ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

SCHOOL OF GRADUATE STUDIES

CONSTRUCTION TECHNOLOGY AND MANAGEMENT STREAM

Identification of the Major Causes to the Delay in the Construction of 40/60 Saving Houses Project in Addis Ababa

By

Endale Mamuye Desse

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 Construction Technology and Management

Advisor: Dr. Abraham Assefa Tsehayae

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DECLARATION

I, the undersigned, declare that this thesis entitled "Identification of the Major Causes to the Delay in the Construction of 40/60 saving Houses Project in Addis Ababa" is my own work, has not been submitted for a degree in any universities and all references used for the thesis has been duly acknowledged.

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ABBREVATIONS

AAIHDP----------Addis Ababa Integrated Housing Development Program

AASHDE----------Addis Ababa Saving Houses Development Enterprise

ANNOVA----------Analysis of Variance

CL----------Client

CPM----------Critical Path Method

CS----------Consultant

CT----------Contractor

ECC----------Ethiopian Civil Code

FIDIC----------Federation Internationale des Ingenieurs Conseils‟
(International Federation of Consulting Engineers)

FM----------Force Majeure

IDT----------Isolated Delay Type

MoWUD----------Ministry of Works and Urban Development

MSEs----------Micro and Small Enterprises

ABSTRACT

Delay is the most frequent problem in the construction industry particularly in developing countries like Ethiopia. However, it can be better managed when the causes are identified and action is taken by the concerned bodies. The main objective of this research is to identify the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa. Overall, 80 respondents from client, consultants and contractors participated in the survey and identified 10 major causes of delay from a list of 45 common causes of delay based on the relative importance index (RII).

The ten major causes of delay in the construction of 40/60 saving houses project 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.

The results of the case studies showed that late material supply was mainly caused by the client due to financial shortage, time taking material procurement process, unfair distribution of material, shortage of transport facilities, scarcity of material in the market etc. Financial difficulty faced by the contractors was caused by both the contractors and the client due to the contractors' poor financial management, and delayed payments to contractors. Problem of electric supply was caused by both the client and the contractors due to frequent power interruption, late maintenance, unsafe construction, unavailability of high capacity stand by generators etc. Furthermore, the impacts of the major causes of delay were time overrun and cost overrun to the client and the contractors.

Key words: *Delay, Questionnaire Survey, Relative Importance Index, Major Causes of Delay, Case Studies, Sources of Delay, Reasons, Impacts*

CHAPTER-1: INTRODUCTION

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

1.1 Background

Nowadays, Addis Ababa is challenged with housing shortage due to the continually increasing population growth and immigration from different corners of the country. In 2004 E.C, the City government launched the Addis Ababa Integrated Housing Development Program (AAIHDP) to alleviate housing shortage. (UN-HABITAT, 2011).The program comprises of four different schemes based on percent of advance payment modalities such as 10/90, 20/80, 40/60 and housing association (refer to Table 1.1).

Table 1.1 Schemes of the Addis Ababa Housing Development Program (UN-HABITAT, 2011)

Scheme of project	Targeted population	Advance payment (%)	Long-term loan (%)
10/90	Low-income	10	90
20/80	Lower middle income	20	80
40/60	Upper middle income	40	60
Housing Association	High income	100	-

The financial sources for the above schemes include bank loan, city budget and down payments from beneficiaries of the project. The independent financial source of housing program is the Commercial Bank of Ethiopia (CBE), which provides funding directly to Housing Development Program and loan service to the beneficiaries. Private sector enterprises participated in designing, supplying construction materials, and in the actual construction work phases (UN-HABITAT, 2011).

The program is aimed at enhancing the construction industry through mass construction of buildings, introducing new technology, capacity building of contractors (financial and technical

supports), creating skilled and semi-skilled professionals, and micro and small enterprises, improving the living standards of residents, reducing slums ,and creating job opportunities (UN-HABITAT, 2011) . So, there is nothing to deny the program's essentiality and the urgent need to deliver built houses as soon as possible. However, the 40/60 housing scheme is delayed due to different delay factors while the registered city dwellers are saving their money for the housing by deducting from their basic livelihood.

Delay negatively affects project stake holders, such as clients, contractors and consultants. To the client, it causes expense and loss of revenue. On the other hand, to the contractor, it causes higher overhead costs, higher material and labor costs .On top of that, to the consultant, it causes incredulity because of the project taking longer than it was planned. Due to construction delay, it is difficult to deliver the project in time, within budget, and expected quality. Hence, it is necessary to address the problems of construction delay to minimize the effect.

1.2 STATEMENT OF THE PROBLEM

Only 1,292 40/60 saving housing units in Sengatera and crown 40/60 project sites are about to be transferred to the public out of 39,229 housing units that are under construction. As per commercial bank of Ethiopia report, 156,932 people are registered for 40/60 saving housing units in August 2013(http://capitalethiopia.com, Aug.10, 2015). At the current rate of construction, it might take decades to deliver the houses fully to the registered public under the 40/60 housing scheme (refer to Table 1.2). This research is aimed at identifying the major causes to the delay in the construction of 40/60 saving housing in Addis Ababa in a bid to address the housing demand in the 40/60 housing scheme in a short period of time.

Table 1.2 Construction progress of 40/60 project sites (Source: AASHDE, November 2015 Monthly Progress Report)

No	40/60 Project Sites	No of Block	Contract Signing Date	Elapse vs Contract period (month)	Executed vs Planned Status (%)	Remark
1	Senga Tera	5	Oct.10/2012	37/18	91.27/100.00	All projects are delayed
2	Crown	14	March 28/2013	32/15	90.85/100.000	
3	Asko	13	Sep.26/2013	26/18	44.12/100.00	
4	Ehil Nigid	6	Sep.03/2013	26/18	77.33/100.00	
5	Hintsa Akrabi	8	Nov.19/2013	24/18	70.43/100.00	
6	Bole Bulbula-1	28	May 26 /2014	18/18	67.62/95.00	
7	Bole Bulbula-2	21	July 07/2015	4/18	6.68/20.00	
8	Tourist Nigid	11	March 18/2015	8/19	10.53/25.00	
9	Meri	14	March 08/2014	20/18	60.25/90.00	
10	Bole Ayat -1	133	May 20/2014	18/15	36.99/75.00	
11	Bole Beshale	58	May 21/2015	6/18	6.05/30.00	
12	Semit	10	May 26/2015	6/13	9.56/30.00	
13	Bole Ayat -2	48	May 28/2015	6/18	8.21/25.00	

1.3 Objective of the research

The main objective of this research is to identify the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa.

1.4 Significance of the research

It is known that there is significant housing demand in Addis Ababa. To meet the demand, the government launched the housing program. Accordingly, in the 40/60 project scheme, multi-million birr is currently deposited by the registered city dwellers hoping to be house owners in the intended period of time. However, the project is delayed due to different factors. This research identifies the major causes to the delay in the construction of 40/60 scheme project so that the contractual parties take action to minimize the causes to ensure the timely delivery of the houses to users and sustainability of the housing program.

1.5 Scope and limitations of the research

The research identified the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa through questionnaire survey. In the questionnaire survey, all thirteen 40/60 project sites (having 16 lots) participated. Since it is difficult to address all contractual parties, only 50 contractors (out of 153), 15 client respondents (out of 16), 15 consultants (out of 16) participated. In the case study, only three most delayed project sites participated through interview due to time limit to address all. In this research, only the three contractual parties (Client, consultants and contractors) participated out of the many project stakeholders.

1.6 Thesis Organization

This thesis is organized into six chapters as discussed hereunder.

Chapter 1-Introduction: presents background, statement of the problem, objective of the research, significance of the research, scope and limitations, and thesis organization.

Chapter 2-Literature Review: deals with introduction, the legal frame work regarding construction delays, classifications of delays, causes of delays from previous studies, delay analysis techniques, and chapter summary.

Chapter 3-Research Methodology: deals with introduction, population, and sample size, data collection methods, and data analysis methods.

Chapter 4-Questionnaire Analysis Results: deals with introduction, questionnaire response rate, Cronbach's alpha coefficients, identification of the major causes of delays, comparison of the major causes of delays, identification of types of delays, spearman rank correlation coefficient, analysis of variance, and chapter summary.

Chapter 5-Case Study Results: deals with introduction, project description, selection process of consultants, and contractors, case study results, and concluding remarks.

Chapter 6-Conclusions and Recommendations: deals with conclusions, and recommendations for minimizing major causes of delays, and recommendations for further studies.

CHAPTER-2: LITERATURE REVIEW

Construction delay is a worldwide problem in the construction industry. Delay is a consequence of non-performance of critical activities on timely basis, which prolongs the completion date of the project. The success of a project is measured in terms of timely completion, cost, and quality. Some projects, which are properly planned and managed, are successfully completed. However, many projects are delayed due to causes related to the owner, the contractor, the consultant or third party/force majeure. Delay is primarily caused by lack of early planning and proper management during the construction. Delay has negative effect in terms of time overrun and cost overrun to both the contractor and the owner.

The objective of this chapter is to review various literatures related to project delay so as to have an input to the undertaking of this research, which is aimed at identifying major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa. The literature review includes introduction about delay and its effect in terms of prevalence and extent in various countries scenario; the legal framework to assess the provisions related to construction delay in the Ethiopia civil code; the MoWUD and FIDIC standard conditions of contract classification of delay by compensation, source and nature/time of occurrence as it helps to undertake delay analysis; identification of delay event i.e. cause-effect and effect-cause approaches; causes of delay found in different but mainly developing countries; review of delay analysis techniques, which are used to calculate project delay and apportion the delay attributable to the parties (contractor, client or neither) so as to decide time extension and/or financial compensation; and finally concluding remarks are presented.

2.1. Introduction

Construction delay is the most frequent phenomenon in the construction industry. According to Assaf & Al-Hejji (2006), construction delay means the time overrun beyond a project completion date specified in a contract or the time overrun beyond a project delivery date that the contractual parties agreed upon. The delay or time overrun results in prolongation costs. The associated prolongation costs incurred by the client are consultant payment, payment for head office follow-up, loss of revenue had the project finished on time, and compensation to the contractor if the

delay is caused by the client, and the costs incurred by the contractor are costs associated with operation and maintenance of temporary facilities, project and head office overhead cost, cost of extension of performance and advance payment guarantees, and loss of revenue.

It is rare that a construction project is completed within the agreed contract period, the allocated budget and the required quality. Delays are the consequences of unmanaged uncertainties resulting from uniqueness of each project in terms of scope, design, quality, location, management and contract type. These uncertainties include availability of resources such as required quantity and quality of material, required number of and skilled manpower, required finance and efficient equipment, site conditions, contractual conditions, competence of the contracting company, etc. Nonetheless, it is possible to minimize the occurrence of delays through proper planning, controlling and management of the uncertainties.

2.1.1 Effect of delays

Many construction projects worldwide face significant delay due to various reasons. According to Haseeb *et al.* (2011), around 80% construction projects in Pakistan faced delays. Assaf & Al-Hejji (2006) found that approximately 70% of the large construction projects in Saudi Arabia experienced time overruns. In Ethiopia, 94% of 52 surveyed public building projects constructed by local contractors in the years between 1995 and 2005 suffered delays (Abdo, 2006).

Construction projects in various countries suffer significant time overrun. Abdullah & Battaineh (2000), evaluated the progress reports of 164 building projects and 28 highway projects constructed during the period of 1997 to 1999 in Jordan and revealed that the actual completion time to the planned contract duration is 160.5% for road projects and 120.3% for building projects. According to Alnuaimi &Moshin (2013), delay in construction projects in Oman during 2007-2009 is more than 40 per cent of the planned time. Assaf &Al-Hejji (2006) indicated that the average time overrun in large construction projects in Saudi Arabia was between 10% and 30%.In Saudi Arabia, any delay or default by a contractor can result in a penalty of 10% of the contract price and a deduction equal to the value of the uncompleted work. However, while working on public works, the Procurement Law specifically forbids contractors from suspending work due to the government's failure to pay, but not provide any further guidance concerning

damages. The only solution to a contractor in this situation is to petition for relief (Husein, 2013/14). Joseph (2004) found that the average total delay in completion of building construction projects in the Botswana public sector, carried out and completed by citizen contractors, was equivalent to 90% of the planned contractual building period where as the average total delay among projects carried out and completed by non-citizen contractors was equivalent to 53% of the planned contractual building period. In Ethiopia, the time overrun for surveyed 52 public building projects constructed by local contractors in the years between 1995 and 2005 ranges from 10% to 367% (Abdo, 2006). A review of 13 completed projects in different regions of Ethiopia constructed between 1985 and 1995 showed that the delays encountered in most of the projects range between 100% and 460% of the original contract time (Ismael, 1996).

Having understood the effect of delays, i.e., the prevalence and extent of delays in construction projects worldwide, a lot should be done to address the problem of construction delay in order to minimize or avoid the consequences imposed in terms of time overrun and cost overrun. This chapter critically examines the definition, legal framework, classification, identification of delay events, causes and data analysis techniques of delays found from literatures.

2.2 Classification of Delays

Before discussing classification of delay based on compensability, source and nature, it is necessary to understand the legal framework related to delay in the Ethiopian civil code, the MoWUD and FIDIC standard conditions of contract.

2. 2.1 The Legal Framework Regarding Construction Delays

The legal framework allocates obligations to parties of a contract to share risks associated with a project delay. When an event that causes delay happens, it is possible to identify the responsible stakeholder as per the contract provisions and the responsible party pays compensation in terms of time or money to the non-responsible party. It also identifies certain conditions so called force majeure which may cause delays in completion of projects, but whose occurrence is beyond the control of the contractor and the client and hence the delay is neither caused by the contractor nor by the client.

2.2.1.1 Delay related Articles in the Ethiopian Civil Code

The Ethiopian Civil Code (ECC) comprises six articles which 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: If the party fails to perform his obligations, his 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

Article 1793: Examples of force majeure 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

Article 1794: Force majeure shall not exist in the following situations: 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 1794: 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.

2.2.1.2 Delay related Clauses in the MoWUD Standard Condition of Contract

Ministry of Works and Urban Development (MoWUD) standard condition of contract is incorporated in the general condition of contract for 40/60 saving houses project. However, it should not have been MoWUD SCC as the owner of the project is MoWUD itself. The delay clauses are hereunder discussed.

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.

Clause 46: Provided that the project progress 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 .In any way, the liquidated damage payable to the client by the contractor shall not exceed 20 % of the contract price

MoWUD special condition of contract(SCC) does not provide adequate and balanced appropriation of delays among the contractor and the client because it stipulates that the contractor is entitled only to extension of time, not damages when delay occurs due to extra work, which is caused by the client (see clause 44). On the other hand, the client is entitled to liquidated damage when delay caused by the contractor.

2.2.1.3 Delay related Clauses in the FIDIC Standard Condition of Contract

FIDIC standard condition of contract is used in international contracts when the contractual parties are from different countries. It stipulates provisions related to construction delays as discussed hereunder.

Clauses 42.2: The Contractor is entitled to extension of time and compensated for the incurred costs if the client fails to give possession of site .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.

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 project progress is too slow to meet the 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: The liquidated damages for delay shall be effected for only non-completed, non-certified portion of works

Almost all delay clauses of MoWUD resemble that of FIDIC SCC as the former is derived from the latter.

2.2.2 Types of Delays by Source

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

2.2.2.1 Client

Delays are caused by the client's actions emanating from his need or inactions contrary to provisions stipulated in the contract. Examples include 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).

2.2.2.2 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.

2.2.2.3 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.

2.2.2.4 Force Majeure

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)

2.2.3 Types of Delays by Compensation

Construction delay is classified into two major types of delay by compensability such as non-excusable (contractor-caused) delay and excusable delay. The excusable delay is further classified into compensable (client-caused) delay and non-compensable (force majeure-caused) delay as discussed hereunder (Alhaji & Danladi, 2012).

2.2.3.1. Non- Excusable Delays

Non-excusable delay is any delay caused by the contractor, his subcontractors or suppliers only. The contractor is responsible for the delay and the owner is entitled to claim any delays to the project as per the contract. The contractor gets neither a time extension nor financial compensation rather the client is entitled to liquidated damages or actual damages provided there is no liquidated damages clause in the contract. These delays include, for example, late commencement of work, poor site management, shortage of material, low productivity of labor, equipment failure, problems with sub-contractor etc. The contractor is generally not entitled to relief and must either make up the lost time through acceleration or compensate the owner. Acceleration is often carried by working overtime and on weekends by adding manpower or even by placing extra shifts and equipment.

2.2.3.2 Excusable Compensable Delays

Excusable compensable delay is caused by either the client or the consultant. The client is responsible for both the time and cost effect of the delay. Contactor gets both a time extension and financial compensation. Examples include failure to pay the contractor, the client's intervention with the work, change order, differing site condition, late decision making etc.

2.2.3.3 Excusable Non-Compensable Delays

Excusable non-compensable delays are caused by third party or force majeure. Contractor is normally entitled to a time extension but no compensation for delay damages. Examples include 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.

2.2.4 Types of Delays by Nature

Construction delays are classified into three categories such as independent delay, serial delay and concurrent delay based on their time of occurrence (Arditi & Robinson, 1995; Stumpf, 2000).

2.2.4.1 Independent delays

An independent delay is defined as a particular delay occurring solely 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.

2.2.4.2 Serial delays

Serial delay is a series of sequential, non-overlapping delays that are linked together (Arditi &Robinson, 1995; Stumpf, 2000). It is caused by the action or inaction of one of the parties (Raid et al., 1991). Measuring the impact of serial delays is comparatively simple as none of the individual delays interferes with one another. Example is when client fails to pay the contractor and then the contractor fails to supply material sequentially (Arditi &Robinson, 1995).

2.2.4.3 Concurrent delays

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

1. Excusable delay and non-excusable delay. Example is when severe weather 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.
2. 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.
3. Excusable delay, non-excusable delay, and compensable delay. Example is when severe weather occurs, 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.
4. 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 in which the owner and the contractor are both responsible for delays in completing the work, there are two different rules such as the "easy rule" and the "fair rule"(Kraeim, 1987). In the easy rule, apportionment of liquidated damages is not allowed; instead the contractor should be entitled for time extension with each party suffering its own losses. In the fair rule, apportionment of liquidated damages is carried out. It is necessary that the records clearly establish some genuine warrant for reasonably assigning the commensurate responsibility for the delay between the owner and the contractor.

2.2.5 Types of delays by responsibility

Delay responsibilities are categorized in to client responsible, contractor responsible, neither party responsible, and both parties responsible so as to identify which party will be entitled for compensation as discussed hereunder, Ahmed et al. (2002).

2.2.5.1 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.

2.2.5.2 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.

2.2.5.3 Neither Party (e.g. force majeure) Responsible

Such delays occur when a delay occurs due to force majeure, neither parties are responsible. However, Contractor will get time extension to complete the project but no financial compensation and client will not be entitled to claim for liquidated or actual damages. Examples include civil war, occurrence of a natural catastrophe such as earthquake, flood etc.

2.2.5.4 Both Parties Responsible

Such delays occur when a delay occurs due to both parties concurrently, Contractor will get time extension to complete the project but no 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.

Many studies have investigated, among the main contractual parties, which one is the most responsible stakeholder for construction delays. Ren *et al.* (2008) revealed that, in construction projects in Dubai, the contractor's contribution is 61.76%, the client's contribution to causes of delay is 11.76%, and that of the consultant is 26.47%.Joseph (2004) showed that in building construction projects in Botswana public sector, contractors were responsible for 48% of the total delay experienced on their projects while the employer or the government was responsible for 31% of the delays. The rest of the delays were due to force majeure. Ahmed *et al.*(2002) came up with the responsibility proportion for delays in Florida, and contractor was responsible for 44 %, owner for the 24 %, government for the 14%, shared for the 12% and consultant for the 6% of the construction delays in Florida. Abdo (2006) revealed that contractors are responsible for 38.5% of the causes of delays in public building projects of Ethiopia whereas consultants for the 25%,clients for the 18.2 %, government for the 9.1%, designers for the 4.6 %, and the rest 4.6 % shared by the stakeholders. The consultants 'contribution to delay in Florida (6%) is much less than that of in Ethiopia (25%) because of specialization of consultants in Florida.

2.2.6 Identification of Delay Events

A delay event is any types of event which causes delay to completion (Alena *et al*, 2015). Identifying delay events is very important, but difficult and time taking to determine the responsible contracting party for a delay. Delay events are typically grouped into either of the Contractor's delay event or the Client's delay event. The contractor delay events include late commencement of work, late material delivery, equipment failure, low productivity of labor, etc. The client's delay event includes late interim payment to contractor, suspension of work, change order, late decision making, etc. If a delay is caused by a contractor' delay event, the client will be entitled to compensation whereas if the delay is caused by a client's delay event the contractor will be entitled to compensation. A contract document shall clearly specify the responsible party

for various kinds of delay events likely to occur in construction projects. There are two primary approaches to identify delay events: effect-based approach and cause-based approach (Farrow, 2001).

The effect-based approach: investigates the as-built schedule to identify the deviations from the as-planned schedule which are the effects of delay events. This approach identifies the effects first and then investigates the causes of those effects.

The cause-based approach: lists out a set of delay events first and then measures the effects of those causes based on a baseline schedule. The cause-based approach requires a reliable as-planned schedule as it must verify that identified delay events were not counted at the as-planned status.

2.3 Causes of Delays

Delays happen in construction projects, but the magnitude of these delays varies from project to project. It is vital to identify the causes of delay in a bid to minimize or avoid delay in any construction project. A number of researches have been conducted on the causes of construction delay worldwide.

Ahmed *et al*. (2002) conducted a research on construction delays in Florida. Questionnaire survey was used to identify the critical causes of delay in building projects of Florida. They categorized causes of delay into six groups: acts of god, design related, financial/economical, management and code related. They found that code-related delay was ranked as the most critical category followed by design-related delays, construction-related delays, and so on. The ten most critical causes of construction delays in Florida were: building permits approval, change order, changes in drawings, incomplete documents, inspections, changes in specifications, decision during development stage, shop drawings approval, design development, changes and laws/ regulations.

Pourrostam &Ismail (2012) studied causes and effects of delay in Iranian construction projects. Projects studied in this research comprised of residential, office and administration buildings, and roads. A questionnaire survey was conducted to identify the causes and effects of delay from 100 consultants and contractors' viewpoint. This research identified 10 most important causes of

delay out of 28 different causes of delay based on their Relative Importance Index .The most important delays were delay in progress payment by client, change orders by client during construction, poor site management, slowness in decision making process by client, financial difficulties by contractors, late in reviewing and approving design documents by client, problems with subcontractors, ineffective planning and scheduling of project by contractor, mistakes and discrepancies in design documents, and bad weather.

Haseeb *et al* (2011) conducted research for the construction delays in Pakistan's large construction prpjects. They used questionnaire survey to get the data about the causes of delay and identified 16 important causes of delay based on relative importance index (RII), which were: finance and payments, inaccurate time estimation, quality of material, delay in payments to supplier and subcontractor, poor site management, old technology, natural disasters, unforeseen site conditions, shortage of material, delays caused by subcontractors, changes in drawings, improper equipment, inaccurate cost estimation, change orders, organizational changes and regulatory changes.

Ren *et al* (2008) identified root causes of construction project delays in Dubai. A questionnaire survey and interviews were conducted to explore each project stakeholder's contributions to the causes of delays. The results showed that unrealistic project duration, many provisional sums and prime cost, nomination of sub-contractors and suppliers, client's irregular payment to the main contractor and variations were the top five causes of delay contributed by the client. Incomplete drawings, delay in approval of documents, incomplete contract documents, changes in drawings and specifications, and duration of inspection procedure were also the major causes contributed by the consultant. Preparing the method statements, ill-financed project, inappropriate organization management, unsmooth external and internal communications, and mistakes in construction were the top delay causes contributed by the contractor.

