. There are strict factory processes and procedures that protect the worker from on-the-job injury. At a construction site, although safety is of greatest importance, workers are subjected to weather-related conditions, changing ground conditions, wind and other crew members who are at the site.

Traditional construction methods require extra materials that lead to increase waste. However prefabricated sub-assemblies are constructed in a factory and extra materials can be recycled in-house. This can reduce sending waste directly to a landfill from a traditional construction site and make environment eco-friendly.

Modular construction can be easily be disassembled and relocated to different sites. This flexibility significantly reduces the demand for raw materials, minimizes expended energy and decreases time overall. Also, modular construction allows for flexibility in the design of the structure allowing for an unlimited number of opportunities. Since prefabricated construction units can be used in different spaces, its neutral aesthetics is able to blend in with almost any building type. The quality and flexibility nature of components are make prefab and modular construction to be sustainable.

### **2.7.2. Local practice in mass residential housing construction**

The Integrated Housing Development Program (IHDP) is a government-led and financed housing provision programme for low-and middle-income households in Ethiopia. The program was initiated and launched in 2004 to solve the low-income housing challenge. The IHDP aims to increase housing supply for the low-income population, recognize existing urban slum areas and mitigate their expansion in the future, increase job opportunities for micro and small enterprises and unskilled laborers, which will in turn provide income for their families to afford their own housing, improve wealth creation and wealth distribution for the nation. The vision of the integrated housing development program was for all slums to be cleared within ten years' time and for Ethiopia to be a middle-income country by 2025.

The initial desire set by the Government for the IHDP for 2006-2010 was to construct 400,000 housing units, to create 200,000 jobs and thereby contribute significantly to the national target of reducing urban unemployment by half, to promote the development of 10,000 small enterprises on a sustainable basis in the construction industry, to deliver 6,000 hectares of serviced land per annum for housing and other investments, to enhance and build the capacity of contractors, consultants, engineers and foremen as well as suppliers of construction materials, to support the private sector to produce 125,000 housing units per annum through the provision of land and infrastructure and a conducive legal and policy framework.

The first pilot condominium housing project was in the neighborhood of Bole Gerji area which consisted of 750 residential housing units and the project was managed by Germany Technical Corporation (GTZ) on behalf of the Addis Ababa city government and the project completion was very successful in terms of timely delivery and completion with budgeted cost. However, GTZ declined to continue their direct involvement with project design and operation, instead taking an advisory role. As per GTZ recommendation Addis Ababa Housing Development Project Office (AAHDPO) was established in 2005 to manage the implementation of the programme. It was set up to ensure the successful delivery of the three main processes in the IHDP in Addis Ababa: the 'design', the 'construction', and the 'housing transfer and administration' (UN-HABITAT, 2011).

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The integrated housing development programme recognizes the opportunity for housing to stimulate the economy, create employment, and improve the capacity of the construction and financial sectors. The programme was also adopted prefabricated concrete elements like precast beam, agrostone and hollow concrete blocks (HCB) for the purpose of reduction of construction costs up to 30% compared with conventional systems, to improve the speed of construction, and to facilitate the development of small and medium enterprises who produce construction elements. (Source UN-HABITAT, 2011). However the programme fail to meet the desired objective in terms of providing affordable houses within a planned time. Since all housing projects are extremely delayed, the cost of houses is not affordable for low and middle-income citizens.

## **2.7.2.1.Prefab industry in Ethiopia**

The first and only a full set of building elements Production Company in Ethiopia is the Prefabricated Building Parts Production Enterprise (PBPPE). It was established in 1987 with the help of the socialist country of Yugoslavia. Back then, the Ethiopian construction industry was at an infant stage, with only a number of modern buildings constructed in Addis Ababa, mainly with prefabricated elements. Within its 33 years of operation, PBPPE has not shown much progress as an organization. It still uses the same outdated batching plant, crane system, and even molds that had been installed during its establishment all those years ago. Moreover, it has fixed specifications for every single component of building construction. So if, for example, one designed a building with slabs spanning 6 meters as is the case in many building designs in Ethiopia, the building would have to be constructed in-situ (not prefabricated) because PBPPE doesn't have slabs spanning greater than 4.20 meters in either (x or y) direction. Neither does the plant have column sections greater than 30cm x 30cm, 34cm x 34cm and shear wall height exceeding 2.62m, among several other restrictions (source: production site visit in 2019).

## **2.8. Identification of Causes of Delay**

Delays happen in construction projects, but the magnitude of these delays vary from project to project. A number of researches have been conducted on the causes of construction delay worldwide. In preventing delays, the most effective solution that has been emphasized in the literature was to identify the main causes and then find solutions to mitigate the risk of their occurrence. The findings of these studies, conducted in different regions, indicate that criticality

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of the various causes might depend on the area where the project was carried out. For example the following few researches were conducted in different countries by different researchers.

Mohammadsoroush Tafazzoli et al. (2017) conducted a nationwide survey to assess the relative criticality of causes of delay in USA and the identified ten major causes of delay are excessive change order by the client during construction, time consuming decision making process of the owner during construction, design error, delay in approving design document by the owner, errors in contract document, unrealistic schedule, delay in getting permits and acquisitions, complexities and ambiguities of project design, poor communications of the owner with the other parties and delay in providing the design document by the designer.

Youcef J-T. Zidane et al. (2015) In Norwegian construction industry, conducted project survey in seven public and private organizations in autumn 2014 and identified the following most top five potential causes of delay (time-thieves and bottlenecks). Decisions delay by the client, lack of management and coordination capacity, quality issues and errors, administration and bureaucracy, and waiting are the most top five potential causes of delay.

Serdar Durdyev et al. (2017) adopted a questionnaire survey and conducted a research to identify the major causes of delay in residential construction projects in Cambodia and the result showed that shortage of materials on site, unrealistic project scheduling, late delivery of material, shortage of skilled labor, complexity of project, labor absenteeism, late payment by the owner for the completed work, poor site management, delay by subcontractor and accidents due to poor site safety are ranked as the main causes of project delays.

In United Arab Emirates (UAE), Ghias ur Rehman conducted a survey research in Abu Dhabi based on the outcome of study the top ten reasons of delay are 1) Lack of coordination with electro mechanical works, 2) selection of lowest bidder commercially, 3) Delay in approvals and late decision, 4) Materials delivery delay, 5) Client introduction of additional works during construction period, 6) Inefficient planning and scheduling of the projects, 7) Labor and equipment non productivity, 8) Coordination issues and quality of works, 9) delay in approvals by client and 10) Original contract duration is not realistic.

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On the other hand Imtiaz Ali Bhatti et al. (2018) Based on detailed literature review of 64 research papers, the top 10 most common factors causing delay in construction projects identified are Difficult for contractor to Finance a Project, Lack of Coordination among stakeholders, Improper Scheduling and Planning, Incapability of Client to take decision, Delay in Payment from Client, Change in scope of work, Low labor productivity, Unskilled labor, Poor contract management and Lack of trained peoples in project team.

In Egypt, Mohamed M. Marzouk and Tarek I. El-Rasas (2014) conducted a research through interview and questionnaire survey and the top ten delay causes of construction projects in Egypt determined are ineffective planning and scheduling of project, difficulties in financing project by contractor, variation orders/changes of scope by owner during construction, poor site management and supervision, type of project bidding and award (negotiation, lowest bidder), low productivity level of labors, effects of subsurface conditions (e.g., soil, high water table, etc.), unqualified workforce, shortage of construction materials in market, and delays in sub-contractors work.

In Tanzania, Valentine G.M. Luvara et al. (2018) conducted a research to determine factors causes delay and cost overruns in public building construction projects in Tanzania and delay in decision making, incomplete design and estimate at the time of tender, Improvement of standard drawing during construction stage and omission and errors in the bill of quantity were the top most severe factors with high severity index i.e. above 70%.

In Nigeria, Olanrewaju Sharafadeen et al. (2015) carry out a study on delay of building construction projects in Nigeria the findings reveal that the causes of delay of building construction projects in Nigeria are lack of funds (8.8%), lack of materials, incomplete drawings and poor communication ranked second (8.4%) while lack of tools and equipment, absenteeism of workers on site, incompetent workers and government policy were ranked third (8%). These were followed by poor site condition, low labor productivity, political instability, weather condition and safety on site.

Michael Chala (2017) conducted a thesis study on Causes of Condominium Houses Construction Project Delay in Addis Ababa: The Case of Bole Arabsa Site from Stake Holders Perspectives. The identified top ten major causes of delay in Construction of Condominium Project in AAHCPO

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at Bole Arabssa Site were late delivery of construction materials, Shortage of construction materials, Low skill of labors on construction site, late procurement of materials, late in revising and approving design documents, poor communication and coordination of project parties, Poor qualification of contractor's and technical staff, lack of effective planning and scheduling of project, Unclear and inadequate drawings by consultant and Inadequate experience. This research also refers Yimenu's (2016) study carried out on AAHCPO cost performance index (CPI) of AAHCPO shows that, AAHCPO experiencing 21% cost overrun and Schedule performance index (SPI) indicates 67 % delay in construction schedule. This show AAHCPO is consuming more money and time than planned budget and time.

Zinabu Tebeje Zewdu (2016) conducted a survey research on Construction Projects Delay and Their antidotes: The Case of Ethiopian Construction Sector and the identified top five delay causing factors are cash flow problem, mismanagement, improper planning, slow decision making and late delivery of material and equipment.

According to Endale Mamuye (2016) MSc thesis to identify the major causes of delay in the construction of saving houses development enterprise, the identified ten major causes of delay were late material supply, financial difficulties faced by the contractor, problem of electric supply, problem of water supply, equipment unavailability, delayed payments to contractors, poor site management, ineffective planning and scheduling, late design review and approval, and slowness in decision making process.

Abdurezak Mohammed Kuhil and Neway Seifu (2019) carried out a research on Causes of Delay in Public Building Construction Projects: A Case of Addis Abeba Administration, Ethiopia and the survey findings revealed the top ten factors that cause construction delays in the public building construction projects in Addis Ababa are: difficulty in project financing (poor financial system), poor project management system, delay in issuance of designs and working drawings, shortage of availability of imported construction materials and goods on market, design errors and complexity of designs, delay in progress payments for completed works, late start & resource mobilization to site, financing problems, inaccurate site investigation report and price inflation.

By the above literature review it was tried to see twelve studies carried out in eight countries located in four different continents (one in North America, one in Europe, three in Asia and seven in Africa from these four studies were in Ethiopia). The topic of all studies was similar but the result is different in each project. For example in USA there is no financial and technical capacity issue by contractors and consultant whereas in Ethiopia it is the major problem. This clearly indicates that construction project has a unique nature and to identify problems it is crucial to study projects independently to provide necessary remedial solution.

### **2.9.Effects of construction delay**

Construction industry is an economic sector which transforms various resources in to constructed facilities. The industry plays a major role in economic development in the less industrialized nations since it constitutes a significant portion of both gross national product (GNP) and employment. The construction industry also plays a key role in satisfying a wide range of physical, economic and social needs and contributes significantly to the fulfillment of various major national goals (Fred Moavenzadeh, 1976).

In broad view, the industry plays a big role in terms of output generation, employment creation, income generation and redistribution and revenue generation. Output generation satisfies basic physical and social needs through buildings and infrastructure. The outputs are also a means of income generation through employment and commerce. For example a commercial building is an output of construction industry when it becomes to be functional; it creates job opportunity and generates income. The industry can also generate income and redistribute and consequently stimulating economic growth through backward and forward linkages through its requirements for goods and services from other industries. Generation of revenue for government from corporate income taxes of companies, the rental income, sales tax, capital gain tax, and employees income tax from those employed in the construction industry (Fred Moavenzadeh,1976 & Dr. Abraham Assefa, 2019).

The strong linkage between the construction industry and other economic sectors is the nature of multiplier effect of the construction industry. As activity increases in the construction industry, as well as in the suppliers to that industry and the ‘suppliers to the suppliers’, there is an increase in wages and salaries to employees throughout this chain. The spending of these wages and salaries

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induces a further round of consumption effects in other areas of the economy which is estimated to create additional jobs. However due to the delays of construction projects, the speed of inter connected economic circulation flow becomes freeze and all participants, directly in the construction operation and indirectly inter connected in the chains of network, are negatively affected and secondary effects of delay developed.

A common characteristic of construction projects is that they are dynamic and have a high level of uncertainty. This results in a cyclical argument, where delays are accepted as inevitable and is considered by some to be a global phenomenon affecting all the various construction project participants (Sambasivan and Soon, 2007). Several researchers highlighted the effects of delay in construction projects. A few are the following:

According to Adel et al (2009) the delay of any construction project affects the direct costs of the project. In the case where the project is a public building or facility, the complications increase as the client is a government department. The effects of delay in such cases may include: confusion regarding the public development plans, disturbance of the budget execution plan for the government authority involved, and public inconvenience resulting from delay of the project. From the contractor's viewpoint, delay is simply an additional liability as the construction period becomes longer, the longer period results in higher overhead costs and expenses, the entire contractor's working capital may become trapped in one project. Delays also mean loss of output and revenues, since the contractor cannot become involved in other projects. The profit lost by the contractor, therefore, is equal to the opportunity cost of the projects the contractor misses.

According to Olanrewaju et al (2015) the general effects of delay are the loss of wealth, time and capacity. For owner, delay means the loss of income and unavailability of facilities. For contractor, delay means the loss of money for extra spending on equipment and materials and hiring the labor and loss of time. Disputes between parties, abandonments of building projects, lawsuits to claim damages, litigations to claim rights, over-cost of the contract sum, overtime of workers and inadequate capacity are all effects of delay.

According to Michael Chala (2017) in his MSc. Thesis on Causes of Condominium Houses Construction Project Delay in Addis Ababa: The Case of Bole Arabsa Site from Stake Holders

Perspectives, the effects of delay he identified were time overrun, cost overrun, dispute, litigation, total abandonment and arbitration.

## **2.10. Advance payment**

An advance payment is an interest free loan given by the owner to the contractor, which is repayable before the completion of the works. It is a payment made in contemplation of the future performance of services. Advance payment, sometimes referred to as a down payment, or ex-gratis payment, is when part of a contractual sum is paid in advance of the exchange, i.e. before any work has been done or goods supplied. In contractual principle, the advance payment is reimbursed gradually by deducting from each interim payment (DOE, 2014). However in the case of construction delay, the refunding of invested advance money is also delay. There is a vacuum here the time value of money is forgotten.

### **2.10.1. Purposes of Advance Payment**

The major aim of advance payment in construction is to complete the work on the agreed time by making financially capable contractors. An advance payment in effect provides the contractor with an interest free loan during the initial phases of the contract where the greatest strain is placed on a contractor's cash flow. It provides the contractor with working capital at the start of the contract in order to commence the work. An advance payment may also be used to purchase materials and plant at an early stage as it provides the contractor with the necessary cash flow to do so. This is done to secure materials which are in short supply or place early orders for imported plant. Advance payments may also be used to provide potentially emerging contractors with the necessary financial support to perform contracts in a higher contractor grading designation. In general the purpose of advance payment given by the client to the project contractor is to reduce the financial burden of the contractor, to assist the contractor to face the difficulty of special mobilization of project and to assist the smaller size contractor firm.

The purpose, amount, conditions and criterion of advance payment are declared in international and local construction standards documents. FIDIC (2006) form of standard document recognized advance payment on article 14.2. Ethiopian Public Procurement Agency (PPA), 2011, states on clause 60 about advance payment and clarify its purpose, amount, conditions and criteria from clause 60.1 to 60.9. According to clause 60.4 advance payment security shall remain effective until

the advance payment has been completely repaid by the Contractor out of interim payments under the contract.

### **2.10.2. Amount of advance payment**

The amount of advance payment varies from country to country and depends on the nature of the works, contract type, status of countries and advance payment policy. Typically it is between 10% and 30% of the contract amount (Ayodeji et al, 2013). In Ethiopia, the amount of advance payment is common between 20% and 30% of the total contract amount. There is always the risk that for whatever reason, the contractor to whom an advance payment is made fails to repay the amount. In order to protect employers against such risk, advance payments should only be made against an approved advance payment guarantee provided by the contractor. This secures the payment against default by the contractor.

### **2.10.3. Advance Payment Bond**

According to Boswell (2010) cited by Ayodeji et al (2013) construction bond is defined as a written agreement in which one party (the surety) guarantees that a second party (the principal) will fulfill its obligations to a third party (the obligee). Bonds are provided in order to create financial security for the employer (or client) for the contractor's failure to perform his contractual obligations. A construction bond is a three-party agreement among a Bank, Client and Contractor. The Advance Payment bond ensures that the contractors fulfill contract within the contract period.

### **2.10.4. Time Value of Money**

The costs are paid and the benefits are received during different periods of the life of the system. Money can have different values at different times. This is because money can be used to earn more money between the different instances of time. Obviously, one million birr now is worth more than one million birr a year from now even if there is no inflation. This is because it can earn money during the interval. One could deposit the money in the bank and earn interest on it. This is the earning power of money over time and is called time value of money, that is, one million birr now has more value than one million birr a year from now. Because the interest rate is the more identifiable and accepted measure of the earning power of money, it is usually accepted as the time value of money and indication of its earning power. We have to be careful not to confuse

the earning power of money, which is related to interest rate, with the buying power of money, which is related to inflation (Abol Ardalan, 2000).

### **2.10.5. Interest Rate**

When money is borrowed, it has to be paid back. In addition to the amount of the loan, an extra amount of money is paid to the lender for the use of money during the period of a loan, just as you pay a rent on a house or a car. The interest rate is referred to by different names such as rent, cost of money, and value of money. In investment terminology, it is called the minimum acceptable rate of return or MARR.

The interest rate will depend on the position in time that the money is needed and the length of time it is required. If money is borrowed for a long period, then the uncertainty of the economy will introduce a risk factor and influence the interest rate. For short periods, it can be assumed that the economy is stable and the risk is predictable. Availability of money in the financial market also has an effect on the interest rate. If the banks have more money than people need to borrow, then the interest rate is low and vice versa. Money, like any other commodity, obeys the laws of supply and demand (Abol Ardalan, 2000).

### **2.11. Gap Identification**

Even though, a lot of studies were conducted locally and globally to identify causes and effects of delay, due to the unique nature of construction projects the following aspects were not addressed properly.

