ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTEMENT OF MANAGEMENT

CAUSES OF DELAYS OF ALUMINUM FABRICATION AND INSTALLATION IN CONSTRUCTION PROJECTS IN ADDIS ABABA

A Research Project Submitted to the Department of Management in Partial Fulfillment of the Requirement for the Degree of Executive Master of Business Administration

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In Partial Fulfillment of the Requirements for EMBA Degree

Approved by Board of Examiners

Advisor	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
_____	_____	_____
External Examiner	Signature	Date
_____	_____	_____

DECLARATION

I, the undersigned, declare that this research project paper is my original work and prepared under the guidance of my advisor, Dr. Mohamed Seid. All the materials used for the study have been fully acknowledged.

Name of Student	Signature	Date
_____	_____	_____

STATEMENT OF CERTIFICATION

This is to certify that Workineh Lakew has carried out his research work on the topic entitled “CAUSES OF DELAYS OF ALUMINUM FABRICATION AND INSTALLATION IN CONSTRUCTION PROJECTS IN ADDIS ABABA”.

The work is original in nature and is suitable for submission for the award of Executive Master of Business Administration.

Advisor: _____

Signature: _____

Date _____

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This accomplishment would not have been possible without them. Thank you.

Workineh Lakew

ACRONYMS

ERCA: Ethiopian Revenue and Customs Authority

CIF: Cost, Insurance & Freight

MWUD: Ministry of Urban Development & Housing of Ethiopia

CPM: Critical Path Method

UAE: United Arab Emirates

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ABSTRACT

Delays on construction projects are worldwide phenomena. Construction projects delays result in several negative effects like disputes, lawsuits, total dissertation and abandonment. Thus, identifying, ranking and confronting the causes of delay are important.

This paper identifies the causes of delay in aluminum fabrication and installation in construction projects in Addis Ababa. This study revealed a total of 52 causes of delay categorized in 8 major groups.

43 Contractors, 21 Consultants, and 19 Aluminum Fabricators were asked to evaluate the frequency and severity of each cause. Data were analyzed with frequency and importance indices. Agreement of the rankings of importance of the causes between groups was tested.

Findings of the research revealed that about 90% of the contractors and 85% of the consultants experienced a 42% and 52% average delay over original contract period. All groups of respondents attest that Owner induced factors are the most frequent and severe cause of delay. They also share the view that Contractor Related causes are third most important. Consultants distinctly perceive that Project related causes are second most severe, whereas Contractors regard Fabricators related causes as runner-ups. Fabricators hold the view that Material Related causes are second in line. Relative agreement of rank of causes between groups showed a high degree of correlation among the groups of respondents.

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Chapter One:Introduction.

1.1 Background of the study

Aluminum is nowadays an important input for construction, packaging, pharmaceuticals, transport, and engineering industries. Despite multiple applications in different fields, the most common by far are transport 27% and the construction sector 25%. (www.aluminumleader.com)

Thanks to its strength, durability, corrosion resistance and recyclability aluminum has shown a continuous and consistent growth in building constructions over the last 100 years. The average growth of demand for aluminum was of 5-7% across the world.(www.aluminumleader.com)

In Ethiopia in particular, although itwas introduced during the Emperor' s regime(1), the major growth of aluminum applications occurred over the last 25 years. By the year 1993 there was only one fabricators of aluminum (www.pasquagiuseppe.com)but there are now over hundred fabricators of different type and capacity. (Addis Ababa Chamber of Commerce directory, and different yellow pages).The Central Statistical Agency of Ethiopia does not have yearly production output of aluminum frames across Ethiopia. However the Ethiopian Customs Authority has recorded total aluminum import of the country for several years. According to the data gathered by ERCA, Ethiopian import of aluminum profiles, pipes and door window and their frames stood at three thousand six hundred twenty seven ton in 2015 having a total CIF value of Birr two hundred forty eight million. In the previous year the recorded import was three thousand one hundred fifty three tons with a CIF value of Birr two hundred thirty nine million. Just fifteen years ago in 2000 import of aluminum stood at eighty-four ton with a CIF value of Birr Two million two hundred sixty. This clearly shows that there is a very high growth of aluminum products consumption in the country.

(1)*Aluminum frames installed at the time are still functioning and visible today, examples include Post office building, Commercial Bank of Ethiopia Addis Ababa Branch Building, Construction and business bank building, Addis Ababa University technology faculty building*)

Aluminum fabricators get aluminum profiles, accessories, gaskets, glass and other input materials directly from abroad or from other importers and manufacture and install doors, windows, partitions, curtain walls, handrails and wall claddings for the construction industry.

Constructions of buildings generally involve a large number of parties. Main actors involved are owner (client), consultant, contractor and subcontractors. Successful completion of projects requires the integrated effort,contribution, dedication, skill and coordination of the main parties. The Client is the decisive element, i.e. it initiates the whole project. It appoints the Consultant and Contractor and finances the project. Not to mention that it looks into getting the project done on time within budget.

The Consultant is a professional who provides expert advice and should have superior know-how in construction than the owner. It translates the owner' s idea into reality.

The Contractor, on the other hand is an organization or individual that performs the construction. It takes primary responsibility that the building is constructed and signs a contract to do so. Nevertheless the Contractor rarely does all the work. Specialists often referred as Subcontractors, usually perform bits of the works.

A subcontractor is a business or person that is not an employee of the Contractor but does portion of the project works. In building construction subcontractors include Plumbers, Electricians, Mechanical Engineers, and even Plasterers, Tillers etc. Experience reveals that Aluminum fabricators are generally involved in projects as sub contractors.

A variation to this arrangement is made when the client is awarding contract to the various specialists and does not have a general contractor. In this case the client is referred as owner-builder. In such projects aluminum fabricators are directly accountable to the owner builder.

Construction projects in Ethiopia are rarely successful in reaching their objective. (MWUD 2006).Harold Kerzener (2009) defined successful project as those has achieved the project objectives: within time, withincost, at the desired performance/technology level, while utilizing the assigned resources effectively and efficiently, andaccepted by the customer.

Majid (2006) on the other hand considers a construction project as successful when it is completed on time within budget and according to client's specification and satisfaction. Many different authors of project management have listed different points to be fulfilled in

order to classify a project as successful. Nonetheless all authorsstress that time is the most important criteria to be achieved in any successful project.

Delay is though very common in construction projects across the World (Assaf and Al-Hejji 2005). In the United Kingdom the National Audit office (2001) found that seventy percent of government construction project experienced delay. A very known project delayed for over three years in London is the Wembley stadium. Similarly seventy percent of Saudi Arabia construction projects experienced delay. (Assaf and Al-Hejji 2005). Morris et al (1998) based on four thousand construction projects across the world found that projects rarely finish on time. Ethiopia is no exception to construction project delays.(MWUD 2006)

1.2 Statement of the problem

Various factors contributing to project delays have been identified and studied by different authors across the globe. Most researchers have tried to rank these factors in order to determine the most critical ones. However their research showed that the critical factors are different from country to country. For example according to M.Haseeb et al, (2011) from Pakistan, the most frequent cause of delay was found to be inaccurate time estimation. Kumaraswamy, M.M. and Chan, W.M. (1998) conducted research in Hong Kong and found that poor risk management and supervision are the most important causes of delay. Other researchers have also arrived at different conclusion in different countries. Besides Assaf and Al-Hejji (2005) have showed that owners, contractors and consultants do not agree on which of the factors mostly contribute to project delays.