Desai &Bhatt (*2013)* studied critical causes of delay in residential construction projects of central Gujarat region of India. The delay was studied through field survey and 59 causes of delay were identified through research. The identified causes of delay were classified into nine groups as project related, owner related, contractor related, consultant related, design-related, material related, equipment related, labor related and external factors depending on their nature

and mode of occurrence. The field survey included 50 respondents where 20 were developers, 17 were contractors, and 13 were consultants. This study used two different ranking techniques: Relative importance index and Importance index based on degree of severity and degree of frequency. Results showed that out of top 10 delay factors, a total of 5 delay factors were common in ranking by both methods. They were original contract duration is too short, shortage of labors, delay in material delivery, low productivity level of labors, and delay in progress payments by owner. Moreover, using both methods, labor related factors were ranked first while external factor was considered having least effect on delay, as it was ranked last.

Sambasivan &Soon (2006) conducted a research on causes and effects of delays in Malaysian construction industry. A questionnaire survey was used to identify the causes of delay from clients, consultants, and contractors. 150 respondents took part in the questionnaire survey. They found out that the ten most important delay causes in Malaysian construction industry were: contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage.

Sweis *et al* (2008) studied delays in residential construction projects in Jordan and classified causes of construction delays using the Drewin's Open Conversion System in to input factors included labor, materials and equipment, and internal environment was among contractor, owner and consultant related factors, and exogenous factors included weather and government regulation. Within the contractor's internal environment, ''financial difficulties'' was the first most important delay cause. Exogenous factors such as severe weather conditions on the job site and changes in government regulations and laws were the least ranked causes according to the perception of all three parties. As per the consultants' responses, the most critical delay causes were: poor planning and scheduling of the project by the contractor, financial difficulties faced by the contractor, and too many change orders from owner. According to the contractors, the most critical delay factors were: financial difficulties faced by the contractor, too many change orders from owner, and shortage of manpower (skilled, semi-skilled, unskilled labor).According to Owners, the most critical delay causes were: poor planning and scheduling of the project by

the contractor, financial difficulties faced by the contractor, and incompetent technical staff assigned to the project. All the three contractual parties agreed that the most critical causes of delay in residential construction projects of Jordan are financial difficulties faced by the contractor and too many change orders by the owner.

Abd El-Razek *et al* (2008) identified the main causes of delay in construction projects in Egypt from the point of view of contractors, consultants, and owners. A literature review was used to identify the causes of delay. Semi structured interviews were conducted to identify the most appropriate causes of delay to Egyptian building projects. A questionnaire survey was used to identify the most important causes of project delay out of 32 main causes of delay. The most important causes of delay identified by the questionnaire survey were: lack of financing by contractor during construction, delays in contractor's payment by owner, design changes by owner or his agent during construction, partial payments during construction, and non-utilization of professional construction/ contractual management.

Shebob *et al* (2011) studied construction delay factors in building construction project in Libya. A semi-structured questionnaire was developed using literature .The delay factors were ranked using the frequency of occurrence and severity scale. The research study found that the critical delays factors are different in UK and Libyan construction projects due to differences in construction methodology and planning techniques used in both countries. The critical delay factors found in Libyan construction projects were low skills of manpower, changes in the scope of the project, slowness in giving instruction, poor qualification of consultant, and delay in delivering site project to contractor.

Alhaji & Danladi (2012) conducted a research on causes of delay in Nigeria construction industry. The survey method used for this research was questionnaire; the questionnaire survey included contractors, clients and consultants in the construction industry in Nigeria. The results obtained from ranking analysis show that improper planning, lack of communication, design errors, and shortage of supply were the most important causes of delays in Nigeria construction industry. Moreover, Abisuga *et al* (2014) studied the causes, effects and methods of minimization of construction project delay as perceived by indigenous and multinational construction firms in Lagos, Nigeria. The study showed that the two types of firms agreed that

out of the total of 52 delay factors, the top five critical delay factors were cash flow problems**,** shortage of construction materials**,** client's financial difficulties**,** inadequate consultant experience**,** and incompetent project team**.**

Fugar *et al* (2010) studied delays in building construction projects in Ghana. Literature and semi-structured interviews were used to identify 32 causes of delay. These delay causes were evaluated using a questionnaire survey in order to identify the most important causes of delay. The questionnaire survey involved 130 respondents, composed of 39 contractors, 37 clients, and 54 consultants. The most important delay causes and groups of delay factors were ranked by their relative importance index. The delay factors were classified into nine major groups such as material, manpower, equipment, financing, environmental, changes, government action, contractual relations, and scheduling and controlling techniques. The financing group of delay factors was the most important factor, followed by material factors and thirdly followed by scheduling and controlling factors. The study result showed that the top ten influencing delay factors were: delay in honoring certificates, underestimation of the costs of projects, underestimation of the complexity of projects, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, shortage of materials, poor professional management, fluctuation of prices/rising cost of materials, and poor site management.

Abdo (2006) conducted a research on delays in public building construction projects and their consequences in Ethiopia through surveying 52 public building projects constructed by local contractors in the years between 1995 and 2005.A questionnaire survey was used to collect data on delays, and 62 responses from contractors, consultants, public owners and construction professionals were analyzed using mean score method. He grouped 80 hypothesized causes of delay into six categories which included design related, management related, construction related, finance related, code related, and force majeure related causes of delay. Of these groups of delay causes, design related causes of delay were the most frequent followed by management related delay causes. He finally identified 10 critical causes of delay in public building construction projects in Ethiopia which included scarcity of material in the market, late material supply, delayed payments to contractors, unrealistic performance schedule, change in subsurface

conditions, client's finance shortage, adverse weather condition, less emphasis to planning, material and labor price escalation, and variations.

2.4 Delay Analysis Techniques

Delay Analysis Techniques (DATs) are used to calculate the amount of a project delay and to identify the proportion of the delay attributable to each party (contractor, owner, or neither) in order that time and/or cost compensation can be decided (Braimah, 2013). The selection of the proper method depends upon the magnitude of the dispute, the time available, the records available, and the funds and effort allocated to the analysis. There are three types of schedules used in Delay Analysis Techniques (Kraiem, 1987).

As-Planned Schedule: illustrates the initial work plan to achieve the scope of work conforming to the contract requirements and used for measuring actual fulfillment of the work.

As-Built Schedule: reflects the actual succession of the events that happened during execution of the project and prepared from careful inspection of project reports and documents.

Adjusted Schedule: serves to quantify and identify the impact of schedule variances on the project and used for determining the effects of different types of delays on the project completion date.

Using the different schedules discussed above, the following delay analysis methods are used to identify the impacts of delays.

2.4.1 As-Planned But for Method

The As Planned But for method utilizes the CPM scheduling format. In this method, all delays of a particular party are injected into the as-planned schedule to form updated schedule, which produces revised project completion date and is compared against the as-built schedule. The difference between the as-built and the revised project completion date yields the amount of delay for which the other party is responsible (Alkass, 1996). The advantage of this method is that it can be performed quickly because there is no need to consider actual progress of the work, It addresses the issue of concurrent delays and scrutinizes delay types (Braimah,2013;

Alkass,1996).The main weaknesses of this method include it does not take into account any changes in the CPM schedule during the course of the project, it assumes that the planned construction sequence remains valid during the project duration owner's point of view and contractor's point of view may yield different results resulting in disputes (Alkass,1996 ; Braimah,2013)

2.4.2 As-built But for Method

This method is a form of "but for" which uses the as-built schedule as a baseline. It involves removing the delays of each party from the as-built network so that the resulting schedule will give the completion date of the project but for the delays of the other party (Braimah, 2013).The main advantage of this method is that it is based on actual events of the project. The shortcomings of this method include the removal of the delays from the as-built schedule could result in an unrealistic as-built but-for schedule, particularly when the schedule sequence has been so much impacted by those delays, it ignores the circumstances at the time of the delay and the dynamic nature of the critical path (Braimh,2013)

2.4.3 Window or Snapshot Analysis

In this method, the total project duration as given by as-built CPM schedule is divided into a number of time periods (windows or snapshots). The dates defining the boundaries of these windows are often determined by major project milestones, significant changes in the critical path, occurrence of major delay events and dates for the issue of schedule revisions or updates. The relationships and duration of the as-built schedule within the snapshot period are imposed upon the as planned schedule, while maintaining the relationships and duration of the as-planned schedule for the remaining activities after the snapshot period. The project completion date of the extended schedule is compared with the established, as-planned completion date of the project prior to this procedure. The difference between the completion dates is the amount of delay that occurred to the project as a result of delaying events during that window or snapshot period, (Alkass, 1996).The accuracy of this technique is a function of the number of windows or snapshots used i.e. the more number of windows or snapshots, the better the accuracy. The advantages of this delay analysis technique include It considers concurrent delays, the dynamic nature of the project's critical paths and the effect of delays in the context of time and CPM

schedule. The shortcomings of this method include it is time consuming and costly to operate and also demands complete project records, it does not scrutinize delay types and hence the results obtained need further analysis to apportion the entitlement, differences in the time periods (or "windows") can produce different results, periodic updates may not be existing which may then require the analyst to perform a highly laborious analysis of project records to create updates (Alkass,1996 ; Braimah,2013).

2.4.4 Time Impact Analysis

The Time Impact analysis method examines the effects of delaying events at window or snapshot periods in the project. This method is similar to window analysis, except that it concentrates on a specific delaying event rather than time periods containing delaying events to determine the time impact of the delay event, Alkass *et al.* (1996). The as-planned schedule is updated at certain critical periods to establish a new completion date. The difference between the new completion date and the date prior to the exercise gives the delay caused by that particular impact (Braimah, 2013).The advantages of this method include the delays are analyzed using real time CPM as delays which are deemed critical on the as-planned CPM schedule might not have been critical when the delay actually occurred and it is applicable during project duration and after completion. However, it has shortcomings such as it may not be practical or realistic to use if there are an overwhelming number of delay events ,the analysis requires intensive effort and is time consuming, periodic updates may not be existing which may then require the analyst to perform highly laborious analysis of project records to creates updates (Braimah,2013).

The accuracy of a delay analysis depends upon: proper classification of delay types, concurrent delays and real time CPM analysis. None of the above discussed existing analysis techniques consider all three issues at the same time. To overcome these problems, an alternate method called the `isolated delay type' (IDT) technique has been developed (Alkass, 1996).

2.4.5 Isolated delay type (IDT) Method

The isolated delay type (IDT) Method takes into account concurrency of delays, scrutinizes delay types and uses real time CPM by using the `but for' method, window analysis and time impact analysis methods together. The IDT Method respects the different delay types within the delaying events and applies only the relevant portion of the delays in that time period (Alkass,

1996). Comparing the project's completion date before and after inserting the delaying events into the schedule may reveal a change in the project's completion date. This difference is attributed to the delays that were incorporated into the schedule.

Advantages of the IDT Method (Alkass, 1996)

- The analysis is done within windows in a systematic and dynamic analysis, using the delays in their real time better to reveal the effect of delays,
- Concurrent delays are analyzed and adjusted to overcome the problem of overstatement of the time extension,
- Delays are scrutinized according to their type (Excusable-compensable, Excusable-non compensable and non-excusable) during the analysis, hence saving substantial time and preventing future mistakes and repetition of the analysis,
- The analysis can be performed using any time period at any stage of the schedule, making it a valuable tool to be used during the construction phase of a project,
- Float is used by both parties,
- The analysis is objective since it can be used for both parties at the same time,and
- The technique can be accommodated within an integrated computer system that utilizes existing management software such as scheduling, spreadsheets, database and expert system.

2.5 Summary

Delays occur when critical activities are not performed timely as per the schedule and are caused by either the contractor, the owner or third party/force majeure. The legal framework (Ethiopian civil code, MoWUD and FIDIC SCCs) allocates liabilities to contractual parties to share risks associated with delay and also identifies cases of force majeure the parties are not responsible for. When non-excusable (contractor-caused) delays occur, the contractor pays liquidated damage or actual damage to the client. On the other hand, when excusable compensable (owner-caused) delays occur, the owner extends project completion date and pays incurred costs to the contractor. However, when excusable non-compensable (e.g. force majeure) delays occur, the contractor is entitled to a time extension to complete the project but not financial compensation.

Independent delays and serial delays are simple for analysis as both are non-overlapping delays whereas concurrent delays are difficult to be analyzed particularly non-excusable (contractor-caused) delays and compensable (owner-caused) delays occur simultaneously as it needs apportionment of delay to the contractual parties based on genuine records.

Causes of delays vary from country to country, even project to project due to prevailing situations and uniqueness of projects. The major causes of delay in public building construction projects in Ethiopia include scarcity of material in the market, late material supply, delayed payments to contractors, unrealistic performance schedule, change in subsurface conditions, client's finance shortage, adverse weather condition, less emphasis to planning, material and labor price escalation, and variations.

Isolated delay type (IDT) delay analysis method is the best method as it scrutinizes delay types, considers concurrent delays and uses real time CPM analysis at the same time.

In the next chapter, the research methodology is presented to describe sampling techniques, data collection methods and data analysis methods to meet the research objective.

CHAPTER-3: RESEARCH METHODOLOGY

Many researchers have conducted studies on causes of construction projects' delay in different countries. In Ethiopia, Abdo (2006) conducted a research to identify causes of delay and their consequences in public building projects. Currently, it is known that the 40/60 saving houses projects have delayed due to various reasons, though housing problem remains a serious concern in Addis Ababa. This research is aimed at identifying the major causes to the delay in the construction of the scheme project in order to address the problem.

The objective of this chapter is to present the sampling, data collection and data analysis methods of the research. This chapter incudes introduction, population and sample size, sampling method, data collection methods and data analysis methods.

3.1 Introduction

This is applied research, which is aimed at addressing open ended problem (Fellows & Liu, 2007) as its objective is to identify major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa, so as to solve the problem. It is also a descriptive research as it is aimed at revealing the existing problem using the responses of client, consultants and contractors (Abiy *et al*, 2009). The overall research process is organized as follows.

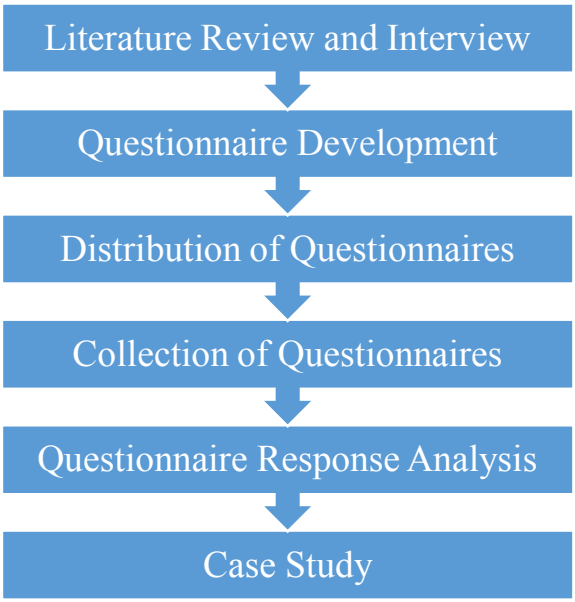

Figure 3.1 Research Process

3.2 Population and sample size

The population of the research consists of Contractors, Consultants and Client currently working on 40/60 saving houses project in Addis Ababa and the sample size is determined using statistical formula put hereunder considering the population and confidence level so as to estimate the number of questionnaires to be distributed to respondents considering the response rate.

The sample size is determined by the following formula (Hogg and Tannis, 2009)

$$n = \frac{m}{\left(1+\frac{m-1}{N}\right)}$$ ----------[Eq. 3.1]

Where n,m and N represent the sample size of the limited, unlimited and available population respectively

The value of m is determined using the following equation:

$$m = \frac{z^2 * p * (1-p)}{\varepsilon^2}$$ ---------- [Eq. 3.2]

Where z=the statistical value for the confidence level used i.e. 2.575, 1.96 and 1.645 for 99%, 95% and 90% confidence level respectively

P=the value of the population proportion that is determined, take a conservative value of 0.5 (Snitch et al, 2002)

ε = the sampling error = 1-confidence level

3.3 Sampling Method

The sampling method used in this research is non-probabilistic snowballing technique to identify potential respondents from client, contractors and consultants through referral networks to respond questionnaires accurately (Fellows& Liu, 2007).

3.4 Data Collection Methods

Data collection methods used in this research were literature review, interview, questionnaire survey and case study.

3.5 Data Analysis Methods

Data analysis methods used in this research include Cronbach's alpha (α) coefficient, Relative Importance Index(RII), Spearman rank correlation coefficient and analysis of variance, as discussed hereunder.

3.5.1 Cronbach's alpha (α) coefficient

The data gathered through questionnaires is checked by Cronbach's alpha (α) coefficient for reliability or consistency. Cronbach's alpha is a measure of reliability of the data on a questionnaire and ranges from 0 to 1.0. It indicates the extent to which the respondents rate the same question. For example, if all respondents give same answer to all questions, the alpha for these questions would be 1.0. The minimum 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 3.3 (Boermans & Kattenberg, 2011)

$$\alpha = \frac{I}{I-1}\left(1 - \frac{\sum_{i=1}^{I}\sigma_i^2}{\sigma_X^2}\right)$$ ---------- [Eq. 3.3]

Where I = the number of items in the scale.

σ_i^2 = the variance of item i, and

σ^2_X = the variance of the observed total test scores.

3.5.2 Relative Importance Index (RII)

The gathered data through questionnaire was analyzed using relative importance index (RII) to determine ranking of causes of delay as applied by different researchers (Odeh &Battineh ,2002; Pourrostam & Ismail, 2012; Sambasivan & Soon, 2007; Desai & Bhatt ,2013; Fugar *et al,* 2010).In this research ,a 5-point Likert scale was used to analyze the data for the ranking of causes of delays .

Relative Importance Index (RII) is determined by equation Eq.3.4, Odeh & Battineh (2002);

$$RII = \frac{\sum_{i=1}^{5} WiXi}{\sum_{i=1}^{5} Xi}$$ ----------[Eq.3.4]

Where i = Response category index = 1, 2, 3, 4 and 5 for not-, slightly-, moderately-, very- and extremely important respectively.

Wi = the weight assigned to i^{th} response = 0, 1,2,3,4 respectively

Xi = Frequency of the i^{th} response;

3.5.3 Spearman rank correlation coefficient

Spearman rank correlation coefficient was used to determine the strength of rankings between two parties i.e. between contractor and consultant, contractor and client, client and consultant (Dai, 2006).

The Spearman rank correlation coefficient is calculated using the following Equation: (Pourrostam &Ismail, 2012).

$$r_s = 1 - \frac{6\sum d}{(N^3 - N)}$$ ---------- [Eq. 3.5]

Where r_s= Spearman rank correlation coefficient;

d =Difference in ranking between two parties

N =The number of variables.

3.5.4 Analysis of Variance (ANOVA)

ANOVA is used to test the significance of agreement among the parties in their rankings or to test the null hypothesis that there is no difference between client, consultant and contractor means i.e. $\mu o=\mu_{CT}=\mu_{CS}=\mu_{CL}$ where μ_{CT}, μ_{CS}, μ_{CL} are means of contractor, consultant and client respectively. This hypothesis is tested using F Statistic assuming normal distribution The null hypothesis is rejected if F (observed value) > FCV (critical value). If so, the only conclusion that can be made is that at least one population mean differs from at least one other population mean as the ANOVA does not reveal which population means differ from which others. If the hypothesis is accepted, the three groups can be considered as random samples from the same population. (Dai (2006);Heron (2009)).

F Statistic is given by the following formula (Heron, 2009)

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

With (I-1) and n (I-1) degrees of freedom, where I is the number of groups.

CHAPTER-4: QUESTIONNAIRE ANALYSIS RESULTS

Before developing the questionnaire, twelve semi-structured interviews were conducted, involving 3 construction professionals from client, 3 consultants and 6 contractors working on three different 40/60 project sites to verify and enhance causes of delays obtained from literatures in the context of 40/60 saving houses project. During the interviews, some of the causes of delays were verified, and additional causes of delays were proposed by the interviewees. The following is a discussion of the interview results for each cause, categorized by cause groups.

1. **Design/changes related:** Incomplete contract documents, mistakes and discrepancies in design documents, and variations (changes to the work) were verified that they are causes of delays in the construction of 40/60 scheme project.
2. **Material Related:** Quality of material, late Material Supply and scarcity of material in the market were verified that they are causes of delays to the 40/60 scheme project.
3. **Labor –related:** Shortage of laborers, low productivity level of laborers and low skills of laborers were verified that they are causes of delays to the 40/60 scheme project. In addition, accidents to laborers and disputes of laborers were proposed as additional causes of delays to the scheme project.
4. **Equipment-related:** Improper equipment, equipment unavailability and equipment failure were verified that they are causes of delays to 40/60 scheme project.
5. **Finance/Economy related:** Delayed payments to contractors, delayed payments to suppliers and subcontractors, client's finance shortage, financial difficulties faced by the contractor, difficulty in accessing credit and material price escalation were verified that they are causes of delays to the 40/60 scheme project. In addition, labor price escalation was proposed to be included.
6. **Management/Administrative:** Organizational changes, old technology, poor supervision, poor site management, mistakes in construction, inaccurate cost estimation, inappropriate organization management, ineffective planning and scheduling of project, inadequate contractor experience, inadequate consultant experience, underestimation of

the complexity of the project and ineffective planning and scheduling of project were verified that they are causes of delays to the 40/60 scheme project.

7. **Contractual-relations:** Non-utilization of professional construction/contractual management, delay in delivering site project to contractor, delay in approval of documents, lack of communication between parties, slowness in decision making process, nomination of sub-contractors and suppliers, delay in performance of subcontractors were verified that they are causes of delays to the 40/60 scheme project
8. **External:** Laws-regulations and adverse weather condition were verified that they are causes of delays to the 40/60 scheme project.
9. **Infrastructure-related**: Problem of electric supply, problem of water supply and problem of access road were proposed to be included.

4.1 Introduction

This chapter deals with the analysis results of the questionnaire survey. First, the questionnaire response rate is presented. Then, the questionnaire survey is checked for reliability using Cronbach's alpha coefficient. After checking the reliability, the identification of the major causes of delays using relative importance index, and then the perceptions 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 source, 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), and chapter summary are presented.

4.2 Questionnaire Response Rate

The questionnaire was prepared and distributed to three contractual parties i.e. contractors, client and consultants currently working on the twelve 40/60 saving houses project sites having sixteen lots through in person contact by going to all the project sites.110 questionnaires were distributed to the parties based on the relative population size of the parties on the project. The questionnaire distribution and collection took three weeks and the response rate is as shown in the Table 4.1.

Figure 4.1 shows the approximate locations of 40/60 saving houses project sites.

Table 4.1 Questionnaire Response Rate

Contractual Parties	Questionnaire distributed	Questionnaire responded	Response Rate
Client	16	15	93.75 %
Consultant	16	15	93.75 %
Contractor	78	50	64.10 %
Total	110	80	72.73 %

Figure 4.1: Approximate Locations of 40/60 saving houses project Sites

Based on Table 4.2 below, in terms of education levels of client respondents 93.33% were BSc degree holders whereas 6.67% were MSc degree holders. In terms of positions within the projects, 66.67 % Site Supervisors, 13.33% Contract Administration Officers and 20.00 % Project Coordinators took part in filling the questionnaire. In addition, average years of experience of the client respondents in building construction, in condominium construction and in 40 /60 saving houses project are 2.4, 1.5, and 1.2 years, respectively.

As shown in Table 4.3 below, in terms of education levels of the consultants' respondents 6.67 % were Diploma holders, 86.67 % were BSc degree holders, and 6.67 % were MSc degree holders. In terms of positions within the projects, 40.00% Site Supervisors, 53.33% Resident Engineers and 6.67 % Project Coordinators participated in responding the questionnaire. Moreover, average years of experience of the consultants' respondents in building construction, in condominium construction and in 40/60 saving houses project are 6.8, 3.3, and 1.8 years, respectively.

Similarly, as shown in Table 4.4 below, in terms of education levels of contractors' respondents 4.0 % were Diploma holders, 84.0 % were BSc degree holders, and 12.0 % were MSc degree holders. In terms of positions within the projects, the proportions of Project Managers, Construction Engineers, Office Engineers and Site Engineers who participated in responding the questionnaire were 40.0 %, 4.0 %, 14.0 % and 42.0 %, respectively. The average years of experience of the contractors' respondents in building construction, condominium construction and 40/60 saving houses project are 5.2, 2.3, and 1.5 years, respectively.