- The advance payment that given to contractors is reimbursed gradually by deducting from each interim payment. In the case of construction delay, the refunding of invested advance money is also delayed. For the construction delay, there is a compensation through liquidated damage clause. However due to delay in refunding advance money clients' money loses its purchasing power through time, fail to use for another projects, and pay interest cost for loan. There is a vacuum here the time value of money is forgotten.
- Studies shows that effects originated from delay are focus on economic aspects of impacts that faced by direct participants of major stakeholders. However construction has considerable interaction and value creation with numerous other sectors. The indirect but

strong interaction with the other sectors can touch the political and social aspects of the society, but those aspects are not well explained.

- Findings of numerous studies are focus on the major causes of delay, however there is no explanation given for why those major delay factors are happened and what are their root causes for the major delay factors.

## 2.12. Summary

Many researchers were study construction delays for several years. The term delay is described by numerous researchers in various ways as it's an extra time taken to complete the specific task or project. A delay in construction projects is a global problem that causes considerable losses for wealth. Due to the complexities in standardizing construction projects, efforts to mitigate risks of delay have not been adequately successful.

The Ethiopian construction sector has shown a remarkable growth by the last two decades. Many public construction projects have been undertaking throughout the country as part of the government's national development plans with significant amount of public expenditure. However, numerous shortcomings are observed in the sector that needs immediate action.

Rights and obligations of each party relating to construction delay are properly identified and stated in local and international standard documents. Some of the standard documents that comprises delay relating terms are FIDIC, MoWUD, PPA (2011) and Ethiopian Civil Code.

Based on their criticality the four basic ways to categorize delays are: (1) Critical or Noncritical delays, (2) Excusable or Non-excusable delays, (3) Compensable or Non-compensable delays and (4) Concurrent or Non-concurrent. Based on their sources construction delays can be classified also as client caused delays, contractor caused delays and consultant caused delays or external factors that beyond the control of the parties or force majeure. Based on their time of incidence nature, construction delays are classified into three categories such as independent delay, serial delay and concurrent delay. Based on responsibility delays can be categorized in to client responsible, contractor responsible, both parties responsible and neither party responsible.

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Most cities around the world are facing major challenges in providing safe and adequate housing for their people, especially cities that are growing rapidly and where the affordable housing options are limited. However the degree of severity is varied between developed and developing countries due to their economic status and technological advancement. The construction sector in developed countries is highly advanced in technology and can solve such kind of problems in a short period of time. However such problem is aggravated in developing countries particularly in Ethiopia.

Singapore is the most successful country in the world in mass public housing construction and the home ownership rate is 91%. To catchup such success in mass housing construction, Singapore was supported by standardized, modularized or prefabricated components. Productivity in construction could receive a substantial boost from standardization, modularization and prefabrication.

The Integrated Housing Development Program (IHDP) is a government-led and financed housing delivery program for low-and middle-income households in Ethiopia. The program was initiated and launched in 2004 to solving the low-income housing challenge. IHDP was also adopted pre-cast concrete elements like precast beam and hollow concrete blocks (HCB) for the purpose of reduction of construction costs (by up to 30 per cent) compared with conventional systems by improving the speed of construction. However the programme fail to meet the desired objective in terms of providing affordable houses within a planned time.

A number of researches have been conducted on the causes of construction delay worldwide. The findings of these studies, conducted in different regions, indicate that criticality of the various causes might depend on the area where the project was carried out. This clearly indicates that construction project has a unique nature.

An advance payment is an interest free loan given by the owner to the contractor which is repayable before the completion of the works. The major aim of advance payment in construction is to complete the work on the agreed time by making financially capable contractors. The amount of advance payment is between 10% and 30% of the contract amount. A construction bond is a three-party agreement among a bank, client and contractor. The advance payment bond ensures that the contractors fulfils contract within the contract period. The earning power of money over time is

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called time value of money. The extra amount of money is paid to the lender for the use of money during the period of a loan known as interest. The interest rate will depend on the position in time that the money is needed and the length of time it is required.

Construction industry is an economic sector that transforms various resources in to constructed facilities. The industry plays a big role in terms of output generation, employment creation, revenue generation, income generation and redistribution. Several researchers highlighted the effects of delay in construction projects. The outlined effects of delays in many literatures are time-overflow, cost-overflow, loss of output and revenues, dispute, arbitration, termination of contract, public inconvenience resulting from delay of the project, the entire working capital may become trapped in one project.

## CHAPTER THREE: RESEARCH METHODOLOGY

The purpose of this chapter is to present the research design, applicable sampling method, data gathering methods, and data analysis and interpretation techniques of the research.

### 3.1. Research Design

The research design refers to the overall structure of the study. As stated earlier, one of the major characteristics of construction projects is their complexity and involvement of variety of stakeholders. To investigate in depth the causal relationship between dependent and independent variables, case study design was appropriate and applied.

### 3.2. Research Methods

The method chosen for the study was mixed method which incorporates both qualitative and quantitative dimensions for the collection and analysis purpose. Because integrating qualitative and quantitative approach result a comprehensive and better understanding than using only one of the pure method.

### 3.3. The sample size

Sampling is the process of choosing a number of study units from a defined study population. A sample is a portion taken from a population with the assumption that the whole is represented by the part of the population under study. The key reason for being concerned with sampling is that of validity.

The total population consists of 132 members (124-contractors, 7-consultants and 1-client) currently working on Addis Ababa 40/60 housing project. The sample size is determined using a simplified statistical formula (Yamane, 1967:886) put hereunder considering the total population, 95% confidence level and 5% precision level.

$$n = \frac{N}{1 + N(e)^2} \dots \dots \dots [Eq. 3.1]$$

Where **n** is the sample size, **N** is the population size, **e** is the level of precision.

The sample size selected for this research was 99 respondents from the three projects which included engineers of client, consultants & contractors and managers working in 40/60 project sites at different levels of construction processes.

### **3.4. Sampling method**

The researcher was used non-probability convenience sampling method by the reason of importance and convenience to get access in terms of proximity and data availability. When project sites are far from the researcher's destination and interviewing people are scattered over a large area, it is time consuming, logistically difficult and more over it is impossible to get reliable and sufficient information. To gather sufficient data and to obtain reliable and concrete evidence for the study observing project activities in proximate was very important. In this regard getting proximity and necessary as well as sufficient data availability was rationale to choose this project to be study.

### **3.5. The data collection techniques**

The technique used to gather factual information was a combination of observation, document scanning, questionnaires and interview.

#### **3.5.1. Observation**

Observing operations and activities enabled to develop holistic view of a topic by exploring and understanding the context of the operations. Both direct observation and participant observation were used. Because this data collecting technique provides direct information about the case, permit researcher to enter in to and understand the situation/context, provides good opportunity for identifying unanticipated outcome and exists in natural, unstructured and flexible setting.

#### **3.5.2. Interview**

To picture the perspectives of the participants and to avoid rigid form of questions unstructured interview was conducted. In this regard face-to-face interview was taken a major share and in a few cases telephone interview was conducted. Unstructured interview yields detailed data with new insights, permit face-to-face contact with the respondents, provide opportunity to explore topics in depth, allowed interviewer to explain or help clarify questions, increasing the likelihood

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of useful respondents and allow interviewer has to been flexible in administrating interview to particular individuals. In this regard client project manager (PM), resident engineer, contractors PMs, engineers of contractors, consultant, and client were the focus groups logistics and finance department were also equally important.

### **3.5.1. Document scanning**

Written documents like contract document, approved payment certificates, notes, diaries, memos, letters, site books and goods receiving vouchers (GRV) were analyzed to extract the real causes. The contract administration, finance, purchasing and logistic departments were focusing areas of document analysis.

### **3.5.2. Questionnaires**

A number of respondents were asked identical questions, in order to gain information that can be analyzed and interpreted. The respondents were selected equally from three parties and three project branches.

### **3.6. Data quality assurance**

To ensure the accuracy of the result, using several data gathering tools on the study is very important. For triangulation, typically a variety of data collection approaches were used in combination. It is often helpful to use several techniques for the same method so that the weakness of one technique is offset by the strength of another. As such, using more than one technique to study the same phenomenon, can strength the validity of the result. That is why the above variety of techniques was designed as data obtaining mechanism.

The process of triangulation was proceed starting with the examination of documents, preliminary interview, then followed by questionnaires and then by observation of the practice to see how things have been going then; interviewing the cases involved in the situation enables to find out the congruence of the facts to reality (Dr. Deribsa Abate, 2018).

### 3.7. Data analysis techniques

In the data analysis the Cronbach's alpha ( $\alpha$ ) coefficient, Relative Importance Index (RII), Spearman rank correlation coefficient and mean score (average) method and analysis of variance, as discussed hereunder were adopted and has been interpreted contextually.

#### 3.7.1. Cronbach's alpha ( $\alpha$ ) coefficient

The reliability or internal consistency of the data collected through questionnaires was checked by Cronbach's alpha ( $\alpha$ ) coefficient. Cronbach's alpha is a measure used to assess the reliability or internal consistency of the data on a questionnaire and it ranges from 0 to 1.0. It indicates the extent to which the respondents rate to the same question. For example, if all respondents give similar answer to all questions, the alpha for these questions would be 1.0. The minimum accepted level for reliability when using Cronbach's alpha coefficient is 0.7 and any value below this indicates that the variables are inconsistent and unreliable (Fellows & Liu, 2007). Cronbach's alpha is calculated using the following equation.

$$\alpha = \left(\frac{K}{K-1}\right) \left(\frac{S^2_y - \sum x^2_i}{S^2_y}\right) \dots\dots\dots[\text{Eq. 3.2}]$$

- Where  $\alpha$  = Cronbach's alpha  
 $K$  = the number of items or groups  
 $S_y^2$  = the variance associated with the observed score  
 $\sum X_i^2$  = the sum of all the variance for each item

#### 3.7.2. Relative Importance Index (RII)

The gathered data through questionnaire was analyzed using relative importance index (RII) to determine ranking of causes of delay. In this research, a 5-point Likert scale was used to analyze the data for the ranking of causes and effects of delays. Relative Importance Index (RII) is determined by the following mostly used empirical formula.

$$RII = \sum \frac{W}{A*N} = \dots\dots\dots[\text{Eq. 3.3}]$$

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Where W = is weighting given to each statement by the respondents, range from 1 to 5, and 1 is given to the least implying and 5 for highest implying.

A = is the highest weight integer (5 in 5-point likert scale)

N = is the total number of respondents.

The value of relative importance index lay between 0 and 1 ( $0 \leq RII \leq 1$ ). According to Akadiri (2011) the level of importance described as follows:

Table 3.1 the importance level of index values

RII values	Importance level	
$0.8 \leq RII \leq 1$	High	H
$0.6 \leq RII \leq 0.8$	High-Medium	H-M
$0.4 \leq RII \leq 0.6$	Medium	M
$0.2 \leq RII \leq 0.4$	Medium-Low	M-L
$0 \leq RII \leq 0.2$	Low	L

### 3.7.1. Spearman rank correlation coefficient

Spearman rank correlation coefficient is a statistical measure of the strength of a monotonic relationship between paired data. It was used to determine the strength of rankings between two parties i.e. between client and consultant, client and contractor and consultant and contractor (Dai, 2006). The Spearman rank correlation coefficient is calculated using [Eq.3.4] (Pourrostan & Ismail, 2012):

$$r_s = 1 - \frac{6\sum d^2}{N^3 - N} \dots\dots\dots[\text{Eq-3.4}]$$

Where:  $r_s$  = Spearman rank correlation coefficient

$d$  = Difference in ranking between two parties

$N$  = The number of variables.

The spearman rank correlation coefficient,  $r_s$ , is lay between -1 and 1 ( $-1 \leq r_s \leq 1$ ). When an  $r_s$  is closer to  $\pm 1$ , an indication of strong relationship between two parties. The strength of correlation can be interpreted by using the following guide for the absolute value of spearman rank correlation

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coefficient (Source: [www.statstutor.ac.uk](http://www.statstutor.ac.uk)). However if the spearman rank correlation coefficient is exactly zero, no correlation at all between the parties.

Table 3.2 The strength level of spearman correlation coefficient

The spearman rank correlation coefficient value	Strength of Relationship
0 to 0.19	Very weak
0.2 to 0.39	Weak
0.4 to 0.59	Moderate
0.6 to 0.79	Strong
0.8 to 1.0	Very strong

### 3.7.2. Analysis of Variance (ANOVA)

ANOVA is a statistical method that stands for analysis of variance also called the Fisher analysis of variance that developed by Ronald Fisher in 1918, which is used to do the analysis of variance between and within the groups whenever the groups are more than two (<http://www.statisticssolutions.com>). In this research, ANOVA was used to test the significance of agreement among the parties in their rankings. In this case the null and alternative hypothesis should be set up first and the null hypothesis assumes that there is no significant difference between the groups and the alternative hypothesis assumes that there is a significant difference between the groups.

$H_0 = \mu_1 = \mu_2 = \mu_3$ , no difference between the populations of the three groups or this three sample means comes from the same overall population, i.e. there is no significant difference between the means of client, consultant and contractor respectively.  $H_a = \mu_1 \neq \mu_2 \neq \mu_3$ , the groups are at different level of stress, i.e. at least one population mean differs from other population mean but not which individual groups are different.

This hypothesis is tested using F-Statistic assuming normal distribution and then, if the F-Statistic or calculated value is greater than F-critical value or table value, the null hypothesis is rejected and

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the alternative hypothesis is accepted. Rejecting the null hypothesis, we will conclude that the mean of the groups are not equal,  $\mu_1 \neq \mu_2 \neq \mu_3$ . If the calculated value less than the table value, we will accept the null hypothesis and reject the alternative hypothesis. F-statistic can be calculated by the following re-arranged empirical formula and critical value can be found on the table at (K-1, n-K) location.

$$F = \frac{SSB*(n-K)}{SSW*(K-1)} \dots\dots\dots [Eq-3.5]$$

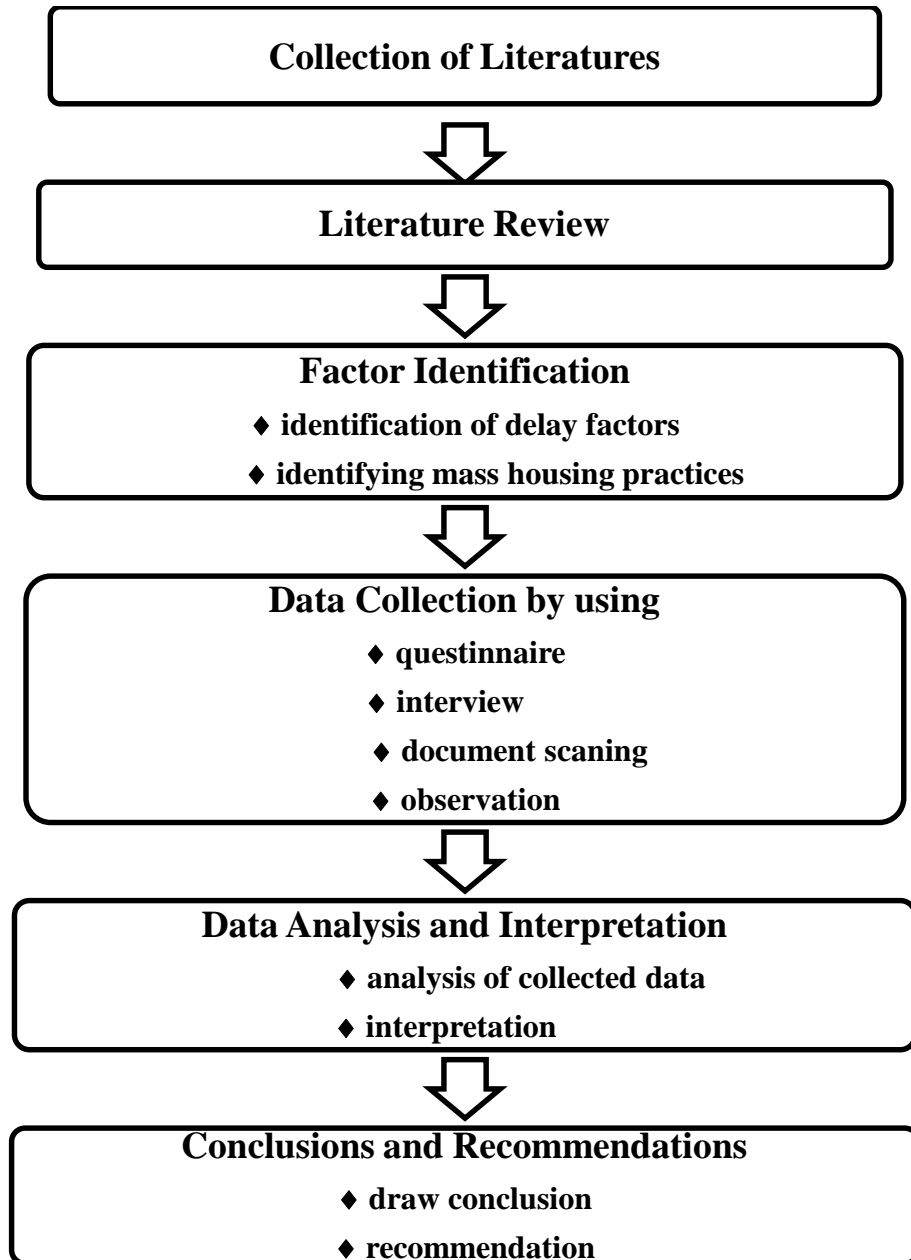
- Where: SSB = mean sum square between groups
- SSW = mean sum square with in groups
- K-1 = degrees of freedom for between groups
- n-K = degrees of freedom for within groups
- n = number of observations
- K = number of groups

$$F = \frac{\text{Between groups variance}}{\text{Within groups variance}} = \frac{\text{mean sum square Between groups}}{\text{mean sum square Within groups}} \dots\dots\dots [Eq. 3.6]$$

In general, for overall data analysis process, Cronbach’s alpha ( $\alpha$ ) coefficient was used to check reliability or consistency of questionnaire data, relative importance index was used to determine ranking of causes and effects of delay, Spearman rank correlation coefficient was used to determine the strength of relationship of rankings between two parties and for the sake of better accuracy ANOVA was also used to test the significance of agreement among the parties in their rankings. All of the above analysis techniques were operated by the help of Microsoft excel.

The overall procedures of the study respectively was, Collection of literature, Literature review, identifies the factors, Collection of data for the case study, Data analysis and interpretation and finally, draws conclusion and recommendations. The designed structure of the research method can be shown by the following flow chart.