In Ethiopian context SirawYenesew(2006)and Abubeker Jeemal(2015) studied the factors contributing to time overruns on Road Construction Projects under Addis Ababa City administration. FeteneNega 2008 studied cause and effects of cost overruns on public buildings construction projects in Ethiopia. However the researcher has not found any published research on time overruns in building construction in Ethiopian context. Moreover there are no researches that identify causes of delay as originated by subcontractors.

Since the outcome of different studies had come to different conclusion it is then important to make surveys and researches in Ethiopia to understand the factors behind project delays.

This research therefore looks at the causes of delay in projects, and identifies the most crucial ones.

1.3 Research Objective

1.3.1 General Objective

The general objective of this study is to identify the most common and frequent factors that contribute to the delay of aluminum fabrication works in building projects across Addis Ababa

1.3.2Specific Objective

The specific objective of the study is to:

- To identify and rank causes of delay by relative importance and importance index
- To test the importance of causes of delays between each group of parties
- To study the difference in perception of the major parties in the aluminum fabrication projects.
- Based on the findings to recommend possible remedies and course of actions to be followed to prevent and minimize aluminum fabrication and installation delays.

1.4 Research Questions

- What are the main causes of delays in aluminum fabrication and installation in construction projects? Which causes are the most important and most frequent?
- Do the various stakeholders agree on the causesof delay?

1.5 Significance of the Study

Delays can lead to budget overrun, poor quality finishing, bad public relations, litigation, arbitration, disputes and claims and total abandonment of the project. (B.P. Sunjka and U.Jacob .2013)

This Study thereforetries to help in identifying the major sources of delays in aluminum fabrication in building construction projects in a bid to:

1. Assist academicians in broadening the subject and provide a deeper understanding of the critical factors that affect project performance in the Country. This paper is also believed to be amotivator for further research.
2. To give an insight to aluminum fabricators and other subcontractors preparing their future strategies and competitive advantage
3. To help owners and contractors in the selection process of aluminum fabricator by advising them for which qualities to look for, to take early remedies during project implementation phase
4. To showcase important factors for policy makers to consider when crafting policies that are related to the construction industry

1.6 Scope of the Study

- This Study does not try to identify all causes of delay of the whole construction projects but it rather attempts to identify the main causes of delay of aluminum fabrication and installation in construction projects.
- Aluminum fabricators either supply material and labor or supply the required labor and expertise only. This study concentrates only on the first type of arrangement. (i.e. Aluminum fabricator in charge of supply, manufacture and installation)
- Some owners prefer to directly involve in construction activities by awarding bits of the works to various specialists. This paper does not involve in researching such type of arrangements.

1.7 Limitation of the Study

All researches have their own limitations. The followings are limitations encountered during the research:

1. Sample Size: Quantitative analysis results are highly dependent on sample size. Due to limited time available both for the researcher and the tight schedule of the respondents the sample size was limited. (Many questionnaires were either not returned or returned empty). Having a broader sample size would have improved the

reliability of the results. However the researcher has tried its bests and personally met most of the respondents and pursued them to give their feedback

2. Respondents bias:People were very suspicious when asked for information .The researcher had tried to convince respondents not willing to provide authentic and genuine information
3. Lack of available data:Collecting secondary data for this research was difficult. Fabricators and contractors were not willing to present data like initial time estimate and final completion dates in projects where time overrun was evident.
4. Lack of prior research: Although the lack of prior research was a motivator for the researcher, having some more references would have improved the quality of this paper.

1.8 Organization of the paper

The rest five chapters are organized as follows.

Chapter two is a literature review. Literature both theoretical and empirical related to the topic are gathered and discussed in detail.In particulate the literature reviewis concerned in the identification and formulation of causes of delay. Among the different causes that are found on various studies the author select the most appropriate for the subject matter and explains the reasons to do so. The theoretical framework of the whole paper is established on this chapter.

Chapter three is concerned with research design and methodology and discusses the research design, the population, data, variable type and source, the mechanism of data collection, the sample design and the method of data analysis.

Chapter four deals with statistically analyzing the data gathered using the required statistical packages. The results of the analysis are presented, interpreted and discussed.

The last fifth chapter is a conclusion and recommendation chapter.

Chapter Two: Literature Review

2.1 Introduction

The literature reviewstarts with definition and concept of project. It continues by defining project delays and shows the classification of these as presented by different authors. It later presents and discusses the causes of project delays found by various researchers across the globe and at country level. It ends with hypothesis formulation.

2.2 Definition of project, and building project

Cleland, DavidI, &Ireland, Lewis R (2008)in their project management handbook quotes” One cannot review the history of civilization without concluding that projects on scales both small and epic have been central to the continued evolution of society.” However there were no definitions of a project until the beginning of the 20th century. Henry Fayol (1841-1925) in his organizational theory was the first to define projects as: “Temporary organizations for the performance of business processes that are limited in time”. Later advocates of social system theory defined project as social systems. Today there are many definitions of project but all revolve around the following definition given by David Cleland and Ro A:

“Project is a temporary organization of a project-oriented company for the performance of a relatively unique short- to medium-term strategically important business process of medium or large scope”

Lewis (2007), recognized projects as different from standard business operational activities as they are unique in nature and do not involve repetitive process. Every project is different from the others, whereas operational activities often include undertaking repetitive identical processes. Projects have a clearly specified start and end date within which the deliverables must be produced.

Building projects are one type of construction project where the deliverable are buildings.

2.3 Project Delay definition

There arenumber of definitions for delay. The Oxford dictionary defines delay as a period of time by which something is late or postponed. All project have a specified start and end date. So delays can occur. Actually delays are very common in construction projects. Before analyzing delays is better to categorize them. Theodre J. Trauner Jr (2009) categorizes project delays in four:

- Critical or non critical
- Excusable or nonexcusable
- Compensable or non Compensable
- Concurrent and nonconcurrent

2.4 Types of Project Delays

Critical delays and Non critical delays

Activities in a project are classified either as critical or non-critical. AGC contract document handbook definition of Critical activities is: All activities that must start and finish on the planned early start and finish times. Failure of a critical activity to start or finish on the planned date will result in the overall project duration being extended. So Critical delay is delay in activities that will eventually delay the project completion date. Non-critical delays are those, which occur on activities that do not alter the final completion date.

Thus in projects it is essential to distinguish activities in critical and non-critical. There are various methods to do so: The Critical path method (CPM) being the pioneer.