Table 4.2 Profile of client respondents working in 40/60 saving houses project

40/60 Project Sites	Education level	Position in the organization	Years of Experience		
			Building construction	Condominium construction	40/60 saving houses project
Asko	BSc	Site supervisor	6	6	1
Ayat-1-site-1	BSc	Site supervisor	0.6	0.6	0.6
Ayat-1-site-2	BSc	Site supervisor	2	0.7	0.7
Ayat-1-site-3	BSc	Site supervisor	2	1	1
Ayat-1-Site-4	BSc	Site supervisor	1	1	1
Ayat-2	BSc	Site supervisor	1.7	1.3	1.3
Bole Beshale	BSc	Contract Administration Officer	2	1	1
Bole Bulbula-Lot 1	BSc	Site supervisor	3	1.5	1.5
Bole Bulbula-Lot 2	BSc	Site supervisor	3	1	1
Crown	BSc	Project Coordinator	1	1	1
Hintsa Akrabi	BSc	Site coordinator	3	2	2
Meri Loke	BSc	Contract Administration Officer	2.8	1.6	2.6
Sengatera	MSc	Project Coordinator	3	1	1
Summit	BSc	Site supervisor	3	0.8	0.8
Tourist Negid	BSc	Project Coordinator	2	2	2

Note: There was only one respondent from each project.

Table 4.3 Profile of Consultants' Respondents working in 40/60 Saving Houses Project

40/60 Project Sites	Education level	Position in the organization	Years of Experience		
			Building construction	Condominium construction	40/60 saving houses project
Asko	BSc	Site Supervisor	2	1	1
Ayat-1-Site-1	BSc	Resident Engineer	2	2	2
Ayat-1-site-2	BSc	Resident Engineer	10	9	1
Ayat-1-Site-3	BSc	Site Supervisor	3	2	2
Ayat-1-site-4	BSc	Site Supervisor	2	2	2
Ayat-2	BSc	Resident Engineer	8	3	1
Bole Beshale	BSc	Resident Engineer	8	3	1
Bole Bulbula Lot-1	BSc	Resident Engineer	4	3	3
Bole Bulbula Lot-2	BSc	Site Supervisor	3	3	2
Crown	BSc	Site Supervisor	1.5	1.5	1.5
Ehil Nigid	MSc	Resident Engineer	6	2	2
Ehil Nigid & Tourist Niged	BSc	Project Coordinator	17	7	3
Hintsa Akrabi	Diploma	Site Supervisor	10	6	1
Meri Loke	BSc	Resident Engineer	5	2	2
Sengatera	BSc	Resident Engineer	20	3	3

Note: There was only one respondent from each project.

Table 4.4 Profile of Contractors' Respondents working in 40/60 Saving Houses Project

40/60 Project Sites	Education level	Position in the organization	Years of Experience		
			Building construction	Condominium construction	40/60 saving houses project
Asko[3]	MSC[1] BSC[2]	Site Engineer[3]	3	2.7	2.3
Ayat -1 Site 1[2]	MSC[1] BSC[1]	Project Manager[1] Site Engineer[1]	7	5	3
Ayat -1 Site 2[2]	MSC[1] BSC[1]	Project Manager[1] Site Engineer[1]	3	2	1.8
Ayat-1 Site 3[2]	BSC[2]	Office Engineer[1] Site Engineer[1]	1	1	1
Ayat -1 Site 4[3]	MSC[1] BSC[2]	Project Manager[3]	7.7	2.7	1.7
Ayat-2[6]	BSC[4] Diploma[2]	Project Manager[3] Construction Engineer[1] Site Engineer[2]	8.5	5.2	1.6
Bole Beshale[3]	MSC[1] BSC[2]	Site Engineer [2] Construction Engineer[1]	4	1.6	0.9
Bole Bulbula Lot1[5]	MSC[1] BSC[4]	Project Manager[4] Site Engineer[1]	7	2.3	1.3
Bole Bulbula Lot 2[5]	BSC[5]	Project Manager[1] Office Engineer[3] Site Engineer[1]	3.4	1.2	0.7
Crown[3]	BSC[3]	Project Manager [1] Office Engineer[1] Site Engineer[1]	8.3	2.7	1.4
Ehil Niged[3]	BSC[3]	Project Manager[2] Site Engineer[1]	7.7	2.7	2
Hintsa Akirabi[2]	BSC[2]	Project Manager[1] Site Engineer[1]	5	1.2	1.2
Meri Loke[4]	BSC[4]	Project Manager[3] Office Engineer[1]	9.4	2.3	1.6
Sengatera[3]	BSC[3]	Office Engineer[1] Site Engineer[2]	3.7	1.3	1.3
Summit[2]	BSC[2]	Site Engineer[2]	1.5	0.7	0.7
Tourist Niged[2]	BSC[2]	Site Engineer[2]	2.8	1.8	1.3

Note: Values in brackets represent the total number of respondents

4.3 Cronbach's alpha (α) coefficient

Cronbach's alpha coefficient was used to test the reliability or consistency of the questionnaire survey. The value of Cronbach's alpha depends on the number of questions, interrelatedness among the questions, and dimensionality (Tavakol, 2011).This alpha value decreases as the number of questions, the interrelatedness among questions and dimensionality decreases. The value of alpha ranges from 0 to 1. The Cronbach's alpha values were determined using equation 3.3 shown in chapter 3 section 3.5.1. Taking client, consultant, contractor and overall respondents, the α-values were 0.964, 0.938, 0.964, and 0.962, respectively. All α-values were greater than 0.70, which is the minimum level for reliability (Fellows& Liu, 2007).Therefore, it can be concluded that the questionnaire survey is reliable and consistent.

4.4 Identification of the Major Causes of Delay

Relative importance index (RII) analysis was conducted using equation 3.4 shown in chapter 3, section 3.5.2, in order to determine the relative importance of the various causes of delays. The five-point scale ranging from 0 (not important) to 4 (extremely important) was used to determine relative importance indices of each cause of delays as shown in Table 4.5. Hence, The RII ranges from 0 to 4 and used to rank the different causes 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 identify the major causes of delays in the construction of 40/60 saving houses project in Addis Ababa.

Table 4.5 Summary of relative importance index and rank for the causes of delay in 40/60 Saving Houses Project in Addis Ababa

Causes of delays	Client		Consultant		Contractor		Overall	
	RII	**Rank**	**RII**	**Rank**	**RII**	**Rank**	**RII**	**Rank**
1.Design /Changes-related	**2.267**	**7**	**2.783**	**4**	**2.390**	**5**	**2.480**	**7**
Variations (Changes to the work)	2.467	26	3.133	10	2.380	24	2.660	17
Incomplete contract documents	1.800	41	2.533	28	1.940	41	2.091	40
Late Design Review & approval	2.733	14	3.067	12	2.860	7	2.887	9
Mistakes & discrepancies in design documents	2.067	36	2.400	33	2.380	24	2.282	36
2. Material-related	**2.667**	**3**	**3.200**	**1**	**2.747**	**2**	**2.871**	**2**
Quality of material	2.400	27	2.600	23	2.580	12	2.527	25
Late material supply	3.000	5	3.733	1	3.100	5	3.278	1
Scarcity of material in the market	2.600	19	3.267	6	2.560	14	2.809	12
3. Labor-related	**2.053**	**8**	**2.427**	**8**	**1.808**	**9**	**2.096**	**9**
Shortage of labors	2.400	27	2.933	14	2.180	35	2.504	27
Low productivity level of labors	2.667	16	3.067	12	2.240	32	2.658	18
Accidents to Labors	1.667	42	2.000	43	1.540	43	1.736	44
Disputes of Labors	1.933	40	2.133	40	1.540	43	1.869	42
Non-Attendance of Labors	1.600	43	2.000	43	1.540	43	1.713	45
4. Equipment-related	**2.933**	**1**	**3.178**	**2**	**2.280**	**7**	**2.797**	**3**
Improper equipment	2.933	7	3.400	3	2.180	35	2.838	11
Equipment unavailability	3.200	2	3.333	4	2.460	19	2.998	5
Equipment Failure	2.667	16	2.800	18	2.200	33	2.556	22
5. Finance/Economy-related	**2.467**	**6**	**2.724**	**5**	**2.660**	**3**	**2.617**	**4**
Delayed payments to contractors	2.533	23	3.133	10	3.200	1	2.956	6
Delayed payments to suppliers and subcontractors	2.600	19	2.867	16	2.680	10	2.716	14
Client's finance shortage	2.533	23	2.867	16	2.780	9	2.727	13
Financial difficulties faced by the contractor	3.333	1	3.533	2	2.920	6	3.262	2
Difficulty in accessing credit	1.600	43	2.067	42	2.060	40	1.909	41
Material Price Escalation	2.267	33	2.133	40	2.560	14	2.320	34
Labor Price Escalation	2.400	27	2.467	30	2.420	21	2.429	29
6. Management/Administrative	**2.655**	**4**	**2.667**	**6**	**2.311**	**6**	**2.544**	**5**

Causes of delays	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Organizational changes	2.333	32	2.600	23	1.880	42	2.271	37
Old technology	2.733	14	2.600	23	2.340	27	2.558	21
Poor supervision	2.800	11	2.400	33	2.460	19	2.553	24
Poor site management	3.133	3	3.267	6	2.380	24	2.927	7
Mistakes in construction	2.267	33	2.333	35	2.160	37	2.253	38
Inaccurate cost estimation	2.400	27	2.333	35	2.400	23	2.378	32
Inappropriate organization management	2.667	16	2.800	18	2.200	33	2.556	22
Ineffective planning and scheduling of project	2.933	7	3.267	6	2.580	12	2.927	7
Inadequate contractor experience	2.533	23	2.800	18	2.140	38	2.491	28
Inadequate consultant experience	2.600	19	2.200	38	2.320	29	2.373	33
Underestimation of the complexity of the project	2.800	11	2.733	21	2.560	14	2.698	15
7. Contractual-relations	**2.476**	**5**	**2.495**	**7**	**2.586**	**4**	**2.519**	**6**
Non utilization of professional construction/Contractual management	2.867	9	2.533	28	2.280	31	2.560	20
Delay in delivering site project to contractor	2.133	35	2.467	30	2.320	29	2.307	35
Delay in approval of documents	2.600	19	2.333	35	2.840	8	2.591	19
Lack of communication between parties	2.000	39	2.600	23	2.620	11	2.407	31
Slowness in decision making process	2.867	9	2.600	23	3.180	3	2.882	10
Nomination of sub-contractors and suppliers	2.067	36	2.200	38	2.340	27	2.202	39
Delay in performance of subcontractors	2.800	11	2.733	21	2.520	18	2.684	16
8. External	**1.933**	**9**	**2.233**	**9**	**2.250**	**8**	**2.139**	**8**
Laws - regulations	1.467	45	2.000	43	2.080	39	1.849	43
Adverse weather condition	2.400	27	2.467	30	2.420	21	2.429	29
9.Infrastracture -related	**2.711**	**2**	**3.178**	**2**	**2.967**	**1**	**2.952**	**1**
Problem of Electric supply	3.067	4	3.333	4	3.200	1	3.200	3
Problem of Water supply	3.000	5	3.267	6	3.160	4	3.142	4
Problem of Access Road	2.067	36	2.933	14	2.540	17	2.513	26

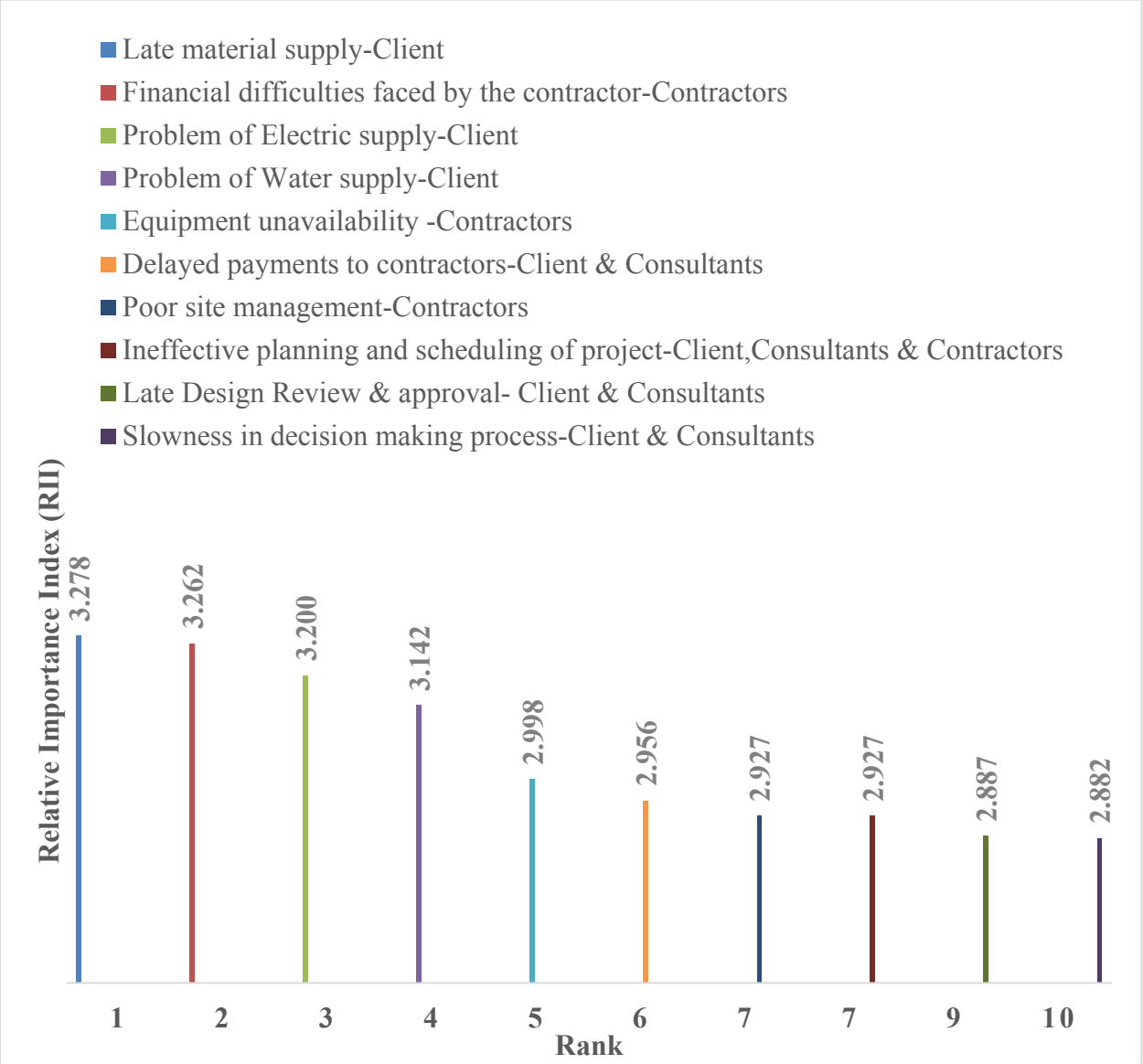

Figure 4.2. Overall top 10 Major Causes of Delay and their Delay sources in the 40/60 Saving Houses Project

The top ten causes to the delay in the construction of 40/60 saving houses project in Addis Ababa are: Late material supply (RII=3.278), Financial difficulties faced by the contractor (RII=3.262), Problem of electric supply (RII=3.200), Problem of water supply (RII=3.142), Equipment unavailability (RII=2.998), Delayed payments to contractors (RII=2.956), Poor site management (RII=2.927), Ineffective planning and scheduling (RII=2.927), Late Design review and approval (RII=2.887), and Slowness in decision making process (RII=2.882).

As shown in Figure 4.2, late material supply is the top ranked cause of delay as perceived by all the parties. In 40/60 saving houses project, major construction materials (cement, re-bars

etc.) are supplied by the client which makes the owner as well as the contractor responsible for the cause of delay. This finding is not in line with other similar studies except in public building projects of Ethiopia, Abdo (2006) identified late material supply as the second top cause of delay out of 80 causes. Fugar *et al*. (2010) identified late material supply with a rank of 12, out of 32 causes of delay, in building projects of Ghana. Ahmed *et al.(*2002) also identified late material supply (Material/Fabrication delays) with a rank of 13,out of 50 causes of delay, in building projects of Florida .On the contrary, late material supply was ranked 19th out of 28 causes of delay in Iranian construction projects (Pourrstom & Ismail,2006). In large construction projects, Hasseb et al. (2011) identified late material supply (late delivery) with a rank of 33, out of 68 causes of delay.

Financial difficulties faced by the contractor was ranked the second top cause of delay in 40/60 saving houses projects. This cause of delay was ranked 5th out of 28 causes of delay in Iranian construction projects (Pourrston & Ismail,2012).Similarly, Alhaji & Danladi (2012) identified financial difficulties faced by the contractor(cash flow problems during construction) with a rank of 5 out of 43 causes of delay in Nigerian construction industry. On the contrary, it was ranked 37th out of 68 causes of delay in large construction projects of Pakistan (Hasseb *et al*,2011).Moreover, Ahmed *et al.* (2012) identified it with a rank of 41 out of 50 causes of delay in building projects of Florida.

Problem of electric supply and problem of water supply was ranked third and fourth respectively in 40/60 saving houses project. However, these were not mentioned as causes of delay in any other studies due to uniqueness of 40/60 saving houses project.

4.5 Comparison of Major Causes of Delay among Contractual Parties

As can be comprehended from the analysis result shown in Table 4.5 below, the contractual parties conflicted 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.

As illustrated in Table 4.6 below, late material supply was ranked top by consultants. However, it was ranked fourth and fifth by contractors and client respectively. This indicates that the contractors and the client conflicted with the consultants in ranking late material supply. Financial difficulties faced by the contractor was ranked second by the consultants, but it was the top by the client. In contrast, contractors ranked it fifth. Problem of electric

supply was the top by contractors whereas both client and consultants ranked it fourth. Problem of water supply was ranked third by contractors while both the client and the consultants ranked it fifth. The consultants perceived equipment unavailability as the second top cause of delay, but ranked fourth by client. On the contrary, it was not perceived as major cause of delay by the contractors.

Delayed payments to contractors was the sixth cause of delay as perceived by consultants though the contractors ranked it top. However, the client did not perceive it as the major cause of delay. Poor site management was the third major cause of delay by the client and the consultant ranked it fifth, but not the major cause of delay by the contractors. Ineffective planning and scheduling was ranked sixth and fifth by client and consultants respectively, but the contractors did not consider it as major cause of delay. Late design review and approval was ranked sixth, seventh and ninth by contractors, consultants and client respectively. Slowness in decision making process was the second top cause of delay by contractors, but ranked seventh by the client and not perceived as major cause by the consultants.

Table 4.6 Comparison of the major causes of delay among the contractual parties

Client			**Consultant**			**Contractor**			**Overall**		
Causes of delays	**RII**	**Rank**	**Causes of delays**	**RII**	**Rank**	**Causes of delays**	**RII**	**Rank**	**Causes of delays**	**RII**	**Rank**
Financial difficulties faced by the contractor	3.333	1	Late material supply	3.733	1	Delayed payments to contractors	3.200	1	Late material supply	3.278	1
Equipment unavailability	3.200	2	Financial difficulties faced by the contractor	3.533	2	Problem of Electric supply	3.200	1	Financial difficulties faced by the contractor	3.262	2
Poor site management	3.133	3	Improper equipment	3.400	3	Slowness in decision making process	3.180	3	Problem of Electric supply	3.200	3
Problem of Electric supply	3.067	4	Equipment unavailability	3.333	4	Problem of Water supply	3.160	4	Problem of Water supply	3.142	4
Late material supply	3.000	5	Problem of Electric supply	3.333	4	Late material supply	3.100	5	Equipment unavailability	2.998	5
Problem of Water supply	3.000	5	Ineffective planning and scheduling of project	3.267	6	Financial difficulties faced by the contractor	2.920	6	Delayed payments to contractors	2.956	6
Improper equipment	2.933	7	Poor site management	3.267	6	Late Design Review & approval	2.860	7	Poor site management	2.927	7

Client			**Consultant**			**Contractor**			**Overall**		
Causes of delays	**RII**	**Rank**	**Causes of delays**	**RII**	**Rank**	**Causes of delays**	**RII**	**Rank**	**Causes of delays**	**RII**	**Rank**
Ineffective planning and scheduling of project	2.933	7	Problem of Water supply	3.267	6	Delay in approval of documents	2.840	8	Ineffective planning and scheduling of project	2.927	7
Non utilization of professional construction/Contractual management	2.867	9	Scarcity of material in the market	3.267	6	Client's finance shortage	2.780	9	Late Design Review & approval	2.887	9
Slowness in decision making process	2.867	9	Delayed payments to contractors and Variations	3.133	10	Delayed payments to suppliers and subcontractors	2.680	10	Slowness in decision making process	2.882	10

As shown in Table 4.7, the analysis results show that Equipment related (RII=2.933), Infrastructure related (RII=2.711) and Material Related (RII=2.667) are the top three groups of delay causes as perceived by the client. However, Material related (RII=3.200), Infrastructure-related (RII=3.178) and Equipment related, (RII=3.178) were ranked top three groups of delays by Consultants. On the other hand, the contractors ranked Infrastructure–related (RII=2.967), Material-related (RII=2.747) and Finance related (RII=2.660) as the top three groups of delay causes. The overall result showed that Infrastructure-related (RII=2.952), Material -related (RII=2.871) and Equipment–related (RII=2.797) are the top three groups of delay causes in the construction of 40/60 saving houses project in Addis Ababa.

Table 4.7 Comparison of Rank of the groups of delay causes among the contractual parties

Causes of delays	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Infrastructure -related	2.711	2	3.178	2	2.967	1	2.952	1
Material-related	2.667	3	3.200	1	2.747	2	2.871	2
Equipment-related	2.933	1	3.178	2	2.280	7	2.797	3
Finance/Economy-related	2.467	6	2.724	5	2.660	3	2.617	4
Management/Administrative	2.655	4	2.667	6	2.311	6	2.544	5
Contractual-relations	2.476	5	2.495	7	2.586	4	2.519	6
Design /Changes-related	2.267	7	2.783	4	2.390	5	2.480	7
External	1.933	9	2.233	9	2.250	8	2.139	8
Labor-related	2.053	8	2.427	8	1.808	9	2.096	9

Infrastructure-related causes of delay, which is the top ranked group of delay causes in 40/60 saving houses as shown in Table 4.7, was not mentioned in any other similar studies as cause of delay.

Material related was the second major group of delay causes as indicated in table 4.7. This finding is consistent with other similar studies. Desai & Bhatt (2013),Abd El-Razek *et al* (2008)

and Fugar et al(2010) identified material related causes of delay as the second major cause of delay out of nine groups of delay causes in residential construction projects of central Gujarat of India , Egyptian building projects and building projects of Ghana respectively.

Equipment related group of delay causes was the third top causes of delay in 40/60 saving houses. Similarly, In Malaysian construction industry, it was identified as the third top cause of delay out of 8 groups of delay causes, Sambasivan & Soon (2006).Moreover, Fugar *et al*.(2010) identified it with a rank of 3 out of nine groups of delay causes in building projects of Ghana. On the other hand, Fugar *et al* (2010) identified it with a rank of sixth out of nine in building projects of Ghana.

4.6 Identification of Types of delay by Source, Responsibility and Compensability

The causes of delay in the construction of 40/60 saving houses project in Addis Ababa are classified into three types of delay such as types of delay by source, responsibility and compensability, which were explained thoroughly in Chapter 2 (Literature Review).The findings on types of delay are discussed hereunder.

4.6.1Type of delay by source

The sources of delay were identified through the questionnaire. These sources of delay include client, consultant, contractor, client and consultant, client and contractor, contractor and consultant, client, consultant and contractor, and force majeure. Of the eight sources of delay, the one which got the highest response by respondents was selected as source of delay cause.