**Chart 3.1 The overall procedures of the study**



## **CHAPTER FOUR: DATA ANALYSIS AND DISCUSSION**

### **4.1. Introduction**

The core objective of this chapter is data analysis, interpretation and discussion of the survey results. To achieve this objective first it is crucial to show organization structure, selection process of consultants and contractors. Next the questionnaire response rate is presented; the reliability of questionnaire survey is checked by using Cronbach's alpha coefficient. After checking the reliability, the major causes of delays identified using relative importance index, and then the insights of the three parties in ranking the causes of delay and groups of delay are compared. On top of that, types of delay identified based on sources; responsibility and compensability are presented thoroughly. Furthermore, the agreement of the parties in ranking the causes of delay is checked using Spearman rank correlation coefficient and analysis of variance (ANOVA). This section also presents the interpretation and discussion of the results from delay and finally, chapter summary are presented.

#### **4.1.1. Organizational structure**

The original name of the organization was Addis Ababa Saving House Development Enterprise (AASHDE) and the overall organization was led by one manager and two deputy managers, i.e. one for construction division and the other is for construction material procurement and administration division. Later on the name "manager" changed to "director". The organization had four main sections.

The first one is contract administration division that is responsible for the overall operation of construction works by coordinating the physical operation of contractors and sub-contractors work and the supervision & contract administration works of the consultants.

The second one is material procurement and administration section that is responsible for material procurement, administration, management and delivery. It includes stoking and distribution of materials.

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The third division is finance section, it is the engine of all operations and mainly responsible for releasing approved payments to contractors, consultants, and MSEs. It has also a responsibility to prepare salaries for workers of the organization, payments for materials and equipment procurement. Moreover it prepares and provides financial reports to concerned body.

The fourth division is micro & small enterprise follow-up and support section which manages and assists all MSEs in the project. Micro and small enterprises are sub-contractors assigned by the client based on their trade license, grade of license, and queue precedence of delivery to the organization. The construction works made by MSEs are under supervision of the main contractors and the works includes sanitary installations, electrical installations, steel works of handrails and guardrails. The production of prefabricated building elements like precast beam, wall HCB and ribbed HCB are also the responsibility of MSEs under the supervision of consultant. There are also loading & unloading MSEs responsible for loading and unloading construction materials.

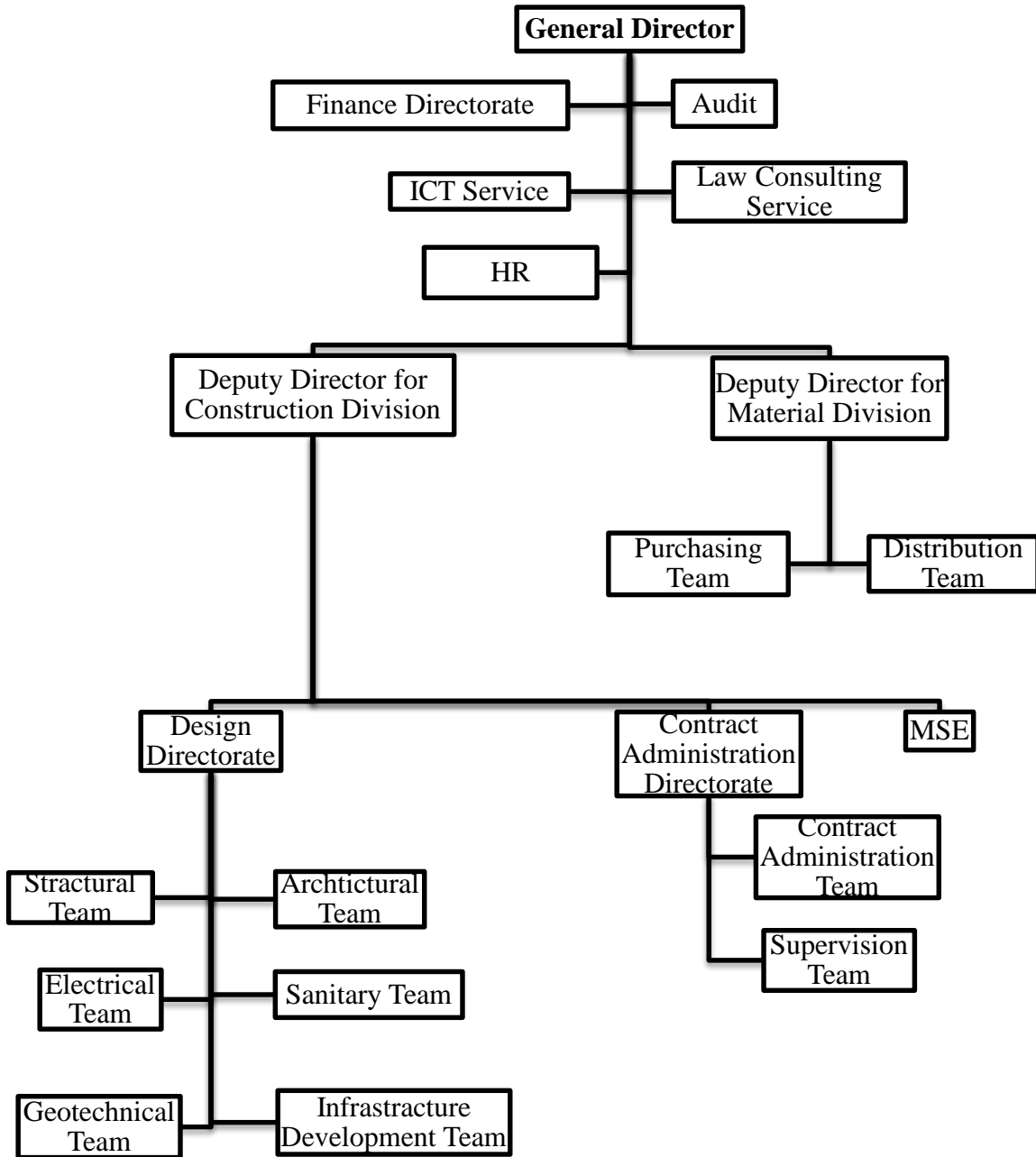
In the head office level of structure, general director, human resource director, finance and audit section leaders, law consulting leader, both deputy directors, contract administration and design section directors MSE section leader all are appointed by their political participation from the ruling party. Branch project managers and deputy project managers are also appointed by the same analogy. Moreover, general director, branch managers and deputy managers can be chosen from non-engineering educational background. The concept of professionalism is undermined in the assignment of project leaders and managers in this huge project. Due to this reason most of the leaders and managers were incapable to lead and manage the project efficiently and effectively.

Currently saving house development enterprise, 40/60, is merged with 20/80 and it is re-organized its structure and the combined name given is Addis Ababa Housing Development Corporation. However type of the housing program is as it is.

The following two charts are representing the head office and branch office 40/60 organizational structure respectively.

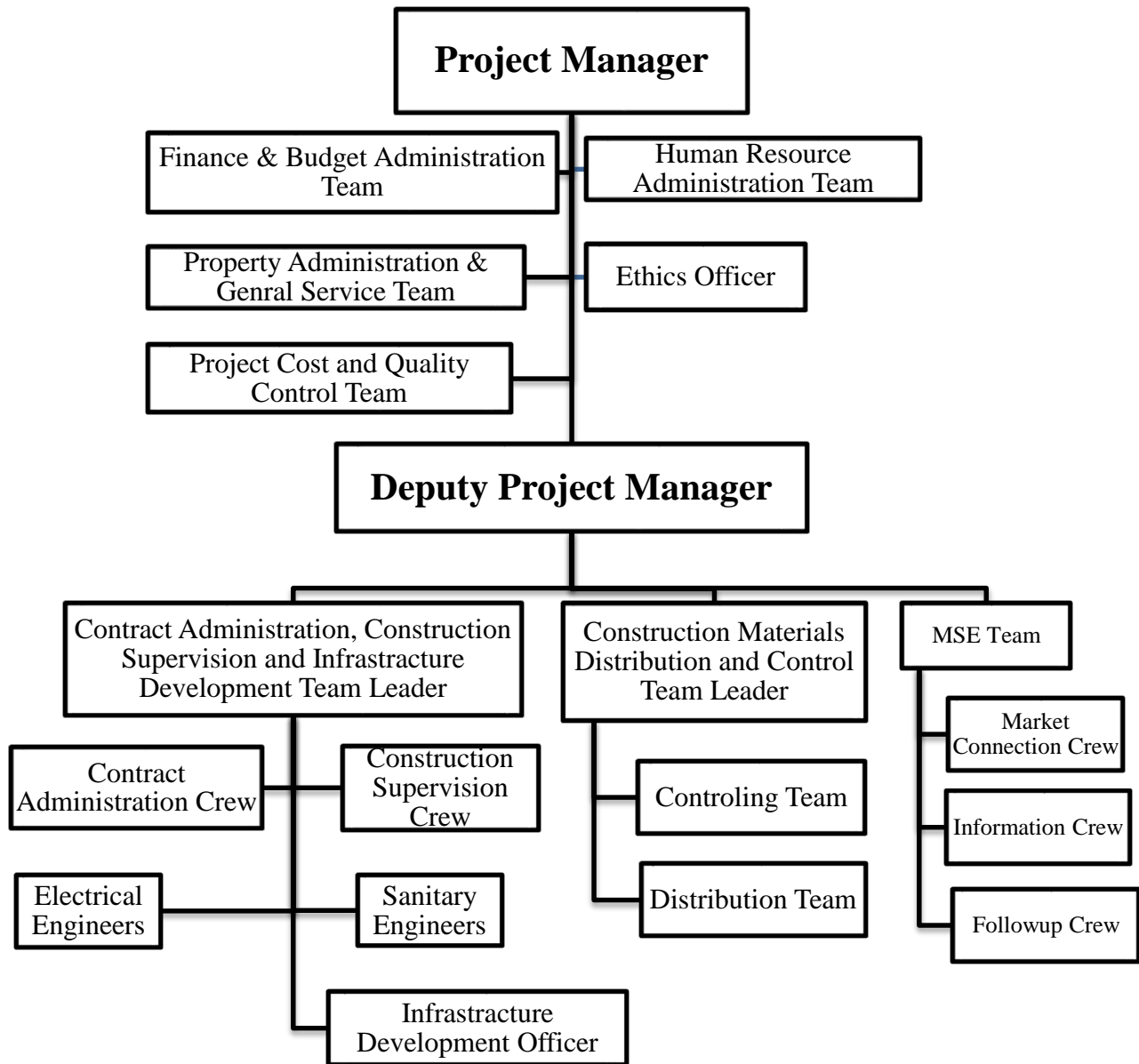
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Chart 4.1 Head office organization structure of Addis Ababa 40/60 housing development



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Chart 4.2 Branch offices organization structure of Addis Ababa 40/60 housing development



#### **4.1.2. Selection Process of Consultants and Contractors**

The selection process of consultants and contractors is one of the determinant factor for the project success and failure. The process used to hire consultants and contractors for the 40/60 housing project is discussed as follows.

##### **4.1.2.1. Selection process of Consultants'**

The invitation for bid was based on open tendering and the process to select successful bidders from applicants was, technical document evaluation accounts 80% and financial document evaluation accounts 20% of the consultant's offer. To open financial documents, the minimum requirement for technical score was 70%. The financial proposal offered by the consultants was monthly salary per block. To determine financial scores for each proposal, the lowest priced proposal was given a financial score of 100, and other proposals were given a score proportionate to this. A total score was determined for each proposal, by combining its Technical and Financial scores and then proposals were ranked and the proposal achieving the highest total score was recommended for contract award.

##### **4.1.2.2. Selection process of Contractors'**

The type of contract used by 40/60 housing project is fixed-unit price. Addis Ababa 40/60 housing construction recruits local contractors based on the following criteria. The big point was given for the financial turnover and the three years financial turnover given a weight of 50%, Work experience in housing project given a weight of 20%, Work experience in any other projects accounts 15%, and good performance accounts 15%. Grade-1 up to grade-3 local contractors, who scored more than 70%, were chosen and grade-1 contractors assigned to build up to 18-story buildings, grade-2 contractors assigned to construct up to 13-story buildings and grade-3 contractors to build up to 9-story buildings. The existing contractors which have better performance during their progress were awarded additional terminated blocks.

### 4.1.3. Some Binding Clauses in the Contract Agreement

In the original contractors' contract document, the agreed contractual modality was fixed unit price and also the price adjustment was boldly stated as not applicable. However the price adjustment was made. The contract agreement of consultants and contractors were stated by some influential statements and clauses. One of the statements related to delay that influence consultants was "the consultant shall be penalized proportional to its profit with a maximum limit of 10% of its monthly supervision and contract administration income for the delayed blocks if the consultant has been proven to be the reason for delay of progress of construction". The contractors also obliged to pay a minimum of 0.1% and maximum of 10% liquidated damage for the delayed work. However no one consultant is punished for the delay of works and there is no single contractor paid liquidated damage even though the project is delayed more than twice of the contract period. Based on the original contract, the contract expiration date of consultants were agreed to be after three months of project completion date and could be renewed up on demand of the client.

Table 4.1. Summary of some binding clauses in the contract agreement

Conditions of contract	Applicable clauses	Conditions
Advance payment amount	Clause 60.2	20% of contract amount
Advance security	Clause 58.1	20% of contract (unconditional)
Performance security	Clause 58.1	10% of contract amount
Price adjustment	Clause 62.7	Not applicable in this contract
Engineers power for variation limit	Clause 15.7	15% of contract price
Time extension limit by engineer	Clause 73	25% of contract time
Commencement time	GCC 71.1	5 calendar days
Program submission time	Clause 41.1	15 calendar days
Program revision period	Clause 41.4	30 calendar days
Liquidated damage	Clause 27	Min 0.1% and Max 10% of contract
Defect liability period	Clause 88	365 calendar days
Interim payment frequency and rate	Clause 64.7	Min 5% of contract amount and one interim payment per month

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Interest rate up on unpaid sum	Clause 67.1	Commercial banks interest policy
Currency type	Clause 59.1	Ethiopian birr
Retention amount	Clause 61.1	5% of certified amount
Contract type	GCC 16.1	Fixed price type of contract
Obligations of public body	GCC 30.2 and 30.3	
Obligations of contractors	GCC 34.1	A list of plants and equipment
	GCC38.3	A list of key personnel schedule
	GCC 38.2(b)	110% amount of aggregate liability
	GCC 52.5	Responsible for Design and construction temporary works
	GCC 80.2	Stress works to be done as per specified material, equipment, quality and components
Warranty in respect to defect of construction	Article 3039 on the civil code	10 years starting final acceptance
Consultants Expiration date of contract	GCC 13.1	After three months of project completion

#### 4.2. Questionnaire Response Rate

The questionnaire was prepared and distributed to three contractual parties i.e. client, consultants and contractors currently working on the three 40/60 housing project branches. A total of 108 questionnaires were distributed in the three branch offices and equal thirty four questionnaires were distributed to each party. Furthermore, twelve questionnaires for each branch two client, consultant and contractor engineers, twelve questionnaires for each branch three client, consultant and contractor engineers and twelve questionnaires for each branch four client, consultant and contractor engineers. The questionnaire distribution and collection took ten days and the response rate is as shown below. Table 4.2 below shows that the total questionnaire response rate and the response given by each party was the same 91.7%. Consultant responses in branch two was 83.3%, branch three was 100% and in branch four were 91.7%. Contractors' responses in branch two were 91.7%, in branch three were 100% and in branch four were 83.3%.

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Table 4.2 Questionnaire Response Rate

Contractual parties		No. of Questionnaire distributed	No. of Questionnaire responded		Response rate	
			By branch	Total	By branch	Total
Client	Branch-2	12	11	33	91.7%	91.7%
	Branch-3	12	11		91.7%	
	Branch-4	12	11		91.7%	
Consultant	Branch-2	12	10	33	83.3%	91.7%
	Branch-3	12	12		100%	
	Branch-4	12	11		91.7%	
Contractor	Branch-2	12	11	33	91.7%	91.7%
	Branch-3	12	12		100%	
	Branch-4	12	10		83.3%	
Total		108	99	99	91.7%	91.7%

Source: Field Survey (February 2020)

As per table 4.3 below, in terms of education levels of client respondents (2) 6.1% were diploma holders, (27) 81.8% were BSc degree holders whereas (4) 12.1% were MSc degree holders. (1) 3% of Consultant respondents were diploma holders, (29) 87.9% were BSc degree holders and (3) 9.1% were MSc holders. In the case of contractors (32) 97% were BSc holders and (1) 3% were MSc holder. The overall educational qualification of respondents in this research were (3) 3% of the respondents diploma holders, (88) 88.9% of the respondents BSc degree holders and (8) 8.1% of them were MSc holders.

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Table 4.3 Educational qualification of respondents

Participant parties in each branch projects		Qualification							
		Diploma		BSc. Degree		Masters		Total	
		No.	In %	No.	In %	No.	In %	No.	In %
<b>Client</b>	Branch-2	0	0	10	30.3	1	3	11	33.3
	Branch-3	1	3	9	27.3	1	3	11	33.3
	Branch-4	1	3	8	24.2	2	6.1	11	33.3
	<b>Total client</b>	<b>2</b>	<b>6.1</b>	<b>27</b>	<b>81.8</b>	<b>4</b>	<b>12.1</b>	<b>33</b>	<b>100</b>
<b>Consultant</b>	Branch-2	1	3	7	21.2	2	6.1	10	30.3
	Branch-3	0	0	12	36.4	0	0	12	36.4
	Branch-4	0	0	10	30.3	1	3	11	33.3
	<b>Total consultant</b>	<b>1</b>	<b>3</b>	<b>29</b>	<b>87.9</b>	<b>3</b>	<b>9.1</b>	<b>33</b>	<b>100</b>
<b>Contractor</b>	Branch-2	0	0	11	33.3	0	0	11	33.3
	Branch-3	0	0	12	36.4	0	0	12	36.4
	Branch-4	0	0	9	27.3	1	3	10	30.3
	<b>Total contractor</b>	<b>0</b>	<b>0</b>	<b>32</b>	<b>97</b>	<b>1</b>	<b>3</b>	<b>33</b>	<b>100</b>
<b>Total All</b>		<b>3</b>	<b>3</b>	<b>88</b>	<b>88.9</b>	<b>8</b>	<b>8.1</b>	<b>99</b>	<b>100</b>

Source: Field Survey (February 2020)

In terms of job positions within the project based on table 4.4 below, (27) 27.3% of client respondents were site supervisors, (5) 5.1% of the respondents from client side were contract administration officers and (1) 1% of client respondent were project manager. From the consultants side (20) 20.2% were site supervisors, (5) 5.1% were office engineers, and (8) 8.1% were resident engineers. From the contractor side (19) 19.2% respondents were site engineers, (3) 3% of the respondents were office engineers and (11) 11.1% of the respondents were project managers.