Non Excusable Delays & Excusable Delays

Non-Excusable delays are events that are within the Contractor' s control or that are foreseeable. These include late performance of subcontractors, untimely performance by suppliers, faulty workmanship that needed rework, or even a project specific labor strike. (Theodre J. Trauner Jr .2009))

An excusable delay sometimes called force majoris due to an unforeseeable event beyond the Contractor's or the Subcontractor's control. These are normally listed in contracts. Excusable

delays include General labor strikes, Fires, Floods, Acts of God, Owner-directed changes, Errors and omissions in the plans and specifications, Unusually severe weather, Intervention by outside agencies and lack of action by government bodies, such as building inspection. (Theodre J. Trauner Jr ,2009)

Compensable Delay& Non-Compensable Delays.

A compensable delay is a delay where the Contractor is entitled to a time extension and to additional compensation. Thus only excusable delays can be compensable. A non-compensable delay means that although an excusable delay have occurred, the Contractor is not entitled to any added compensation resulting from the excusable delay.

Whether or not a delay is compensable depends primarily on the terms of the Contract. In most cases, a Contract specifically notes the kinds of delays that are non compensable.(Theodre J. Trauner Jr ,2009)

Concurrent delay & Non concurrent delay

Oxford English dictionary defines concurrent as "Existing, happening or done at the same time". Even if the English meaning is clear concurrent delays in construction are the most discussed between attorney and scheduling experts. (Theodre J. Trauner Jr ,2009)

Concurrent delays are typical situation where more than one factor delays the project at the same time or in overlapping periods of time. (Alaghbari et al 2007).

Concurrent delays are best described by example. Theodre J. Trauner Jr (2009) made the following example:

"If shop drawings and bulk excavation are both on the critical path and predecessors to the start of footing excavation and both predecessors are scheduled to finish on the same day, then both predecessors control the start of footing excavation. If the finish of bulk excavation was delayed 30 days, from June 1 to July 1, due to equipment failures and the finish of formwork shop drawings was delayed 30 days, from June 1 to July 1, due to a redesign, then the Project was concurrently delayed by the shop drawings and bulk excavation.

In this situation, typically the delay to bulk excavation is non-excusable, and the delay to shop drawings is excusable. Most contracts do not specify which delay takes precedence, if any. Assigning 15 days of non-excusable delay to excavation and 15 days of excusable delay to the shop drawings may be one way to apportion the delay. The existing case law in the

jurisdiction of the Project also may offer some explanation as to how this situation has been viewed from a legal perspective. In some jurisdictions, the occurrence of concurrent excusable and non-excusable delays results in the Contractor receiving a time extension but no additional compensation. Obviously, a carefully drafted Contract should address this potential occurrence."

A second situation occurs when there are initially concurrent delays, but one delay ends before the other delay. A third situation occurs when there are two or more critical paths and the delay to one path starts before the delay to the other critical path. (Theodre J. Trauner Jr (2009)

Analyzing concurrent delays and separating excusable and non excusable delay is often very difficult and is many times source of litigation between parties of construction.

2.5 Effects of project delays

Delay problems are cause of disputes, negotiation, lawsuit, total dissertation, litigation and abandonment.(M. Haseeb et.al (2011)). The consequences are different for the different parties. For the owner delay means the loss of income and unavailability of facility. It may also be source to poor quality finishing. For the contractor and fabricator delay means the loss of money due to extra spending on equipment or labor or materials, loss of time, and loss of reputation and bad public relations.

2.6 Causes of project delays

There are various causes of delays in construction projects. Many articles and studies conducted have outlined main causes of project delays. A survey of these articles shows that the causes of delays are different from country to country. Beyond that, reasons for delay vary from project to project and the reasons are different and unique for every project.

Causes of project delays may be attributable to a single party or to different parties. Many of the previous researches have categorized delays based on the accountability.

2.7 Review of Related Studies

1. Assaf SA, Al-Khalil M, Al-Hazmi M. Causes of delays in large building construction projects.

This study was made in 2006 in Saudi Arabia. A survey on time performance of different types of construction projects was conducted to determine the causes of delay and their importance according to each of the project parties, i.e., the owner, consultant and the contractor. The field survey conducted included 23 contractors, 19 consultants, and 15 owners. Seventy-three causes of delay were identified during the research. 76% of the contractors and 56% of the consultants indicated that average of time overrun is between 10% and 30% of the original duration. The most common cause of delay identified by all the three parties is ''change order''. Surveys concluded that 70% of projects experienced time overrun and found that 45 out of 76 projects considered were delayed.

From owner's point of view, the most frequent causes of delay are related to both contractor and labors.Inputs of the contractors indicate that the most frequent causes of delay are related to the owners. Consultants, like owners, assign awarding the lowest bidder as the most frequent factor of delay.

2. B.P. Sunjka and U. Jacob, Significant Causes and Effects of Project delays in the Nigerian Delta

This research was published in 2013. The researchers identified 38 causes of project delays and categorized them into 8 (client related, contractor related, labor and equipment related, material related, consultant related, community related, contractual relationship related and External issues). The researchers managed to get 83 respondents from public, private sector and multinational companies.

Results from the analysis of data showed that the respondents in the Nigerian Delta perceived that the eleven factors listed below were most important causes of project delays

1. Youth unrest, militancy and communal crises
2. Inadequate planning by the contractors
3. Delay or non-payment of compensation to the communities

4. Wrong choice of consultants and contractors by the clients
5. Weather condition; poor contract management by the consultants
6. Late identification and resolution of drawings and specification errors and omissions by the consultants
7. Lack of community buy-in
8. Poor contract management by the consultants
9. Inappropriate design by the consultants
10. Unrealistic contract duration by the clients
11. Poor coordination of subcontractors by the contractors

The result showed that civil unrest was the most important cause of delay.

3. An Investigation into Causes And Effects of Delays IN UAE (OmaymaMotaleb and Mohammed Kishk)

The UAE is one of the biggest spenders on construction. It is projected to spend $329 billion on major projects by 2030. This amount will outstrip that of both Saudi Arabia and Qatar by 2030 (www.gulfbusiness.com). However as this investigation made in 2010 showed, delay is very common in UAE. This study was based on a questionnaire survey that investigated 42 potential delay factors. These were categorized into five sets. (Contractors, consultants, project managers, clients, financial and other unforeseen factors)

Questionnaires were collected from 35 respondents. Typical results have shown that change orders, financial and other client-related factors are the most significant causes of delay. Besides, cost and time overruns are the most significant effects.

4. Causes and Effects of Delays in Large Construction Projects of Pakistan (M. Haseeb, Xinhai-Lu, AneesaBibi, Maloof-ud-Dyian2, WahabRabbani)

This research made in Pakistan in 2011, interview and got feedback from a total of 100 persons representing government officials, private sector, contractors, consultants, and labor. Fourteen factors of delay were used in this research. Result showed that the most important

and highly ranked financial related delay causes in construction industry of Pakistan are delay in payments to supplier and subcontractors,inadequate fund allocation, client’s constraints, client’s financial problems, inflation, and monthly payment problems.

According to the findings of this study Finance and payments by the clients, 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 were the top most factors that cause delay in construction projects in Pakistan.