The analysis result shown in Figure 4.3 indicated that of the 45 causes of delay in the construction of 40/60 saving houses project in Addis Ababa, 37.78% were caused by Contractor, 17.78% were caused by the client, consultant and contractor, 15.56% were caused by Client, 13.33% were caused by client and consultant, 8.89% were caused by consultant, 2.22% were caused by the client and contractor, 2.22% were caused by contractor and consultant and the rest 2.22% were caused by Force Majeure.

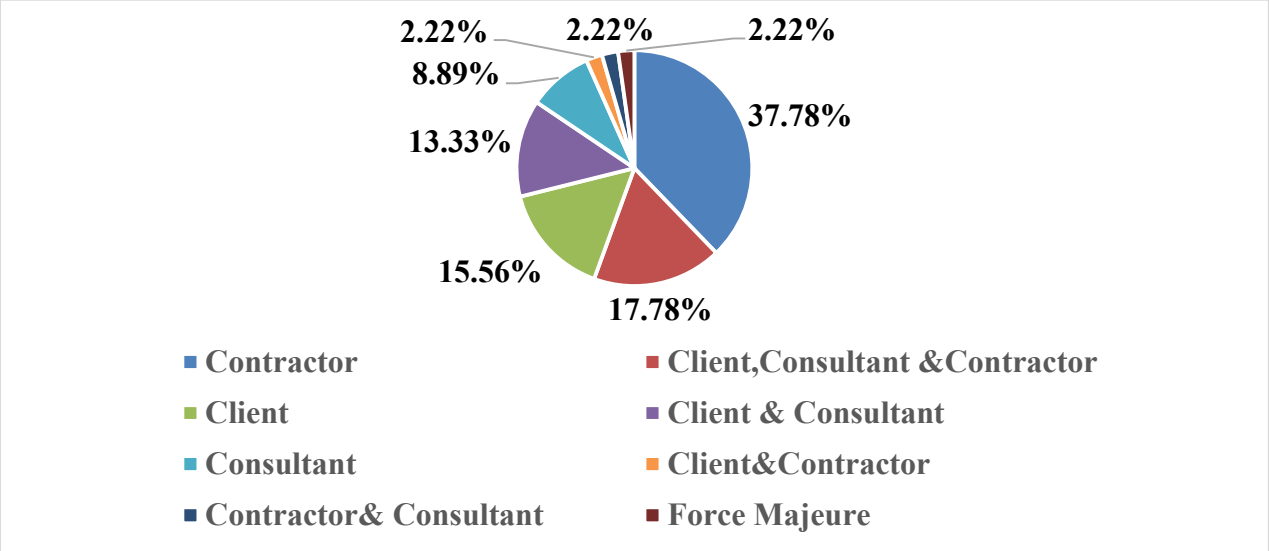

Figure 4.3: Types of delay by source

4.6.2 Type of delay by responsibility

Based on source of delay identified through questionnaire, the responsible party is identified. The responsible parties for the causes of delay include Client, Contractor, Both Client and Contractor, and Neither Client nor Contractor. The client takes responsibility for the consultant.

The analysis result shown in Figure 4.4: types of delay by responsibility showed that the client is responsible for the 37.78% and also the contractor is responsible for the 37.78% of the delay where as both client and contractor take responsibility for 22.22% of the delay and for the rest 2.22%,neither contractor nor client are responsible .

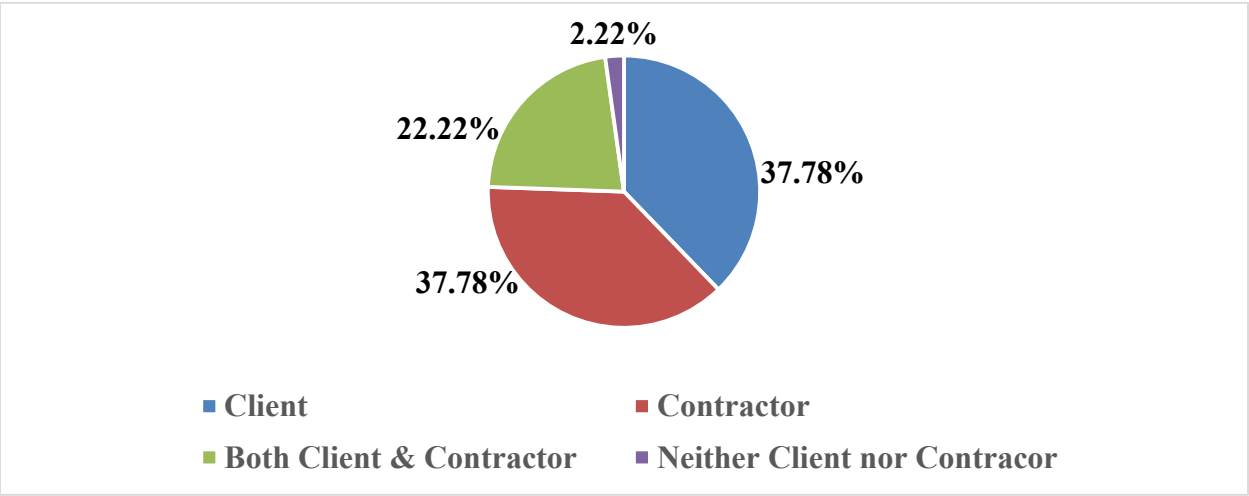

Figure 4.4: Types of delay by responsibility

4.6.3 Type of delay by compensability

Depending on the type of delay by responsibility, the three types of delay by compensability 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 Figure 4.5 indicated that the 45 causes of delay were analyzed for compensability and the result showed that 37.78 % are non-excusable delays, which compensates neither time nor finance while 37.78 % are found to be excusable compensable, which compensates both time and finance and the rest 24.44% of delay causes are excusable-non compensable which grants only extension of time to complete the project.

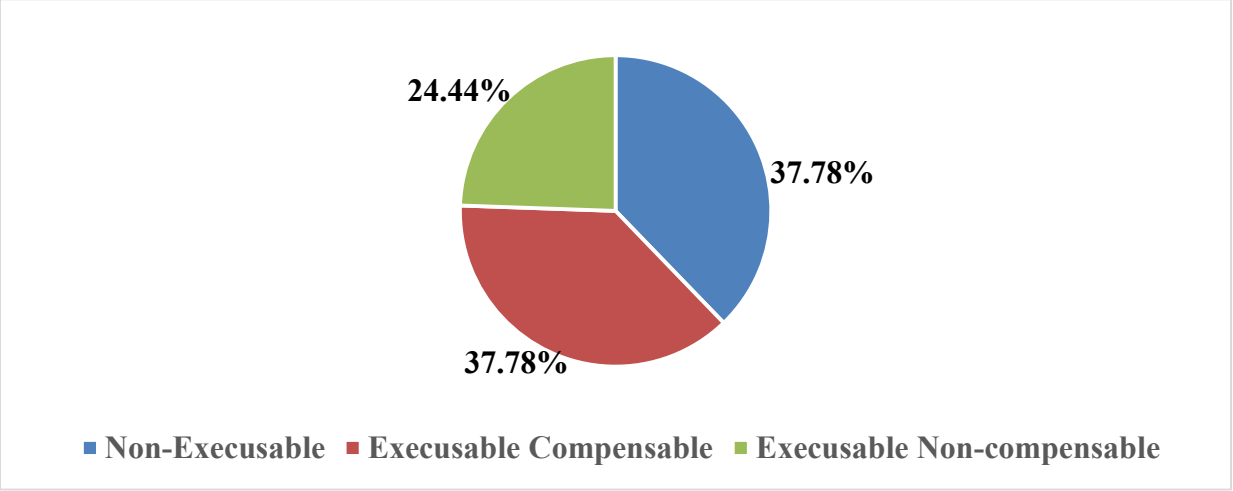

Figure 4.5: Types of delay by compensability

Based on the analysis results presented in Table 4.8 below, of the top ten causes of delay, late material supply (Rank=1), problem of electric supply (Rank=3) and problem of water supply (Rank=4) are caused by the client whereas financial difficulties by the contractor (Rank=2), equipment unavailability (Rank=5), and poor site management (Rank=7) are caused by contractor. On the other hand, delayed payments to contractors (Rank=6), late design review and approval (Rank=8) and slowness in decision making process (Rank=9) are caused by both client and consultants. All the three parties caused ineffective planning and scheduling of project (Rank=7).Moreover, the client is responsible for six of the top ten causes of delay whereas the contractor is responsible for only three of them and both the client and the contractors are

responsible for one major cause of delay. Six of the top ten causes of delay are excusable compensable, three of them are non-excusable and the rest is excusable non-compensable

Table 4.8 Identification of types of delay by source, responsibility and compensability

Causes of delay	Overall		Type of delay by Source	Type of delay by responsibility	Type of delay by compensability
	RII	Rank			
Late material supply	3.278	1	Client	Client	Excusable-Compensable
Financial difficulties faced by the contractor	3.262	2	Contractor	Contractor	Non-Excusable
Problem of Electric supply	3.200	3	Client	Client	Excusable-Compensable
Problem of Water supply	3.142	4	Client	Client	Excusable-Compensable
Equipment unavailability	2.998	5	Contractor	Contractor	Non-Excusable
Delayed payments to contractors	2.956	6	Client &Consultant	Client	Excusable-Compensable
Poor site management	2.927	7	Contractor	Contractor	Non-Excusable
Ineffective planning and scheduling of project	2.927	7	Client, Consultant Contractor	Both Client and Contractor	Excusable- Non compensable
Late Design Review & approval	2.887	9	Client &Consultant	Client	Excusable-Compensable
Slowness in decision making process	2.882	10	Client& Consultant	Client	Excusable-Compensable
Improper equipment	2.838	11	Contractor	Contractor	Non-Excusable
Scarcity of material in the market	2.809	12	Client	Client	Excusable-Compensable
Client's finance shortage	2.727	13	Client	Client	Excusable-Compensable
Delayed payments to suppliers and subcontractors	2.716	14	Contractor	Contractor	Non-Excusable
Underestimation of the complexity of the project	2.698	15	Client, Consultant &Contractor	Both Client and Contractor	Excusable- Non compensable

Causes of delay	Overall		Type of delay by Source	Type of delay by responsibility	Type of delay by compensability
	RII	Rank			
Delay in performance of subcontractors	2.684	16	Contractor	Contractor	Non-Excusable
Variations (Changes to the work)	2.660	17	Client &Consultant	Client	Excusable-Compensable
Low productivity level of labors	2.658	18	Contractor	Contractor	Non-Excusable
Delay in approval of documents	2.591	19	Client &Consultant	Client	Excusable-Compensable
Non utilization of professional construction/Contractual management	2.560	20	Client, Consultant &Contractor	Both Client and Contractor	Excusable- Non compensable
Old technology	2.558	21	Contractor	Contractor	Non-Excusable
Equipment Failure	2.556	22	Contractor	Contractor	Non-Excusable
Inappropriate organization management	2.556	22	Client, Consultant &Contractor	Both Client &Contractor	Excusable- Non compensable
Poor supervision	2.553	24	Consultant	Client	Excusable-Compensable
Quality of material	2.527	25	Client, Consultant &Contractor	Both Client and Contractor	Excusable- Non compensable
Problem of Access Road	2.513	26	Client	Client	Excusable-Compensable
Shortage of labors	2.504	27	Contractor	Contractor	Non-Excusable
Inadequate contractor experience	2.491	28	Contractor	Contractor	Non-Excusable
Adverse weather condition	2.429	29	Force Majeure	Neither Client nor Contractor	Excusable- Non compensable
Labor Price Escalation	2.429	29	Contractor	Contractor	Non-Excusable
Lack of communication between parties	2.407	31	Client, Consultant &Contractor	Both Client and Contractor	Excusable- Non compensable

Causes of delay	Overall		Type of delay by Source	Type of delay by responsibility	Type of delay by compensability
	RII	Rank			
Inaccurate cost estimation	2.378	32	Consultant	Client	Excusable-Compensable
Inadequate consultant experience	2.373	33	Consultant	Client	Excusable-Compensable
Material Price Escalation	2.320	34	Client &Contractor	Both Client &Contractor	Excusable- Non compensable
Delay in delivering site project to contractor	2.307	35	Client	Client	Excusable-Compensable
Mistakes & discrepancies in design documents	2.282	36	Consultant	Client	Excusable-Compensable
Organizational changes	2.271	37	Client, Consultant &Contractor	Both Client &Contractor	Excusable- Non compensable
Mistakes in construction	2.253	38	Contractor &Consultant	Both Client &Contractor	Excusable- Non compensable
Nomination of sub-contractors and suppliers	2.202	39	Contractor	Contractor	Non-Excusable
Incomplete contract documents	2.091	40	Client &Consultant	Client	Excusable-Compensable
Difficulty in accessing credit	1.909	41	Contractor	Contractor	Non-Excusable
Disputes of Labors	1.869	42	Contractor	Contractor	Non-Excusable
Laws - regulations	1.849	43	Client, Consultant &Contractor	Both Client &Contractor	Excusable- Non compensable
Accidents to Labors	1.736	44	Contractor	Contractor	Non-Excusable
Non-Attendance of Labors	1.713	45	Contractor	Contractor	Non-Excusable

As indicated in Table 4.9, late material supply is caused by both the client and the contractor as perceived by the client whereas the consultants and the contractors perceived it is caused by the client only. Delayed payments to contractors is caused by both the client and the consultant as perceived by the client whereas the consultants and the contractors indicated that it is caused by the client only. Moreover, the client perceived that poor site management is caused by all the three parties whereas the consultants and the contractors perceived that it is caused by only the contractor. Ineffective planning and scheduling is caused by both the consultant and the contractor as perceived by the consultants while the client and the contractors responded that it is caused by all the three parties. As per the client respondents, slowness in decision making process is caused by all the three parties. However, the consultants and the contractors perceived it is caused by both the client and the consultant.

Table 4.9 Comparison of type of delay by source among client, consultants and contractors' respondents

Causes of delays	Client			Consultant			Contractor			Overall		
	RII	Rank	Source of delay	RII	Rank	Source of delay	RII	Rank	Source of delay	RII	Rank	Source of delay
Late material supply	3.000	5	CL&CT	3.733	1	CL	3.100	5	CL	3.278	1	CL
Delayed payments to contractors	2.533	23	CL&CS	3.133	10	CL	3.200	1	CL	2.956	6	CL&CS
Poor site management	3.133	3	CL,CS&CT	3.267	6	CT	2.380	24	CT	2.927	7	CT
Ineffective planning and scheduling of project	2.933	7	CL,CS&CT	3.267	6	CT&CS	2.580	12	CL,CS&CT	2.927	7	CL,CS&CT
Slowness in decision making process	2.867	9	CL,CS&CT	2.600	23	CL&CS	3.180	3	CL&CS	2.882	10	CL& CS
Scarcity of material in the market	2.600	19	FM	3.267	6	CL	2.560	14	CL	2.809	12	CL
Old technology	2.733	14	CL,CS&CT	2.600	23	CT	2.340	27	CT	2.558	21	CT
Inappropriate organization management	2.667	16	CL,CS&CT	2.800	18	CT	2.200	33	CL,CS&CT	2.556	22	CL,CS&CT
Quality of material	2.400	27	CL,CS&CT	2.600	23	CL&CT	2.580	12	CT	2.527	25	CL,CS&CT
Inaccurate cost estimation	2.400	27	CS	2.333	35	CL &CS	2.400	23	CL&CS	2.378	32	CS

Causes of delays	Client			Consultant			Contractor			Overall		
	RII	**Rank**	**Source of delay**	**RII**	**Rank**	**Source of delay**	**RII**	**Rank**	**Source of delay**	**RII**	**Rank**	**Source of delay**
Inadequate consultant experience	2.600	19	CS	2.200	38	CL&CS	2.320	29	CS	2.373	33	CS
Material Price Escalation	2.267	33	CL&CT	2.133	40	CL&CT	2.560	14	CT	2.320	34	CL&CT
Mistakes & discrepancies in design documents	2.067	36	CS	2.400	33	CL&CS	2.380	24	CS	2.282	36	CS
Nomination of sub-contractors and suppliers	2.067	36	CL&CT	2.200	38	CT	2.340	27	CT	2.202	39	CT
Incomplete contract documents	1.800	41	CL&CS	2.533	28	CL&CS	1.940	41	CS	2.091	40	CL&CS
Laws - regulations	1.467	45	CL,CS&CT	2.000	43	CL	2.080	39	CL,CS&CT	1.849	43	CL,CS&CT

As shown in Table 4.10, the client perceived both the client and the contractor are responsible for late material supply whereas the consultants and the contractors responded that only the client is responsible for the late material supply. The consultants and the contractors perceived the contractor is responsible for the poor site management, but the client perceived both the client and the contractor are responsible for it. As per the client, both the client and the contractor take responsibility for slowness in decision making process .However, the consultants and the contractors perceived only the client is responsible for slowness in decision making process. The client perceived neither the client nor the contractor are responsible for scarcity of material in the market whereas both the consultants and the contractors indicated that the client take responsibility for the scarcity of material in the market. Furthermore, all the three parties are responsible for old technology as perceived by the client whereas the consultants and the contractors perceived the contractor is responsible for the old technology.

Table 4.10 Comparison of Type of delay by responsibility and compensability among respondents

	Client		Consultant		Contractor		Overall	
Causes of delay	**Responsibility**	**Compensability**	**Responsibility**	**Compensability**	**Responsibility**	**Compensability**	**Responsibility**	**Compensability**
Late material supply	CL & CT	Excusable Non-compensable	CL	Excusable compensable	CL	Excusable compensable	CL	Excusable compensable
Poor site management	CL& CT	Excusable non-compensable	CT	Non-excusable	CT	Non-excusable	CT	Non-excusable
Slowness in decision making process	CL&CT	Excusable non-compensable	CL	Excusable compensable	CL	Excusable compensable	CL	Excusable compensable
Scarcity of material in the market	Neither CL nor CT	Excusable non-compensable	CL	Excusable compensable	CL	Excusable compensable	CL	Excusable compensable
Old technology	CL&CT	Excusable non-compensable	CT	Non-excusable	CT	Non-excusable	CT	Non-excusable
Inappropriate organization management	CL&CT	Excusable non-compensable	CT	Non-excusable	CL&CT	Excusable non-compensable	CL&CT	Excusable non-compensable
Quality of material	CL&CT	Excusable non-compensable	CL&CT	Excusable non-compensable	CT	Non-excusable	CL&CT	Excusable non-compensable
Material Price Escalation	CL&CT	Excusable non-compensable	CL&CT	Excusable non-compensable	CT	Non-excusable	CL&CT	Excusable non-compensable
Nomination of sub-contractors and suppliers	CL&CT	Excusable non-compensable	CT	Non-excusable	CT	Non-excusable	CT	Non-excusable
Laws - regulations	CL&CT	Excusable non-compensable	CL	Excusable compensable	CL&CT	Excusable non-compensable	CL&CT	Excusable non-compensable

As indicated in Table 4.10 above, the client perceived that late material supply is excusable non-compensable, but it is excusable compensable as perceived by the consultants and the contractors. Poor site management is excusable non-compensable as perceived by the client. However, both the consultants and the contractors perceived it is non-excusable. The consultants and the contractors indicated that slowness in decision making process and scarcity of material in the market are excusable compensable whereas the client responded both are excusable non-compensable. As per the client respondents, old technology is excusable non-compensable whereas the consultants and the contractors perceived it is non-excusable.

4.7 Spearman Rank Correlation Coefficient (Rs)

The Spearman rank correlation coefficient was determined to assess the strength of relationship between two parties of ranking. It was calculated using equation 3.5 shown in chapter 3 section 3.5.3. The value of the Spearman rank correlation coefficient ranges from +1 (perfect correlation), to 0 (no correlation), to −1 (perfect negative correlation). The results of the correlation shown in Figure 4.6, between client and consultant, client and contractor, and contractor and consultant were 0.95, 0.80 and 0.75 respectively. These values show that there is very strong agreement or correlation between the rankings of client and consultant. Moreover, the agreement of rankings between client and contractor as well as contractor and consultant is also strong.

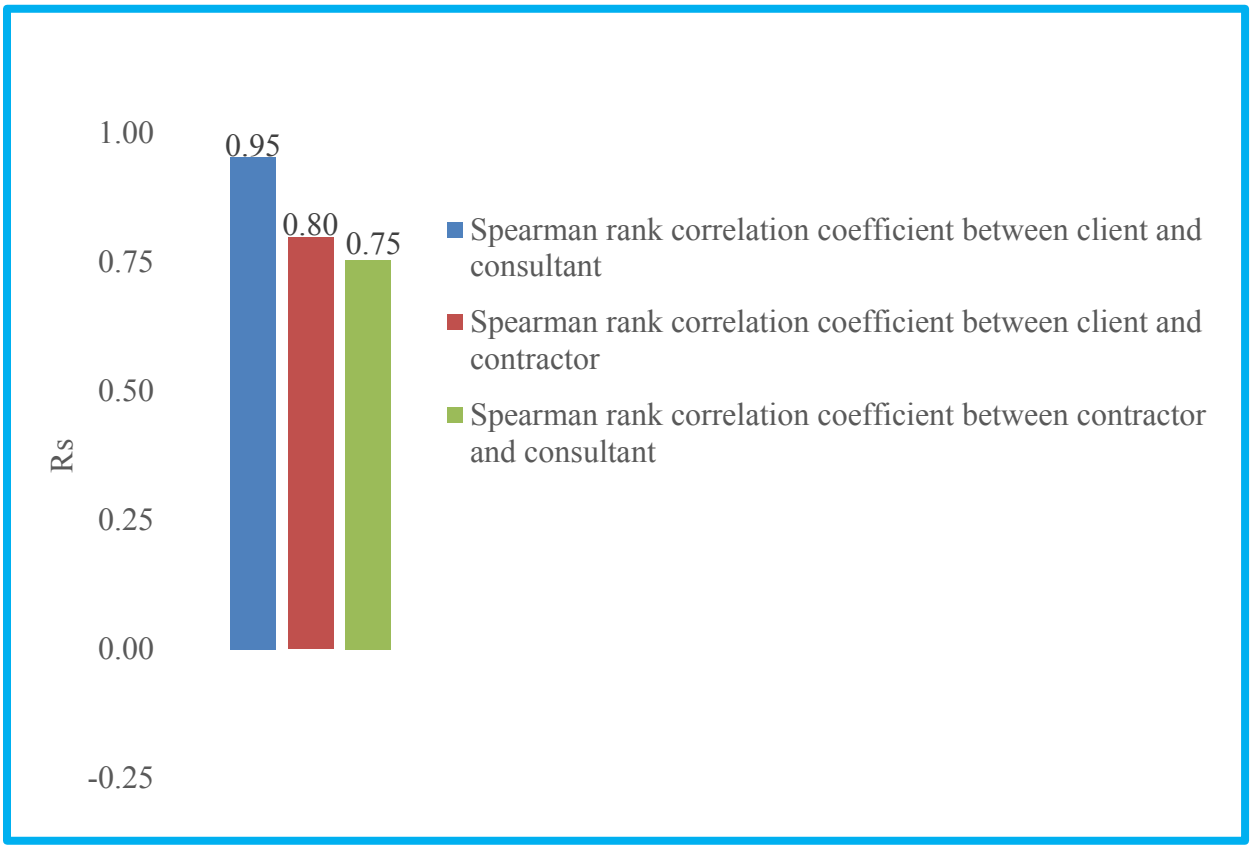

Figure 4.6: The agreement between the parties in rankings

4.8 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. The output of the analysis is as shown in Table 4.11.The result shows that F-statistic=5.506 > F-critical=3.065 at a *p-value* of 0.005, so the null hypothesis is rejected i.e. the three groups can not be considered as random samples from the same population.

Table 4.11 Output of ANOVA analysis

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.106	2	1.053	5.506	0.005	3.065
Within Groups	25.246	132	0.191			
Total	27.353	134				

4.9 Summary

Questionnaire survey was conducted to identify the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa and also to identify type of delay by source, responsibility and compensability. Overall, 80 responses out of 110 questionnaires distributed, were obtained from the contractors, consultants and client working in the project.