The overall job position of respondents in this research identified that, (19) 19.2% of the respondents were site engineers, (47) 47.5% of the respondents were site supervisors, (8) 8.1% of respondents were office engineers, (5) 5.1% of respondents were contract administration officers, (8) 8.1% respondents were resident engineers and (12)12.1% of the respondents were project managers.

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Table 4.4 Job position of respondents

No.	Job Position in the organization		Client		Consultant		Contractor		Total	
			No	In %	No	In %	No	In %	No	In %
1	Site engineer	Branch-2	-	-	-	-	9	9.1	9	9.1
		Branch-3	-	-	-	-	7	7.1	7	7.1
		Branch-4	-	-	-	-	3	3	3	3
		<b>Total</b>	-	-	-	-	<b>19</b>	<b>19.2</b>	<b>19</b>	<b>19.2</b>
2	Site supervisor	Branch-2	9	9.1	3	3	-	-	12	12.1
		Branch-3	9	9.1	11	11.1	-	-	20	20.2
		Branch-4	9	9.1	6	6.1	-	-	15	15.2
		<b>Total</b>	<b>27</b>	<b>27.3</b>	<b>20</b>	<b>20.2</b>	-	-	<b>47</b>	<b>47.5</b>
3	Office engineer	Branch-2	-	-	2	2	-	-	2	2
		Branch-3	-	-	-	-	2	2	2	2
		Branch-4	-	-	3	3	1	1	4	4.1
		<b>Total</b>	-	-	<b>5</b>	<b>5.1</b>	<b>3</b>	<b>3</b>	<b>8</b>	<b>8.1</b>
4	Contract admin. Officer	Branch-2	2	2	-	-	-	-	2	2
		Branch-3	2	2	-	-	-	-	2	2
		Branch-4	1	1	-	-	-	-	1	1
		<b>Total</b>	<b>5</b>	<b>5.1</b>	-	-	-	-	<b>5</b>	<b>5.1</b>
5	Resident engineer	Branch-2	-	-	5	5.1	-	-	5	5.1
		Branch-3	-	-	1	1	-	-	1	1
		Branch-4	-	-	2	2	-	-	2	1
		<b>Total</b>	-	-	<b>8</b>	<b>8.1</b>	-	<b>0</b>	<b>8</b>	<b>8.1</b>
6	Project manager	Branch-2	-	-	-	-	2	2	2	2
		Branch-3	-	-	-	-	3	3	3	3
		Branch-4	1	1	-	-	6	6.1	7	7.1
		<b>Total</b>	<b>1</b>	<b>1</b>	-	-	<b>11</b>	<b>11.1</b>	<b>12</b>	<b>12.1</b>
<b>Total in all</b>			<b>33</b>	<b>33.3</b>	<b>33</b>	<b>33.3</b>	<b>33</b>	<b>33.3</b>	<b>99</b>	<b>100</b>

Source: Field survey (February 2020)

As per table 4.5 below the years of working experience of the client respondents, (22) 22.2% of the respondents have less than 5 years working experience, (9) 9.1% of the respondents have 5-10 years working experience, (2) 2% of the respondents have 11-15 years working experience. From the consultant side, (15) 15.2% of the respondents have less than 5 years working experience, (15) 15.2% of the respondents have 5-10 years working experience, (3) 3% of the respondents have 11-15 years working experience. From the respondents of contractor side (19) 19.2% have less than 5 years working experience, (7) 7.1% of the respondents have 5-10 years working experience, (6)

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6.1% of the respondents have 11-15 years working experience and (1) 1% of the respondent have greater than 15 years of working experience. The overall working experience of the respondents were (56) 56.6% of the respondents have less than 5 years' work experience, (31) 31.3% of the respondents have 5-10 years' work experience, (11) 11.1% of the respondents have 10-15 years' work experience and (1) 1% of the respondents have greater than 15 years of work experience.

Table 4.5 Years of working experience of the respondents

Year of experience		Client		Consultant		Contractor		Total	
		No	In %	No	In %	No	In %	No	In %
Less than 5 years	Branch-2	8	8	6	6.1	7	7	21	21.2
	Branch-3	7	7.1	4	4	6	6.1	17	17.2
	Branch-4	7	7.1	5	5.1	6	6.1	18	18.2
	<b>Total</b>	<b>22</b>	<b>22.2</b>	<b>15</b>	<b>15.2</b>	<b>19</b>	<b>19.2</b>	<b>56</b>	<b>56.6</b>
5-10	Branch-2	3	3	4	4	1	1	8	8.1
	Branch-3	3	3	7	7.1	3	3	13	13.1
	Branch-4	3	3	4	4	3	3	10	10.1
	<b>Total</b>	<b>9</b>	<b>9.1</b>	<b>15</b>	<b>15.2</b>	<b>7</b>	<b>7</b>	<b>31</b>	<b>31.3</b>
10-15	Branch-2	-	-	1	1	3	3	4	4
	Branch-3	1	1	1	1	3	3	5	5.1
	Branch-4	1	1	1	1	-	-	2	2
	<b>Total</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>6</b>	<b>11</b>	<b>11.1</b>
Greater than 15 years	Branch-2	-	-	-	-	-	-	-	-
	Branch-3	-	-	-	-	-	-	-	-
	Branch-4	-	-	-	-	1	1	1	1
	<b>Total</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>Total</b>		<b>33</b>	<b>33.3</b>	<b>33</b>	<b>33.3</b>	<b>33</b>	<b>33.3</b>	<b>99</b>	<b>100</b>

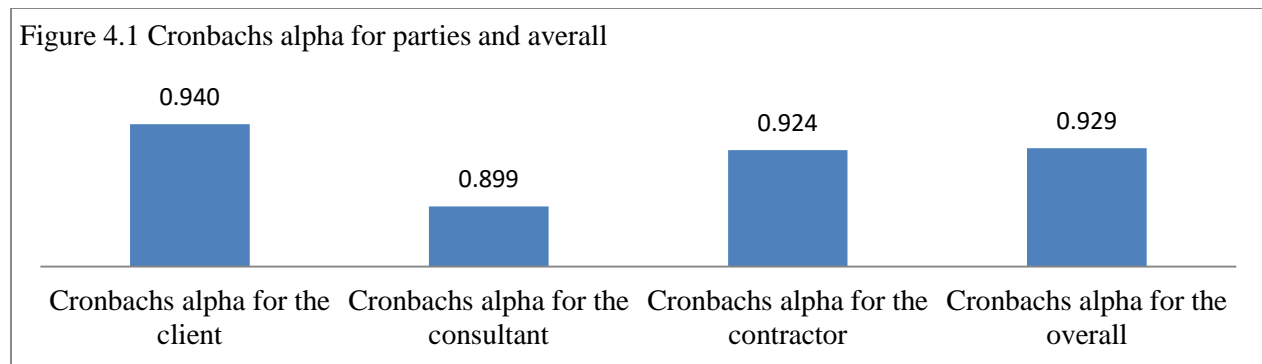
Source: Field Survey (February 2020)

### 4.3. Reliability and validity issues

Quality is always one of the most important issues in research and therefore it can be judged mainly through testing the reliability and validity. Reliability is a central concept in measurement and it basically means consistency. Validity is the best available approximation to the truth of a given inference or conclusion.

#### 4.3.1. Cronbach's alpha ( $\alpha$ ) coefficient

Cronbach's alpha coefficient was used to test the reliability or consistency of the questionnaire survey and its value ranges from 0 to 1. The Cronbach's alpha values were determined using equation 3.2 shown in chapter 3 section 3.7.1. Taking client, consultant, contractor and overall respondents, the  $\alpha$ -values were 0.940, 0.899, 0.924, and 0.929, respectively. All  $\alpha$ -values were greater than the minimum level for reliability. The minimum level for reliability explained by Fellows & Liu (2007) is 0.7. Therefore, it can be concluded that the questionnaire survey was reliable and consistent.



### 4.4. Determination of Relative Importance Index and Ranking of Delay factors

Relative importance index (RII) analysis was conducted using equation 3.3 to determine the relative importance of the various causes of delays. The five-point likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to determine relative importance index of each cause of delays as shown in table 4.6 below. The rankings as responded by the three groups of parties (i.e. client, consultants and contractors) were compared to show the perceptions of the three parties and finally the overall ranking was determined in order to identify the major top twenty causes of delays in Addis Ababa 40/60 housing construction project.

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Table 4.6 Summary of relative importance index and ranking of delay factors

Causes of delay	Client		Consultant		Contractor		Average score	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
<b>A. Design related causes</b>	<b>0.684</b>	<b>6</b>	<b>0.662</b>	<b>6</b>	<b>0.667</b>	<b>7</b>	<b>0.671</b>	<b>6</b>
Design errors and incomplete drawings	0.776	9	0.745	9	0.745	11	0.756	8
Complexities and ambiguities of project design	0.570	58	0.606	59	0.527	68	0.568	65
Delays in providing the design documents by the designer	0.679	47	0.642	48	0.691	32	0.671	44
Inadequate experience of the designer	0.655	50	0.624	52	0.642	50	0.640	52
Poor contract document and specifications	0.733	29	0.667	40	0.739	13	0.713	26
Frequent design change	0.691	43	0.685	27	0.655	45	0.677	41
<b>B. Materials Related Causes</b>	<b>0.742</b>	<b>3</b>	<b>0.733</b>	<b>2</b>	<b>0.734</b>	<b>2</b>	<b>0.737</b>	<b>2</b>
Late delivery of materials by the client	0.976	1	0.976	1	0.988	1	0.980	1
Poor procurement of materials	0.745	19	0.642	48	0.697	31	0.695	32
Escalation of material prices	0.758	12	0.727	11	0.758	9	0.747	9
Shortage of construction material in the market	0.600	54	0.655	46	0.630	52	0.628	56
Change in material types and specifications during construction	0.618	52	0.703	16	0.588	59	0.636	54
Delay in testing and approving of materials	0.758	12	0.697	17	0.745	11	0.733	14
Poor quality of materials	0.564	62	0.618	54	0.576	61	0.586	61
Existence of Unreliable suppliers	0.636	51	0.624	52	0.630	52	0.630	55
Delay in importation of materials	0.739	22	0.679	33	0.739	13	0.719	20
<b>C. Client related Causes</b>	<b>0.720</b>	<b>5</b>	<b>0.754</b>	<b>1</b>	<b>0.754</b>	<b>1</b>	<b>0.742</b>	<b>1</b>
Slow decision making by the client	0.782	8	0.879	4	0.939	2	0.867	4
Poor supervision of work by the client	0.612	53	0.642	48	0.661	43	0.638	53
Late in approving design documents by the client	0.679	47	0.661	43	0.655	45	0.665	48
Improper contractor selection	0.952	3	0.903	3	0.764	7	0.873	3
Delay in interim payments of completed work by the client	0.588	55	0.697	17	0.764	7	0.683	37
Frequent changes order by the client during construction	0.709	37	0.739	10	0.739	13	0.729	16
Incapable project manager delegation	0.691	43	0.685	27	0.691	32	0.689	36
Lack of communication and coordination	0.752	16	0.667	40	0.681	35	0.700	30
Bureaucracy of government authorities	0.794	7	0.818	6	0.848	4	0.820	6
Presence of multiple stakeholders	0.764	11	0.727	11	0.721	23	0.737	13
<b>D. Consultant Related Causes</b>	<b>0.767</b>	<b>1</b>	<b>0.643</b>	<b>7</b>	<b>0.725</b>	<b>3</b>	<b>0.712</b>	<b>4</b>
Inadequate consultant experience	0.739	22	0.588	65	0.709	29	0.679	40

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Delay in approving shop drawings and sample materials	0.800	6	0.697	17	0.733	17	0.743	10
Poor contract management by the consultant	0.739	22	0.618	54	0.721	23	0.693	34
Weak supervision by the consultant	0.715	34	0.594	63	0.673	40	0.661	49
Delay in approving payment certificate	0.848	5	0.691	24	0.776	5	0.772	7
Technically Incapable consultant staff	0.758	12	0.673	38	0.739	13	0.723	18
Malpractice (unethical practices) by the consultant	0.776	9	0.673	38	0.770	6	0.739	12
<b>E. Contractor Related Causes</b>	<b>0.767</b>	<b>2</b>	<b>0.730</b>	<b>3</b>	<b>0.677</b>	<b>5</b>	<b>0.725</b>	<b>3</b>
Rework for mistakes in construction	0.685	45	0.606	59	0.588	59	0.626	57
Difficulties in financing project by contractor	0.964	2	0.970	2	0.909	3	0.947	2
Inadequate contractor experience	0.745	19	0.679	33	0.655	45	0.693	33
Inappropriate construction methods	0.727	32	0.697	17	0.600	57	0.675	42
Poor site management and supervision	0.733	29	0.679	33	0.630	52	0.681	39
Improper project planning and scheduling	0.745	19	0.752	8	0.679	36	0.725	17
Incompetent project team	0.709	37	0.661	43	0.679	36	0.683	38
Obsolete technology used by contractor	0.861	4	0.879	4	0.733	17	0.824	5
Delays in sub-contractors work	0.752	16	0.721	14	0.752	10	0.741	11
Fraud practices by contractor	0.697	40	0.685	27	0.545	65	0.642	51
Poor cash flow management by the contractor	0.739	22	0.697	17	0.715	27	0.717	22
<b>F. Equipment Related Causes</b>	<b>0.640</b>	<b>8</b>	<b>0.643</b>	<b>7</b>	<b>0.603</b>	<b>8</b>	<b>0.629</b>	<b>8</b>
Low skilled equipment operators	0.570	58	0.515	68	0.533	67	0.539	69
Equipment availability problem in the market	0.545	64	0.594	63	0.539	66	0.560	66
Improper and insufficient number of equipment	0.739	22	0.764	7	0.655	45	0.719	21
Frequent equipment breakdown and shortage of parts	0.570	58	0.600	61	0.570	63	0.580	63
Low productivity and inefficient level of equipment	0.715	34	0.697	17	0.594	58	0.669	45
Scarcity of hard currency to import equipment	0.703	39	0.691	24	0.727	20	0.707	28
<b>G. Labour Related Causes</b>	<b>0.661</b>	<b>7</b>	<b>0.670</b>	<b>5</b>	<b>0.669</b>	<b>6</b>	<b>0.667</b>	<b>7</b>
Unqualified work force (Shortage of skilled labour)	0.733	29	0.697	34	0.685	34	0.705	29
Low productivity level of labour	0.697	40	0.727	20	0.727	20	0.717	23
Labour absenteeism	0.576	57	0.636	49	0.648	49	0.620	58
Labor strikes	0.545	64	0.612	64	0.552	64	0.570	64
<b>H. Contractual and Administrative Causes</b>	<b>0.721</b>	<b>4</b>	<b>0.671</b>	<b>4</b>	<b>0.702</b>	<b>4</b>	<b>0.698</b>	<b>5</b>

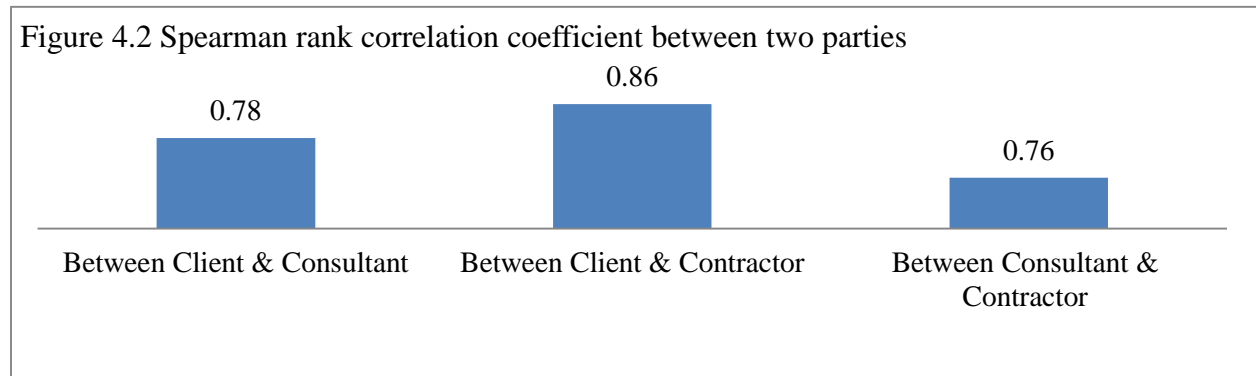
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Inappropriate consultant agreement	0.752	16	0.679	33	0.733	17	0.721	19
Inappropriate client partial material supply agreement	0.739	22	0.685	27	0.721	23	0.715	24
Political assignment of client project managers	0.685	45	0.648	47	0.667	41	0.667	46
Political interference for technical and contractual works.	0.715	34	0.691	24	0.721	23	0.709	27
Discrepancies between BOQ, specification and drawings	0.758	12	0.709	15	0.727	20	0.731	15
Inappropriate organization management	0.679	47	0.612	56	0.642	50	0.644	50
Lack of sense of ownership by the managers of organization	0.739	22	0.685	27	0.715	27	0.713	25
Incapable contract administration team	0.727	32	0.667	40	0.679	36	0.691	35
<b>I. External Related Causes</b>	<b>0.540</b>	<b>9</b>	<b>0.567</b>	<b>9</b>	<b>0.561</b>	<b>9</b>	<b>0.556</b>	<b>9</b>
Unforeseen ground and geological conditions.	0.545	64	0.588	65	0.509	69	0.547	68
Adverse weather conditions	0.570	58	0.600	61	0.667	41	0.612	59
Changes in government regulations and laws	0.588	55	0.582	67	0.576	61	0.582	62
Slow permit by government/municipality	0.552	63	0.612	56	0.624	55	0.596	60
Fluctuations in cost/ currency	0.697	40	0.685	27	0.709	29	0.697	31
Natural disasters (flood, hurricane, earthquake)	0.291	67	0.333	70	0.279	70	0.301	70
Local political instability	0.679	47	0.679	33	0.661	43	0.673	43
Lack of infrastructure (road, water, electric supply, etc.)	0.655	50	0.661	43	0.679	36	0.665	47
Right of way problem	0.564	62	0.485	69	0.606	56	0.552	67

Due to variety of perceptions among the client, consultant and contractors, the ranking given by each party also may not be necessarily identical in all causes of delay and becomes diversified rank for the same issue. This conflict on the rankings of causes of delay due to either the respondents' perception or favoring for the parties they are working for and blaming the other parties. To negotiate the conflicted rankings of the parties, the average relative importance index of client, consultant and contractors taken as the governing ranking.

#### 4.5. Spearman Rank Correlation Coefficient (rs)

The Spearman rank correlation coefficient was determined to assess the strength of relationship of ranking between two parties. It was calculated using equation 3.4 and the results of the correlation between client and consultant, client and contractor, and consultant and contractor were 0.78, 0.86 and 0.76 respectively. These values show that there is very strong agreement or correlation between the rankings of client and contractor. There is also strong agreement of rankings between client and consultant as well as consultant and contractor. The values obtained from the analysis indicate that the ranking correlation among the parties is in a good acceptable level.



#### 4.6. Analysis of Variance (ANOVA)

The null hypothesis that there is no difference among the client, the consultant and the contractor means was checked using F-Statistic at 95 % confidence level. The analysis was carried out in Excel and completed by using equation 3.5. The result shows that  $F\text{-statistic} = 1.12 < F\text{-critical} = 3.0$  at an  $\alpha$ -value of 0.05, which is still in the acceptable region, so the null hypothesis is fail to reject, i.e. the three groups can be considered as random samples from the same population

Table 4.7 Excel output of analysis of variance (ANOVA).

Sources of variation	Sum square	Degree of freedom	F-statistics	$\alpha$ -value	F-critical
Between groups	0.02	2	1.12	0.05	3.0
Within group	1.89	207			
Total	1.91				

Client, consultant and contractors are the three groups and the number of observed questions for each group are 70 and the total observation is 210. Degree of freedom between groups in table 4.7 above was obtained by deducting one from the number of groups (k), i.e.  $k-1 = 3-1$  and degree of freedom within group was obtained by deducting number of groups from total observation (n) in existing groups, i.e.  $n - k = 210-3$ .

#### **4.7. Identification of Top-20 Major Causes of Delay**

The level of importance described by Akadiri (2011) is explained in table 3.1. Based on this level of importance it was tried to level the causes of delay in the construction of 40/60 housing project and (6) 8.6% causes of delay leveled as high level of importance, (53) 75.7% causes of delay lay in the range of medium-high level of importance, (10) 14.3% causes of delay have medium level of importance and (1) 1.4% cause of delay have medium-low level of importance.

Even though 84.3% of the causes of delay have high and medium-high level of importance in this questionnaire analysis, the following twenty causes of delay in 40/60 housing construction project have got emphasis by the interviewee people as the major causes of delay in this project.

The top twenty causes of delay in the construction of Addis Ababa 40/60 housing project shown in the table 4.8 below are: late delivery of materials by the client (RII=0.980) is the primary cause equally top ranked by the three parties, difficulties in financing project by contractor (RII=0.947), improper contractor selection (RII=0.873), slow decision making by the client (RII=0.867), obsolete technology used by contractor (RII=0.824), bureaucracy of government authorities (RII=0.820), delay in approving payment certificates by the consultant (RII=0.772), design errors and incomplete drawings (RII=0.756), escalation of materials price (RII=0.747), delay in approving shop drawings (RII=0.743), delays in sub-contractors work (RII= 0.741), malpractice (unethical practices) by the consultant (RII=0.739), presence of multiple stakeholders (RII=0.737), delay in testing and approving of materials (RII=0.733), discrepancies between BOQ, specification and drawings (RII=0.731), frequent changes order by the client during construction (RII=0.729), improper project planning and scheduling (0.725), technically incapable consultant staff (RII=0.723), inappropriate consultant agreement (RII=0.721) and delay in importation of materials (RII=0.719) respectively from first ranked to twentieth ranked.

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Obsolete technology means the state of old fashioned or outdated technology. For example most contractors still used chuter to transport concrete in the basement instead of concrete pump or crane.

Table 4.8 Identified top-20 causes of delay in 40/60 housing construction project.

No	Causes of delay	Client		Consultant		Contractor		Average	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
1	Late delivery of materials by the client	0.976	1	0.976	1	0.988	1	0.980	1
2	Difficulties in financing project by contractor	0.964	2	0.970	2	0.909	3	0.947	2
3	Improper contractor selection	0.952	3	0.903	3	0.764	7	0.873	3
4	Slow decision making by the client	0.782	8	0.879	4	0.939	2	0.867	4
5	Obsolete technology Used by contractor	0.861	4	0.879	4	0.733	17	0.824	5
6	Bureaucracy of government authorities	0.794	7	0.818	6	0.848	4	0.820	6
7	Delay in approving payment certificate by the consultant	0.848	5	0.691	24	0.776	5	0.772	7
8	Design errors and incomplete drawings	0.776	9	0.745	9	0.745	11	0.756	8
9	Escalation of material prices	0.758	12	0.727	11	0.758	9	0.747	9
10	Delay in approving shop drawings	0.800	6	0.697	17	0.733	17	0.743	10
11	Delays in sub-contractors work	0.752	16	0.721	14	0.752	10	0.741	11
12	Malpractice by the consultant	0.776	9	0.673	38	0.770	6	0.739	12
13	Presence of multiple stakeholders	0.764	11	0.727	11	0.721	23	0.737	13
14	Delay in testing and approving of materials	0.758	12	0.697	17	0.745	11	0.733	14
15	Discrepancies between BOQ, specification and drawings	0.758	12	0.709	15	0.727	20	0.731	15
16	Frequent changes order by the client during construction	0.709	37	0.739	10	0.739	13	0.729	16
17	Improper project planning and scheduling	0.745	19	0.752	8	0.679	36	0.725	17
18	Technically Incapable consultant staff	0.758	12	0.673	38	0.739	13	0.723	18
19	Inappropriate consultant agreement	0.752	16	0.679	33	0.733	17	0.721	19
20	Delay in Importation of materials	0.739	22	0.679	33	0.739	13	0.719	20

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As shown in the table 4.8 clearly, the ranking given by each party was not the same in many of the major delay factors. Some of the rankings given by the parties were very far apart. Even though few undeniable causes of delay were similarly ranked by the three parties, when the delay factors are client sourced, the owner tried to protect himself and the other two parties were gave the same or very closely similar rank for the issue. On the other hand when the delay factors are consultant sourced or contractor sourced, the consultant or the contractor denied to accept the issue and the other the two agreed in ranking. This conflict on the ranking of delay factors due to the individual respondents perception, favoring for their organization and/or to protect themselves from accountability. For the aim of clarity it is better to show some of the rankings that given by the client, consultants and contractors.

Improper contractor selection and obsolete technology used by contractors were the major delay factors that have a consensus ranking by the client and consultant, in contrast the contractor tried to refuse. In the case of the delay factor improper contractor selection, the client and consultant gave rank 3<sup>rd</sup> for the issue, whereas it was ranked 7<sup>th</sup> by the contractor. The delay factor obsolete technology used by contractors was ranked 4<sup>th</sup> by the client and consultants however it was ranked 17<sup>th</sup> by the contractors. This is because contractors believed that they were selected by the correct way and they consider they are used necessary latest technologies, but this deny is to protect themselves from accountability.

Delay in approving payment certificate by the consultants, technically incapable consultant staff and inappropriate consultant agreement are consultant related issues that have a better agreement in ranking by the client and contractors, whereas the ranks given by the consultants were very far from the other two parties.

Delay in approving payment certificate by the consultants ranked 5<sup>th</sup> by the client and contractors, but it was ranked 24<sup>th</sup> by the consultants. This is because the consultants to give a better value for them and to protect themselves from accountability.

The second consultants related delay factor was technically incapable consultant staff and it was ranked 12<sup>th</sup> by the client and 13<sup>th</sup> by the contractors whereas 38<sup>th</sup> by the consultants. The reason

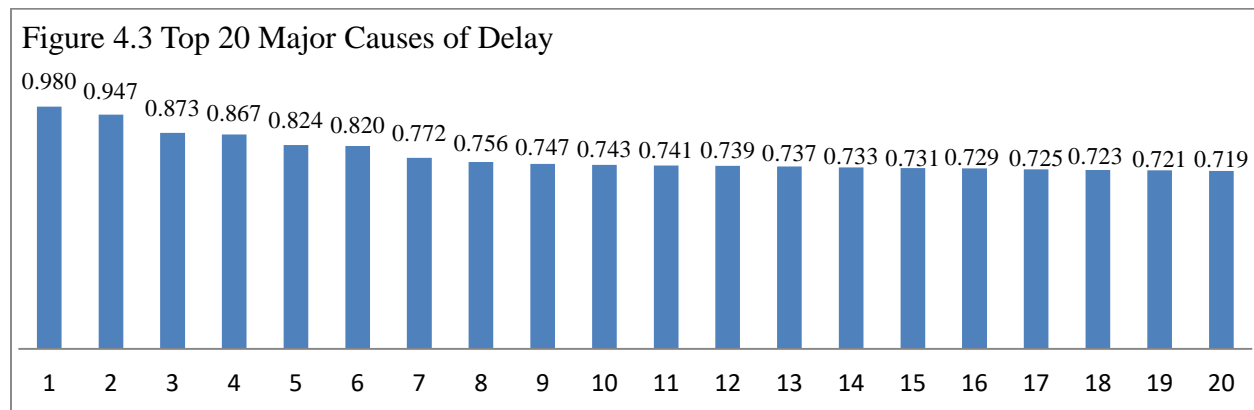
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that the rank given by the consultant very far apart from the other parties was some of the respondents consider themselves capable and the others to seeming capable and to retain or to sale themselves in the market by tackle such kinds of issues.

The other major delay factor that ranked 33<sup>rd</sup> by the consultants 16<sup>th</sup> by the client and 17<sup>th</sup> by the contractor was inappropriate consultant agreement. Since the monthly payment per block was suitable for consultants. Because the staffs job is secure from delay of the project and the company's monthly revenue is sustained.

Finally, improper planning and scheduling was another factor that was ranked 8<sup>th</sup> by the consultants, 19<sup>th</sup> by the client and 36<sup>th</sup> by the contractor. In this case the rankings given by all the three parties were conflicted. The reasons for this diverged ranks are the client and contractors to defend themselves from accountability and more planning and scheduling was expected from the contractors that was needed for the whole operational activities consequently the contractor highly defend to escape from liability. The client also expected to plan and schedule for material procurement and delivery. However, the client believed that the planning and scheduling originated from the consultants because, the material quantity and delivery time schedule made by the consultant. Due to this reason the owner protect himself by sharing accountability to the consultant.

On the other hand some of the major delay factors are ranked without getting side or no need to get side. This is happened because of the perceptions of the individual respondents.



#### 4.8. Ranking causes of delay by the cause groups

The questionnaire was organized in to nine general cause groups of delay. Very important major causes of delay were identified from different cause groups. The following ranking of cause groups of delay helps to identify which cause groups contribute more for the delay of the project.

As shown in Table 4.9 hereunder, the analysis result shows that consultant related causes (RII=0.769), contractor related causes (RII=0.767) and material related causes (RII=0.742) are the top three groups of delay causes as perceived by the client. However, client related causes (RII=0.754), material related (RII=0.733) and contractor related causes were ranked top three groups of delays by consultants. On the other hand, client related causes (RII=0.754), material related causes (RII=0.734) and consultant related causes (RII=0.725) were ranked the top three groups of delays by contractor. The overall result showed that client related causes (RII=0.742), material related causes (RII=0.737) and contractor related causes (RII=0.725) are the top three group causes of delay in Addis Ababa 40/60 housing construction project. The only less causative of delay group perceived equally by the three parties was external related cause group.

Table 4.9 Ranking by the groups of causes of delay

Groups of Causes of Delay	Client		Consultant		Contractor		Average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Client related causes	0.720	5	0.754	1	0.754	1	0.742	1
Material related causes	0.742	3	0.733	2	0.734	2	0.737	2
Contractor related causes	0.767	2	0.730	3	0.677	5	0.725	3
Consultant related causes	0.769	1	0.643	7	0.725	3	0.712	4
Contractual and administrative causes	0.721	4	0.671	4	0.702	4	0.698	5
Design related causes	0.684	6	0.662	6	0.667	7	0.671	6
Labor related causes	0.661	7	0.670	5	0.669	6	0.667	7
Equipment related causes	0.640	8	0.643	7	0.603	8	0.629	8
External related causes	0.540	9	0.567	9	0.561	9	0.556	9

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#### 4.9. The root causes of major delay factors

In the construction of 40/60 housing project every delay factor has another root cause. To investigate the root causes of major delay factors semi-structured interview was conducted and the following causes of causes are identified as shown table 4.10.

Table 4.10. The root causes for major delay factors.

No	Major Causes of delay	Reasons for causes of delays
1	Late delivery of materials by the client	<ul style="list-style-type: none"> <li>• Time taking government procurement process</li> <li>• Time taking shipment of importation of materials (e.g. Re-bar)</li> <li>• Inaccurate estimation of quantity in procurement planning</li> <li>• Resource levelling and coordination problem by the client</li> <li>• Bureaucratic process for material requisition and permission</li> <li>• Low productivity level of micro and small enterprises (e.g. HCB, and precast beam are not delivered on time)</li> <li>• Unethical practice in logistics department</li> <li>• Lake of integration in supply chain management</li> <li>• Insufficient supply by local suppliers e.g, reinforcement bar</li> <li>• Lack of qualified people to handle the supply and logistics</li> </ul>
2	Difficulties in financing project by contractor	<ul style="list-style-type: none"> <li>• Cash flow management problem</li> <li>• Misuse of advance payment (e.g. they used for another project)</li> <li>• Less focus given for condominium projects by contractor</li> <li>• Lack of financial capacity</li> <li>• expending payments for personal interest</li> <li>• diminished the purchasing power of their money due to inflation and continual rising of material price</li> <li>• Advance money wrongly released without disbursement unable to control by the client</li> </ul>
3	Improper contractor selection	<ul style="list-style-type: none"> <li>• Serious corruption practice</li> <li>• Lack of experience faced by document evaluation team</li> </ul>

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		<ul style="list-style-type: none"> <li>• Fixed price modality of contract don't attract capable contractor</li> <li>• Forged documents provided by contractors</li> </ul>
4	Slow decision making by the client	<ul style="list-style-type: none"> <li>• Incapable organization and project managers delegation</li> <li>• Attempt for fraud practice</li> <li>• Lack of professionalism</li> <li>• Decision makers busy by political tasks</li> <li>• Long chain of bureaucracy</li> <li>• Lack of experience in decision maker</li> <li>• Less accountability of decision maker taken by government</li> <li>• Time taking process to give decision for the matter</li> <li>• Lack of clarity of the issue that requires decision</li> </ul>
5	Obsolete technology used by contractor	<ul style="list-style-type: none"> <li>• Lack of financial capacity to purchase latest technology</li> <li>• Contractors negative attitude towards new technology</li> <li>• Relatively high initial investment cost of latest equipment</li> <li>• Fails to make cost benefit analysis by contractors</li> <li>• Lack of skilled person to operate new technology</li> <li>• Knowledge gap to use accelerating chemicals</li> <li>• Contract agreement don't invite them to use fully prefabricated elements</li> </ul>
6	Bureaucracy of government authorities	<ul style="list-style-type: none"> <li>• Hierarchy of government authority and long chain of command</li> <li>• Consistent of rigid rules which are enemy of work progress</li> </ul>
7	Delay in approving payment certificate by the consultants.	<ul style="list-style-type: none"> <li>• Contractor fails to renew advance and performance bonds</li> <li>• Contractors include extra quantity which are non-executed work</li> <li>• Incapable quantity surveyor employed by contractor</li> <li>• Intentionally hold by the consultant to attempt corruption</li> <li>• The payment is checked by many officers</li> <li>• The consultant has not been liable for the delay of payment</li> </ul>
8	Design errors and incomplete drawings	<ul style="list-style-type: none"> <li>• The original design was made by less experienced designer</li> <li>• Frequent design change (e.g. from 12 to 14 then to 15 story)</li> <li>• Complexity of design</li> </ul>

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9	Escalation of material prices	<ul style="list-style-type: none"> <li>• Scarcity of hard currency for imported materials</li> <li>• Shortage of local and imported materials</li> <li>• Sabotage due to the nature of greedy merchants</li> <li>• The need for shortcut prosperity</li> </ul>
10	Delay in approving shop drawings	<ul style="list-style-type: none"> <li>• Lack of appropriate planning &amp; schedule and lack of capacity</li> <li>• To attempt fraud practice</li> </ul>
11	Delays in sub-contractors work	<ul style="list-style-type: none"> <li>• Financial problem, lack of skilled manpower, lack of knowledge late material supply, delayed payments to sub-contractors</li> <li>• attitude problem(stop work when they get payment)</li> </ul>
12	Malpractice (unethical practices) by the consultant	<ul style="list-style-type: none"> <li>• Greediness of personality and mental state of “stealing”</li> <li>• Consultant staffs are paid insufficient salaries</li> <li>• The contractor tried bypass smoothly by paying to them</li> <li>• The need for shortcut prosperity</li> </ul>
13	Presence of multiple stakeholders	<ul style="list-style-type: none"> <li>• It needs the participation of client, consultant, contractor, MSE, financial institutions like banks and insurances, regulatory body, Ethiopian electric service, AAWSA, Addis Ababa road authority. These all parties have varied interest and work plan</li> </ul>
14	Delay in testing and approving of materials	<ul style="list-style-type: none"> <li>• To attempt corruption</li> <li>• Waiting due to queue</li> </ul>
15	Discrepancies between BOQ, specification and drawings	<ul style="list-style-type: none"> <li>• Lack of communication and coordination among quantity surveyor, contract administrator and architects</li> <li>• Lack of knowledge and experience of professionals</li> <li>• Frequent design change and change order</li> <li>• Negligence</li> </ul>
16	Frequent changes order by the client during construction	<ul style="list-style-type: none"> <li>• Political interference, material shortage, late comer of needs</li> <li>• Frequent replacement of organization leaders</li> </ul>
17	Improper project planning and scheduling	<ul style="list-style-type: none"> <li>• Lack of knowledge and experience to make good plan</li> <li>• Most contractors use traditional method of planning</li> <li>• Poor inspection of consultant</li> </ul>

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18	Technically Incapable consultant staff	<ul style="list-style-type: none"> <li>• Staffs are acquired without computation and hired by family</li> <li>• Lack of on the job training</li> </ul>
19	Inappropriate consultant agreement	<ul style="list-style-type: none"> <li>• Consultants do not worry about work progress, because they paid their salary per block per month, i.e. delay is a continual job security for them without interruption.</li> <li>• Political interferences</li> <li>• lack of knowledge and experience</li> </ul>
20	Delay in Importation of materials	<ul style="list-style-type: none"> <li>• Time taking Shipment problem,</li> <li>• lack of hard currency,</li> </ul>

#### 4.10. Type, Sources and responsible body of the major delay factors

Each causes of delay have its own starting place and the responsible body for the issue. These major delay factors also can be categorized based on their compensability. The following table shows that sources, responsible body and compensability of the major delay factors.

Table 4.11 Identification of sources, responsible body and type of the major delay factors.

Major causes of delay	Sources of causes	Accountable body	Compensability
Late delivery of materials by the client	Client	Client	Excusable & compensable
Difficulties in financing project by contractor	Contractor	Contractor	Non-excusable
Improper contractor selection	Client & contractor	Client & contractor	Non-excusable
Slow decision making by the client	Client	Client	Excusable & compensable
Obsolete technology Used by contractor	Contractor	Contractor Consultant	Non-excusable
Bureaucracy of government authorities	Client	Client	Excusable & compensable
Delay in approving payment certificate	Consultant	Consultant Client	Excusable & compensable
Design errors and incomplete drawings	Client & consultant	Client & consultant	Excusable compensable
Escalation of material prices	External	There is no accountable body	Non-excusable

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Delay in approving shop drawings	Consultant	Consultant	Excusable & compensable
Delays in sub-contractors work	Contractor	Contractor	Non-excusable
Malpractice (unethical practices) by the consultant	Consultant Contractor	Contractor	Non-excusable
Presence of multiple stakeholders	Client & contractor	Client & contractor	Non-excusable
Delay in testing and approving of materials	Client & consultant	Client & consultant	Excusable & compensable
Discrepancies between BOQ, specification and drawings	Client & consultant	Client & consultant	Excusable & compensable
Frequent changes order by the client during construction	Client	Client	Excusable & compensable
Improper project planning and scheduling	Contractor, client & Consultant	Contractor Consultant	Non-excusable
Technically Incapable consultant staff	Consultant	Consultant	Non-excusable
Inappropriate consultant agreement	Client	Client	Non-excusable
Delay in Importation of materials	Client & contractor	Client & contractor	Non-Excusable, Non-compensable for contractors

#### 4.10.1. Severity Identification of Sources of Delay Factors

The sources of each major delay factors were identified through the questionnaire and interview. These sources of delay include client, consultant, contractor, client and consultant together, client and contractor jointly, contractor and consultant together, client, consultant and contractor collectively, and external factors.

The analysis result shown in table 4.12 that, 26.35% were caused by Client, 14.32% were caused by the consultant, 16.07% were caused by contractor, 14.21% were caused by client and consultant, 14.9% were caused by Client and contractor 4.73 were caused by consultant and contractor, 4.64% were caused by client, consultant and contractor, and the remaining 4.78% were caused by external factors.

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Table 4.12. Percentage of sources for major delay factors

Sources of delay	Frequency	$\sum$ RII	percentage
Client	5	4.117	26.35
Consultant	3	2.2	14.32
Contractor	3	2.512	16.07
Client and Consultant	3	2.22	14.21
Client and Contractor	3	2.329	14.90
Consultant and Contractor	1	0.739	4.73
Client, Consultant and Contractor	1	0.725	4.64
External Factor	1	0.747	4.78
	<b>Total RII</b>	<b>15.627</b>	<b>100.00</b>

#### 4.10.2. Severity Identification of Responsible Body for Delay Factors

Based on source of delay identified through questionnaire and interview, the responsible party is identified. The responsible parties for the causes of delay include client, consultant, contractor, client and consultant jointly, both client and contractor, and there is no accountable body.

The analysis result shown in table 4.13: types of delay by responsibility showed that 26.35% of responsibility taken by the client, 9.38% of the responsibility taken by the consultant, 15.53% of the responsibility taken by contractor, 19.15% of the responsibility taken by the client & consultant jointly, 14.9% of the responsibility taken by the client & contractor 9.91% of the responsibility shared by the consultant and contractor and finally for the remaining 4.78% there is no accountable body.

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Table 4.13. Percentage of accountability

Accountable body	Frequency	$\sum$ RII	Percentage
Client	5	4.117	26.35
Consultant	2	1.466	9.38
Contractor	3	2.427	15.53
Client and Consultant	4	2.992	19.15
Client and Contractor	3	2.329	14.90
Consultant and Contractor	2	1.549	9.91
there is no accountable body	1	0.747	4.78
	<b>Total RII</b>	<b>15.627</b>	<b>100</b>

#### 4.10.3. Severity Identification by Type of Delay

Based on the types of delay the following three types of delays are identified. These include non-excusable delay for contractor caused delay, excusable compensable delay for client caused delay, and excusable non-compensable delay for causes of delay by both client and contractor or neither client nor contractor.

The analysis result shown in the table 4.14 indicated that the top 20 major causes of delay were analyzed for compensability and the result showed that 49.77% are non-excusable delays, which compensates neither time nor finance while 45.63% are found to be excusable compensable, which compensates time or finance or both time and finance and the rest 4.6% of delay causes are excusable-non compensable which grants only extension of time to complete the project.

Table 4.14. Percentage of compensability

Compensability	Frequency	$\sum$ RII	Percentage
Non-excusable	10	7.8	49.77
Excusable Compensable	9	7.13	45.63
Excusable Non-compensable	1	0.72	4.60
	<b>Total RII</b>	<b>15.63</b>	<b>100</b>

#### **4.10.4. The nature of major delay factors**

Based on their time of occurrence nature, most of the 40/60 housing construction project major delay factors can be categorized under serial and concurrent delays. Serial delays were highly observed, because delays in material procurement planning for example causes for the delay of procurement process consequently it causes for the late delivery of materials. The delay of reinforcement bar delivery, causes to wait idle the next activities on the queue like bar cutting, bending, placing, concrete work, HCB wall work, plastering, painting and other next activities. Due to the occurrence of severe weather condition, contractors finance difficulty and late material delivery at the same time, concurrent delays were also observed.

#### **4.11. Case Study of Selected Project Sites**

This topic deals with in-depth investigation of the causes and effects of delay of three selected 40/60 project branch sites which were investigated through observation, interviews and documents scanning of the project to advance the results acquired from questionnaire analysis. To conduct the case study, three 40/60 project branches were chosen and to obtain comprehensive information about the causes and effects of delays, project sites which administered by Branch-2, Branch-3 and Branch-4 were convenient.

##### **4.11.1. Branch two 40/60 housing project site**

This project site is located in Bole sub city around Ayat area. In this project at the beginning, three class-1 consultants and 53 grade one up to grade three contractors were participated in the construction of 106 building blocks. From the total building blocks 66 blocks are B+G+8 typology, 27 blocks are B+G+10 typology and the rest 13 blocks are 2B+G+13 typology. In the project there are three types of bed rooms, i.e. one-bed, two-bed and three-bed rooms. The number of houses in each bed-room is 140 housing units are 1-bed room, 2,682 housing units are 2-bed room, 2,128 housing units are 3-bed room and the number of shops are 2251.

This project was started on 08/03/2014. The total labor cost agreed at the original contract of the 106-blocks was 2,452,660,365 birr and the original contract period of the project was 600 calendar

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days for B+G+8 typology, 660 calendar days for B+G+10 typology and 750 calendar days for 2B+G+13 typology.

Based on the originally agreed contract, the project should have been completed on 08/04/2016 for the maximum period. However the project takes 2,263 calendar days for 93% average completion up to May 30/2020. Currently the maximum and late progresses of construction in this project branch site are the following.

Table 4.15 Percentage completion of Bole Ayat-1 and Meri project sites

Site Name	Typology	Minimum progress	Maximum progress	Average status
Meri	2B+G+13	87.2%	95.8%	93%
Ayat-1	B+G+10	80.2%	95.9%	
	B+G+8	78.4%	95.7%	

The lift installation, municipality water supply line and water pump are total remaining works whereas sanitary riser and fixtures, WC, floor drain, kitchen sink, fire fitting, waste water outlet and disposal and roof water tank are under progress remaining works for better status buildings. For late status buildings, floor and wall ceramic, marble tile, porcelain tile works, pipe installation, aluminum frame installation and cleaning works are remaining works in addition to the above listed works. The site work like car parking, walkways, local access roads green areas, curve stones, and retaining walls are under progress.

The consultant fee in this project branch is 11,000 birr per block per month and it costs a total of 1,166,000 birr for 106 blocks per month. This monthly payment was fair for the original contracting period. However currently it may not be sufficient due to decline of purchasing power of money through extended time. The advance payment given to main contractors was 490,532,073 birr and it is completely repaid back after five years when the project is reached 80% completion. Since some of main construction materials are supplied by the client, the site security guard is hired by the owner and the security service fee is 330,000 birr per month. Due to their poor performance 14 contractors are terminated in this project. The major reason for their poor performance was financial difficulty.

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Figure 4.4. Currnt external view of Bole Ayat-1 project site



Figure 4.5. External view of 2B+G +13 typology Meri site buildings



#### 4.11.2. Branch three 40/60 housing project site

The location of this project site is Bole sub city around Bole Beshale Area. At the beginning, one class-1 consultant and 10 grade one, 7 grade two and 10 grade three contractors were participated in the construction of 58 building blocks. From the whole building blocks 21 buildings are B+G+9 typology, 15 buildings are 2B+G+13 typology and the remaining 22 building blocks are 2B+G+15 typology. A total of 6,581 houses are on progress and the number of houses in each bed-room is 902 housing units are 1-bed room, 2,874 housing units are 2-bed room and 1,406 housing units are 3-bed room and also 1,414 shops.

This project was started on 15 May 2015. The total labor cost agreed at the original contract of the 58-blocks was 2,281,293,045 birr and the original contract period of the project was 520 calendar

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days for B+G+9 typology, 670 calendar days for 2B+G+13 typology and 730 calendar days for 2B+G+15 typology.

The project was expected to complete on 15 May 2017 as per originally agreed contract. However up to May 30/2020 the project consumed 1,841 calendar days for 71% completion. Due to their poor progress 5 contractors are terminated and other 2 contractors are returned by organization top leaders administration decision. The consultant fee is 10,715.13 birr per block per month; it costs a total of 621,477.54 birr for 58 blocks per month. The advance payment given to main contractors was 456,258,639 birr and it is not completely repaid back even the project is elapsed more than 5 years. The site security service fee is 365,000 birr per month. The current maximum and minimum status of each typology is the following:

Table 4.16 Percentage completion of Bole Beshale project site

Site Name	Typology	Minimum progress	Maximum progress	Average status
Bole Beshale	B+G+9	62.2%	77.2%	71%
	2B+G+13	64.9%	79.1%	
	2B+G+15	50.2%	76.7%	

Figure 4.6. Partial External view of Bole Beshale project site buildings



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Figure 4.7 (a) and (b) Maximum & minimum progress B+G+9 typology buildings respectively.



(a) Better progress



(b) late progress

Figure 4.8 (a) and (b) Maximum and minimum progress 2B+G+13 typology buildings respectively



(a) Better progress



(b) late progress

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Figure 4.9 (a) & (b) Maximum and minimum progress 2B+G+15 typology buildings respectively



(a) Better progress



(b) late progress

#### 4.11.3. Branch four 40/60 housing project site

Project sites that are administered by the branch four office located in Bole sub city around Ayat condominium area and a few building blocks are located near to semmit Pepsi factory. At the beginning, three class-1 consultants and 44 grade one up to grade three contractors were joined in the construction of 100 building blocks. From the entire building blocks 24 blocks are B+G+8 typology, 8 blocks are B+G+10 typology, 34 blocks are 2B+G+13 typology and the remaining 34 building blocks are 2B+G+15 typology. The number of houses in each bed-room is 1,640 housing units are 1-bed room, 4,080 housing units are 2-bed room and 2,144 housing units are 3-bed room. There are also 2,732 shops. The total number of houses under construction by this branch project site is 10,596 including commercial shops.

The project has two phases and the first phase of this project was started on May 2013 and the second phase was started on May 2015. The total labor cost agreed at the original contract of the 100-blocks was 4,605,170,986 birr and the original contract period of the project was 395 calendar days for B+G+8 typology, 473 calendar days for B+G+10 typology, 670 calendar days for 2B+G+13 typology and 730 calendar days for the construction of 2B+G+15 typology building blocks.

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Based on the originally agreed contract, the completion date of phase-one project was on March 2015 and phase-two project sites was on May 2017 for the maximum period. However the project require 2,575 calendar days for 80.1% completion of phase-one project site, 1,845 calendar days for 79.6% completion of Semmit site and 60.2% completion of phase-two site-4 project site up to May 30/2020. The current maximum & minimum status of construction in this project branch site are the following.

Table 4.17 Percentage completion of Bole Ayat-2 and Semmit project sites

Site Name	Typology	Minimum progress	Maximum progress	Overall Average status
Ayat-2 Site-2	2B+G+13	45.9%	74.5%	60.2%
	2B+G+15	45.1%	77.6%	
Ayat-2 Site-4	B+G+8	71.4%	81.5%	80.1
	B+G+10	72.5%	91.2%	
	B+G+13	66.2%	90.3%	
Semmit site	B+G+8	66%	89.2%	79.6

The consultant supervision and contract administration fee is 474,662.5 birr per month for site-two consultant, 12,496.43 birr block per month for site-four consultant and 10,077 birr per block for semmit site consultant and it costs a total of 1,200,254 birr for 100 blocks per month. The advance payment given to main contractors was 921,034,197 birr and it is not completely repaid back even though the project time is elapsed more than 5 years. The site security service fee is 374,127 birr per month. Due to their poor performance a total of 6 contractors are terminated 4 contractors from site-2 project site and 2 contractors from site-4 project site.

Figure 4.10. Partial External view of Bole Ayat-2 project site-2



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Figure 4.11 (a) & (b) Maximum and late progress of 2B+G+13 typology buildings respectively



(a) Better progress



(b) late progress

Figure 4.12 (a) and (b) Maximum and late progress of 2B+G+15 typology buildings respectively



(a) Better progress



(b) late progress

Figure 4.13. Partial External view of Bole Ayat-2 project site-4



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Table 4.18 summary of facts in three project branches

Description		Branch-2	Branch-3	Branch-4	Total
No. of contractors		53	27	44	124
No. of consultants		3	1	3	7
Terminated contractors		14	6	6	26
No. of building blocks		106	58	100	264
No. of houses	1-Bed	140	902	1640	2682
	2-Bed	2682	2874	4080	9636
	3-Bed	2128	1406	2144	5678
	Shop	2251	1414	2,732	6,397
	Total	7,201	6,596	10,596	24,393
Original contract amount		2,452,660,365	2,281,293,045	4,605,170,986	9,339,124,396
Amount of advance given		490,532,073	456,258,609	921,034,197	1,867,824,879
Monthly consultant fee		1,166,000	621,477.54	1,200,254	2,987,731.54
Monthly security fee		330,000	365,000	374,127	1,069,127
Monthly workers salary		817,947	878,374	926,884	2,623,205
Average completion status		93%	72%	73.5%	79.5%
Elapsed time		2,363	1,841	2,575 & 1,845	

#### 4.12. Costs Originated from Delay

The simplest explanation of the term delay damages is those costs that increase as a sole result of a delaying event on a project. Such increased cost may be direct or indirect costs. In the construction of 40/60 housing project damages resulting from project delay includes salaries and benefits of workers, costs of rental cars, spare parts, fuel & lubricants, allowance & overtime costs, site security service fee, consultants service fee, stationary materials, repair and maintenance of vehicles, utilities like telephone, electric power and water consumption costs, inflated material costs and interest costs for loan are some of the costs.

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For the purpose of efficient construction by reducing contractors' financial burden the construction of 40/60 housing project invested significant amount of advance money. For the three project branch sites studied in this thesis, around 1.87 billion birr was invested before five years when the projects are awarded to contractors to be returned within two years according to original contract period. However currently after more than three additional years are elapsed it is not completely refunded. Even though, the advance money is protected from lost through guarantee, there are several reasons for our choice to get the money immediately. First, it can invest the money that received today at similar projects, and make it grow. The return from investing in the desired project meets the objective of the company. Second, there is a threat of inflation. For the last several years, the rate of inflation in Ethiopia was high. When there is monetary inflation, the value of currency decreases over time. A goods and services purchased for one million birr today may cost one million plus by the next year. Third, if there is any uncertainty associated with the cash flow in the future, the less that cash flow will be valued. Fourth, if the money deposited at the bank, it will generate income in the form of interest the income may also investing again. In other way the client reduce the cost arising from bond interest by reducing payback period of time.

Since the overall project cost is the cumulative effects of each minor costs, for the sake visualization how the project costs are shoot-up due to construction delay, the following few cost items were investigated and the result obtained shown below is only for three years that is extra time from original contract period.

Table 4.19 Summary of few costs originated from delay

Cost Items	Average Yearly Amount for Each Project Branch Sites				Total for 3-years
	Branch-2	Branch-3	Branch-4	Total for 3-branches	
Consultant fee	13,992,000	7,457,730	14,403,048	35,852,778	107,558,334
9.5% Advance Interest	46,600,547	43,344,571	87,498,249	177,443,367	532,330,101
Site security service fee	3,960,530	4,380,000	4,489,527	12,830,057	38,490,171
Salaries for workers	9,815,362	10,540,484	11,122,611	31,478,457	94,435,371
Other overhead costs	2,445,172	5,446,591	6,000,000	13,891,763	41,675,289
<b>Total Costs per year</b>	<b>76,813,611</b>	<b>71,169,376</b>	<b>123,513,435</b>	<b>271,496,422</b>	<b>814,489,266</b>

From the analysis of the above few cost items, it is clearly shows that the project cost is extremely escalated when major portions of costs like material cost, price adjustment costs, damaged material costs, and all loan interest costs, are calculated. Furthermore, it is easily understood that the 40/60 housing construction project cost is significantly elevated when the head office overhead costs including rental office costs are added.

#### **4.13. Effects of Delay**

Numerous studies were conducted locally and internationally about the effects of delay in the construction sector. Time over run, cost overrun, termination of contract, arbitration, litigation, dispute between contracting parties and total abandonment are the common effects of delay published in many literatures. The effects of delay in 40/60 housing construction project are numerous due to several reasons. The following 24 effects of delay are identified through interview and questionnaire survey study. The effects of delay that investigated in the construction of 40/60 housing project are the following.

1. Cost-overrun
2. Time-overrun
3. Increase unemployment rate due to failure to start new projects
4. Client loses time value of money due to delayed advance reimbursement
5. The client (government) mistrusted by the people
6. Reduce the quality of construction
7. Contribute for cost of living
8. Fail to contribute in the reduction of climax housing demand
9. Construction materials exposed to vandalism and robbery
10. Contribute for continual rising of housing price
11. The entire working capital may become trapped in one project
12. Loss of output and revenues due to unavailability of product
13. Termination of contract
14. Public inconvenience resulting from delay of the project
15. Unable to fair distribution of resource or wealth
16. Contribute for escalation of housing rent price
17. Disturbance of the budget execution plan for the government authority

18. The saved registered public money becomes decline its purchasing power
19. Dispute between contracting parties
20. Arbitration
21. The desperation house seekers withdraw their money from the bank
22. Make confusion regarding the public development plans
23. Prolong the renewing objective of the slum area of the city
24. Total abandonment or rejection of the project (e.g. ketila jarso site)

To locate on the order of relative severity of these effects of delay, it was very important to use relative importance index method of instrument. Before using RII mechanism to arrange on their order of precedence, it was crucial to check the data reliability using Cronbach's alpha and then after ranking by their order of precedence using RII, the strength of relationship of ranking between two parties was verified by spearman correlation coefficient.

#### **4.13.1. Cronbach's alpha ( $\alpha$ ) coefficient for effects of delay**

Cronbach's alpha coefficient was used to test the reliability or consistency of the questionnaire survey for effects of delay and it was determined using equation 3.2. Taking client, consultant, contractor and overall respondents, the  $\alpha$ -values were 0.989, 0.991, 0.977, and 0.910, respectively. All  $\alpha$ -values were greater than 0.70. Therefore, it can be concluded that the questionnaire survey for effects of delay is reliable and consistent.

#### **4.13.2. Ranking Effects of Delay by Using Relative Importance Index**

Relative importance index (RII) analysis was conducted using equation 3.3 to determine the relative importance of the various effects of delays. Hence, the RII determined by using five-point likert scale ranges from 1 to 5 to rank the different effects of delays. The rankings as responded by the three groups of parties (i.e. client, consultants and contractors) were compared to show the perceptions of the three parties and finally the overall ranking was determined in order to put by their severity order of effects of delays in Addis Ababa 40/60 housing construction project.

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Table 4.20 Ranking effects of delay by using RII

Effects of Delay	Client		Consultant		Contractor		Mean Score	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
cost-overrun	0.861	1	0.848	1	0.885	2	0.865	1
time-overrun	0.842	2	0.830	2	0.897	1	0.857	2
Fail to start new projects and increase unemployment rate	0.830	3	0.800	3	0.824	3	0.818	3
Client loses time value of money due to delayed advance reimbursement	0.824	4	0.776	4	0.782	4	0.794	4
the client (government) mistrusted by the people	0.800	5	0.733	7	0.758	5	0.764	5
reduce the quality of construction	0.770	7	0.758	5	0.752	6	0.760	6
Contribute for cost of living	0.752	9	0.715	10	0.745	7	0.737	7
Fail to contribute in the reduction of climax housing demand	0.764	8	0.721	9	0.721	11	0.735	8
construction materials exposed to vandalism and deterioration	0.745	10	0.727	8	0.697	15	0.723	9
Contribute for continual rising of housing price	0.782	6	0.697	13	0.673	19	0.717	10
The entire working capital may become trapped in one project	0.733	12	0.739	6	0.679	18	0.717	11
loss of output and revenues due to unavailability of facilities	0.727	13	0.685	15	0.733	9	0.715	12
termination of contract	0.715	15	0.700	12	0.727	10	0.714	13
public inconvenience resulting from delay of the project	0.709	17	0.709	11	0.709	13	0.709	14
unable to fair distribution of resource or wealth	0.715	15	0.667	18	0.739	8	0.707	15
contribute for escalation of housing rent price	0.739	11	0.648	21	0.715	12	0.701	16
disturbance of the budget execution plan for the government authority involved	0.703	18	0.691	14	0.697	15	0.697	17
The saved registered public money lose its purchasing power	0.721	14	0.661	19	0.691	17	0.691	18
Dispute between contracting parties	0.655	21	0.679	16	0.703	14	0.679	19
Arbitration	0.630	22	0.673	17	0.667	20	0.657	20
The desperation house seekers withdraw their money from the bank	0.679	20	0.642	22	0.630	21	0.651	21
Make confusion regarding the public development plans	0.697	19	0.655	20	0.588	22	0.646	22
Prolong the renewing objective of the slum area of the city	0.606	23	0.618	23	0.521	24	0.582	23
Total abandonment or rejection of the project	0.594	24	0.600	24	0.544	23	0.579	24

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Due to conflicts of perceptions arising from individuals and groups everyday life experience among the client, consultant and contractors, the ranking given by each party becomes diversified for the same issue. To negotiate the conflicted rankings of the parties, the average relative importance index (RII) of client, consultant and contractors taken as the governing ranking.

The analysis of relative importance index shown on the table 4.14 above 22 effects of delay in the construction of 40/60 housing project are laid in the range of high and medium-high level severity. Cost overrun (RII=0.865), time overrun (RII=0.857) and fail to start new projects and increase unemployment rate (RII=0.818) are have high level of effects. On the other hand two delay effects, i.e. Prolong the renewing objective of the slum area of the city (RII=0.582) and total abandonment or rejection of the project (RII=0.579) have medium level of effects. The rest 19 delay effects are laid on the range of medium-high level of effect.

#### **4.13.3. Spearman Rank Correlation Coefficient (rs) For Effects of Delay**

The Spearman rank correlation coefficient was determined to assess the strength of relationship of ranking between two parties. It was calculated using equation 3.4 and the results of the correlation between client and consultant, client and contractor, and consultant and contractor were 0.83, 0.74 and 0.76 respectively. These values show that there is very strong agreement or correlation between the rankings of client and contractor. There is also strong agreement of rankings between client and contractor as well as consultant and contractor. The values obtained from the analysis indicate that the ranking correlation among the parties is in good acceptable level.

#### **4.14. Secondary effects of 40/60 housing construction project delay effects**

Construction industry plays a major role in economic development by generating output, employment creation, revenue generation, income generation and redistribution. The industry also plays a key role in satisfying a wide range of physical, economic and social needs. The strong linkage between the construction industry and other economic sectors is the nature of multiplier effect of the construction industry (Fred Moavenzadeh). When the construction industry freeze by any reason, the networks of commercial relations with the other economic sectors immediately snapped and fails the guaranty of job opportunities of the citizen. The effect of construction sector affects many other sectors both positively and negatively.

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As a portion of construction sector, the delay effects of 40/60 housing project highly affect the other commercial and economic sectors and the cumulative effect also has impact for the national economy. This expanded and secondary effects of the delay effects of 40/60 housing construction project is shown here on table 4.21.

Table 4.21 Secondary effects of 40/60 delay effects

Effects of Delay	Secondary effects of delay effects
Cost-overrun	<ul style="list-style-type: none"> <li>• The cost transferred to the individual dweller become difficult to pay and they try to sale their shelter</li> <li>• Due to project requirement of additional budget the government extend launching of other new projects</li> <li>• It blocks the extra needs of dwellers</li> </ul>
Time-overrun	<ul style="list-style-type: none"> <li>• The product fail to give service on the planned time</li> <li>• Registered house seekers obliged to live in rental houses</li> <li>• The house seekers become despaired</li> </ul>
Fail to start new projects and increase unemployment rate	<ul style="list-style-type: none"> <li>• Decline the commercial exchange of Contractor to supplier and supplier to supplier and less economic circulation in the market</li> <li>• High unemployment rate makes political instability</li> <li>• Jobless people faced social and economic crises, promote robbery and addiction of bad habits</li> <li>• It affects the other service giving sectors like cafeteria, grocery, boutiques, due to less demand</li> </ul>
Client loses time value of money due to delayed advance reimbursement	<ul style="list-style-type: none"> <li>• Purchasing power of money becomes low and then budget deficit faced by the government</li> <li>• Client obliged to pay bond interest for loan money</li> </ul>
The client (government) mistrusted by the people	<ul style="list-style-type: none"> <li>• Government lost political acceptability</li> <li>• House seekers withdraw their money from the bank and try to buy illegal plot of land from local farmers</li> </ul>
Reduce the quality of construction	<ul style="list-style-type: none"> <li>• Reduce the service life of houses</li> <li>• Dwellers obliged to expend extra costs for modification</li> <li>• Needs frequent Maintenance and the cost affect resident</li> </ul>
Contribute for cost of living	<ul style="list-style-type: none"> <li>• Create social crisis</li> </ul>

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	<ul style="list-style-type: none"> <li>• Encourage day and night robbery</li> </ul>
Fail to contribute in the reduction of climax housing demand	<ul style="list-style-type: none"> <li>• Increase the number of homeless society in the city</li> <li>• Increase economic burden due to rental houses</li> </ul>
Construction materials exposed to vandalism and robbery	<ul style="list-style-type: none"> <li>• Increased the cost of houses that touch each resident</li> <li>• Due to imported materials purchased in hard currency, it wastes dollars that may use to buy medicine</li> <li>• Contribute for economic decline of the country</li> </ul>
Contribute for continual rising of housing price	<ul style="list-style-type: none"> <li>• Middle income people house seekers unable to buy</li> <li>• The city houses monopolized by few rich people</li> <li>• It makes the living standard of people is far apart</li> </ul>
The entire working capital may become trapped in one project	<ul style="list-style-type: none"> <li>• Due to the failure to transfer houses to the dwellers, the client cannot collect revenue from residents and sales of shops. The plan to start new projects failed due to the tied up of transaction of money and interruption of budget deficit &amp; allocation,</li> </ul>
Loss of output and revenues due to unavailability of facilities or product	<ul style="list-style-type: none"> <li>• Client fail to collect revenue from sales of houses</li> <li>• Fail to start new projects and to provide houses</li> </ul>
Termination of contract	<ul style="list-style-type: none"> <li>• Increase the cost of the houses and burden for residents</li> <li>• It makes bad relationship between client and contractors</li> <li>• Make contractors bankrupt and fail the capacity building objective</li> <li>• Workers under contractor lose their job opportunity</li> <li>• Work load due to valuation of work at date of termination,</li> <li>• Preparation of payment up on termination,</li> <li>• Preparation of contract document for the remaining work</li> <li>• Process of new contractor selection to substitute</li> </ul>
Public inconvenience resulting from delay of the project	<ul style="list-style-type: none"> <li>• Causes for the government hate by the public</li> <li>• People continue discomfort life style</li> </ul>
Unable to fair distribution of resource or wealth	<ul style="list-style-type: none"> <li>• Riches become richer and poor become poorer</li> <li>• People who are not beneficiary try to attack the government by using any media convenient for them</li> </ul>

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	<ul style="list-style-type: none"> <li>• Developed bad relationship people with government</li> <li>• People think of themselves the second citizen</li> </ul>
Contribute for escalation of housing rent price	<ul style="list-style-type: none"> <li>• It became unaffordable for low income people</li> <li>• Citizen frequent miss their turf makes unstable life</li> <li>• Always obliged to adapt new turf or environment</li> <li>• Citizen obliged to lose their social life's like "Edir"</li> </ul>
Disturbance of the budget execution plan for the government authority	<ul style="list-style-type: none"> <li>• Makes confusion and ambiguity</li> <li>• Loss of confidence</li> </ul>
The saved registered public money decline its purchasing power	<ul style="list-style-type: none"> <li>• They required to pay additional money when they have got their house</li> </ul>
Dispute between contracting parties	<ul style="list-style-type: none"> <li>• Disagreement between client &amp; contractor, consultant &amp; contractor and client &amp; consultant makes unstable working environment</li> <li>• There is always conflict of opinion</li> <li>• Create distrusted each other</li> </ul>
Arbitration	<ul style="list-style-type: none"> <li>• It is Costly and</li> <li>• It requires expert arbitrator</li> </ul>
The despaired house seekers withdraw their money from the bank	<ul style="list-style-type: none"> <li>• Discourage saving culture</li> <li>• Banks may face deficit of money</li> </ul>
Make confusion regarding the public development plans	<ul style="list-style-type: none"> <li>• Government does not make sure for the next year plan</li> <li>• Burden for the new coming projects</li> </ul>
Prolong the renewing objective of the slum area of the city	<ul style="list-style-type: none"> <li>• The slam areas of inner city continued below standard</li> <li>• Citizens continued to live in inconvenient environment</li> <li>• Unsafe environment in terms of health and it is difficult to access anti-fire hazard brigade.</li> </ul>
Total abandonment or rejection of the project	<ul style="list-style-type: none"> <li>• Citizens loss their job opportunity</li> <li>• Snapped the economic network of participants</li> <li>• It makes disappointment by the registered people</li> <li>• Lose its desired objective</li> </ul>

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**4.15. Matching of major delay factors with the corresponding effects**

Table 4.22 hereunder, shows that the major causes of delay with corresponding effects. Most of the major delay factors have their own particular effects. The analysis result indicates that time and cost overrun are the common effects caused by most major delay factors. The ultimate impact of all major causes of delay are increase unemployment rate, public inconvenience and the government mistrusted by the people, contribute for cost of living and continual rising of purchasing and rent price of houses, unable to reduce the pick demand of houses and fail to distribute resources fairly, the saved public money decline its purchasing power and the despaired house seekers withdraw their money.

Table 4.22. The major causes and corresponding effects of delay.

No	Major Causes of delay	Corresponding Effects of Major Delay Factors
1	Late delivery of materials by the client	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Reduce quality of construction</li> </ul>
2	Difficulties in financing project by contractor	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Termination of contract</li> <li>• Dispute between contracting parties, arbitration</li> </ul>
3	Improper contractor selection	<ul style="list-style-type: none"> <li>• Reduce the quality of construction</li> <li>• Termination of contract and arbitration</li> </ul>
4	Slow decision making by the client	<ul style="list-style-type: none"> <li>• Time overrun, cost overrun</li> <li>• Lose time value of money</li> <li>• Client mistrusted by the people</li> <li>• Material exposed to vandalism and robbery</li> <li>• Dispute between contracting parties</li> </ul>
5	Obsolete technology used by contractor	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Reduce quality of construction</li> </ul>
6	Bureaucracy of government authorities	<ul style="list-style-type: none"> <li>• Time overrun</li> <li>• Cost overrun</li> </ul>
7	Delay in approving payment certificate by the consultants.	<ul style="list-style-type: none"> <li>• Dispute between contracting parties and arbitration</li> <li>• Time and cost overrun</li> <li>• Reduce quality of construction</li> </ul>

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8	Design errors and incomplete drawings	<ul style="list-style-type: none"> <li>• Time and cost overrun,</li> <li>• Reduce quality of construction</li> </ul>
9	Escalation of material prices	<ul style="list-style-type: none"> <li>• Cost overrun, reduce quality of construction,</li> <li>• the entire working capital trapped in one project</li> </ul>
10	Delay in approving shop drawings	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Dispute between contracting parties</li> </ul>
11	Delays in sub-contractors work	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Reduce quality of construction</li> </ul>
12	Malpractice (unethical practices) by the consultant	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Public inconvenience &amp; client mistrusted</li> <li>• Reduce quality of construction</li> </ul>
13	Presence of multiple stakeholders	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> </ul>
14	Delay in testing and approving of materials	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Dispute between contracting parties &amp; arbitration</li> </ul>
15	Discrepancies between BOQ, specification and drawings	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Dispute between parties</li> </ul>
16	Frequent changes order by the client during construction	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Quality of construction reduce</li> <li>• Dispute between parties and arbitration</li> <li>• Prolong the renewing objective of slum areas</li> </ul>
17	Improper project planning and scheduling	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Disturbance of budget execution plan</li> </ul>
18	Technically Incapable consultant staff	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Reduce quality of construction</li> </ul>
19	Inappropriate consultant agreement	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Fail to start new projects</li> <li>• Reduce quality of construction</li> <li>• Dispute between contracting parties</li> </ul>
20	Delay in Importation of materials	<ul style="list-style-type: none"> <li>• Time and cost overrun</li> <li>• Reduce quality of construction</li> <li>• Loss of revenue due to unavailability of product</li> <li>• Dispute between contracting parties and arbitration</li> </ul>

#### **4.16. Comparison of findings with literature**

Some causes and effects of delay that identified in this study were common with that of identified in the literature that has been referenced in this study. For example: late delivery of material by the client was common problem with studies in Cambodia, UAE and Ethiopia. Difficulties financing project by contractor was the same problem studies in UAE and Egypt. On the other hand slow decision by the client was identical problem research outcome in USA, Norwegian, UAE and Tanzania with this study. However as a particular nature of construction projects, from the 20 major delay factors identified in this research, seven causes of delay were not recognized as a causes of delay in the previous studies. These major delay factors that are investigated in this study but not well-known in the literature are improper contractor selection, obsolete technology used by the contractors, malpractice by the consultant, presence of multiple stakeholders, incapable consultant staff, inappropriate consultant agreement and delay in importation of materials.

Most previous studies in the identification of causes and effects of delay in building construction were not focused on the root causes of delay and secondary effects of delay. As a construction project a series of activities are on the critical path and the delay of those activities on the series, origination for the major delay factors. However, the root causes and secondary effects of delay are properly investigated in this study.

The common effects of delay identified and published in many literatures were time over run, cost overrun, termination of contract, arbitration, litigation, dispute between contracting parties and total abandonment. However the effects of delay in 40/60 housing construction project are numerous due to several reasons. In addition to the above worldwide recognized effects of delays other 18 serious effects of delay are identified in this study. Due to the acute delay of the project, several costs are incurred through prolonged time. The time value of money, the interest cost of advance money, consultant fee, security fee and related costs are identified that were not got emphasis before.

#### 4.17. Summary of Findings

The selection process of consultants was based on open tendering and the process to select successful bidders from participants, Technical document evaluation accounts 80% and financial document evaluation accounts 20% of the consultant's offer. To open financial documents, the minimum requirement for technical score was 70%. The financial proposal offered by the consultants was monthly salary per block. On the other hand local contractors are recruited based on the criteria of three years financial turnover given a weight of 50%, work experience in housing project given a weight of 20%, work experience in any other projects accounts 15%, and good performance accounts 5%. Grade-1 up to grade-3 local contractors, who scored more than 70%, were chosen and grade-1 contractors assigned to build up to 18-story buildings, grade-2 contractors assigned to construct up to 13-story buildings and grade-3 contractors to build up to 9-story buildings. The existing contractors which have better performance during their progress were awarded additional terminated blocks and site works.