5. Critical Causes of Delay in Residential ConstructionProjects: Case Study of Central Gujarat Region ofIndia, MeghaDesai , Rajiv Bhatt

This study identifies the causes of delays in residential construction projects of Indian construction industry. Total 59 causes were identified under 9 major groups. Total 50 respondents comprises of 20 developers, 17 contractors and 13 architects participated in this field survey. Results were shows that out of top 10 factors total 5 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, delay in progress payments by owner. Moreover, by both methods labor related factors ranked first while external factor was considered having least effect on delay as it is ranked last. All three parties agreed on that labor related factor was most important while external factor was least important.

6. Related studies made in Ethiopia

Abubeker Jemal made a study on road projects time overrun and cost overrun in 2015. Although road projects are somehow different from building projects, his result showed that factors causing delay are somehow similar to building projects. He found that financing problems (payments) are in the top two factors according to all consultants, contractors and clients. The other most affecting road project delay is the Right of way problem. This of

course cannot be a factor in building construction. Other common top causes include improper planning, change orders, shortage in material, and slow decision-making.

2.8 Summary of Causes of Project Delays as identified by varies studies

The previously presented studies have categorized the causes of delay into various groups. Assaf SA et.al categorized the causes into eight (Project related, Owner related, Contractor related, Consultant related, Designer related, Material related, Equipment related, Labor related and External). Most of the causes of delay identified by the other studies can be categorized into these, howeverB.P. Sunjka and U. Jacob Nigerian Delta study have one more category: Community related. Their study even showed that Youth Unrest (in this category) in the region was the most common cause of project delay.

Project Related causes

These are causes that cannot be attributed to one party. Project related causes usually arise during planning phase before implementation. One of the most common and most important projects delay cause in this category is inaccurate time estimation of contract duration.

Estimating project duration is one of the different tasksin project management. The accuracy of estimates is vital for any project especially at the preliminary stages. These estimates would enable the owner to take the crucial decision of whether to undertake the project at all or not. “ Early project estimates effect the most basic decisions about a project: whether it will be undertaken at all; how large it will be; how elaborate, sophisticated and durable it will be; and how much it will cost.” (Murat Ciraci, DenizAyse Polat,2009).

Project time estimating involves breaking down of project into activities and estimating time for each small activity and later on add the times using different tools available. It is highly dependent on the knowledge management of the estimating entity. This very difficult and cumbersome process may be a source of error. However as mentioned byB.P. Sunjka and U. Jacob political interference may also be a source of inaccurate time estimation.

Table 1: Project Related Causes of Delay according to the five reviewed studies

NB: Numbers indicate the researches as presented in this thesis		1	2	3	4	5
	LIST OF CAUSES	**PROJECT RELATED**				
1	Original contract duration is too short	x	x	x	x	x
2	Legal disputes b/w various parts	x	x		x	x
3	Inadequate definition of substantial completion	x			x	
4	Ineffective delay penalties	x				x
5	Type of construction contract	x				
6	Type of project bidding and award	x				
7	Contract modifications				x	

Owner Related causes

These are causes attributable to owner. The previously presented Saudi Arabian and UAE studies have identified Change Order as the most common owner related cause of project delays. The Pakistan and Indian researches found out that delay in payments is the most significant cause. The Nigerian study finding is that wrong choice of contractor and consultant is the most substantial cause.

Table 2: Owner Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**OWNER RELATED**				
1	Delay in progress payments by owner	x	x	x	x	x
2	Delay to furnish and deliver the site to the contractor by the owner	x				x
3	Change orders by owner during construction	x	x	x	x	x
4	Late in revising and approving design documents by owner	x				x
5	Delay in approving shop drawings and sample materials	x				x
6	Poor communication and coordination by owner and other parties	x	x	x	x	x
7	Slowness in decision making process by owner	x	x	x	x	x
8	Conflicts between joint-ownership of the project	x				
9	Unavailability of incentives for contractor for finishing ahead of schedule	x				x
10	Suspension of work by owner	x				x
11	Insufficient funding		x	x	x	
12	Interference with project performance		x		x	
13	Impractical allocation of resources		x	x	x	
14	Wrong choice of consultants & contractors		x	x		
15	Wrong organizational structure linking to the project		x		x	
16	Lack of capability of client representative			x	x	
17	Inadequate project management assistance			x		
18	Lack of experience of client in construction.			x		
19	Unreasonable constraint to client			x	x	

Contractor Related causes

Contractor related causes are also common in theses studies. Inadequate contractor experience, difficulties by contractor to finance project and inefficient planning were found to be important issues causing delay in UAE, Saudi Arabia, and Nigeria. Poor site management is an issue in Pakistan and India.

Table 3: Contractor Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**CONTRACTOR RELATED**				
1	Difficulties in financing project by contractor	x	x	x	x	x
2	Conflicts in sub-contractors schedule in execution of project	x				x
3	Rework due to errors during construction	x	x		x	x
4	Conflicts b/w contractor and other parties (consultant and owner)	x				
5	Poor site management and supervision by contractor	x	x	x	x	x
6	Poor communication and coordination by contractor with other parties	x	x			x
7	Ineffective planning and scheduling of project by contractor	x	x	x	x	x
8	Improper construction methods implemented by contractor	x	x	x	x	x
9	Delays in sub-contractors work	x			x	
10	Inadequate contractors work	x				x
11	Frequent change of sub-contractors because of their inefficient work	x				
12	Poor qualification of the contractors technical staff	x	x		x	
13	Delay in site mobilization	x				x
14	Inadequate contractor experience.			x	x	
15	Unreliable sub- contractor			x		
16	Inaccurate cost estimating			x	x	
17	Obsolete technology			x	x	
18	Delay payment to supplier/ subcontractor			x	x	
19	Inaccurate time estimation				x	

Consultant Related causes

Table 4: Consultant Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**CONSULTANT RELATED**				
1	Delay in performing inspection and testing by consultant	x	x	x		x
2	Delay in approving major changes in the scope of work by consultant	x				x
3	Inflexibility (rigidity) of consultant	x				x
4	Poor communication/coordination between consultant and other parties	x	x			x
5	Late in reviewing and approving design documents by consultant	x			x	x
6	Conflicts between consultant and design engineer	x				x
7	Inadequate experience of consultant	x		x		x
8	Improper contract packaging/delivery strategy		x			
9	Over inspection		x			
10	Poor contract management		x	x		

Designer Related causes

Table 5: Designer Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**DESIGNER RELATED**				
1	Mistakes and discrepancies in design documents	x	x	x	x	x
2	Delays in producing design documents	x	x	x	x	x
3	Unclear and inadequate details in drawings	x	x	x	x	x
4	Complexity of project design	x			x	x
5	Insufficient data collection and survey before design	x		x	x	x
6	Misunderstanding of owners requirements by design engineer	x				x
7	Inadequate design-team experience	x				
8	Un-use of advanced engineering design software	x				
9	Changes in drawings				x	
10	Quality assurance				x	