Cronbach's alpha coefficient was used to test the reliability or consistency of the questionnaire survey. Taking client, consultant, contractor and overall respondents, the α-values were 0.964, 0.938, 0.964, and 0.962, respectively. Since all α-values are greater than 0.7, the minimum level for reliability, the questionnaire survey is reliable or consistent.

Relative importance index was used to identify the major causes of delay in the construction of 40/60 saving houses project from the client, consultants, contractors and overall respondents.

The client perceived that financial difficulties faced by the contractor, equipment unavailability, poor site management, problem of electric supply, late material supply, problem of water supply, improper equipment, ineffective planning and scheduling of project, non-utilization of professional construction/contractual management and slowness in decision making process were the ten major causes of delay in the construction of 40/60 saving houses project whereas the consultants responded that the major causes of delay in the construction of 40/60 saving houses project were late material supply, financial difficulties faced by the contractor, improper equipment, equipment unavailability, problem of electric supply, ineffective planning and scheduling of project, poor site management, problem of water supply, scarcity of material in the market, delayed payments to contractors and variations. On the other hand, the contractors perceived that delayed payments to contractors, problem of electric supply, slowness in decision making process, problem of water supply, late material supply, financial difficulties faced by the contractor, late design review and approval, delay in approval of documents, client's finance shortage, delayed payments to suppliers and subcontractors were the ten major causes of delay in the construction of 40/60 saving houses project.

The overall ten major causes of delay out of 45 common causes delay in the construction of 40/60 saving houses project 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.

Out of nine groups of delay causes, Infrastructure related (problem of electric supply, problem of water supply and problem of access road), material related (quality of material, late material supply and scarcity of material in the market) and equipment related (improper equipment, equipment unavailability and equipment failure) were the top three groups of delay causes in the construction of 40/60 saving houses project.

Of the 10 major causes to the delay in the construction of the 40/60 scheme project, late material supply, problem of electric supply and problem of water supply were caused and taken responsibility by the client and they are excusable compensable delays. On the other hand, financial difficulties faced by the contractor, equipment unavailability and poor site management were caused and taken responsibility by the contractor and they were non-excusable delays. Delayed payments to contractors, late design review and approval, and slowness in decision making process were caused by both client and consultant, but the client was responsible and hence these causes of delay are excusable compensable delays and lastly ineffective planning and scheduling was caused by all the three parties, but taken responsibility by both the client and the contractor, and thus it is excusable non-compensable delay.

The Spearman rank correlation coefficients between client and consultant, client and contractor, and contractor and consultant were 0.95, 0.80 and 0.75 respectively. These values show that there is very strong agreement or correlation between the rankings of client and consultant, and also the agreement of rankings between client and contractor as well as contractor and consultant is strong enough.

The result of Analysis of Variance (ANOVA) showed that F-statistic=5.506 > F-critical=3.065 at a *p-value* of 0.005, so the null hypothesis is rejected.

The next Chapter-5 presents the case study results in three of most delayed 40/60 saving houses projects so as to further identify the source of delay, the reasons, the impacts and the solutions.

CHAPTER-5: CASE STUDY RESULTS

This chapter deals with in-depth investigation of the causes of delay in selected three 40/60 saving houses project through interviews and referring documents of the project to enhance the findings obtained from questionnaire survey. In this chapter, introduction is presented, the project is described, the project participants are discussed, organizational structure of the project is presented, the selection process of consultants and contractors is explained, the case study results about source of delay, reasons, impacts and solutions for identified major causes of delay by the interviewees in each contractual parties is thoroughly tabulated and discussed, and finally summary are presented.

5.1 Introduction

Case study is defined as an in-depth investigation of particular instances of a phenomenon, (Fellows and Liu, 2007). The main criticisms on case study are that it is difficult to make generalization as a limited number of cases are studied. Secondly, many case-study research projects are executed with insufficient precision, quantification, objectivity, or rigor in which investigators have not followed standard procedures or have allowed a biased view to influence the direction of the findings because of lack of standard procedures or guidance (Tylor et al. 2011).

5.2 The project description

5.2.1 The Project

The 40/60 saving houses projects have been constructed in four sub cities namely Lideta, Bole, Akaki kality, and Kolfe keranio in a total area of 164.59 hectare. Up to now, 39,229 houses have been constructed in 12 project sites since Dec 29, 2012. Only 1,292 houses in Sengatera and Crown sites are ready to be transferred to users. Ministry of Works and Urban Development (MOWUD) is the owner of the project and Addis Ababa Saving Houses Development Enterprise (AASHDE) is responsible for supervising and administering the project. There are four AASHDE Branch offices in Bole sub city which are responsible for supervising and administering the project sites under their branch. Seven project sites such as Sengatera, Crown,

Asko, Ehil Nigid, Tourist Nigid, Hintsa Akirabi and Bole Bulbila are under the management of Branch-1. Branch-2 manages two projects such as Bole Ayat-1 and Meri Loke, whereas, Branch-3 manages only one project site that is Bole Beshale. Branch -4 manages two project sites such as Bole Ayat-2 and Summit. Since the commencement of the project in 2005 E.C, more than 11 billion birr was disbursed for the execution of the project. As illustrated in Figure 5.1, the released budget in 2008 is greater than the disbursed budget in three years period (2005-2007 E.C) as the number of the projects has been increased.

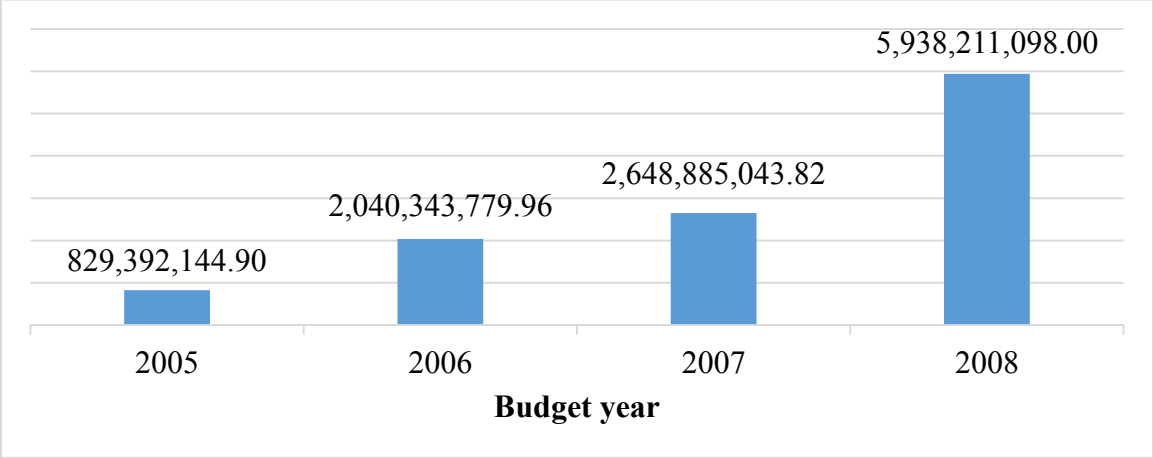

Figure 5.1.Yearly released budget in Birr for the 40/60 saving houses project (Source:AASHDE)

5.2.2 The Project Participants

In this project, the original design was prepared by ETG Consulting firm and approved by MOWUD. In the design review, supervision and contract administration, nine class-1 and class-2 consulting firms have participated. A total of 153 Grade 1 up to 3 contractors have participated for the construction so far. Micro and small enterprises have also participated in production, loading and unloading, and installation works. Furthermore, suppliers participated in the project.

5.2.3 Organizational Structure of the Projects

AASHDE is directed by MoWUD. The Enterprise has four main sections; one is a contract administration section that is responsible for construction works and the other is procurement section that is responsible for material delivery. The finance section is responsible for releasing payments to contractors, consultants, and MSEs. The consultant and contractors are under the management of the contract administration section. The other section is MSEs follow up section

which manages and assists all MSEs in the project. Installation MSE are subcontractors responsible for installation works like electrical, sanitary, handrails and guardrails installation in the projects and they are under supervision of the main contractors. The others are Production MSEs which are responsible for production works like hollow concrete blocks, ribbed blocks and precast beams. The loading and unloading MSEs are responsible for loading and unloading construction materials. In general, the organizational structure of the project is as illustrated in Figure 5.2.

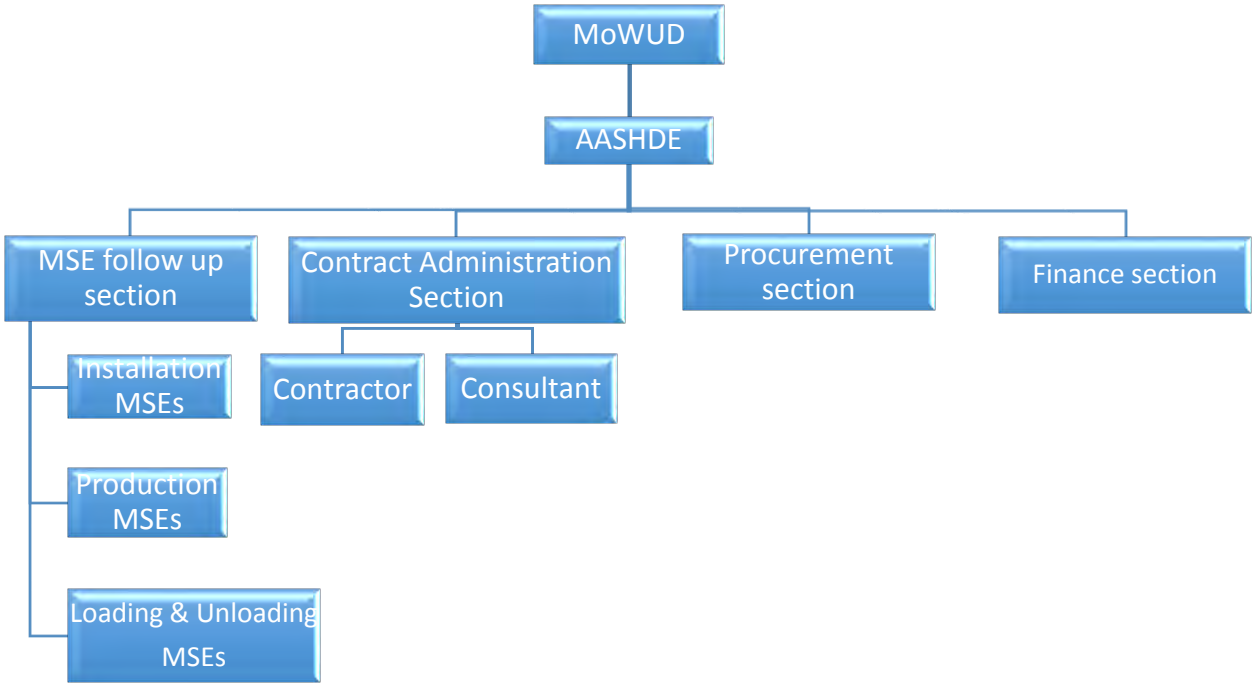

Figure 5.2: Organizational structure of the 40/60 saving houses project

5.3 Selection Process of Consultants and Contractors

Hereunder, the process used to recruit consultants and contractors for the 40/60 housing projects is discussed.

5.3.1 Consultants' selection process

Consultants were selected based on open tendering. The bid evaluation considered Technical (80%) and Financial (20%) evaluation approach of the consultant's offer. All proposals reaching the minimum technical score of 70% proceeded to the financial evaluation. 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.

5.3.2 Contractors' selection process

The contract type of 40/60 scheme project is fixed-unit price. Hence, the AASHDE recruits local contractors based on financial turnover (3 years) (accounts for 50%), Work experience (in mass housing) (accounts for 20%) and other projects (accounts for 15%), and good performance (accounts for 5%). New local contractors with Grade 1 up to 3, which scored more than 70%, were booked for the construction as per their grade, and block typology. The existing contractors which scored better points in performance evaluation were awarded additional blocks.

5.4 Case study results

Three 40/60 project sites, namely Sengatera, Crown and Asko were selected to conduct the case study, because these sites were the most delayed ones and hence a better and detailed information about the causes of the delays can be obtained. The case study results in the respective sites will be discussed below.

5.4.1 Case Study-1: Sengatera 40/0 saving houses project site

The first case study was conducted on Sengatera site. The site is located in Lideta sub city nd lays on an area of 2.2 hectare. In this project, one class-1 consultant and five grade-1 contractors participated in the construction of five blocks with typology 2B+G+12. In the project, a total of 110 shops in the ground, first, and second floors, and 100 bed type 1, 100 bed type 2, and 100

bed type 3 units from 3rd to 12th floor are included. It is estimated that the project will accommodate 1,260 people. This project was started on December 29, 2012. The total labor contract of the five blocks including supplementary works is more than 160 million birr and the original contract period of the project was 540 days. Some main construction materials such as cement, aggregate, reinforcement bars, blocks, precast, ceramic and porcelain tiles are supplied by the client. Sanitary and electrical materials are supplied by both client and contractor. Handrails and guardrails are supplied and fixed by MSEs whereas the aluminum doors and windows are supplied and fixed by B&C Aluminum works PLC. The project should have been completed on June 15, 2014 as per the original contract. Nevertheless, the project was extended 267 days due to supplementary contract agreement, whose contract amount was 79% of the original contract amount, and hence the revised completion date of the project became March 12, 2015, but no claims were approved so far . However, the current status (till the end of August, 2016) of the project was still 98.33% complete, due to many delay factors. The remaining (on progress) works in the project are sanitary fixtures and electrical fittings installation, sanitary and electric lines connection site works like sewer line installation, walkway, etc.

Figure 5.3 Sengatera 40/60 project site

Figure 5. 4 On progress walkway

Figure 5.5 On progress Manhole work

Figure 5.6. Excavation work for sewer line installation

5.4.1.1 Background information about Interviewees

The case study was conducted on Sengatera 40/60 saving houses project site through interviewing the three contractual parties currently working on the site. The interview took 2-3 hours per interviewee. The background information of the interviewees is as illustrated in Table 5.1.

Table 5.1 Background information about interviewees at Sengatera 40/60 project site

Type of Organization	Position in the organization	Education level	Years of Experience in Building Construction	Years of Experience in condominium construction	Years of Experience in 40/60 saving houses project
Client	Site Coordinator	MSc	3	1	1
Consultant	Site Supervisor	BSc	8	3.5	3.5
Contractor	Project Manager	BSc	12	5	3
	Site Engineer	BSc	3	1.3	1.3

5.4.1.2 Identification of source of delay, reasons, impacts and solutions

5.4.1.2.1. Client's response-Sengatera 40/60 project site

According to the Site Coordinator's perception, incomplete contract documents, quality of material, late material supply, delayed payments to contractors, delayed payments to suppliers and subcontractors, client's finance shortage, financial difficulties faced by the contractor, poor site management, slowness in decision making process and delay in performance of subcontractors were perceived as the major causes of delay in the construction of Sengatera 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by a site coordinator is presented in Table 5.2 below. The % impacts of delays were assigned based on the rough estimation of the Site Coordinator.

Table 5.2: Client's response - Sengatera 40/60 project site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Incomplete contract documents	Client and consultant	Lack of pre-planning, lack of qualified and experienced professionals, not giving due attention and ample time for contract document preparation, no proper checking and approval, lack of integration among professionals preparing the contract document	[9%]:Time overrun due to incomplete sanitary and electrical drawings, and BOQ Cost overrun due to the increment in material and labor, consulting fee, management fee, overhead cost through time	Proper pre-planning, assigning qualified & specialized professionals, integration among professionals, preparing the contract documents
Quality of material	Client and Consultant	Poor supervision, improper nominations of MSEs	[3%]:Time overrun due to re-work, cost overrun due to re-work and wastage of materials especially HCB and precast, poor quality of works	Proper supervision, training to MSE

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Late material supply	Client and contractor	Financial shortage, time taking procurement process, imported materials such as reinforcement bars, sanitary materials etc, supplier change (from client to contractor like gravel, sanitary materials etc.),information gap on suppliers, inaccurate estimation of quantity, lack of integration among stakeholders, bureaucracy in material requisition	[7%]:Time overrun due to waiting for material supply, demobilization of labor, cost overrun due to increase in material price ,	The client need strong procurement management, the government should capacitate local manufacturers particularly re-bar, sanitary materials etc production, the consultant should estimate quantity of materials accurately, there should be strong integration among stakeholders
Delayed payments to contractors	Client	Financial shortage, absence of standard quantity, long checking and approval process(Consultant project office to client project office to branch-1 office to AASHDE)	[10%]:Time overrun Cost overrun Demotivate the contractor	Checking and approval process should be shortened

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Delayed payments to suppliers and subcontractors	Client and contractor	Financial shortage from the client, delayed payments to contractor, delayed payment preparation, checking and approval process	[5%]:Time overrun Cost overrun	Timely payment to contractors, suppliers and then to subcontractors
Client's finance shortage	Client	Forecasting problem for budget allocation, unplanned extension of project, problem related to bank process	[15%]:Time overrun and Cost overrun	Proper planning, strong integration between the client and the bank
Financial difficulties faced by the contractor	Client and contractor	Transferring payments to other projects, Contractor's financial management problem, delayed payments to contractors, expending payments for personal interest	[7%]:Time overrun and cost overrun	Proper financial management by the contractor, follow up on the usage of payments by the client
Poor site management	Contractor	Poor management skill, improper assignment of professionals, negligence of professionals, not knowing the work procedure, absence of proper scheduling, not fulfilling the key personnel requirement by the client	[6%]:Time overrun and cost overrun	Fulfilling key personnel requirement by the contractor, the contractor should follow up the site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Slowness in decision making process	Client	Lack of professionalism, bureaucracy, lack of integration	[8%]:Time overrun and cost overrun	Professionalism, shorten the bureaucracy by involving the concerned bodies only in the decision making
Delay in performance of Subcontractors	Client	Financial problem, lack of manpower, lack of knowledge late material supply, delayed payments to MSEs, attitude problem(stop work, get paid)	[5%]:Time overrun and cost overrun	MSEs should be under the control of the contractors, training Support and follow up

Note: Percentages in parenthesis indicate rough estimation of impact shares as per the client respondent.

5.4.1.2.2. Consultant's response-Sengatera 40/60 project site

According to a Site Supervisor's perception, variations (changes to the work), late design review and approval, quality of material, late material supply, scarcity of material in the market, client's finance shortage, financial difficulties faced by the contractor, ineffective planning and scheduling of the project, slowness in decision making process, nomination of sub-contractors and suppliers, delay in performance of subcontractors are the top ten major causes of delay in Senagtera 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by a site supervisor is presented in Table 5.3. The % impacts of delays were assigned based on the rough estimation of the Site Supervisor.

Table 5.3: Consultant's response –Sengatera 40/60 project site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Variations (changes to the work)	Client & consultant	Lack of planning, lack of qualification from professionals, problem in design preparation, negligence of the client, consulting fee, socio-political impacts	[10%]:Time overrun, cost overrun due to the increase in material price through time overrun	Proper pre-planning, specialization, detail checking and investigation,
Late design review and approval	Client & consultant	Resignation of professionals, late design review payment, slowness in responding the consultant's request for necessity of design review	[1.5%]:Time overrun & cost overrun due to re-work (sanitary & electrical), quality problem	Proper organizational management, timely payment for design review,
Quality of material	Client & contractor	Corruption in approval of materials and selection of especially sanitary and electrical suppliers, intervention of the client on consultant decision, to minimize cost, limited number	[8%]:Time overrun due to long process of approval & rejection of materials from supplier, cost overrun ,poor quality of works	Specialized & qualified professionals should engage in procurement ,proper procurement management,

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
		of potential suppliers, lack of qualification, gap in assigning production supervisor (1 supervisor to 20 Production MSEs), absenteeism of production supervisor		
Late material supply	Client & contractor	Limited number of potential suppliers, Long decision period for procurement of materials, late supplier change(from client to contractor),late payment for supplier	[6.5%]:Time overrun & cost overrun	Proper pre-planning, integration among stakeholders, early procurement
Scarcity of material in the market	Force majeure	Limited number of potential suppliers, selective specification of materials. For instance, ACQUA water closet, Hand wash basin made of white vitreous china etc.,	[6%]:Time overrun & cost overrun	Conducive investment attraction, encouraging local manufacturers to manufacture quality materials, sufficient electric power supply

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
		Bias on approval of materials by professionals		
Client's finance shortage	Client	Not fulfilling public procurement regulation by the client, not utilizing budget properly, incorrect budget forecasting	[2%]:Time overrun & cost overrun	qualified budget experts, The client should abide by the public procurement regulation, proper budget forecasting
Financial difficulties faced by the contractor	Contractor & client	Improper financial management by the contractor (using payments to other projects and personal need), delayed payments to contractors by the client due to financial shortage	[4%]:Time overrun & cost overrun	Proper financial management by contractor, timely payments to contractors by client
Ineffective planning and scheduling of project	Contractor, client & consultant	Not giving due attention to planning & scheduling of project, lack of qualification,	[5%]:Time overrun & cost overrun	Proper attention to planning & scheduling, qualified planners & schedulers need to be involved in the project

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Slowness indecision making process	Client & contractor	Organizational change (resignation of personnel),under qualification of professionals, fear of risk, absence of good governance, attitude problem, not giving proper attention to the project by the contractor, not responding to the client's request	[15%]:Time overrun & cost overrun	Attitude change(positive thinking),proper training, employing qualified professionals, conducive working environment with job description
Nomination of sub-contractors & suppliers	Client & contractor	Selecting least bidder subcontractor by contractor, least cost for material purchase by contractor, client focuses on job creation not job qualification, corruption in selection of suppliers	[7%]:Time overrun & cost overrun	Proper selection criteria for sub-contractors, good governance, proper implementation of public procurement regulation

Note: Percentages in parenthesis indicate rough estimation of impact shares as per the consultant respondent.

5.4.1.2.3. Contractors' response-Sengatera 40/60 project site

According to a Project Manager's and a Site Engineer's perception, variations, late design review and approval, late material supply, delayed payments to contractors, delayed payments to suppliers and subcontractors, financial difficulties faced by the contractor, poor site management, delay in performance of subcontractors, problem of electric supply, problem of water supply, problem of access road are the major causes of delay at Sengatera 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by a Project Manager and a Site Engineer is presented in Table 5.4. The % impacts were assigned based on the rough estimation of the Site Engineer.

Table 5.4: Contractor's response –Sengatera 40/60 project site

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
Variations(Changes to the work)	Client and consultant	Incomplete contract preparation(sanitary & electrical drawings),lack of pre-planning, absence of detail design, late assignment of MSES(Sanitary & electrical installation works)	[15%]:Time overrun ,cost overrun, quality problem	Proper pre-planning, timely assignment of subcontractors
Late design review and approval	Client and consultant	Negligence ,beurecracy, lack of qualification/experience in designs, lack of integration, slowness in decision making process	[25%]:Time overrun ,cost overrun, quality problem due to re-work	Proper pre-planning, assignment of qualified professionals, integration between client and consultant
Late material supply	Client	Suppliers' incapacity, lack of plan, importation of materials, financial shortage, beaurocracy on	[8%]:Time overrun and cost overrun	Material approval process, procurement process, material requisition process need to be shortened,

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
		procurement process , distant material store from the site, long material requisition process, late material request, lack of integration		timely material request, material supply schedule, capacitate the local manufacturers
Delayed payments to contractors	Client and consultant	Late checking of payments ,long payment approval process, client's finance shortage due to improper budget allocation	[12%]:Time overrun & cost overrun	The consultant should assign a professional specifically to payment checking, proper budget allocation, the payment approval process should be shortened
Delayed payments to suppliers and sub-contractors	Client, consultant and contractor	Late payment preparation from the contractor, late checking from the consultant and late approval from the client ,client's financial shortage,	[4%]:Time overrun and cost overrun	The consultant should assign a professional specifically to payment checking, proper budget allocation, the payment approval process should be

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
				shortened
Financial difficulties faced by the contractor	Contractor, client and consultant	Improper financial management by the contractor(using payments to other projects and personal need),delayed payments to contractors due to late checking and approval, client's finance shortage due to budget deficit	[4%]:Time overrun and cost overrun	Proper financial management by the contractor, timely payments to contractors, proper budget forecasting and allocation
Poor site management	Client, consultant and client	Not employing experienced and qualified professionals, Not fulfilling key personnel requirement from the contractors and the consultant, ineffective planning and scheduling	[7%]:Time overrun, cost overrun and quality problem	Employing qualified professionals, Fulfilling key personnel requirement from the consultant and the contractors, proper planning and scheduling
Delay in performance of	Client and contractor	Financial shortage, lack of	[5%]:Time overrun and	Assigning

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
subcontractors		knowledge, lack of skilled manpower, lack of proper training, delayed payments, improper assignment of subcontractors	cost overrun	Subcontractors(MSEs) based on their qualification, proper training, timely payments to subcontractors
Problem of electric supply	Client and contractor	Power interruption, late maintenance	[3%]:Time overrun and cost overrun	Consistent power supply, immediate maintenance, High capacity standby Generator
Problem of water supply	Client and contractor	Water supply interruption, damaging water supply line, late maintenance	[2%]:Time overrun and cost overrun	Consistent water supply, due protection to water supply line, immediate maintenance to damaged water supply line

Note: Percentages in parenthesis indicate rough estimation of impact shares as per the contractor respondent.