The major causes of delay in the construction of Addis Ababa 40/60 housing project were identified through questionnaire survey, interview, direct observation and document scanning. Overall, 99 responses out of 108 questionnaires distributed, were obtained from the contractors, consultants and client working in the project. Cronbach's alpha coefficient was used to test the reliability of the questionnaire survey. Taking client, consultant, contractor and overall respondents, the  $\alpha$ -values were 0.94, 0.899, 0.924, and 0.929, respectively. Since all  $\alpha$ -values are greater than 0.7, the questionnaire survey is reliable. Relative importance index was used to identify the major causes of delay in the construction of 40/60 housing project from the client, consultants, contractors and overall respondents. The agreement between ranking of two parties, i.e. between client and consultant, client and contractor and consultant & contractor was checked by spearman rank correlation coefficient and the results were 0.78, 0.86 and 0.76 respectively. This result indicated that the agreement of ranking between the parties was strong.

Based on the result of analysis late delivery of materials by the client, difficulties in financing project by contractor, improper contractor selection, slow decision making by the client, obsolete technology used by contractors, bureaucracy of government authorities, delay in approving payment certificates by the consultant, design errors and incomplete drawings, escalation of

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materials price, delay in approving shop drawings, delays in sub-contractors work, malpractice (unethical practices) by the consultant, presence of multiple stakeholders, delay in testing and approving of materials, discrepancies between BOQ, specification and drawings, frequent changes order by the client during construction, improper project planning and scheduling, technically incapable consultant staff, inappropriate consultant agreement, and delay in importation of materials respectively were identified top-20 major causes of delay out of 70 delay factors.

To investigate the root causes of major delay factors semi-structured interview was conducted. According to interview result time taking shipment and procurement process, inaccurate estimation of quantity in procurement planning, lack of integration and coordination in supply chain management, lack of qualified personnel to handle resources in the supply and logistics, low productivity level of micro and small enterprises, insufficient supply by local suppliers, bureaucratic process and unethical practice in logistics department were the root causes for late materials delivery by the client.

Cash flow management problem, misuse of advance payment, less focus given for condominium projects by contractor, lack of financial capacity, expending payments for personal interest, diminish the purchasing power of money due to inflation and scarcity of hard currency were also the root causes of difficulties in financing project by contractors. Serious corruption practice, presence of low experienced document evaluation team, less attractive fixed price contract modality and existence of forged documents were the origins of improper contractor selection. The identified reasons for contractors to use old technology were lack of financial capacity to purchase latest technology, relatively high initial investment cost of latest equipment, contractors negative attitude towards new technology, fails to make cost benefit analysis by contractors, lack of skilled person to operate new technology, knowledge gap to use accelerating chemicals, contract agreement does not invite them to use fully prefabricated elements and there is no access to use it at all.

The reasons for slow decision making by the client were to attempt fraud practice, lack of professionalism, lack of capacity and experience of decision maker, lack of clarity of the issue and long chain of bureaucracy. On the other hand the causes for delay in approving payment certificate by the consultant were to attempt corruption, contractor fails to renew advance and performance

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bonds, the payment is checked by many officers, due to less quality BOQ the payment rejected to be corrected and the consultant has not been liable for the delay of payment. The origin of design error and incomplete drawing were also frequent design change, complexity of design and design made by low experienced architect.

The results obtained from analysis indicated that late material delivery, bureaucracy, frequent change order during construction and unsuitable contract modality award to consultant were major delay factors arisen from client. Providing technically incapable staff, delay approving payment certificate, shop drawing and sample materials were main causes of delay sourced from consultant side. On the other hand financial difficulty, failure to use latest technology and sub-contractors work delay were contractors' sourced causes of delay. The sources of the rest major delay factors were shared jointly by the client & consultant, client & contractor, consultant & contractor, and by three contracting parties. The source of few delay factors also identified to be external source.

The causes of delay were grouped into nine groups of delays factors. Client related causes of delay was ranked the most significant group of delay factor, followed by the cause groups of materials related, contractor related, consultant related contractual and administrative related, design related, labor related, equipment related and external related cause groups of delay respectively.

There are twenty four major effects of delay identified in the construction of 40/60 housing project which includes: cost-overrun, time-overrun, increase unemployment rate due to failure start new projects, client loses time value of money due to delayed advance reimbursement, the client (government) mistrusted by the people, reduce the quality of construction, contribute for cost of living, fail to contribute in the reduction of housing demand, construction materials exposed to vandalism and robbery, contribute for continual rising of housing price, tied-up of working capital, loss of output and revenues due to unavailability of expected product, termination of contract, public inconvenience, unable to fair distribution of resource or wealth, contribute for escalation of housing rent price, disturbance of the budget execution plan for the government authority, the saved registered public money decline its purchasing power, dispute between contracting parties, arbitration, the dispirited house seekers withdraw their money from the bank, make confusion regarding the public development plans, fail to renew of the slum area of the inner city and total abandonment of the project.

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These effects of delay have networks of expanded effects to the other economic sectors as well as to the individual citizen and community member. The cumulative extended effects that sourced from the delay of 40/60 housing construction project creates a social, economic and political crises of the city.

From the twenty major delay factors identified in this research, seven causes of delay were not recognized as a causes of delay in the previous studies. Earlier studies in the identification of causes and effects of delay in building construction were not focus on the root causes of delay and multiplier effects of delay. The effects of delay in 40/60 housing construction project are numerous due to several reasons. In addition to the worldwide recognized effects of delays other 18 serious effects of delay are identified in this study.

## **CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS**

### **5.1. Conclusions**

The core objective of this study was to investigate the major causes and effects of delay in the construction of Addis Ababa 40/60 housing project and to indicate strategies and methods of minimizing construction delays. Questionnaire survey was conducted to identify the major causes and effects of delay from the three main stakeholders' point of view. Based on the findings the following conclusions are drawn.

1. All 40/60 houses project construction sites are taking more than five years to complete all project activities and this extended time of construction is wasted more than 150% of extra time of the original contract period. Due to this drastic delay of construction, the project cost also highly elevated.
2. The bottleneck of most influential delay factors from the twenty major causes of delay in the construction of Addis Ababa 40/60 housing project were late delivery of materials by the client, difficulties in financing project by contractor, improper contractor selection, slow decision making by the client and obsolete technology used by contractors.
3. Time taking procurement process, inaccurate estimation of quantity in procurement planning, lake of integration and coordination, lack of qualified personnel to handle resources in the logistics, low productivity level of micro and small enterprises, bureaucratic process, misuse of advance payment by the contractors, serious corruption practice, lack of professionalism, lack of capacity and experience of decision makers, frequent design change were some of the root causes for the major delay factors.
4. The finding showed that cost-overrun, time-overrun, increase unemployment rate due to fail to start new projects, client loses time value of money, the government mistrusted by the people and reduce the quality of construction were a few of effects of construction delay in Addis Ababa 40/60 housing construction project.

## 5.2. Recommendations

Based on the findings of the study the following recommendations are forwarded.

1. To avoid the time taking process of material delivery by the client, the contract modality of material supply shall be changed to supply and fix by contractors. In this effect to reduce the financial burden faced by contractors when all construction materials are supplied by them, it shall increase the advance payment to 30% with tight controlling and supervision mechanism.
2. Contractors' financial difficulties shall be improved by organizing strong and knowledge based financial management system in their company and it is crucial to manage properly their cash flow by avoiding misuse of advance payment. The advance money should be used only for its desired objective.
3. To speed up the construction operation and to complete the project on the initially agreed time contractors shall use latest construction technology, decisions should be made at the right time by the right professional body, time taking payment approval process should be improved by prepare master take off in advance by the client, consultants and contractors jointly, all the three main contracting parties should give serious attention to planning and scheduling of project and should follow up the implementation of plans and schedules. Policy makers in the industry also shall formulate obligatory rules for delayed advance money contractors to pay interest cost.
4. The magnitude of design errors, discrepancies between BOQ, specification and drawing should be minimized creating strong integration and coordination between client and consultant with designer to review the design early. The design should made by qualified and well experienced designer. Moreover client should minimize the need for frequent design change and change orders during construction.
5. The consultant agreement shall be lump sum contract for this kinds of massive public projects. In such type of contract consultants tried to protect themselves from time and cost overruns

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and they do not attempt to try activities to be delay and they try support contractors technically to implement activities efficiently to complete the project before or on the agreed time.

6. Project owner should select technically and financially capable contractors and consultants from existing market and the selection process should be implemented genuinely by loyal, well experienced, knowledgeable and committed professionals. The city administration shall invite foreign international contractors who have sufficient finance and can provide latest construction technology that helps to transfer technology and knowledge to local contractors in the construction of mass housing projects until the peak demand of shelter becomes decline.
7. Further study is recommended for investigation of the effects of delay by conducting holistic research in all 40/60 project sites including head office by considering all cost originating items. The effects of delay caused by micro and small enterprises also left for further study. The impacts of delay on the contractors' perspective also recommended for further study.

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## APPENDIX-I: QUESTIONNAIRE SURVEY



**Addis Ababa University**

**Addis Ababa Institute of Technology School of Civil and Environmental Engineering**

**Masters of Science in Construction Technology and Management Stream**

**Title: Study on Investigating Causes and Effects of Delay in Addis Ababa 40/60 Housing  
Construction: A Case Study on Some Selected Project Sites**

### **Objective of the questionnaire survey**

**Dear respondent,**

The aim of this survey is to identify the potential causes of delay with associated effects and the possible mechanisms to reduce the occurrence of delay in the construction of 40/60 housing project. In order to accomplish these objectives, it is crucial to conduct this questionnaire which is required to be filled with relevant facts as much as possible. I would like to confirm that all the data included in this questionnaire will be used only for academic purpose.

Thanks in advance for your co-operation!

Mollaye Takele

Addis Ababa University Addis Ababa Institute of Technology School of Civil and Environmental  
Engineering Post Graduate Student in Construction Technology and Management

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### **Section I: Respondents Profile**

**Mark your answer by ticking the response for the following questions.**

1. What is the Name of your Project Site? \_\_\_\_\_
  
2. In which one of the following companies working currently?  
Client       Consultant       Contractor
  
3. What is your educational status?  
Diploma       BSc.       MSc.       PhD
  
4. Which of the following best describes your current position?  
Project manager       Supervisor       Office engineer   
Site engineer       Resident engineer       Contract administrator   
Project Coordinator       Other
  
5. What is your year of work experience in Building Construction?  
< 5       5 – 10       10 – 15       ≥ 15

### **Section II: different causes of delay**

The following are the factors which might be the causes of construction delay. Based on your experience, please indicate the extent to which you agree with the following statements.

<b>Scale of Agreement</b>	
<b>1</b>	<b>= Strongly Disagree</b>
<b>2</b>	<b>= Disagree</b>
<b>3</b>	<b>= Moderately Agree</b>
<b>4</b>	<b>= Agree</b>
<b>5</b>	<b>= Strongly Agree</b>

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No	Causes of delay	Scale of Agreement level				
		1	2	3	4	5
<b>A. Design related causes</b>						
1	Design errors and incomplete drawings					
2	Complexities and ambiguities of project design					
3	Delays in providing the design documents by the designer					
4	Inadequate experience of the designer					
5	Poor contract document and specifications					
6	Frequent design change					
<b>B. Materials Related Causes</b>						
7	Late delivery of materials by the client					
8	Poor procurement of materials					
9	Escalation of material prices					
10	Shortage of construction material in the market					
11	Change in material types and specifications during construction					
12	Delay in testing and approving of materials					
13	Poor quality of materials					
14	Existence of Unreliable suppliers					
15	Delay in Importation of materials					
<b>C. Client related Causes</b>						
16	Slow decision making by the client					
17	Poor supervision of work by the client					
<b>Causes of delay</b>		<b>Scale of Agreement level</b>				
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
18	Late in approving design documents by the client					
19	Improper contractor selection					
20	Delay in interim payments of completed work by the client					
21	Frequent changes order by the client during construction					

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22	Incapable project manager delegation					
23	Lack of communication and coordination					
24	Bureaucracy of government authorities					
25	Presence of multiple stakeholders					
<b>D. Consultant Related Causes</b>						
26	Inadequate consultant experience					
27	Delay in approving shop drawings and sample materials					
28	Poor contract management by the consultant					
29	Weak supervision by the consultant					
30	Delay in approving payment certificate					
31	Technically Incapable consultant staff					
32	Malpractice (unethical practices) by the consultant					
<b>E. Contractor Related Causes</b>						
33	Rework for Mistakes in construction					
34	Difficulties in financing project by contractor					
35	Inadequate contractor experience					
36	Inappropriate construction methods					
37	Poor site management and supervision					
38	Improper project planning and scheduling					
39	Incompetent project team					
40	Obsolete technology Used by contractor					
41	Delays in sub-contractors work					
42	Fraud practices by contractor					
43	Poor Cash flow management by the contractor					
<b>F. Equipment Related Causes</b>						
44	Low skilled Equipment operators					
45	Equipment availability problem in the market					
46	Improper and Insufficient number of equipment					
<b>Causes of Delay</b>		<b>Scale of Agreement level</b>				
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

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47	Frequent equipment breakdown and shortage of parts					
48	Low Productivity and inefficient level of equipment					
49	Scarcity of hard currency to import equipments					
	<b>G. Labour Related Causes</b>					
50	Unqualified work force (Shortage of skilled labour)					
51	Low productivity level of Labour					
52	Labour absenteeism					
53	Labor strikes					
	<b>H. Contractual and Administrative Causes</b>					
54	Inappropriate consultant agreement					
55	Inappropriate client partial material supply agreement					
56	Political assignment of client project managers					
57	Political interference for technical and contractual works.					
58	Discrepancies between BOQ, specification and drawings					
59	Inappropriate organization management					
60	Lack of sense of ownership by the managers of organization					
61	Incapable contract administration team					
	<b>I. External Related Causes</b>					
62	Unforeseen ground and geological conditions.					
63	Adverse Weather conditions					
64	Changes in government regulations and laws					
65	Slow permit by government/municipality					
66	Fluctuations in cost/ currency					
67	Natural disasters (flood, hurricane, earthquake)					
68	Local political instability					
69	Lack of infrastructure (road, water, electric supply, etc.)					
70	Right of way problem					

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**Section III: different effects of delay**

The following statements might be the effects of delay which occurred when the 40/60 housing construction is delayed. Based on your experience, please indicate the extent to which you agree with the following statements.

Scale of Agreement	
1	= Strongly Disagree
2	= Disagree
3	= Moderately Agree
4	= Agree
5	= Strongly Agree

No	Effects of delay	Scale of Agreement level				
		1	2	3	4	5
1	The entire working capital may become trapped in one project					
2	loss of output and revenues due to unavailability of facilities					
3	Total abandonment or rejection of the project					
4	Dispute between contracting parties					
5	Arbitration					
6	public inconvenience resulting from delay of the project					
7	disturbance of the budget execution plan for the government authority involved					
8	Make confusion regarding the public development plans					
9	termination of contract					
10	time-overflow					
11	cost-overflow					
12	the client (government) mistrusted by the people					
13	unable to fair distribution of resource or wealth					
14	Fail to contribute in the reduction of climax housing demand					
15	contribute for escalation of housing rent price					
16	The desperation house seekers withdraw their money from the bank					
17	Contribute for continual rising of housing price					
18	Client loses time value of money due to delayed advance reimbursement					
19	Unable to start new projects and increase unemployment rate					
20	construction materials exposed to vandalism and deterioration					
21	The saved registered public money lose its purchasing power					
22	Contribute for cost of living					
23	Prolong the renewing objective of the slum area of the city					
24	reduce the quality of construction					

**Appendix-II: Interview for basic information about the project**

1. When was the project started? .....
2. What is the contract period? .....
3. What is the total cost of the project? .....
4. What is the current status (in %) of the project? .....
5. How many contractors are participated? .....
6. How many consultants are participated?.....
7. What is the class of consultants?.....
8. What is the grade of contractors? .....
9. What was the consultant selection criteria?.....
10. What was the contractor selection criteria?.....
11. What are the typologies of the blocks? .....
12. How many blocks are there in each typology? .....
13. How many houses are there in bed types? .....
14. Who prepared the original project design?.....
15. Who approved the original project design?.....
16. By how much is the project delayed? .....
17. Have you got any approved claims (extension of time, escalation etc.)? .....
18. What is the delay analysis method you used? -----
19. What is your organizational structure?.....
20. How many contractors are terminated?.....
21. What is the grade of terminated contractors?.....
22. Why those contractors are terminated?.....
23. Why the project is delayed?.....
24. Who is responsible for the project delay?.....
25. How many birr's of consultant monthly payment?.....
26. How much money is the monthly security fee?.....
27. Is there any building 100% completed including lift installation?.....
28. Do you think that the government give attention for the housing projects?.....
29. Is the advance money completely returned?.....
30. Is the advance money was taken by terminated contractors returned? If not, why?.....

### **Appendix-III: Interview for the root causes of major delay factors**

What are the causes of occurrence for the following major delay factors?

1. Late delivery of materials by the client
2. Difficulties in financing project by contractor
3. Improper contractor selection
4. Slow decision making by the client
5. Obsolete technology used by contractors
6. Bureaucracy of government authorities
7. Delay in approving payment certificates by the consultant
8. Design errors and incomplete drawings
9. Escalation of materials price
10. Delay in approving shop drawings
11. Delays in sub-contractors work
12. Malpractice (unethical practices) by the consultant
13. Presence of multiple stakeholders
14. Delay in testing and approving of materials
15. Discrepancies between BOQ specification and drawings
16. Frequent changes order by the client during construction
17. Improper project planning and scheduling
18. Technically Incapable consultant staff
19. Inappropriate consultant agreement
20. Delay in Importation of materials

**Appendix-IV: Interview for the secondary effects of delay effects (effects of effects)**

What are the impacts of the following effects of delay?

1. cost-overrun
2. time-overrun
3. increase unemployment rate due to failure to start new projects
4. Client loses time value of money due to delayed advance reimbursement
5. the client (government) mistrusted by the people
6. Reduce the quality of construction
7. Contribute for cost of living
8. Fail to contribute in the reduction of climax housing demand
9. Construction materials exposed to vandalism and robbery
10. Contribute for continual rising of housing price
11. The entire working capital may become trapped in one project
12. loss of output and revenues due to unavailability of product
13. termination of contract
14. public inconvenience resulting from delay of the project
15. unable to fair distribution of resource or wealth
16. contribute for escalation of housing rent price
17. disturbance of the budget execution plan for the government authority involved
18. The saved registered public money becomes decline its purchasing power
19. Dispute between contracting parties
20. Arbitration
21. The desperation house seekers withdraw their money from the bank
22. Make confusion regarding the public development plans
23. Prolong the renewing objective of the slum area of the city
24. Total abandonment or rejection of the project