Material Related causes

Table 6: Material Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**MATERIAL RELATED**				
1	Shortage of construction materials in market	x	x		x	
2	Changes in material types and specifications during construction	x			x	x
3	Delay in material delivery	x		x	x	x
4	Damage of sorted material while they are needed urgently	x				x
5	Delay in manufacturing special building materials	x				x
6	Late procurement of materials	x				x
7	Late in selection of finishing materials due to availability of many types in market	x			x	x
8	Poor quality of material		x		x	
9	Rise in material prices				x	

Labor Related causes

Table 7:Labor Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**LABOR RELATED**				
1	Shortage of labors	x		x	x	x
2	Unqualified workforce	x	x	x	x	x
3	Nationality of labors	x				
4	Low productivity level of labors	x		x	x	x
5	Personal conflict of labors	x	x			x
6	Slow mobilization of labor			x		
7	Absenteeism			x	x	
8	Strike.			x	x	
9	Low motivation /morale			x	x	
10	Labor injuries				x	

Equipment Related causes

Table 8:Equipmet Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**EQUIPMENT RELATED**				
1	Equipment breakdowns	x	x		x	x
2	Shortage of equipment	x		x	x	x
3	Low level of equipment-operators skill	x				x
4	Low productivity and efficiency of equipment	x			x	x
5	Lack of high-technology mechanical equipment	x		x	x	
6	Allocation problems			x	x	
7	Shortage of equipment parts				x	
8	Improper equipment				x	

External Related causes

Table 9:External Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**EXTERNAL**				
1	Effect of subsurface conditions	x		x	x	x
2	Delay in obtaining permits from municipality	x				x
3	Hot weather effect on construction activities	x	x		x	
4	Rain effect on construction activities	x				x
5	Unavailability of utilities in site (such as, water, electricity, telephone, etc.)	x				x
6	Effect of social and cultural factors	x				x
7	Traffic control and restriction at job site	x				x
8	Accident during construction	x				x
9	Differing site (ground) conditions	x				x
10	Changes in government regulations and laws	x	x		x	x
11	Delay in providing services from utilities (such as water, electricity)	x				x
12	Delay in performing final inspection and certification by a third party	x				x
13	Natural disasters (e.g. floods, lightning strikes)		x		x	
14	Interference by political leaders		x			
15	Problem with neighbors.			x	x	
16	High interest rate			x	x	
17	Inflation/prices fluctuation			x	x	
18	Organizational changes				x	
19	Slow site clearance				x	

Community Related causes

Table 10:Community Related Causes of Delay according to the five reviewed studies

		1	2	3	4	5
	LIST OF CAUSES	**COMMUNITY RELATED**				
1	Lack of community buy-in		x			
2	Delay or non payment of compensation		x			
3	Youth Unrest, militancy and communal crisis				x	

2.9 Summary of Literature review, and selection of causes

Aluminum fabricators are engaged in construction projects either as subcontractor accountable to the prime (general) contractor or as specialists accountable to the owner builder.

Delay in construction is a worldwide problem. Its effects have been discussed. Determining the causes of delay is important. Some of the causes of delay identified from the previous literature are proper to the aluminum fabricators. For the purpose of the study the causes are divided into eight and are hereunder presented.

A	PROJECT RELATED
	LIST OF CAUSES
1	Original contract duration is too short
2	Legal disputes b/w various parts
3	Ineffective delay penalties
4	Type of project bidding and award
5	Poor communication and coordination between parties

The usual type of contract type used for aluminum fabrication is the ad-measurement contract. Lump sum contracts and Design build contracts are not common. So contract type cannot be a cause of delay. The researcher has left out this cause.

B	OWNER RELATED
	LIST OF CAUSES
1	Delay in progress payments by owner
2	Change orders by owner during construction
3	Late in revising and approving design documents, shop drawings, samples by owner , late decision making
4	Unavailability of incentives for fabricator for finishing ahead of schedule
5	Suspension of work by owner
6	Interference with project performance
7	Wrongchoice of consultants & contractors
8	Lack of capability of client representative or experience of client in construction

C	GENERAL (PRIME) CONTRACTOR RELATED
	LIST OF CAUSES
1	Difficulties in financing project by contractor
2	Conflicts in sub-contractors schedule in execution of project and inefficient planning
3	Rework due to errors during RELATED construction
4	Poor site management and supervision by contractor
5	Delay in other subcontractor's work
6	Inaccurate cost and/or time estimating

D	CONSULTANT RELATED
	LIST OF CAUSES
1	Delay in performing inspection and testing by consultant, approving changes and samples
2	Inflexibility (rigidity) of consultant
3	Inadequate experience of consultant
4	Over inspection
5	Unclear details in drawings and frequent changes
6	Insufficient data collection and market survey before design

E	ALUMINUM FABRICATOR RELATED
	LIST OF CAUSES
1	Difficulties in financing project by fabricator
2	Rework due to errors
3	Poor supervision and site management by fabricator
4	Ineffective planning & scheduling
5	Improper construction methods
6	Poor qualification of labor and technical staff
7	Shortage of labor
8	Delay in mobilization
9	Inadequate fabricator work EXPERIENCE
10	Inaccurate cost estimating
11	Obsolete technology, shortage of equipment and tools
12	Inaccurate time estimating
13	Fabricator busy in other work commitments in other projects (Overstretched fabricator)
14	Logistic problems, delay in procurement, slow mobilization of labor

F	MATERIAL RELATED
	LIST OF CAUSES
1	Shortage of materials in market
2	Changes in material types and specifications during construction
3	Poor quality of material
4	Rise in material prices

G	LABOR RELATED
	LIST OF CAUSES
1	Shortage of labor in market
2	Absenteeism, Low motivation /morale
3	Labor injuries

I	EXTERNAL
	LIST OF CAUSES
1	Rain effect on installation activities
2	Unavailability or frequent breakdowns of electricity
3	Changes in government regulations and laws
4	Interference by political leaders
5	Inflation/prices fluctuation
6	Foreign currency shortage

So a total of forty-nine causes of delay have been identified from literature review.

Three causes of delay that have not been mentioned in the reviewed researches have been added. The first is the overstretched aluminum fabricator case. In such cases the fabricator may not be able to match its responsibilities on time, as it is full with many commitments in other projects, and may be a source of delay.

The other extra cause is a logistics. Aluminum fabricators work simultaneously in workshop and at project site. Frequent transportation of finished products, semi finished products, and tools are required for the successful completion of projects. Inability to smoothly run internal logistics may then be a cause for failure to complete projects on time.

The final external related cause that may affect projects performance in Ethiopia is foreign currency shortage.

2.10 Hypothesis

The following hypothesis will be tested in the research:

1. **Hypothesis 1:** Ho= There is no association between the response of the contractors and consultants for causes of delay in aluminum works in construction projects

   H1= There is association between the response of the contractors and consultants for causes of delay in aluminum works in construction projects

2. **Hypothesis 2:**Ho= There is no association between the response of the contractors and aluminum fabricators for causes of delay in aluminum works in construction projects

   H1=There is association between the response of the contractors and aluminum fabricators for causes of delay in aluminum works in construction projects

3. **Hypothesis 3:** Ho= There is no association between the response of the consultants and aluminum fabricators for causes of delay in aluminum works in construction projects

   H1=There is association between the response of the consultants and aluminum fabricators for causes of delay in aluminum works in construction projects

Chapter Three: Research design and Methodology

3.1 Introduction

This chapter describes the methodology of the study. The main themes of this chapter are research strategy, research design and data collection. The objective of this research is to identify the major causes of delay in building projects aluminum fabrication in Addis Ababa and draw possible conclusions and recommendations based on the findings.