The major causes of delay identified by the respondents of the contractual parties in Sengatera 40/60 project site were mapped as shown in Figure 5.7 below to illustrate the interrelationship between delays (similarity between responses) and their source(either internal or external). Client's finance shortage, quality of material, and slowness in decision making process were the common causes of delay between the client and the consultant. On the other hand, the common causes of delay between the client and the contractor were delayed payments to contractors, delayed payments to suppliers and sub-contractors, delay in performance of sub-contractors, and poor site management whereas the common causes of delay between the consultant and the contractor were variations (changes to the work), and late design review and approval. Late material supply and financial difficulties faced by the contractor were the common causes of delay among the three contractual parties.

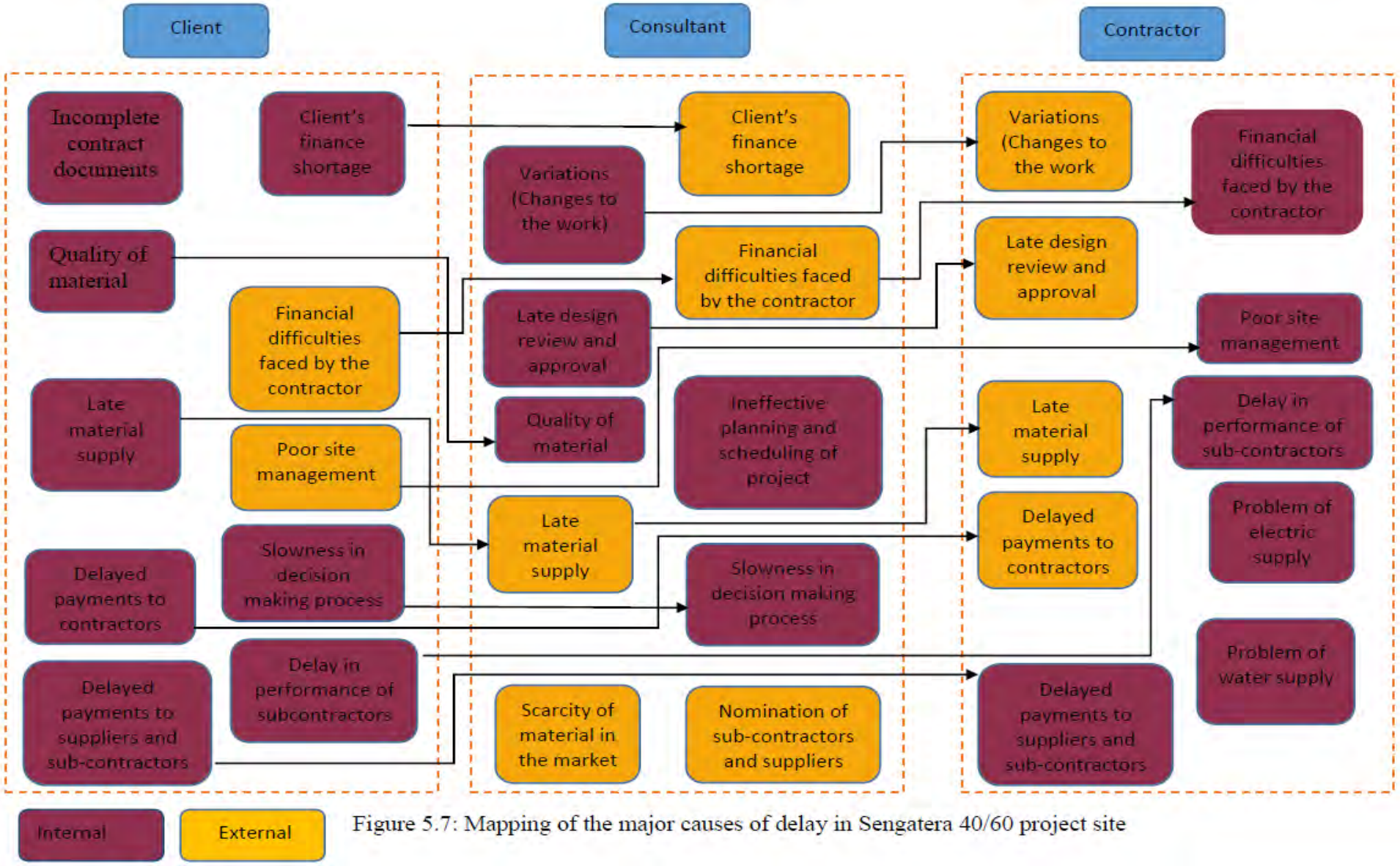

Figure 5.7: Mapping of the major causes of delay in Sengatera 40/60 project site

The sources of delay for major causes of delay identified by the respondents of the contractual parties in Sengatera 40/60 project site were mapped as shown in Figure 5.8 below to illustrate the similarity, and difference between responses ,and their source(either internal or external). Both client and consultant agreed that client's finance shortage was caused by only the client. The client responded that quality of material was caused by both the client and the consultant whereas the consultant argued that it was caused by client and contractor. On the other hand, the client perceived that slowness in decision making process was caused by only the client, but the consultant responded that it was caused by the client and the contractor. Both the client and the contractor agreed that delayed payments to contractors was caused by the client and the consultant. The client responded that delayed payments to suppliers and sub-contractors was caused by client and the contractor whereas the contractor perceived it was caused by all the three parties. The client perceived that delay in performance of sub-contractors was caused by only the client whereas the contractor perceived it was caused by both the client and the contractor. On the other hand, the client perceived that poor site management was caused by only the client, but the contractor responded it was caused by all the three parties. The consultant and the contractor agreed that both variations, and late design review and approval were caused by the client and the consultant. Both the client and the consultant agreed that late material supply ,and financial difficulties faced by the contractor were caused by the client and the contractor whereas the contractor responded that late material supply was caused by the client, and financial difficulties faced by the contractor was caused by all the three parties.

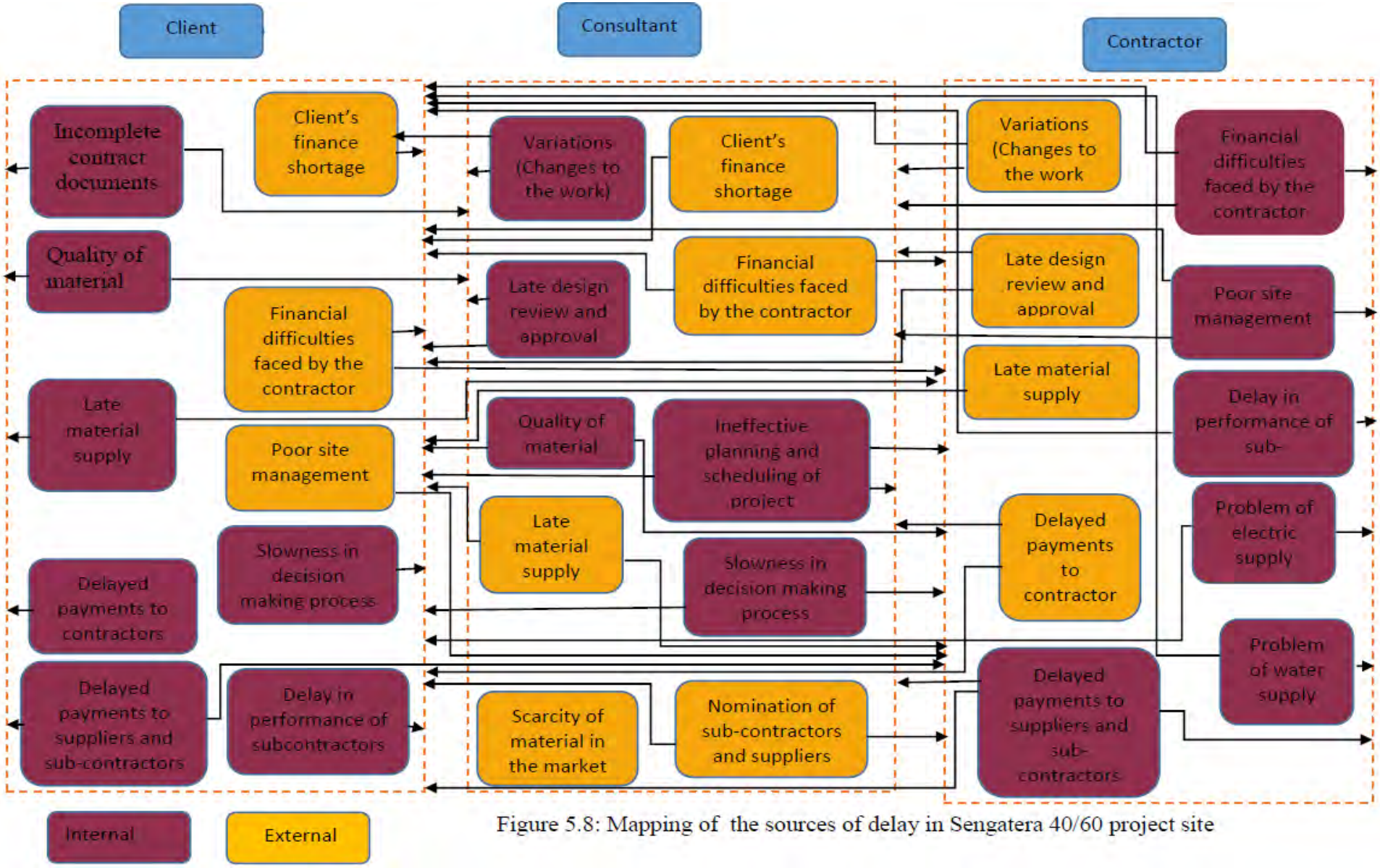

Figure 5.8: Mapping of the sources of delay in Sengatera 40/60 project site

5.4.2 Case study-2: Crown 40/0 saving houses project site

The second case study was conducted on Crown site. The site is located in Akaki Kality sub city, and lays in an area of 5.9 hectare. In this project, one class-1 consultant and seven grade-1 contractors participated in the construction of fourteen blocks with typology B+G+9. In the project, a total of 210 shops in the ground and first floors, and 224 bed type 1, 224 bed type 2, and 224 bed type 3 units from 2nd to 9th floor are included. It is estimated that the project will accommodate 2,822 people. This project was started on May 17, 2013. The total labor contract of the fourteen blocks including supplementary works is more than 300 million birr and the original contract period of the project was 455 days. Some main construction materials such as cement, aggregate, reinforcement bars, blocks, precast, ceramic and porcelain tiles, sanitary fixtures, electrical fixtures, lift are supplied by both client and contractor. Handrails and guardrails are supplied and fixed by MSEs whereas the aluminum doors and windows are supplied and fixed by B&C Aluminum works PLC. The project should have been completed on August 17, 2014 as per the original contract. Nevertheless, the project was extended 225 days due to supplementary contract agreement, whose contract amount was 58% of the original contract amount and hence the revised completion date of the project became March 10, 2015, but no claims were approved so far. However, the current status (till the end of August, 2016) of the project was still 96.09 % complete, due to many delay factors. The remaining (on progress) works in the project are sanitary pipes, fixtures and electrical fittings installation, sanitary and electric lines connection, finishing works(ceramic, porcelain etc.), site works like sewer line installation, etc.

Figure 5.9: Crown 40/60 project site

Figure 5.10 Cobblestone pavement

Figure 5.11Sewer line installation

Figure 5.12 Retaining wall construction

5.4.2.1 Background information about Interviewees

The case study was conducted on Crown 40/60 saving houses project site through interviewing the three contractual parties currently working on the site. The interview took 2-3 hours per interviewee. The background information of the interviewees is as illustrated in table 5.5.

Table 5.5 Background information about interviewees at Crown 40/60 project site

Type of Organization	Position in the organization	Education level	Years of Experience in Building Construction	Years of Experience in condominium construction	Years of Experience in 40/60 saving houses project
Client	Site coordinator	Diploma	20	3	3
Consultant	Resident Engineer	BSc	9	4	2
Contractor	Project Manager	BSc	3	3	3

5.4.2.2 Identification of source of delay, reasons, impacts and solutions

5.4.2.2.1. Client's response –Crown 40/60 project site

According to a Site Coordinator's perception, variations (changes to the work), mistakes and discrepancies in design documents, late material supply, improper equipment, delayed payments to contractors, delayed payments to suppliers and subcontractors, poor supervision, slowness in decision making process, delay in performance of subcontractors and problem of electric supply were perceived as the major causes of delay in the construction of Crown 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by a site coordinator is thoroughly presented in Table 5.6 below. The % impacts of delays were assigned based on the rough estimation of the Site Coordinator.

Table 5.6: Client's response –Crown 40/60 project site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Variations(changes to the work)	Consultant and client	Inaccurate quantity estimation, discrepancy in design documents(between Drawing and Bill of quantity),short planning time	[12%]: Time overrun and cost overrun	Experienced professionals for quantity surveying, proper document preparation
Mistakes and discrepancies in design documents	Consultant	Not enough planning time, lack of experience of professionals, lack of integration among designers	[15%]: Time overrun and cost overrun	Experienced professionals for design, strong integration among designers, ample design period
Late material supply	Client	Late contract agreement with production MSEs, financial and technical incapacity of MSEs, power interruption, shortage of transport facilities, scarcity of material in the market, long procurement process	[7%]: Time overrun and cost overrun	Capacity building of MSEs, proper planning, proper procurement management, proper logistics management
Improper equipment	Contractor	Financial incapacity of the contractor, loose follow up on fulfillment of equipment requirement	[3%]: Time overrun, cost overrun and quality	Capacity building of the contractor by supplying key machineries in credit, strict follow up on

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
				fulfillment of equipment requirement
Delayed payments to contractors	Client and consultant	Absence of master takeoff, long payment checking and approval process, client's finance shortage, resignation of personnel	[8%]: Time overrun, cost overrun	Master takeoff ,proper periodic budget forecasting, concise payment checking and approval process
Delayed payments to suppliers and subcontractors	Client and consultant	Absence of master takeoff, long payment checking and approval process, client's finance shortage, resignation of personnel	[8%]: Time overrun, cost overrun	Master takeoff, proper periodic budget forecasting, concise payment checking and approval process
Poor supervision	Consultant	Low bid offer, low salary for professionals, lack of experience of professionals	[8%]: Time overrun, cost overrun and quality	Engineering estimate, qualified supervisors
Slowness in decision making process	Client and consultant	Long decision making process, resignation of professionals, not the right person at the right position, fear of risk	[10%]: Time overrun, cost overrun	Concise decision making process, the right person at the right position

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Delay in performance of subcontractors	Client	Late material supply, incapacity of MSEs, absence of material supply schedule, absence of strict follow up	[5%]: Time overrun, cost overrun	Strict follow up, capacity building of MSEs, timely material supply
Problem of electric supply	Client	Power interruption, poor quality transformer, late maintenance	[4%]: Time overrun, cost overrun	Continuous electric supply, good quality transformer, immediate maintenance

Note: Percentages in parenthesis indicate estimation of impact shares as per the client respondent.

5.4.2.2.2. Consultant's response –Crown 40/60 project site

According to a Resident Engineer's perception, variations (changes to the work), late design review and approval, late material supply, improper equipment, delayed payments to contractors, delayed payments to suppliers and subcontractors, material price escalation, inaccurate cost estimation, delay in approval of documents and slowness in decision making process are the top ten major causes of delay in Crown 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by the Resident Engineer is presented in Table 5.7. The % impacts of delays were assigned based on the rough estimation of the Resident Engineer.

Table 5.7: Consultant's response –Crown 40/60 project site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Variations (changes to the work)	Client & consultant	Material unavailability, high material cost, client's demand, inaccurate quantity and cost estimation, finance	[8%]:Time overrun & cost overrun	Market study, proper strategy, authorization and responsibility to consultants
Late design review and approval	Client & consultant	Late initiation of design review, lack of qualified and experienced designers, interference of non-professionals from the client, beaurecracy for design approval, slowness in decision making	[9%]:Time overrun, cost overrun, low quality due to demolition	Early initiation of design review, immediate response for design approval, employing qualified designers, non-interference of non-professionals from the client
Late material supply	Client & contractor	Financial shortage, poor procurement management, lack of communication among stakeholders, not forecasting material demand, long material requisition process,	[4%]:Time overrun ,cost overrun, quality problem	Proper material supply management, proper finance allocation, proper forecasting of material demand, proper communication among

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
				stakeholders, shorter material requisition process
Improper equipment	Contractor	Financial incapacity, underestimation of the complexity of the project	[4%]:Time overrun, cost overrun, low quality of work	Price adjustment, proper attention to the project
Delayed payments to contractors	Client, consultant and contractor	Inaccurate payment preparation, late payment checking and approval due to negligence, lack of skill and corruption, client's financial shortage	[6%]:Time overrun & cost overrun	Accurate payment preparation, timely payment checking and approval, proper budget allocation
Delayed payments to suppliers and subcontractors	Client and consultant	Late payment preparation, late payment checking and approval due to negligence, lack of skill and corruption, client's financial shortage	[5%]:Time overrun & cost overrun	timely payment preparation, checking and approval, proper budget allocation
Material price escalation	Force majeure	High demand, low supply, suppliers' incapacity, limited number of suppliers, chain of brokers	[3%]:Time overrun , cost overrun, quality problem	Capacity building of local manufacturers, investment attraction to the material manufacturing, binding

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
				agreement with suppliers
Inaccurate cost estimation	Client and consultant	Improper market study, poor qualification and negligence of professionals, client interference	[4%]:Time overrun ,cost overrun and quality problem	Proper market study, employing qualified cost estimators, non-interference of the client
Delay in approval of documents	Client and consultant	Incapacity of professionals, documentation, lack of references, poor communication, long approval process	[7%]:Time overrun & cost overrun	Employing qualified professionals, proper documentation, shorten approval process
Slowness in decision making process	Client and consultant	Lack of qualification, negligence, corruption, unavailability of proper references, bureaucracy, incomplete documentation	[10%]:Time overrun & cost overrun	Employing qualified professionals, proper references, proper documentation, accountability

Note: Percentages in parenthesis indicate estimation of impact shares as per the consultant respondent.

5.4.2.2.3. Contractor' response –Crown 40/60 project site

According to a Project Manager's perception, late design review and approval, late material supply, delayed payments to contractors, delayed payments to suppliers and subcontractors, ineffective planning and scheduling of project, non-utilization of professional construction, inappropriate organization management, poor supervision, slowness in decision making process and adverse weather condition are the major causes of delay at Crown 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by the Project Manager is presented in Table 5.8. The % impacts of delays were assigned based on the rough estimation of the Project Manager.

Table 5.8: Contractor's response –Crown 40/60 project site

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
Late design review and approval	Client and consultant	Lack of preparation, lack of qualification, lack of confidence, negligence, poor management	[10%]:Time overrun ,cost overrun, quality problem	Early preparation, follow up, experience sharing, responsibility
Late material supply	Client and contractor	Lack of planning, unfair distribution of material due to corruption, inadequate transport facilities, not having enough stock, late material requisition and follow up, limited number of manpower, unskilled manpower	[30%]: Time overrun, cost overrun, quality problem	Preplanning, strong management on material supply, skilled manpower should be assigned, enough number of manpower should be assigned,
Delayed payments to contractors	Client and consultant	Long payment checking and approval process, corruption, lack of qualification, client's finance shortage	[9%]:Time overrun & cost overrun	Concise payment checking and approval process, time limit for payment checking and approval, proper budget forecasting and allocation, proper

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
				financial management,
Delayed payments to suppliers and sub-contractors	Client, consultant and contractor	Lack of financial planning, long payment checking and approval process, corruption, lack of qualification, client's and contractor's finance shortage	[9%]:Time overrun and cost overrun	Concise payment checking and approval process, time limit for payment checking and approval, proper budget forecasting and allocation, proper financial management,
Poor supervision	Consultant	Negligence of professionals, employing less experienced professionals not to pay high, number of professionals assigned	[6%]:Time overrun ,cost overrun and quality problem	Recruiting and employing qualified and interested professionals with attractive salary, strong manpower management
Inappropriate organization management	Contractor, client and consultant	Lack of proper organizational structure, not assigning qualified top managers	[4%]:Time overrun and cost overrun	Establishing proper organizational structure, assigning qualified top managers

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
Ineffective planning and scheduling of project	Client, consultant and contractor	Not giving proper attention and time, lack of experienced and qualified planners, negligence	[10%]:Time overrun and cost overrun	Employing qualified planners, proper follow up,
Non-utilization of professional construction/contractual management	Consultant ,client and contractor	Less salary to less qualified and experienced professionals, Lack of strict follow up from the client	[6%]:Time overrun, cost overrun and quality problem	Employing qualified and experienced professionals, strict follow up from the client
Slowness in decision making process	Client and consultant	Fear of risk, lack of confidence, lack of experience and qualification,	[8%]:Time overrun and cost overrun	Employing qualified professionals,
Adverse weather condition	Force majeure	Rain season	[4%]:Time overrun , cost overrun and quality	Proper planning considering the summer, timely site handover

Note: Percentages in parenthesis indicate estimation of impact shares as per the contractor respondent.

The major causes of delay identified by the respondents of the contractual parties in Crown 40/60 project site were mapped as shown in Figure 5.13 below to illustrate the interrelationship between delays (similarity between responses), and their source(either internal or external). Variations (changes to the work), and improper equipment were the common causes of delay between the client and the consultant. On the other hand, the common cause of delay between the client and the contractor was poor supervision whereas the common cause of delay between the consultant and the contractor was late design review and approval. Late material supply, delayed payments to contractors, delayed payments to suppliers and sub-contractors, and slowness in decision making process were the common causes of delay among the three contractual parties.