3.2 Research strategy

The research strategy follows quantitative approach. This is because quantitative research has the advantage of having different instruments to measure and analyze stakeholder’s perception regarding causes of time overrun in aluminum fabrications.

3.3 Research design

This research is a systematic triangulation of applied, exploratory, and descriptive type. It is applied and exploratory because the research finds whether time overrun exists or not in aluminum projects. It is descriptive because it tried to describe the relevant aspect from various perspectives and compares the result.

The research is conducted in the months of March and April 2016. Respondents were asked for data at one point in time only. Thus this research is cross-sectional.

3.4 Research Instruments

The data of this research have been collected from primary sources. Data generating tool employed is a questionnaire. Developing a reliable and valid questionnaire is central in research.

First, a literature review was conducted through books, and empirical studies. 114 causes of delays for construction projects across the countries represented by the empirical researched were identified. These causes were categorized in eight main groups.

Second, a focus group of two consultants; two contractors and three fabricators were contacted. The list of causes was shown to them and an unstructured interview was made. As the settings in the various countries are different, and the subject of this study is limited to one type of subcontractor only. The causes of delay were discussed and checked for applicability. Many factors that do not affect aluminum fabrications were dropped out. Some were grouped together and three others were added. These three factors, discussed in the literature review, were according to some of the focus group respondent’s important and frequent causes of delay. Later data analysis will cross check if their perception is supported. The output at this stage identified a total of fifty-twofactors of delay.

The questionnaire has three sections. The first section contains general questions that include all closed type questions aiming to categorize respondents based on their role and experience in the construction sector in general and the aluminum segment in particular.

The second and third sections are targeted towards identifying the causes of delays as explained by the literature review. The list of causes is same in both sections. The second section is concerned with the relative importance or severity of the cause whereas section three is engaged in the occurrence or frequency of the factors of delay. Both frequency of occurrence and severity were categorized on a four-point scale. Frequency of occurrence is categorized as follows: always, often, sometimes and rarely (on 4 to 1 point scale). Similarly, degree of severity was categorized as follows: extreme, great, moderate and little (on 4 to l point scale). An open-ended question asking respondents for comments was left at the end of the questionnaire to provide them room to explain their idea.

The questionnaire was designed so that that it is easy to read and respond. It was first disseminated through Google forms. The researcher had hoped that the Google form was convenient for the respondents. However the response rate was very low. Hence a printed version of the form was circulated to the sample group subjects.

To furtherverify the content validity of the questions (respondents not understanding the terminology and layout of the questions) the questionnaire was tested on four respondents. Alterations were carried out, based on their feedback. Special attention was made not to have

leading and loading questions. Test-retest reliability was checked by distributing the questionnairetwo-week apart for three individuals. Results were satisfactory.

3.5 Population of the Study

Target population of this study consists of: General Contractors, Consultants and Aluminum fabricators. The Ethiopian Ministry of Urban development & Housing registers and licenses contractors. Accordingly contractors are categorized as GC, BC and RC. GCs are contractors working on all sort of construction from building, to roads and dams. BCs are contractors having a scope of constructing buildings only, and RC are Road Contractors. The elements of the study are the GCs and BCs. The Registering body further categorized contractors into ten according to their capability. A total of 6288 contractors belonging to the different category are registered in the Ethiopian 2008 calendar. The focus of this research is to find the causes in projects where aluminum is usually used. Hence, this research focused on Grade 1, Grade 2, and Grade 3 contractors. There are a total of 340 grade one, two and three contractors (159, 68 and 113 respectively).

The actual figure of consultants and fabricator was difficult to obtain. Alternative mechanism used was to access the Addis Ababa Chamber of Commerce directory and other yellow pages. This resulted in identifying 82 consulting companies and 109 fabricators.

3.6 Sampling Methods and Sample Size

The two important elements of quantitative research are sampling method and sample size. Patton (2014), states that obtaining an unbiased sample is the main criterion when evaluating the adequacy of a sample. To this end the population frame for the various categories was downloaded from the MWUD website or collected from various sources. Then a systematic sampling method was used. The systematic sampling design involves drawing every “ n_{th}“element in the population starting with a randomly chosen element between 1 and “ n”. (Sekaran, U.Martin,T.,Trafton and Osbern 1980). However response rate was very low. To further increase responses other questionnaires were distributed. Sampling in this case was

convenient sampling. As the contractors were supposed to be homogenous, the samples collected are believed to represent the population.

Sample size is the other most important element of research. Nesbary (2000), proved that the larger the sample size, the greater the probability the sample will reflect the general population. Taro Yamane (1973) formula is used to determine the sample size.

$$n = \frac{N}{1 + N(e^2)}$$

Where:

n= the sample size required,

N= number of people in the population size

e =allowable error (%).

Accordingly sample size of each subgroup was calculated:

Sample size of Contractors = 78

Sample size of Consultants = 19

Sample size of fabricators = 24

Accordingly the questionnaire was distributed to 97 contractors 28 consultants and 31 aluminum fabricators all systematically selected. Response rate was very low for contractors and aluminum fabricators. (18.56% and 22.5% respectively). Some more questionnaires were distributed to convenient contractors and subcontractors. Final respondents, dropping out those with 25% or more questions unfilled were 43 contractors, 21 Consultants and 19 fabricators. Even though contractor's respondents were lower than the required sample size the research was continued. (Sample sizes larger than 30 and less than 500 are appropriate for most research (Sekaran, U.Martin,T.,Trafton and Osbern 1980)

3.7 Data Analysis

The collected data were analyzed through statistical approach.

Importance Index technique:

The importance index of each cause is calculated as a function of both frequency and severity indices:

Importance Index (IMP.I.)(%) = [F.I(%)* S.I. (%)]/100

- *Frequency index* is calculated using the frequency of occurrence

Frequency Index (F.I.) (%) = ∑ a (n/N) * 100/4

Where,

"a" is the constant expressing weighting given to each response for (ranges from 1 rarely to 4 always)

"n" is the frequency of the responses and

"N "is total number of responses.

- *Severity index*: calculated based on the severity as indicated by the participants.

Severity Index (S.I.) (%)= ∑ a (n/N) * 100/4

Where,

"a" is the constant expressing weighting given to each response (ranges from 1 low to 4 extreme)

Spearman Rank Correlation

In order to test the relative agreement between the responses from different groups, the ranks of the calculated severity index corresponding to the causes of delay were analyzed using the Spearman's rank correlation method. Spearman' s rank correlation is a non-parametric test. Non-parametric tests are also referred to as distribution- free tests. These tests have the obvious advantage of not requiring the assumption of normality or the assumption of homogeneity of variance. They compare medians rather than means and, as a result, if the data have one or two outliers, then their influence is negated. (Sadi A. Assaf ,Sadiq Al-Hejji, 2006) The value of Spearman's rank correlation coefficient varies from positive one to negative one. "+1" indicates a perfect positive correlation and "-1" indicates perfect negative

correlation between two variables (Kendall and Gibson , 1990; Kothari , 2004) . A value near "0" means that there is no correlation between the two populations.

The formula for Spearman's correlation is:

$$r_{s=}1 - \{\frac{6\sum d^2}{(n^3 - n)}\}$$

Where:

"r" is the Spearman rank correlation coefficient between the two parties,

"d" is the difference between ranks assigned to variables for each cause,

and"n" is the number of pairs of rank.

Hypothesis Testing

At this point, the sample rank correlation "r_s"is used to make an inference about the population rank correlation coefficient ρ_s. To this end, the following hypotheses is tested:

$$H_o: \rho_s = 0$$

$$H_1 = \rho_s \neq 0$$

Under the assumption that the null hypothesis is true and the population rank-correlation coefficient is 0, the following sampling distribution of "r_s"can be used to conduct the test.

$$\mu_{r_s} = 0$$

$$\sigma_{r_s} = \sqrt{\frac{1}{n-1}}$$

Then "Z" is calculated and "p" value for two-tailed test is read from chart. If the p value is less than the significance level then the null hypothesis is rejected.

Chapter Four: Results and Discussions

4.1 General Characteristics of respondents

The respondents consisted of 43 contractor, 21 consultants and 19 fabricators. 16% of all respondents have more than ten years of experience, 36% have five to ten years of experience and the rest have experience less than five years.

90.7% of the contractors and 85.7% of the consultants have experienced delay in the aluminum fabrication and installation. 76% of the contractors and 81% of the consultants have reported that the delay was critical. The contractors singled out that the average time of delay of aluminum fabrication is about 41.8% from the original contract time. The consultants result showed a 51.2% average delay in aluminum fabrication and installation.

4.2 Ranking of the Causes of Delay

The fifty-two causes of delay were ranked as per the frequency index and importance index. The following tables show the top ten results based on frequency index.

Rankings Based on Frequency Index

TABLE 11: CONTRACTOR' S RANK OF CAUSES AS PER FREQUENCY INDEX

ITEM	DESCRIPTION	Frequency Index	RANK
1	Delay in progress payments by owner	93%	1
2	Delay in other subcontractor's work	82%	2
3	Fabricator busy in other work commitments in other projects (Overstretched fabricator)	78%	3
4	Original contract duration is too short	76%	4
5	Inflation/prices fluctuation	73%	5
6	Change orders by owner during construction	72%	6
7	Difficulties in financing project by fabricator	72%	6
8	Poor supervision and site management by fabricator	72%	6
9	Delay in mobilization by fabricator	72%	6
10	Ineffective planning & scheduling by fabricator	72%	10

TABLE 12: CONSULTANT' S RANK OF CAUSES AS PER FREQUENCY INDEX

ITEM	DESCRIPTION	FI	RANK
1	Conflicts in sub-contractors schedule in execution of project and inefficient planning	81%	1
2	Delay in progress payments by owner	74%	2
3	Change orders by owner during construction	73%	3
4	Original contract duration is too short	71%	4
5	Ineffective planning & scheduling	71%	4
6	Late in revising and approving design documents, shop drawings, samples by owner, late decision making	70%	6
7	Delay in other subcontractor's work	70%	6
8	Poor supervision and site management by fabricator	70%	6
9	Fabricator busy in other work commitments in other projects (Overstretched fabricator)	69%	9
10	Logistic problems, delay in procurement, slow mobilization of labor	69%	9

TABLE 13: FABRICATOR' S RANK OF CAUSES AS PER FREQUENCY INDEX

ITEM	DESCRIPTION	Frequency Index	RANK
1	Delay in progress payments by owner	86%	1
2	Difficulties in financing project by contractor	76%	2
3	Original contract duration is too short	75%	3
4	Conflicts in sub-contractors schedule in execution of project and inefficient planning	75%	3
5	Shortage of labor in market	74%	5
6	Unavailability or frequent breakdowns of electricity	72%	6
7	Foreign currency shortage	71%	7
8	Change orders by owner during construction	70%	8
9	Shortage of materials in market	70%	8
10	Rise in material prices	70%	8

Tables 11,12 & 13 show that three causes are common to the three groups: *Delay in progress payment by owner, Change Order by Owner and Original Contract Duration.* Furthermore Contractors and Consultants share 70% of the top ranked causes of delay. The most frequent cause of delay according to Contractors and Fabricators is the delay in payment by Owners. Nevertheless Consultants showcased inefficient planning as well as conflicts in subcontractor's schedule as the most frequent cause of delay.

TABLE 14: RANKING BY CATEGORY USING FREQUENCY INDEX

ITEM	Category of delay	Contractor's	Consultant's	Fabricator's
1	Project Related	8	6	8
2	Owner Related	1	3	3
3	Contractor Related	4	1	2
4	Consultant Related	3	5	5
5	Fabricator Related	2	2	6
6	Material Related	5	4	4
7	Labor Related	6	8	1
8	External Related	7	7	7

Looking at the categories of delay, Contractor's response indicates that Owner Related Factors are the most frequent. Fabricator related causes come second in the Contractor's frequency rank table. Consultants also put fabricator related causes as second most frequent. However Consultants response suggests that Contractor related factors are the most frequent.Overstretched fabricator cause is the third most frequent factor both in the consultants and fabricator table. Fabricators on the other hand ,put labor related causes as the most frequent, and attribute the Contractors for the second most frequent cause of delay.

Rankings Based on Importance Index

The Importance index as discussed in the previous chapter takes into account both frequency and severity of the causes. It is, thus, a better measure than the frequency. The following tables show the rankings based on this measure.

TABLE 15: CONTRACTOR' S RANK OF CAUSES AS PER IMPORTANCY INDEX

ITEM	DESCRIPTION	Importance Index	RANK
1	Delay in progress payments by owner	78%	1
2	Fabricator busy in other work commitments in other projects (Overstretched fabricator)	65%	2
3	Original contract duration is too short	63%	3
4	Delay in other subcontractor's work	61%	4
5	Difficulties in financing project by fabricator	60%	5
6	Inflation/prices fluctuation	55%	6
7	Change orders by owner during construction	54%	7
8	Shortage of labor	51%	8
9	Late in revising and approving design documents, shop drawings, samples by owner, late decision making	51%	9
10	Lack of capability of client representative or experience of client in construction	50%	10

TABLE 16: CONSULTANT' S RANK OF CAUSES AS PER IMPORTANCY INDEX

ITEM	DESCRIPTION	Importance Index	RANK
1	Delay in progress payments by owner	65%	1
2	Original contract duration is too short	60%	2
3	Fabricator busy in other work commitments in other projects (Overstretched fabricator)	59%	3
4	Change orders by owner during construction	56%	4
5	Rise in material prices	54%	5
6	Delay in other subcontractor's work	54%	6
7	Late in revising and approving design documents, shop drawings, samples by owner, late decision making	52%	7
8	Shortage of labor	51%	8
9	Ineffective planning & scheduling by fabricator	51%	9
10	Inaccurate time estimating	51%	10

TABLE 17: FABRICATOR' S RANK OF CAUSES AS PER IMPORTANCY INDEX

ITEM	DESCRIPTION	Importance Index	RANK
1	Delay in progress payments by owner	74%	1
2	Difficulties in financing project by contractor	65%	2
3	Original contract duration is too short	61%	3
4	Shortage of materials in market	57%	4
5	Rise in material prices	55%	5
6	Change orders by owner during construction	54%	6
7	Difficulties in financing project by fabricator	53%	7
8	Shortage of labor	52%	8
9	Inaccurate cost and/or time estimating by contractor	51%	9
10	Unavailability or frequent breakdowns of electricity	50%	10

Delay in progress payment by owner is the most outstanding cause of delay shared by all groups of respondents. All of the three groupsshare four of the causes in the top ten list. These are *Delay of payment by owners, Initial Contract period too short, Change orders by owners and Shortage of labor.* Contractors and owners share two more in the top ten factors. (*Overstretched fabricator and Delay in other subcontractor's work).*

Looking at the ranking's per category of cause, Contractors, Consultant and Fabricators identified that Owner related causes are the topmost important. Contractor Related Causes are third most important cause of delay. Contractor's indicated that Fabricator Related causes are second important cause, whereas Consultant's attribute responsibility to Contractor's causes. Fabricators have material related causes on their second line.

	TABLE 18: RANKING BY CATEGORY USING IMPORTANCE INDEX			
ITEM	**Category of delay**	**Contractor's**	**Consultant's**	**Fabricator's**
1	Project Related	6	2	8
2	Owner Related	1	1	1
3	Contractor Related	3	3	3
4	Consultant Related	5	7	6
5	Fabricator Related	2	4	5
6	Material Related	4	5	2
7	Labor Related	8	8	4
8	External Related	7	6	7

4.3 Importance Rank Correlation.

Spearman' s rank correlation coefficient is calculated based on the equation shown in Chapter three. It is used to measure the degree of agreement or disagreement associated with the importance ranking of each two parties, while ignoring the ranking of the third party. Calculation was made in excel spreadsheet, and result is as follows.

	Parties	**Spearman's coefficient**
1	Contractor Consultant	0.745
2	Contractor Fabricator	0.586
3	Consultant Fabricator	0.639

TABLE 19: Spearman' s rank correlation coefficient

Table 19 shows that there is a relatively good agreement between all groups. Contractor consultants have the highest agreement of 74.5%, Consultant Fabricator's have 63.9% and Contractor fabricator have 58.6%.

4.4 Hypothesis testing.

To further test the agreement between parties the two tailed hypothesis presented in Chapter one are tested for:

$$H_o: \rho_s = 0$$

$$H_1 = \rho_s \neq 0$$

$\sigma_{r_s} = \sqrt{\frac{1}{n-1}} = \sqrt{\frac{1}{52-1}} = 0.14$, and $\mu_{r_s} = 0$ for all three hypothesis.

$z = \frac{r_s - \mu_{r_s}}{\sigma_{r_s}}$ = 5.32 for hypothesis 1, z=4.19 for hypothesis 2 and z=4.56 for hypothesis 3

Using chart “p” value is calculated for two-tailed test. Since “p” value for all tests is less than 0.05, all three null hypotheses are rejected. Thus weinfer that there is association between the response of the contractors and consultants and fabricators for causes of delay in aluminum works in construction projects

Chapter Five: Conclusion and Recommendation

5.1 Conclusion

This research started by identifying 52 possible causes of delay of aluminum works in construction projects in Addis Ababa. The causes were categorized into eight groups: Project Related, Owner Related, Contractor Related, Consultant Related, Fabricator Related, Material Related, Labor Related and External Related. Respondents consisting of contractors, consultants and fabricators were asked to fill the frequency of occurrence and severity of each cause.

The data collected were analyzed by frequency and importance.Results established that Owner related causes are the most important causes of delay in aluminum projects in Addis Ababa. In fact, all respondents agree that Delay in payments by owner is the most contributing factor of delay.

Consultants indicate that Project related factors are the second most essential causes of delay. Contractors on the other hand hold Fabricator’s as second most cause for the delay. Fabricators pass the second responsibility to material related causes. Contractor related causes are found to be the third most significant cause according to all parties.

Spearman Rho was used to verify the level agreement between parties. Hence finding is that the level of agreement regarding causes of delay is high between contractors, consultants and toalesser degree fabricators. The dependability of this research emanates from the very reason of all group’s relative agreement on the causes of delay.

5.2 General Recommendations

Effects of delay in projects have different consequences for the various parties. For the owner delay is loss of income and unavailability of facility. Nevertheless, the research has found that owner related factors are the most frequent and severe causes of delay. As a result it would be worth considering for Owners to:

- Prepare the finance needed for the project ahead of time. Ask the consultant and contractor for a schedule of payment and be prepared to pay interim payment to the contractor on time.
- Understand clearly the drawings and specification before the implementation phase, in order to minimize change orders during construction.
- Avoid delay in reviewing, approving design and samples
- Avoid giving the project to the least bidder. The Owners should together with the Consultant check the reputation of the Contractor before awarding the Contract.

In a similar fashion, Contractors too loose money, time, and reputation because of delay. Thus Contractors should:

- Prepare a realistic and detailed project schedule before embarking in construction activities. Stick to the schedule and make continuous supervision of subcontractor’s works
- Prepare a cash flow schedule based on the project progress and make payments on time to suppliers and subcontractors
- Avoid giving the subcontracts to overstretched fabricators. Ask for projects at hand report from subcontractors.
- Avoid giving the subcontract to least bidder. Have a list of reputable subcontractors and develop a relationship.

Fabricators also loose their reputation time and money because of delay. Fabricators should:

- Know their capability and avoid receiving projects before they are overstretched.
- Prepare a detailed works schedule of all projects at hand and make continuous supervision.
- Take care in preparing time and cost estimation
- Have a good human resource strategy.

Consultants are the least affected party by delay. In order not to loose their reputation consultants would need to:

- Check thoroughly design documents and specification, and make necessary remedies ahead of constructions schedule.

- Avoid delay in reviewing drawings and approving samples
- Develop a good communication platform for owners, contractors and subcontractors. Conduct and administer scheduled and non-scheduled meetings.
- Check if the initial time estimate is correct and do not overpromise to the client.

5.3 Recommendations for further studies

This study has provided a perspective on the most significant delay causes in aluminum projects in Addis Ababa. Similar studies can be made for the whole construction projects or for a specific type of construction projects,Detail studies can be done to evaluate the different specific causes of delay and their effect.

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Annex 1: Questionnaire