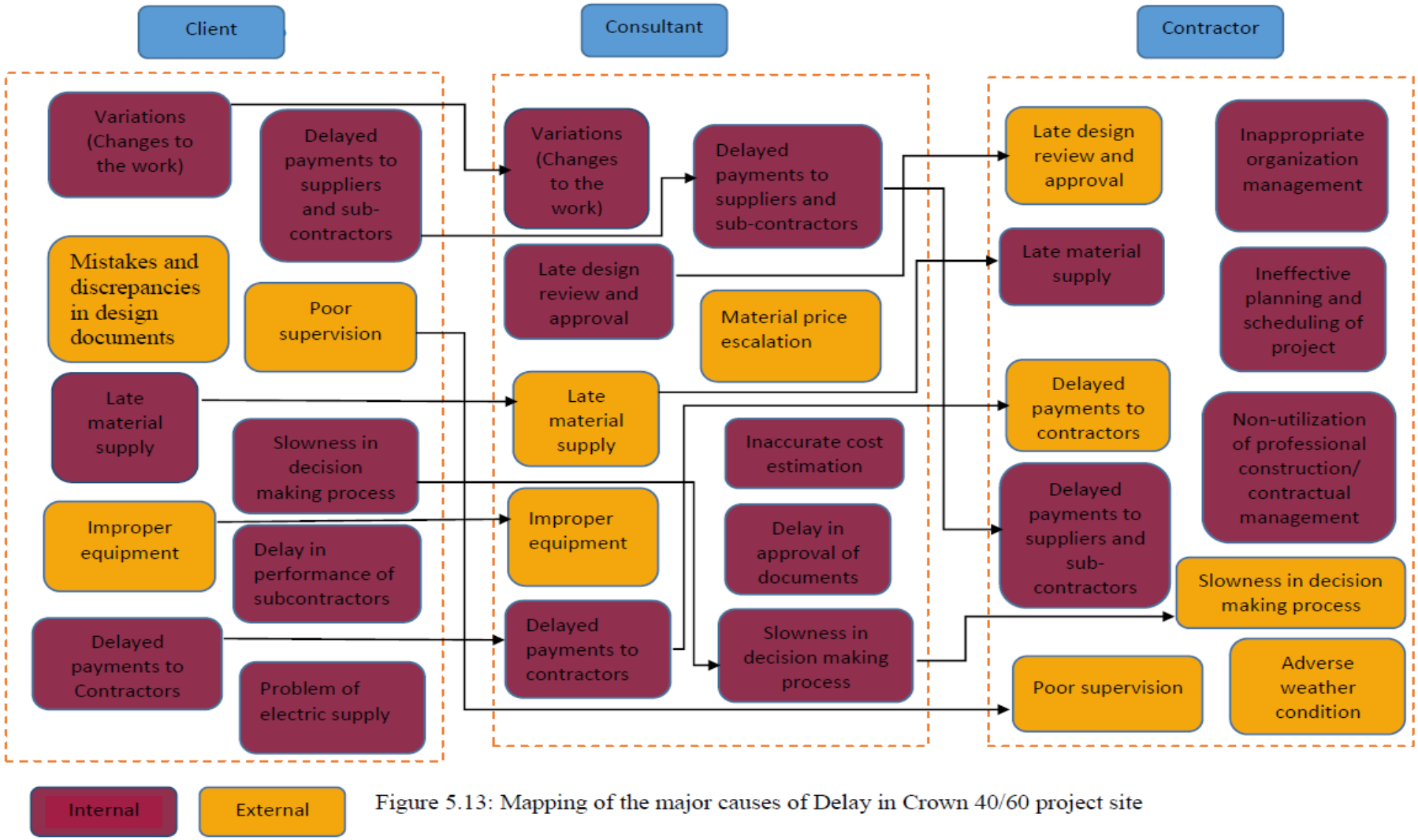

Figure 5.13: Mapping of the major causes of Delay in Crown 40/60 project site

The sources of delay for major causes of delay identified by the respondents of the contractual parties in Crown 40/60 project site were mapped as shown in Figure 5.10 below to illustrate the similarity, and difference between responses ,and their source(either internal or external). Both the client and the consultant agreed that variations was caused by client and consultant, and improper equipment was caused by the contractor. Both the client and the consultant agreed that poor supervision was caused by the client. Both the consultant and the contractor agreed that late design review and approval was caused by the client and the consultant. On the other hand, all the three parties agreed that late material supply was caused by client and contractor, and slowness in decision making process was caused by both client and consultant. However, both client and contractor perceived that delayed payments to contractors was caused by client and consultant whereas the contractor perceived it was caused by all the three parties. Client and consultant agreed that delayed payments to suppliers and sub-contractors was caused by both the client and the consultant while the contractor argued that it was caused by all the three parties.

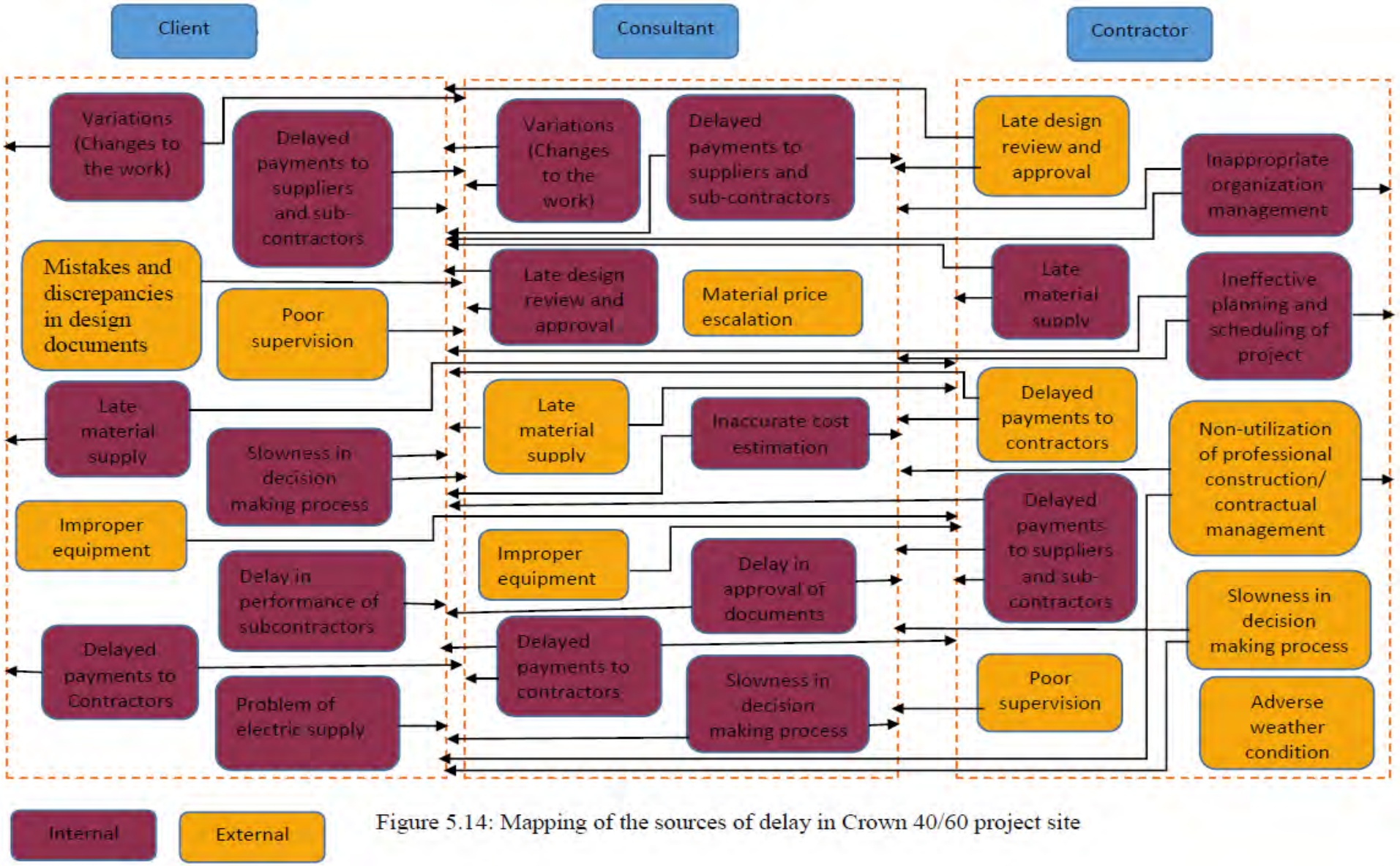

Figure 5.14: Mapping of the sources of delay in Crown 40/60 project site

5.4.3 Case study-3: Asko 40/0 saving houses project site

The third case study was conducted on Asko site. The site is located in Kolfe Keranio sub city within an area of 5.4 hectare. In this project, one class-1 consultant and six grade-1 contractors participated in the construction of thirteen blocks with typology 2B+G+13.Originally,it was designed for 2B+G+12 with 6 household rooms per floor, but after the construction was started, it was changed to 2B+G+13 with 10 household rooms per floor. In the project, totally 286 shops in the ground, first and second floors, and 286 bed type 1, 858 bed type 2, and 286 bed type 3 units from 3rd to 13th floor are included. It is estimated that the project will accommodate 6,006 people. This project was started on November 01, 2013. The total revised labor contract of the thirteen blocks is more than half billion birr and the original contract period of the project is 540 days. Some main construction materials such as cement, reinforcement bars, blocks, precast beams, ceramic and porcelain tiles, sanitary fixtures, electrical fixtures and lift are supplied by the client. Handrails and guardrails are supplied and fixed by MSEs whereas the aluminum doors and windows are supplied and fixed by B&C Aluminum works PLC. The project should have been completed on May 25, 2015 as per the original contract. The project was extended 267 days due to revised contract agreement, whose contract amount was 215% of the original contract amount, and the revised completion date became February 22, 2016. However, the current status (till the end of August, 2016) of the project was still 59.94 % complete, due to many delay factors. The remaining (on progress) works in the project are structural work (near to completion),Block work (on progress),plastering work(on progress),roofing work, water proofing work, finishing work, sanitary installation, electrical installation, site works, etc.

Figure 5.15: Asko 40/60 project site

Figure 5.16 Varied status of the blocks in the Asko 40/60 project site

5.4.3.1 Background information about Interviewees

The case study was conducted on Asko 40/60 saving houses project site through interviewing the three contractual parties currently working on the site. The interview took 2-3 hours per interviewee. The background information of the interviewees is as illustrated in table 5.9.

Table 5.9 Background information about interviewees at Asko 40/60 project site

Type of Organization	Position in the organization	Education level	Years of Experience in Building Construction	Years of Experience in condominium construction	Years of Experience in 40/60 saving houses project
Client	Site coordinator	BSc	6	6	1.5
Consultant	Site Supervisor	BSc	2	1.6	1.6
Contractor	Project Manager	BSc	20	1	1

5.4.3.2 Identification of source of delay, reasons, impacts and solutions

5.4.3.2.1. Client's response –Asko 40/60 project site

According to a Site Coordinator's perception, variations (changes to the work), late material supply, shortage of labors, equipment unavailability, delayed payments to contractors, client's finance shortage, poor site management, inadequate contractor experience, problem of electric supply and problem of water supply were perceived as the major causes of delay in the construction of Asko 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by the site coordinator is thoroughly presented in Table 5.10 below. The % impacts of delays were assigned based on the rough estimation of the Site Coordinator.

Table 5.10: Client's response-Asko 40/60 project site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Variations(Changes to the work)	Consultant and client	Inaccurate quantity estimation, client's need	[10%]:Time overrun, cost overrun	Accurate quantity estimation, proper planning
Late material supply	Client	Poor procurement management, unfair distribution of material due to corruption,	[15%]:Time overrun, cost overrun	Proper procurement management, proper material distribution management
Shortage of labors	Contractor	Distant site location, absence of other construction sites around the project	[5%]:Time overrun, cost overrun and quality	Attractive wage, transport facility, proper management of manpower utilization
Equipment unavailability	Contractor	Financial incapacity of the contractor, underestimation of the project	[15%]:Time overrun, cost overrun and quality	Capacity building of the contractor, strict follow up for the fulfillment of equipment requirement
Delayed payments to contractors	Client	Client's finance shortage due to poor budget forecasting ,long payment checking and approval process,	[5%]:Time overrun, cost overrun	Proper budget forecasting, concise payment checking and approval process

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Client's finance shortage	Client	poor budget forecasting	[5%]:Time overrun, cost overrun	Proper budget forecasting
Poor site management	Contractor	Not fulfilling key personnel, poor contractor's organizational management	[15%]:Time overrun, cost overrun and quality	Fulfilment of key personnel, proper organizational management
Inadequate contractor experience	Client	Improper contractor selection, improper licensing	[10%]:Time overrun, cost overrun and quality	Proper licensing, capacity building of the contractor, Proper contractor selection
Problem of electric supply	Client	Power interruption, late maintenance, poor quality transformer, not giving proper attention to the project	[10%]:Time overrun, cost overrun	Continuous electric power supply, immediate maintenance, good quality transformer, providing stand by generator
Problem of water supply	Client	Water supply interruption	[5%]:Time overrun, cost overrun and quality	Continuous water supply

Note: Percentages in parenthesis indicate estimation of impact shares as per the client respondent.

5.4.3.2.2. Consultant's response –Asko 40/60 project site

According to a Site supervisor's perception, variations (changes to the work), late material supply, scarcity of material in the market , delayed payments to contractors, delayed payments to suppliers and subcontractors, financial difficulties faced by the contractor, poor site management, inadequate contractor experience, non-utilization of professional construction/ contractual management and problem of electric supply are the top ten major causes of delay in Asko 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by the Site Supervisor is presented in Table 5.11.The % impacts of delays were assigned based on the rough estimation of the Site Supervisor.

Table 5.11: Consultant's response –Asko 40/60 project site

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
Variations (changes to the work)	Client & consultant	Lack of experience sharing, lack of qualification of professionals,	[10%]:Time overrun & cost overrun	Experienced professionals, detail site reconnaissance, proper planning, experience sharing
Late material supply	Client	Shortage of transportation, scarcity of material in the market, long procurement process, poor material supply management	[15%]:Time overrun & cost overrun	Qualified professionals, the contractor to transport material, the contractor to supply material,
Scarcity of material in the market	Client	Incapacity of local manufactures, high demand	[12%]:Time overrun, cost overrun	capacity building of local manufacturers , attracting foreign investors especially on re-bar manufacturing
Delayed payments to contractors	Client	client's financial shortage,	[8%]:Time overrun & cost overrun	proper budget forecasting and allocation
Delayed payments to suppliers and subcontractors	Client and contractor	client's financial shortage, contractor's poor financial management	[5%]:Time overrun & cost overrun	proper budget forecasting and allocation, proper contractor's financial management
Financial difficulties faced by the contractor	Contractor and client	Client's finance shortage, Improper contractor's financial	[10%]:Time overrun , cost overrun	Proper budget allocation, proper contractor's financial

Causes of delay	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
		management		management
Poor site management	Client ,consultant and contractor	Lack of experienced professionals, not fulfilling key personnel requirement, not implementing kaizen,	[4%]:Time overrun ,cost overrun	Fulfilling key personnel requirement, implementation of kaizen
Inadequate contractor experience	Client	Corruption in recruiting contractors	[16%]:Time overrun & cost overrun	Secure contractor's selection, serious termination measures
Non-utilization of professional construction/contractual management	Client ,consultant and contractor	Not fulfilling key personnel requirement, lack of proper follow up on fulfillment of key personnel ,lack of decision making	[10%]:Time overrun & cost overrun	Fulfillment of key personnel requirement, proper follow up and measures
Problem of electric supply	Client and contractor	Poor quality transformer, unsafe construction(demolishing formwork),late response from the EEPCo, absence of stand by generators	[4%]:Time overrun & cost overrun	Good quality transformer, safe construction, immediate response from EEPCo, stand by generators

Note: Percentages in parenthesis indicate estimation of impact shares as per the consultant respondent.

5.4.3.2.3. Contractor's response –Asko 40/60 project site

According to a Project Manager's perception, late design review and approval, late material supply, shortage of labors, delayed payments to contractors, poor supervision, poor site management, inaccurate cost estimation, inadequate contractor experience, slowness in decision making process and problem of electric supply are the major causes of delay at Asko 40/60 project site. The source of delay, the reasons, impacts and solutions for identified major causes of delay as responded by a Project Manager and a Site Engineer is presented in table 5.12. The % impacts of delays were assigned based on the rough estimation of the Project Manager.

Table 5.12: Contractor's response –Asko 40/60 project site

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
Late design review and approval	Client and consultant	Late initiation of design review, lack of qualification, slow decision making	[10%]:Time overrun ,cost overrun, quality problem	Early initiation of design review, immediate decision making, qualified designers
Late material supply	Client	Scarcity of material, unorganized material distribution, poor logistic management, long procurement process	[12%]:Time overrun and cost overrun	Proper material distribution management, early procurement, proper logistic management, capacity building of local manufacturers
Shortage of labors	Contractor	Distant site location, unavailability of construction sites around the project	[5%]:Time overrun & cost overrun	Attractive wage, transport facility, labor transfer
Delayed payments to contractors	Client and consultant	client's finance shortage, long payment checking and approval process	[10%]:Time overrun and cost overrun	time limit for payment checking and approval, proper budget forecasting and allocation
Poor supervision	Consultant	Negligence of professionals ,employing less experienced professionals not to pay high, poor	[6%]:Time overrun ,cost overrun and quality problem	qualified professionals with attractive salary, strong manpower management

Causes of delay	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
		manpower management		
Poor site management	Contractor	Poor managerial skill, not fulfilling key personnel requirement, lack of proper follow up from the company owners	[8%]:Time overrun and cost overrun	fulfillment of key personnel, proper follow up from company owners
Inaccurate cost estimation	Consultant	Not considering all cost factors ,lack of qualification, not conducting proper market study	[5%]:Time overrun and cost overrun	Proper cost breakdown, qualified cost estimators, proper market study
Inadequate contractor experience	Client	Corruption during contractor selection	[10%]:Time overrun and cost overrun	Secure contractor selection strategy, capacity building
Slowness in decision making process	Client	Beaurecracy , lack of experience and qualification, fear of risk, lack of proper references	[8%]:Time overrun and cost overrun	Employing qualified professionals, proper references
Problem of electric supply	Client and contractor	Power interruption, unsafe construction (e.g formwork dismantling), late response from EEPCO	[6%]:Time overrun and cost overrun	Immediate response from EEPCo, safe construction

Note: Percentages in parenthesis indicate estimation of impact shares as per the contractor respondent

The major causes of delay identified by the respondents of the contractual parties in Asko 40/60 project site were mapped as shown in Figure 5.17 below to illustrate the interrelationship between delays (similarity between responses), and their source(either internal or external). Variations (changes to the work) was the common cause of delay between the client and the consultant whereas the common cause of delay between the client and the contractor was shortage of labors. Late material supply, delayed payments to contractors, inadequate contractor experience, problem of electric supply, and poor site management were the common causes of delay among the three contractual parties.

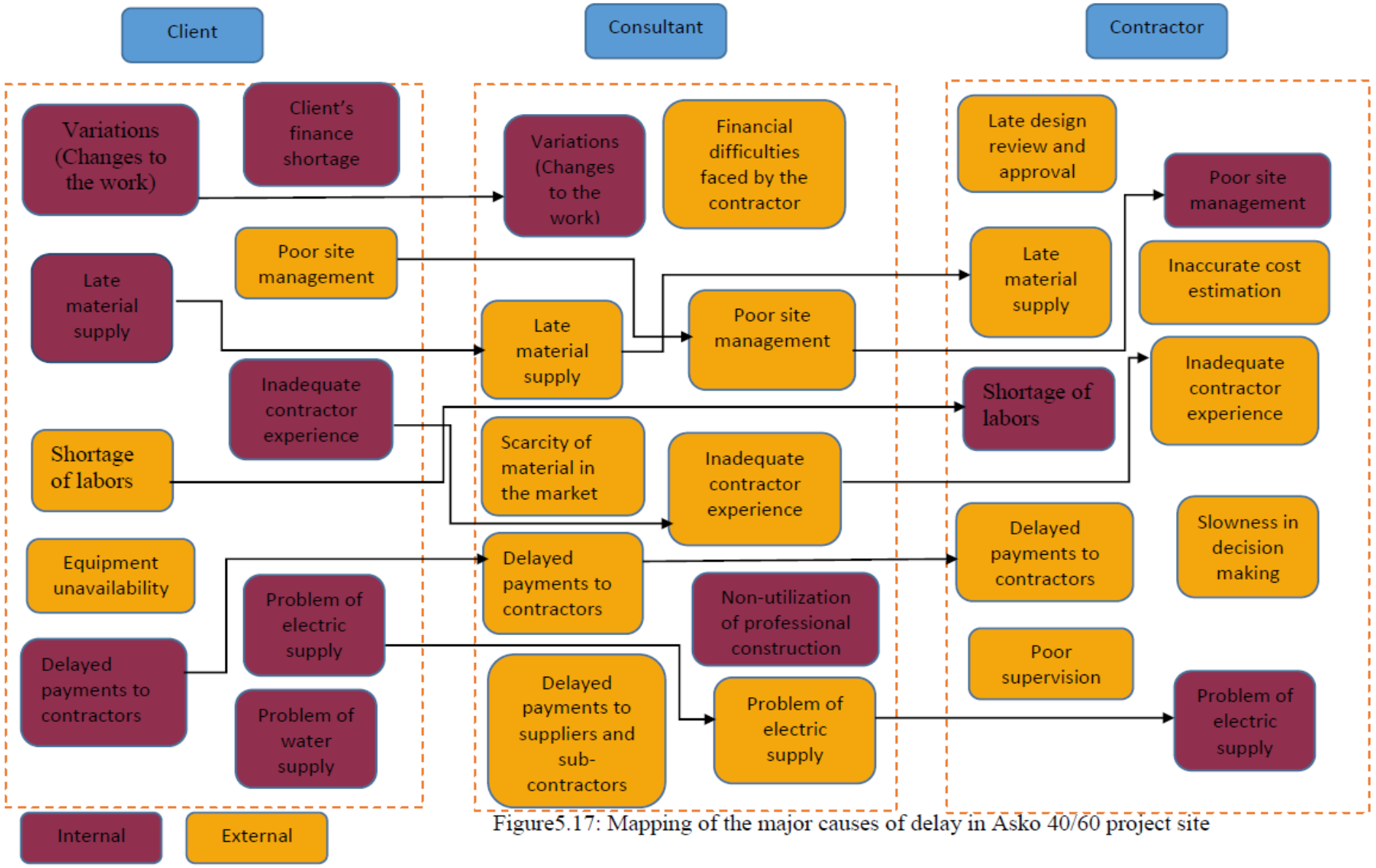

Figure5.17: Mapping of the major causes of delay in Asko 40/60 project site

The sources of delay for major causes of delay identified by the respondents of the contractual parties in Asko 40/60 project site were mapped as shown in Figure 5.18 below to illustrate the similarity, and difference between responses ,and their source(either internal or external). Both the client and the consultant agreed that variations was caused by client and consultant whereas both the client and the contractor agreed that shortage of labors was caused by the contractor. On the other hand, all the three parties agreed that late material supply, and inadequate contractor experience were caused by the client. However, both client and consultant perceived that delayed payments to contractors was caused by client whereas the contractor perceived that it was caused by client and consultant. Both consultant and contractor agreed that problem of electric supply was caused by client and contractor whereas the client perceived that it was caused by client. Both client and contractor agreed that poor site management was caused by contractor whereas the consultant perceived that it was caused by all the three parties.

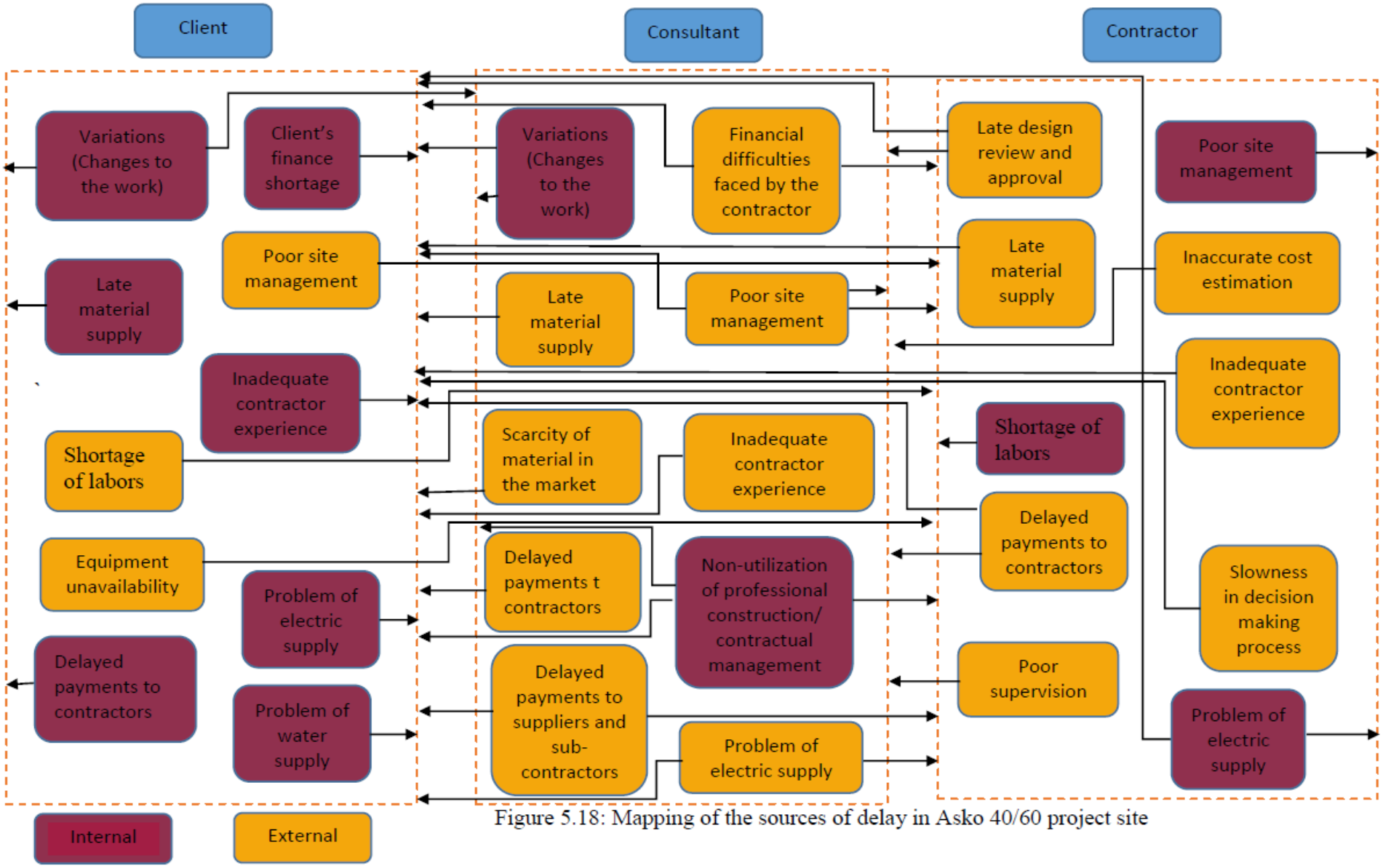

Figure 5.18: Mapping of the sources of delay in Asko 40/60 project site

5.5 Summary

Three case studies in three most delayed 40/60 project sites such as Sengatera, Crown and Asko were conducted to enhance the findings obtained through questionnaire survey. Overall, ten experienced professionals (four from contractors, three from consultants and three from client) participated in the case study interviews. In the case studies, the source of delay, the reasons, the impacts and the solutions for identified major causes of delay were addressed.

Late material supply was caused by the client. The main reasons for the late material supply were client's financial shortage, suppliers 'incapacity, time taking material procurement, approval and requisition processes, unfair distribution of material, shortage of transport facilities, scarcity of material in the market etc. The recommended solutions are proper budget forecasting and allocation, strong material procurement, logistics and distribution management, capacity building of local construction material manufacturers etc.

Secondly, financial difficulties faced by the contractor was caused by both the client and the contractor because of the contractor's poor financial management and delayed payments to contractors. Proper financial management by the contractor, timely payments to contractors and proper budget forecasting and allocation were recommended to solve the problem.

Thirdly, problem of electric supply was caused by both the client and the contractor. The main reasons were power interruption, unsafe construction, late maintenance, poor quality transformer, unavailability of high capacity stand by generators etc. Consistent power supply through integration with EEPCo, immediate maintenance, good quality transformer, safe construction, high capacity standby generators were recommended to address problem of electric supply.

Problem of water supply was caused by client and contractor. Water supply interruption, damaging water supply line, late maintenance were mentioned as reasons for problem of water supply. This problem is solved through consistent water supply, due protection to water supply line and immediate maintenance to damaged water supply line.

Equipment unavailability was caused by the contractor. The main reasons for it were financial incapacity of the contractor and underestimation of the project by the contractor. To solve the equipment unavailability, the contractor should fulfill the equipment requirement as per the contract and there should be strict follow up from the client and the consultant.

Delayed payments to contractors was caused by both the consultant and the client. The main reasons were client's finance shortage, lack of skill and corruption, long payment checking and approval process, absence of master takeoff etc. Concise payment checking and approval process, implementation of time limit for payment checking and approval process, proper budget forecasting and allocation, and master takeoff were recommended as solutions.

Poor site management was caused by the contractors due to not fulfilling the key personnel requirement by the contractor, ineffective planning and scheduling of the project, poor contractor's organizational management, lack of proper follow up from company owners, not implementing kaizen management strategy etc. The recommended solutions for the poor site management were fulfilling of the key personnel requirement by the contractor, proper planning and scheduling, proper organizational management, implementation of kaizen etc

Ineffective planning and scheduling of the project was caused by client, consultant and contractor. The main reasons were not giving due attention to planning and scheduling of project, lack of qualified and experienced planners, poor follow up on the implementation of plans and schedules. The recommended solutions are proper attention to planning and scheduling, employing qualified and experienced planners, and proper follow up on the implementation.

Late design review and approval was caused by both the client and the consultants. Late initiation of design review, slow decision making for design approval, resignation of professionals, lack of integration between the client and the consultant, lack of experience sharing etc. Integration between the client and the consultant, early initiation of design review, immediate response for design approval, qualified and experienced designers, experience sharing etc. were the recommended solutions for late design review and approval

Slowness in decision making process was caused by both the consultant and the client because of lack of integration between client and consultant, not the right person at the right position, incomplete documentation, unavailability of proper reference etc. Strong integration between client and consultant, the right person at the right position, proper documentation, proper references etc. were recommended as solutions.

The impacts of the major causes of delay were time overrun and cost overrun to the client and the contractor. Thus, all the parties should strive to minimize the major causes of delay.

CHAPTER-6: CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The main objective of this research was to identify the major causes of delay in the construction of 40/60 saving houses project in Addis Ababa. Questionnaire survey was conducted to identify the major causes of delay from client's, consultants' and contractors' viewpoint. The summary of the findings is discussed as follows:

- The ten major causes of delay in the construction of 40/60 saving houses project 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.
- The questionnaire analysis results showed that late material supply, problem of electric supply, and problem of water supply were caused and taken responsibility by the client and they were excusable compensable delays. On the other hand, financial difficulties faced by the contractor, equipment unavailability and poor site management were caused and taken responsibility by the contractor and they were non-excusable delays. Delayed payments to contractors, late design review and approval, and slowness in decision making process were caused by both client and consultant, but the client was responsible and hence these causes of delay were excusable compensable delays, and lastly ineffective planning and scheduling was caused by all the three parties, but taken responsibility by both the client and the contractors, and thus it was excusable non-compensable delay.
- The case study results showed that late material supply was caused by the client due to financial shortage, time taking procurement process, unfair distribution of material, shortage of transport facilities, scarcity of material in the market etc. On the other hand, financial difficulty faced by the contractor was caused by the contractors and the client due to improper financial management by the contractors, and delayed payments to contractors due to client's finance shortage and late payment checking and approval. Moreover, problem of electric supply was caused by the client, and the contractors due to frequent power interruption, late maintenance, unsafe construction, and unavailability of generators etc.

- All the major causes of delay resulted in time overrun and cost overrun to the client, and the contractor.

6.2 RECOMMENDATIONS

6.2.1 Recommendations for minimizing the major causes of delay

1. **Late material supply**
    - The client should apply proper material procurement, logistics and distribution management.
    - The government should capacitate local construction material manufacturers
    - The client should shorten material requisition and material approval process.
    - The client should have proper forecasting of material demand.
    - The client should have proper budget allocation.
2. **Financial difficulties faced by the contractor**
    - The contractor should have proper financial management
    - The client should pay payments to contractors timely
3. **Problem of electric supply**
    - The client should ensure continual power supply by integration with EEPCO.
    - The contractors should have safe construction so as not to damage electric lines.
    - The contractors should have high capacity stand by generators at project site
4. **Problem of water supply**
    - The client should ensure continual water supply by integration with AAWSA.
    - The contractors should apply safe construction not to damage water supply lines.
5. **Equipment unavailability**
    - The contractor should fulfill equipment requirement as per the contract.
    - The client should strictly follow up the fulfillment of equipment requirement.
6. **Delayed payments to contractors**
    - The client should apply concise payment checking and approval process.
    - The client should accurately forecast and allocate budget periodically.
    - The consultant should prepare master takeoff.

7. **Poor site management**
    - The contractors and the consultants should fulfill the key personnel requirement.
    - All the three parties should employ qualified and experienced professionals.
    - All the three parties should have proper planning and scheduling.
    - All the three parties should implement kaizen management strategy.
8. **Ineffective planning and scheduling of project**
    - All the three parties should pay attention to planning and scheduling of project.
    - All the three parties should assign qualified and experienced planners.
    - All the three parties should follow up the implementation of plans and schedules.
9. **Late design review and approval**
    - The consultant should assign qualified designers.
    - There should be strong integration between the client and the consultant.
    - The client and the consultant should initiate design review early.
    - The consultant and the client should have experience sharing.
    - The client should approve design review timely.
10. **Slowness in decision making process**
    - The client and the consultant should have concise decision making process.
    - The client and the consultant should assign the right person at the right position.
    - The client and the consultant should have proper references and documentation.

Most importantly, all contractual parties in the project should integrate their endeavors to ensure timely delivery of houses tand sustainability of the housing program, and reduce time overrun and cost overrun to both the client and the contractor.

6.2.2 Recommendations for further studies

This research concentrated on identifying the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa.

Further study is recommended for investigation of the impacts of the delay in the construction of 40/60 saving houses project by applying delay analysis and cost analysis methods and study applicable remedial systems to the major causes of delay.

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Appendices

Appendix I- Interview

Dear Interviewee

At present, I am working on a research entitled Identification of The Major Causes to the Delay in the construction of 40/60 Saving Houses Project in Addis Ababa for the partial fulfillment of the requirements for the degree of Master of Science (MSc) in Construction Technology and Management at Addis Ababa University, Institute of Technology.

Construction delay is the most frequently occurring phenomenon in the construction industry. Currently, it is known that the 40/60 saving houses project has delayed due to various reasons, though housing problem remains a big concern in Addis Ababa. The main objective of this research is to identify the major causes to the delay in the 40/60 scheme project .To meet this research objective, it is necessary to have the contribution of contractors, client and consultants currently working on the scheme project and hence you are one of the stakeholders recruited to conduct this interview. The aim of this interview is to verify causes of delays obtained from various literatures to the context of 40/60 scheme project and propose additional causes if any. Your voice will be recorded to supplement the note taken during the interview. I confirm that your response will be kept confidential and will be used only for the purpose of this research

Thank you very much for your cooperation!

Researcher- Endale Mamuye

Advisor: - Dr. Abraham Assefa

Background Information about interviewee

1. What is the Name of the Project Site?

   ---

2. What is your education level?

   Diploma ☐ BSC ☐ MSC ☐ PHD ☐

3. What is the type of organization you are working in now?

   Client ☐ Consultant ☐ Contractor ☐

4. What is your position in the organization?

   ---

5. What is your work experience in Building Construction?

   ---

6. What is your work experience in condominium housing construction?

   ---

7. What is your work experience in 40/60 saving houses project?

Please Check validity by ticking [√] for valid causes of delays or [×] for invalid causes of delays to the context of 40/60 scheme project and propose additional causes if any. In addition, you can give any comments.

Category of causes of delays	**Main causes of delays**	**Validity [√] or [×]**
1.Design /Changes-related	Change order	
	Changes in drawings	
	Changes in specifications	
	Incomplete contract documents	
	Decision during development stage	
	Design Development	
	Shop drawings approval	
	Mistakes and discrepancies in design documents	
	Change in subsurface conditions	
	Change in the scope of the project	
	Variations	
Additional causes if any		
2. Material-related	Quality of material	
	Late material supply	
	Scarcity of material in the market	
Additional causes if any		
3. Labor-related	Shortage of labors	

Category of causes of delays	Main causes of delays	Validity [√] or [×]
	Low productivity level of labors	
	Low skills of labor	
Additional causes if any		
4. Equipment-related	Improper equipment	
	Equipment unavailability	
	Equipment Failure	
Additional causes if any		
5. Finance/Economy-related	Delayed payments to contractors	
	Delayed payments to suppliers and subcontractors	
	Client's finance shortage	
	Financial difficulties faced by the contractor	
	Difficulty in accessing credit	
	Ill-financed project	
	Fluctuation of prices/rising cost of materials	
Additional causes if any		

Category of causes of delays	Main causes of delays	Validity [√] or [×]
6. Management/Administrative	Organizational changes	
	Old technology	
	Poor supervision	
	Poor site management	
	Mistakes in construction	
	Unrealistic contract duration	
	Inaccurate cost estimation	
	Not Preparing the method statements	
	Inappropriate organization management	
	Less emphasis to planning	
	Ineffective planning and scheduling of project	
	Inadequate contractor experience	
	Inadequate consultant experience	
	Underestimation of the complexity of the project	
	Many Provisional Sums and Prime	
Additional causes if any		
7. Contractual-relations	Non utilization of professional construction/Contractual management	
	Delay in delivering site project to contractor	
	Delay in approval of documents	
	Unsmooth internal and external communications	
	Lack of communication between parties	
	Slowness in giving instruction	
	Slowness in decision making process	

Category of causes of delays	Main causes of delays	Validity [√] or [×]
	Duration of inspection procedure	
	Nomination of sub-contractors and suppliers	
	Delay in performance of subcontractors	
	Problems with subcontractors	
Additional causes if any		
8. External	Regulatory changes	
	Laws – regulations	
	Building Permits Approval	
	Adverse weather condition	
	Natural disasters	
Additional causes if any		

Please give your comments

Thank you very much for your time and cooperation!

Appendix II-Questionnaire

Dear Participant

At present, I am working on a research entitled Identification of The Major Causes to the Delay in the construction of 40/60 Saving Houses Project in Addis Ababa for the partial fulfillment of the requirements for the degree of Master of Science (MSc) in Construction Technology and Management at Addis Ababa University, Institute of Technology. The main objective of this research is to identify the major causes to the delay in the 40/60 scheme project .To meet this research objective, it is necessary to have the response of contractors, client and consultants currently working on the scheme project and hence you are one of the stakeholders recruited to respond this questionnaire. Accuracy in answering the questions included in the questionnaire is necessary to have reliable output of the data analysis. Moreover, your immediate response helps to finish the research timely. I confirm that your response will be kept confidential and will be used only for the purpose of this research

Looking forward to your soonest response,

With Regards,

Endale Mamuye

Advisor: - Dr. Abraham Assefa

If you have any question or look for clarification on the questionnaire, please contact me on Tel:-09-27-94-12-60 or E-mail:-endale.mam@gmail.com

Introduction

Construction delay means the time overrun beyond a project completion date specified in a contract or the time overrun beyond a project delivery date that the contractual parties agreed upon. The delay or time overrun results in cost overrun to both contractor and client.

Force majeure means an unforeseeable occurrence beyond the control or without the fault of the client, the contractor or the consultant which absolutely prevents the contractor from performing his obligations.

Objective

The main objective of this research is to identify the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa.

Instruction

Please answer the questions as accurately as possible and honestly.

Your immediate response is highly appreciable!

Background Information about participants

1. What is the Name of the Project Site?

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2. What is your education level?

   Diploma ☐ BSC ☐ MSC ☐ PHD ☐

3. What is the type of organization you are working in now?

   Client ☐ Consultant ☐ Contractor ☐

4. What is your position in the organization?

   ---

5. What is your work experience in Building Construction?

   ---

6. What is your work experience in condominium housing construction?

   ---

7. What is your work experience in 40/60 saving houses project?

Question: Which of the following are the major causes to the delay in the construction of 40/60 saving houses project? Please rate the importance of delay cause and identify the source of delay to the cause by circling the appropriate one.

N.B:-You can add and rate important causes of delay in the blank spaces provided in the table.

Causes of delay	**Scale of Importance** 0-Not important, 1-Slightly Important, 2- Moderately Important, 3- Very Important, 4-Extremely Important					**Source of delay** CL=Client, CT=Contractor CS=Consultant CL& CS=Client & Consultant CL&CT=Client & Contractor, CT&CS=Contractor & Consultant CL,CS & CT=Client, Consultant & Contractor FM=Force Majeure							
1.Design /Changes-related													
Variations (Changes to the work)	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Incomplete contract documents	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Late Design Review & approval	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Mistakes & discrepancies in design documents	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

2. Material-related													
Quality of material	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL & CS**	**CL& CT**	**CT&CS**	**CL,CS& CT**	**FM**
Late material supply	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL & CS**	**CL& CT**	**CT&CS**	**CL,CS& CT**	**FM**
Scarcity of material in the market	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
3. Labor-related													
Shortage of labors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Low productivity level of labors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

Accidents to Labors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Disputes of Labors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Non-Attendance of Labors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
4. Equipment-related													
Improper equipment	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Equipment unavailability	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Equipment Failure	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

5. Finance/Economy-related													
Delayed payments to contractors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Delayed payments to suppliers and subcontractors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Client's finance shortage	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Financial difficulties faced by the contractor	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Difficulty in accessing credit	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Material Price Escalation	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Labor Price Escalation	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

6. Management/ Administrative													
Organizational changes	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Old technology	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Poor supervision	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Poor site management	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Mistakes in construction	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Inaccurate cost estimation	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Inappropriate organization management	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Ineffective planning and scheduling of project	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Inadequate contractor experience	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

Inadequate consultant experience	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Underestimation of the complexity of the project	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
7. Contractual-relations													
Non utilization of professional construction/Contractual management	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Delay in delivering site project to contractor	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Delay in approval of documents	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Lack of communication between parties	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

Slowness in decision making process	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Nomination of sub-contractors and suppliers	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Delay in performance of subcontractors	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
8. External													
Laws - regulations	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Adverse weather condition	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
9.Infrastracture - related													

Problem of Electric supply	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Problem of Water supply	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**
Problem of Access Road	**0**	**1**	**2**	**3**	**4**	**CL**	**CT**	**CS**	**CL&CS**	**CL&CT**	**CT&CS**	**CL,CS&CT**	**FM**

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION!

Appendix III- Case Study: Interview

Dear Interviewee

At present, I am working on a research titled "Identification of the Major Causes to the Delay in the construction of 40/60 Saving Houses Project in Addis Ababa" for the partial fulfillment of the requirements for the degree of Master of Science (MSc) in Construction Technology and Management at Addis Ababa University, Addis Ababa Institute of Technology. The main objective of this research is to identify the major causes to the delay in the 40/60 scheme project. To meet this research objective, it is necessary to have the response of contractors, client and consultants currently working on the scheme project and hence you are one of the stakeholders recruited to respond this interview. In fact, I conducted questionnaire survey on all 40/60 project sites and came up with findings. The top ten causes of delay are identified through the questionnaire survey. Now, I need to gather detailed information about these causes of delay to enhance the research findings through case study on selected three project sites such as Sengatera, Crown and Asko as they are the most delayed projects. I confirm that your response will be kept confidential and will be used only for the purpose of this research.

With Regards,

Endale Mamuye

Advisor: - Dr. Abraham Assefa

Thank you very much for your cooperation!

Introduction

Construction delay means the time overrun beyond a project completion date specified in a contract or the time overrun beyond a project delivery date that the contractual parties agreed upon. The delay or time overrun results in cost overrun to both contractor and client.

Force majeure means an unforeseeable occurrence beyond the control or without the fault of the client, the contractor or the consultant which absolutely prevents the contractor from performing his obligations.

Objective

The main objective of this research is to identify the major causes to the delay in the construction of 40/60 saving houses project in Addis Ababa.

Instruction

Please answer the questions as accurately as possible and honestly.

Your immediate response is highly appreciable!

Thank you very much for your cooperation!

Part 1. Background information about the interviewee

1.1 What is the Name of the Project Site?

1.2 What is your education level?

Diploma ☐ BSC ☐ MSC ☐ PhD ☐

1.3 What is the type of organization you are working in now?

Client ☐ Consultant ☐ Contractor ☐

1.4 What is your position in the organization?

1.5 What is your work experience in Building Construction?

1.6 What is your work experience in condominium housing construction?

1.7 What is your experience in 40/60 saving houses project?

Part 2. Background information about the project

2.1 What is the total cost of the project? ----------

2.2 When was it started? ----------

2.3 What is the contract period? ----------

2.4 What is the current status (in %) of the project? ----------

2.5 What is the planned status (in %) of the project? ----------

2.6 How many contractors participated? ----------

2.7 What is the class and grade of consultant and contractors respectively? ----------

2.8 What are the typologies of the blocks? ----------

2.9 How many blocks are being constructed? ----------

2.10 How many houses are there in bed types? ----------

2.11 By how much is the project delayed? ----------

2.12 Have you got any approved claims (extension of time, escalation etc.)? ----------

2.13 What is the delay analysis method you used? ----------

Part 3. Which of the following are the major causes to the delay in the construction of 40/60 saving houses project? Please identify the existence of the following causes of delay in your project and then respond on the source of delay, reasons for the causes of delay, specify related impacts and recommend solutions for only the identified top ten causes of delay as per your experience on the project.

N.B:-You can add a cause of delay that you perceive is not included in the list below in the blank rows given in the table and respond related questions.

Causes of delay	**Check (Yes/No)**	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
1.Design /Changes-related					
1.1 Variations(Changes to the work)					
1.2 Incomplete contract documents					
1.3 Late Design Review & approval					
1.4 Mistakes & discrepancies in design documents					

Causes of delay	**Check (Yes/No)**	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
2. Material-related					
2.1 Quality of material					
2.2 Late material supply					
2.3 Scarcity of material in the market					

Causes of delay	Check (Yes/No)	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
3. Labor-related					
3.1 Shortage of labors					
3.2 Low productivity level of labors					
3.3 Accidents to Labors					
3.4 Disputes of Labors					
3.5 Non-Attendance of Labors					

Causes of delay	**Check (Yes/No)**	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
4. Equipment-related					
4.1 Improper equipment					
4.2 Equipment unavailability					
4.3 Equipment Failure					

Causes of delay	Check (Yes/No)	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
5. Finance/Economy-related					
5.1 Delayed payments to contractors					
5.2 Delayed payments to suppliers and subcontractors					
5.3 Client's finance shortage					
5.4 Financial difficulties faced by the contractor					
5.5 Difficulty in accessing credit					
5.6 Material Price Escalation					

Causes of delay	**Check (Yes/No)**	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
5.7 Labor Price Escalation					
6. Management/Administrative					
6.1 Organizational changes					
6.2 Old technology					
6.3 Poor supervision					

Causes of delay	Check (Yes/No)	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
6.4 Poor site management					
6.5 Mistakes in construction					
6.6 Inaccurate cost estimation					
6.7 Inappropriate organization management					
6.8 Ineffective planning and scheduling of project					
6.9 Inadequate contractor experience					
6.10 Inadequate consultant experience					

Causes of delay	**Check (Yes/No)**	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
6.11 Underestimation of the complexity of the project					
7. Contractual-relations					
7.1 Non utilization of professional construction/Contractual management					
7.2 Delay in delivering site project to contractor					

Causes of delay	Check (Yes/No)	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
7.3 Delay in approval of documents					
7.4 Lack of communication between parties					
7.5 Slowness in decision making process					
7.6 Nomination of sub-contractors and suppliers					
7.7 Delay in performance of subcontractors					

Causes of delay	**Check (Yes/No)**	**Source of delay**	**Reasons**	**Impacts (Time, Cost, Other)**	**Solutions**
8. External					
8.1 Laws - regulations					
8.2 Adverse weather condition					
9.Infrastracture -related					

Causes of delay	Check (Yes/No)	Source of delay	Reasons	Impacts (Time, Cost, Other)	Solutions
9.1 Problem of Electric supply					
9.2 Problem of Water supply					
9.3 Problem of Access Road					

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION!