

ADDIS ABABA UNIVERSITY  
SCHOOL OF COMMERCE



Analyzing the Causes and Effect of Road Construction Project  
delay the Case of Rama Construction

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A Thesis Submitted to School of Commerce in Partial Fulfillment of the  
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ADDIS ABABA UNIVERSITY  
SCHOOL OF COMMERCE

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Delay the Case of Rama Construction

BY FIKERTE WONDIMU

Dr. TEMESGEN BELAYNEH

## **DECLARATION**

I, hereby, declare that this research report entitled **Analyzing the Causes and Effect of Road Construction Project Delay the Case of Rama Construction** is my original work and has not been submitted earlier either to this university or elsewhere for an award of any other degree.

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## **DEDICATION**

*I dedicate this research work to my friend Ato Zemenfes G/egziabher and my colleague Ato Amenu Bekele, for their passion, dedication and support.*

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## **ABSTRACT**

*One of the most common problems in the construction project in general and in road construction is delays. Thus the objective of this study is analyzing the causes of road project delay and its effects in case of Rama Construction Company, and the ranking made using relative importance index and its relation using spears man correlation. Delays of a construction project can be defined as the late completion of works as compared to the planned schedule or contract schedule. Project activities are subject to considerable uncertainty which may lead to numerous schedule disruptions. Delays can be minimized only when their cause are identified. This study was carried out based on literature review and a questionnaire survey. A total of forty nine factors that grouped by seven that have contribution to the causes of delay, the six factors that effects delays and fourteen methods of minimizing construction delays were identified based on literature review. The questionnaire survey was distributed to the targeted respondent. The objectives of the study have met it objective. The top ten main causes identified using RII from the respondent selection, that includes improper construction methods implement, low level of equipment-operator's skill, late in revising and approving design documents, late procurement of materials, low productivity and efficiency of equipment, change orders by owner during construction, delay in material delivery, low productivity level of labors, ineffective planning and scheduling of project and delay to furnish and deliver the site. Time overrun, cost overrun and dispute were the common effects of delays in construction projects. To minimize delays in construction projects it has been identified that the first top five methods, use appropriate construction methods, complete and proper design at the right time, proper material procurement, effective strategic planning, and proper project planning and scheduling.*

**Key Words:** Relative Importance Index (RII), Time overrun, cost overrun

## **List of Acronyms**

<b>ERA</b>	ETHIOPIAN ROADS AUTHORITY
<b>RSDP</b>	ROAD SECTOR DEVELOPMENT PROGRAM
<b>ISO</b>	INTERNATIONAL STANDARD ORGANIZATION
<b>ETB</b>	ETHIOPIAN BIRR
<b>GOE</b>	GOVERNMENT OF ETHIOPIA
<b>CPM</b>	CRITICAL PATH METHOD
<b>RI</b>	RELATIVE IMPORTANCE
<b>RII</b>	RELATIVE IMPORTANCE INDEX
<b>C. COF</b>	CORRELATION COEFFICIENT
<b>SIG</b>	SIGNIFICANCE

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## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 BACKGROUND OF THE STUDY**

A client, be it public or private agency, an entrepreneur, or a builder, undertakes development facilities like housing, roads and power plants with certain objective or long term aims. For example, the typical objectives or the strategic aims of a government in developing infrastructure like road may include economic growth (Chitkara, 2000).

The road network of Ethiopia continues to provide the principal mode of freight and passenger transport. The performance of the road sector plays a vital role in growing the economy of the country. Our service sectors and our people rely heavily on the availability and satisfactory performance of our road network and transport services ERA report, (2011).

Recognizing the importance of the road transport in supporting social and economic growth and its role as a catalyst to meet poverty reduction targets, the Government of Ethiopia has placed increased emphasis on improvement of the quality and extent of road infrastructure in the country. To address constraints in the road sector, related to restricted road network coverage and poor condition, the Government formulated the Road Sector Development Program in 1997.

When the Road Sector Development Program (RSDP) commenced in 1997, the challenges facing the road sector were immense. The total road network was only 26,550 km, of which over half was in a poor condition.

It is important to construct roads and provide transport service in order to lower transport costs of inputs and outputs of production. The provision of adequate road transport services is essential for the economic and social development of Ethiopia. Road transport is the dominant mode and accounts for 90 to 95 percent of motorized inter-urban freight and passenger movements. But because of its limited road network, provision of infrastructure has remained one of the formidable challenges for Ethiopia in its endeavor towards socio-economic development and poverty reduction. The government of Ethiopia is increasing its expenditure on infrastructure each year, if we consider the total expenditure of the government on Federal, Regional and Community roads in the year 2007/8, 2008/9, 2009/10 it was 8.4, 11.7 and 14.1 Billion Birr respectively (ERA report, 2011)

In the country economy the involvement of local contractors have significant improvement compared to the past year condition. The domestic construction industry is encouraging. Specifically, participation of the local contracting industry has increased, in terms of both the value and number of projects, over the last thirteen years of the RSDP. Even if their contribution has improvement, their capacity limited to grow their participation in the road construction projects. Because of this Only 9 out of the 27 general contractors have the capacity to carry out road infrastructure projects (Bekele, 2005).

Within the participation of both private sector and government organ in the road network expansion, the accomplishment of the project according to the stated plan could not be performed. Delay of project completion is a major problem in construction that often leads to costly disputes and acrimonious relationship between the parties involved and while it may be unrealistic to believe that all causes of delay can be brought under control, it would be sensible to determine the most important delay factors so that efforts can be made to control these factors Al-khalil and Al-Ghafly, (1999b).

## **1.2 ORGANIZATIONAL PROFILE**

Rama Construction Private Limited Company is A Category - I General Construction Company. The company certified in Integrated System of Quality and Environmental Management System ISO 9001:2008 and ISO 14001:2004. Ethiopia. The Company established in 1995 in Addis Ababa, registered under Ethiopian law.

Ever since its establishment the Company has successfully accomplished different construction works estimated at hundreds of millions of Birr for the Federal Government, Regional Governments and the Private sectors of Ethiopia. Currently the Company is undertaking a number of construction activities in different parts of the country. This company engaged in both building and road construction work.

### 1.3 PROBLEM STATEMENT

The road network of the country in the past five decades, compared to the 1951, has increased with factor seven to reach the level in 2009. In 1951 the total stock of road network was only 6,400 Km; in 2009 it increased to 46,812 Km. In spite of recent growth in the network, the classified road network is one of the least developed in Africa with a density of 38.6 km per thousand square kilometers (ERA report, 2009). From the current length of the network only 5,459 Km (11.7%) is paved with asphalt. This shows prevalence of very big opportunity in the construction business for those who can compete in the industry.

In the recent years the contribution of local contractor is increased compared to the past condition. The domestic construction industry is encouraging. Specifically, participation of the local contracting industry has increased, in terms of both the value and number of projects, over the last thirteen years of the RSDP (Road Sector Development Program). Local contractors are mostly involved on projects financed by the GOE, with contract values averaging ETB 1,640 million for the period from 1997 to June 2010. Local involvement on larger construction contracts is still marginal, although some local contractors are now taking relatively bigger contracts, with values amounting to as much as ETB 825 million. ERA is carrying out a small number of civil works by its own force account, particularly in areas where the private industry is not willing to work. ERA report RSDP, (2011).

Even if the contribution of local contractors is increasing from time to time, there are some problems observed in the accomplishment of the project within the target period. Because of this the improvement of contractors' capacity is important. The condition stated in the ERA report RSDP Performance and Future Plan, (2011). The performance of some contracting companies can also be improved. In some cases contractors can take a much longer time to mobilize than agreed in the contract agreement. After commencement, physical works on some projects have not progressed according to the contract period. As a result, some projects have not been completed within the contractually agreed time frame and project completion costs have been higher than the agreed contract price. According to ERA in most of the time, there is a delay between two up to three years after the end of the contract time. Because of this problem ERA make an agreement to each contractor to include penalty charge in the contract price.

In Ethiopia current construction problems research made and the findings are presented in this way. Contractor is the primary responsible body especially in the case of unjustifiable delays and incurs pressure, even if it is justifiable delay. As per the contractors' response, the top five factors identified to result in delay of construction projects are cash flow problem during construction, mismanagement by the contractors, improper planning slow decision making and late delivery of material and equipment. Zinabu te ze., 2016

Therefore this study focused on analyzing the major cause of delay and indicates its effect; this study adds additional factors to the previous study that contribute to the road construction delay. In addition to this the research helps the company management by giving information about the methods of minimizing construction delay.

#### **1.4 RESEARCH QUESTION**

- What are the major causes of delay for construction project?
- Is the data available to differentiate delay problems and analyze them
- What are the most causes that have direct relation to the effect
- Is identifying and rank the methods of minimizing construction delays.

#### **1.5 OBJECTIVE OF THE STUDY**

##### **General objective of the study**

The general objective of this study is analyzing the causes of road project delay and its effects in case of Rama Construction.

##### **Specific objective**

1. To identify the major causes of delays.
2. To analyze different delay problems with their effect
3. To identify the methods of minimizing construction delays..

### **1.6 SIGNIFICANCE OF THE STUDY**

In the recent year the expansion of road network is significant. Analyzing cause and effect of construction delay is the current issue. Conducting a study in this topic helps the Rama construction by giving important information and providing the methods of minimizing the delay factors. Besides, this information can assist Ethiopian Roads Authority to take remedial action and it can also be used as input for further research.

### **1.7 SCOPE LIMITATION OF THE STUDY**

This study focused on delay factors in Rama road contraction considering three types of delays i.e. excusable and non excusable, compensable and non compensable and concurrent delay with responsible bodies are tested to analyze causes of delay.

### **1.8 LIMITATION OF THE STUDY**

The study has a limitation to apply to other road constructor companies. In addition to this there is lack of related literature in our country.

### **1.9 ORGANIZATION OF THE PAPER**

The study contains five chapters, following this chapter; the second chapter incorporates literature review part. Chapter three comprises methodology part; chapter four deals about data presentation, analysis and interpretation. The last chapter deals with conclusions and recommendations

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

#### **2.1 INTRODUCTION**

In the study of Alaghbari, et al. (2007), delay is generally acknowledged as the most common, costly, complex and risky problem encountered in construction projects. Because of the overriding importance of time for both the Owner (in terms of performance) and the Contractor (in terms of money), it is the source of frequent disputes and claims leading to lawsuits.

During project execution, project activities are subject to considerable uncertainty which may lead to numerous schedule disruptions. This uncertainty stems from a number of possible sources: activities may take more or less time than originally estimated, resources may become unavailable, material may arrive behind schedule, new activities may have to be incorporated or activities may have to be dropped due to changes in the project scope, ready times and due dates may be modified, etc. As a result, the validity of static deterministic scheduling has been questioned and/ or heavily criticized (Eliyu M.Goldratt, 1997)

Construction project time performance has long been identified, together with cost, quality and safety as one of the four main critical success factors in any construction project (Johansen and Wilson, 2006). The initial planning framework of a project, including contractor commitment to the overall construction timescale, is set during the preconstruction ‘first planning’ period. Adequate preconstruction planning is therefore recognized as essential to limit potential for later construction delays and cost overruns. However, many recent industry initiatives while recognizing the need for accurate planning at the strategic level have resulted in much focus upon improving site-based construction planning (Johansen and Wilson, 2006)). This, of course is after the contractor has irretrievably committed to a contractually binding construction project timescale. The production of feasible preconstruction and project master plans is essential to achieve later success during the construction phase and any failure in producing this can affect both the client’s and contractor’s success and negate or neutralize any successful onsite planning. Construction delay is considered one of the most recurring problems in the construction industry.

Construction planning is aimed at making effective use of space, people, materials, plant, information, access, energy, time and money in order to achieve the set project objectives, and is made up of four main parts: (1) programming and scheduling; (2) method statements; (3) organizational systems; and (4) site set-up and layout (Gidado, 2004 cited by Johansen and Wilson (2006)). These four parts are interdependent both with one another and also with the environment surrounding the project, while the planning strategies proposed are 'refined' by considering the financial and physical constraints imposed with the aim being to implement reliable cost, time, quality and safety plans.

Okpala, Aniekwu, 1988), found that insufficient construction materials in market always became an excuse for delay in project completion. Insufficient construction materials in the market were due to:-

- Not enough statistical data's related to construction materials in current market.
- Rise and fall price of construction materials in market.
- Waiting period quite long and uncertain delivery of ordered construction materials.
- Not enough financial sources to pay the order
- Not enough transportation for construction materials.

Business Rountable in 1983 defined construction material management as a system for controlling to ensure that quantity and quality of materials and machineries needed can be delivered to site at the specific time and with reasonable cost.

Thomas, Sanvido, Sanders, S.R.(1989),”the system of construction materials management comprise of:-

- Place arrangement
- Place cleanliness
- Materials delivery plan
- Materials availability
- Materials distribution

According to Nkado, (1995) stated that site productivity, which impliedly affect construction time, is affected by buildability (which is not clearly defined), management and leadership, knowledge of subcontractors work, the nature of the relationships between the general

contractor, subcontractor and client's agent and the degree of coordination in design information and the completeness of project information. Other factors include work space availability, attendance of operatives, learning curve, weather, labor relations, project complexity, foundation condition and effectiveness of supervision.

Walker (1995) stated that there are four factors that significantly affect construction time performance. These are: Construction Management Effectiveness, Sophistication of Client and the Client's representative in terms of creating and maintaining a positive project team relationship with the construction management and design team, Design team effectiveness in communicating with construction management and client's representative teams, and a small number of factors describing project scope and complexity.

Construction project delays mean additional implementation time completion of projects that have been planned and specified in the contract documents. (www.iosrjournals.org) Delays have an adverse impact on project success in terms of time, cost, quality and safety. The effects of construction delays are not confined to the construction industry only, but influence the overall economy of a country, where construction plays a major role in its development. Thus, it is essential to define the most significant causes of delay in order to avoid or minimize their impact on construction projects. Faridi & El-Sayegh, (2006).

According to Bramble and Callahan in (1987) delays is timeframe whereby part of construction projects being extended or not constructed due to unforeseen circumstances. The incident of delays may occur from internal organization or matters related to parties involved in the construction of the projects. Delays can be categorized into two category: forgive and un forgive. The forgiven delays were due to clients and consultants. The un forgiven delays were due to contractors.

Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. So it is essential to define the actual causes of delay in order to minimize and avoid delays in any construction project Alaghbari, Kadir & Salim, (2007)

## **2.2 THE PROBLEMS IN CONSTRUCTION PROJECT**

In essence, the way of handling the implementation of simple construction projects to the construction of mega-projects, each of which established a specific pattern management system, which is special. Nevertheless, the stages of the main activities in the process of construction of various types of projects tend to form a sort order that is similar to one another, may even be the

same for some projects. The principal of activities is based on areas of expertise and the professions involved, whereas the sequence of stages arranged based on the specific conditions relating to the technical challenges and the need for a mechanism in the process, which further is attached to a main feature of the industry. The problem faced in the process of the construction outline can be classified into two, namely:

- a. Issues relating to the interdependence and influence are closely between cost, time and quality. Implementation of construction has always aimed to produce a quality result with financing money is not wasteful, and all of which should be available in a limited time span, given the large investment costs to be invested.
- b. The issue that is highly correlated with the activities of coordination and control for all management functions. In the implementation of an activity involving the construction of the owners, consultants and contractors. In this case, they have their respective duties. Coordination between owners, consultants and contractors are necessary in order to the work can proceed smoothly and in accordance with the wishes of the previous.  
([www.iosrjournals.org](http://www.iosrjournals.org))

### **2.3 TYPES OF DELAYS**

According to Scott (1997), a delay in project implementation can be classified into three things: a compensable delay, non-compensable delay, and concurrent delay. According to Popescu and Charoengam (1995), when seen based on its responsibility, the delay can be classified into excusable delay, non- excusable delay, and concurrent delay. Identification of Construction Delays Prior to implementation of a project is necessary to identify the risk factors that could affect the project time performance. These factors could derive from the owner, the supervising consultant, and project implementers (contractors).

According Praritama (1976), internal factors are the cause of the delay caused by the project implementers. In the construction phase, the project executor is a contractor. In the internal factor or factors of implementation aspects that potentially caused the delay of which is a factor of materials, tools, labor, and management execution. External factors are factors of delays caused by parties outside of the executor of the project, but contribute directly on the construction project. The external factors include the delay caused by the owner, supervisors and planners.

Ogunlana and Promkuntong (1996) conducted a study on construction delay on Thailand. They found that the problems faced by the construction industry in developing economies like Thailand could be: (a) shortages or inadequacies in industry infrastructure (mainly supply of resources); (b) caused by clients and consultants and (c) caused by contractor's incompetence/inadequacies. They recommended that there should be concerted effort by economy managers and construction industry associations to provide the necessary infrastructure for efficient project management

Chan and Kumaraswamy (2002) conducted a survey to determine and evaluate the relative importance of the significant factors causing delays in Hong Kong construction projects. They analyzed and ranked main reasons for delays and classified them into two groups: (a) the role of the parties in the local construction industry (i.e. whether client, consultants or contractors) and b) the type of projects. Results indicated that five major causes of delays were: poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, client initiated variations and necessary variations of works.

According to Alaghbari et al (2007) opine that delays could be grouped in the following four broad categories according to how they operate contractually: non-excusable delays; Excusable non-compensable delays; excusable non-compensable delays; excusable compensable delays and concurrent delays.

### **2.3.1 EXCUSABLE DELAYS**

Excusable delays, also known as “force majeure” delays. These delays are commonly called “acts of God” because they are not the responsibility or fault of any particular party. Most contracts allow for the contractor to obtain an extension of time for excusable delays, but not additional money. Alaghbari, Wa'el, et al (2007)

Labor disputes; fire; unusual delay in deliveries unavoidable delays; compensable delays; unforeseen delays in transportation, and other causes beyond the contractor’s control could be example of executable Delays

### **2.3.2 NON-EXCUSABLE DELAYS**

Basically, these delays are caused by contractors or subcontractors or materials suppliers. The contractor might be entitled to compensation from the delaying subcontractor or supplier, but no compensation is due from the owner. Therefore, non-compensable delays usually result in no additional money and no additional time being granted to the contractor. Alaghbari, Wa'el, et al (2007)

In general the most common **Non Excusable** delays are caused due to following causes that are ordinary and foreseeable weather conditions, a subcontractor’s delays; the contractor’s failure to adequately manage and coordinate the project site; and the contractor’s financing problems.

### **2.3.3 COMPENSABLE DELAYS**

Compensable delays are those that are generally caused by the owner or its agents. The most common form of compensable delay is inadequate drawings and specifications, but compensable delays can also arise from the owner’s failure to respond in a timely fashion to requests for information or shop drawings, owner’s changes in design or materials, and owner’s disruption and/or change in the sequence of the work. The contractor is entitled to both additional money and additional time resulting from compensable delays. Alaghbari, Wa'el, et al (2007)

### **2.3.4 CONCURRENT DELAYS**

The concept of concurrent delay has become a very common presentation as part of some analysis of construction delays. The concurrency argument is not just from the standpoint of

determining the project's critical delays but from the standpoint of assigning responsibility for damages associated with delays to the critical path. Owners will often cite concurrent delays by the contractor as a reason for issuing a time extension without additional compensation. Contractors will often cite concurrent delays by the owner as a reason why liquidated damages should not be assessed for its delays. Unfortunately, few contract specifications include a definition of concurrent delay and how concurrent delays affect a contractor's entitlement to additional compensation for time extension or responsibility for liquidated damages.

In analyzed concurrent delays, each delay is assessed separately and its impact on other activities and the project duration is calculated. There are some guidelines for concurrent delays classification. Firstly, if excusable and non excusable delays occur concurrently, only a time extension is granted to the contractor. Next, if excusable with compensation and excusable without compensation delays occur concurrently, the contractor is entitled to time extension, but not to damages. Lastly, if two excusable with compensation delays occur concurrently, the contractor is entitled to both time extension and damages.

In addition, although the guidelines are useful for the purpose of carrying out the delay analysis, it is in the best interest of all parties involved in a construction project to agree, at the beginning, the definitions of such delays and accommodate them throughout the contract language. There was no reliable method to differentiate the impact of contractor caused delays from client caused delays until the development of CPM schedule analysis is developed. By the available of sophisticated computerized techniques, the possibility to segregate the impacts of apparently concurrent client and contractor delays would be higher. Abebit Hmariam,2013

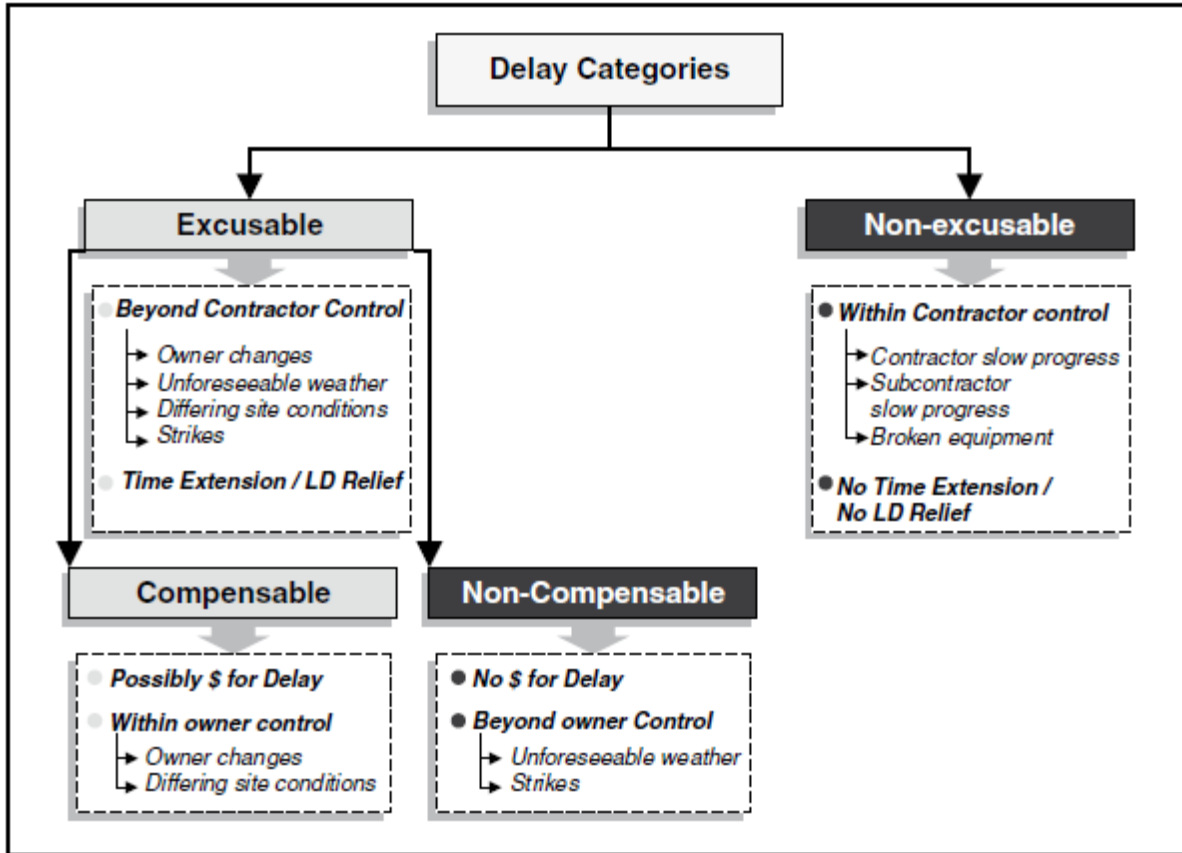


FIG 1 Delay Categories (Theodore, 2009) Pages 25

**2.4 CAUSES OF DELAY**

There are many factors that contributed to causes of delays in construction projects. These range from factors inherent in the technology and its management, to those resulting from the physical, social, and financial environment. There are in total of seven groups of causes for delay in construction project:

**Table 1:** List of causes of delay categorized into 8 groups Theodore, (2009)

Causes of delay by client	Cause of delay
	1. Delay in progress payments by owner
	2. Delay to furnish and deliver the site
	3. Change orders by owner during construction
	4. Late in revising and approving design documents
	5. Poor communication and coordination
	6. Slowness in decision making process
	7. Conflicts between joint-ownership of the project
8. Suspension of work	
	1. Difficulties in financing project by contractor
	2. Conflicts in sub-contractors schedule in execution of project
	3. Conflicts between contractor and other parties (consultant and owner)
	4. Ineffective planning and scheduling of project
5. Improper construction methods implement	

Causes of delay by contractor	6. Delays in sub-contractors work
	7. Inadequate contractor's work
	8. Frequent change of sub-contractors
	9. Poor qualification of the contractor's technical staff
	10. Delays in site mobilization
Causes of delay by Consultant	1. Delay in approving major changes in the scope of work
	2. Poor communication and coordination
	3. Inadequate experience of consultant
	4. Mistakes and discrepancies in design documents
	5. Delays in producing design documents
	6. Unclear and inadequate details in drawings
	7. Insufficient data collection and survey before design
	8. Un-use of advanced engineering design software
Causes of delay by materials	1. Shortage of construction materials in market
	2. Changes in material types and specifications during construction
	3. Delay in material delivery
	4. Damage of sorted material while they are needed urgently
	5. Delay in manufacturing special building materials
	6. Late procurement of materials
	1. Equipment breakdowns
	2. Shortage of equipment

Causes of delay by equipment	3. Low level of equipment-operator's skill
	4. Low productivity and efficiency of equipment
	5. Lack of high-technology mechanical equipment
Causes of delay by labors	1. Shortage of labors
	2. Working permit of labors
	3. Low productivity level of labors
	4. Personal conflicts among labors
Causes of delay by external factors	1. Effects of subsurface conditions (e.g. soil, high water table, etc.)
	2. Delay in obtaining permits from municipality
	3. Hot weather effect on construction activities
	4. Traffic control and restriction at job site
	5. Accident during construction
	6. Changes in government regulations and laws
	7. Delay in providing services from utilities (such as water, electricity)
	8. Delay in performing final inspection and certification by a third Party

According to Murali Sambasivan\*, Yau Wen Soon, (2006) Construction works involve huge amounts of money and most of the contractors find it very difficult to bear the heavy daily construction expenses when the payments are delayed. Work progress can be delayed due to the late payments from the clients because there is inadequate cash flow to support construction expenses especially for those contractors who are not financially sound.

And they also argue that Contract-related factors such as change orders (changes in the deliverables and requirements) and mistakes and discrepancies in the contract document result in cost overrun. Mistakes and discrepancies in the contract document can be in scope, deliverables,

resources available and allocated, payment terms, achievement of various milestones, and the project duration. In most of the instances, time overrun leads to cost overrun.

**2.5 EFFECTS OF DELAY**

According to Oseghale et al, (2008) delays in the execution of building projects lead wastage & underutilization of resources and increase in the final cost of projects due to idle and unproductive time remobilization.

One major effect of delay to the contractor is on the area of indirect cost incurred on site. The nature of most indirect expense items; such as salaries of key staff, plant and equipment on site increases as long as the project experience delays. It is reasonably adequate to say that indirect cost increases directly with time.

Delays in projects are often a source of disputes and claims between the owner and the contractor, so it would be very expensive in value, both in terms of the contractor and the owner. The contractor will be fined a penalty in accordance with the contract. In addition, contractors are also experiencing additional overhead cost for the project is still ongoing. In terms of owners, project delays will impact income reductions due to delay in the operation of its facilities.

Aibinu and Jagboro (2002) studied the effects of construction delays on project delivery in Nigerian construction industry. The six effects of delay identified were: times overrun cost overrun, dispute, arbitration, total abandonment and litigation

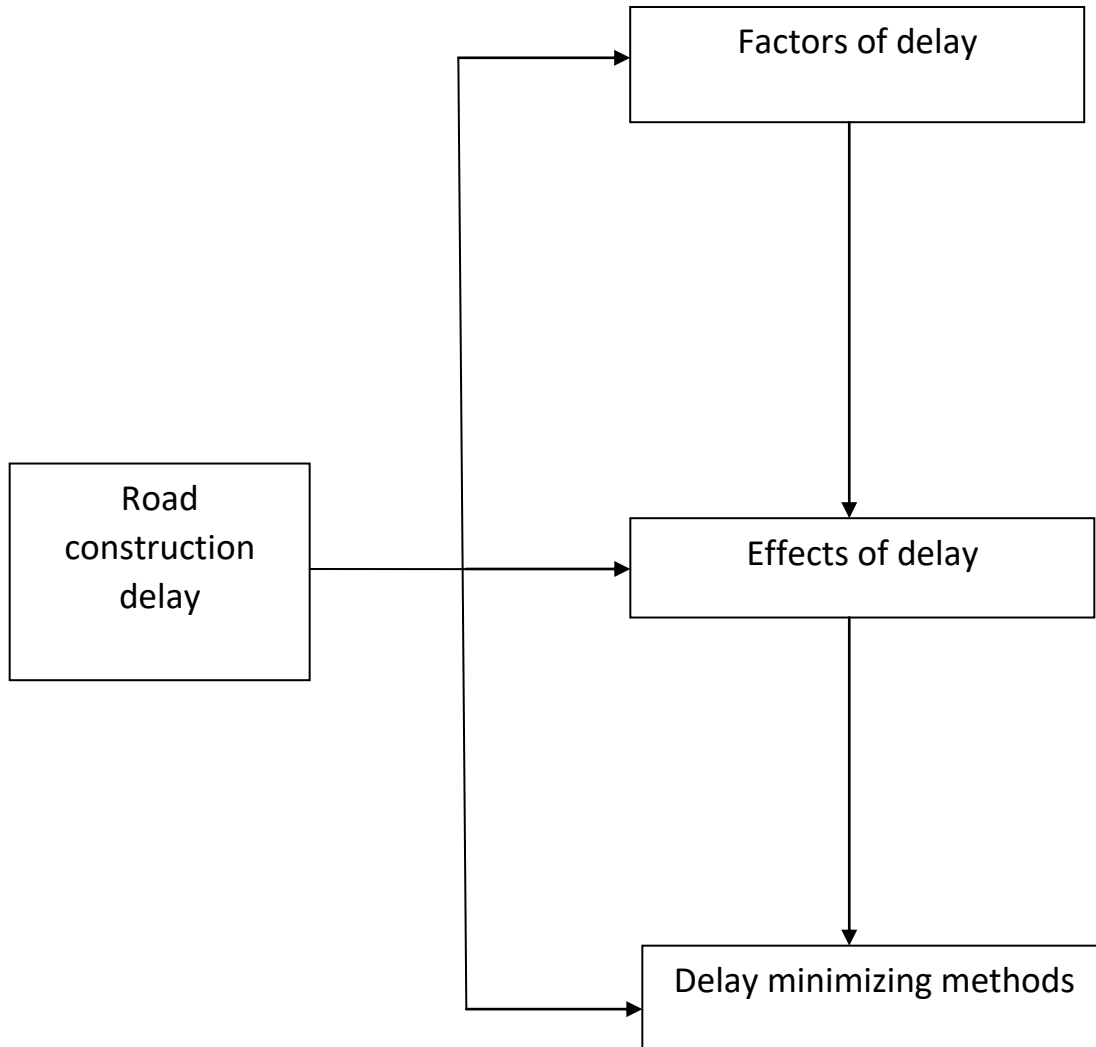
**2.6 METHODS OF MINIMIZING AND MANAGEMENT OF DELAY**

At the time of construction delay, owners face a financial problem. However they try to compensate this from the income of the contractors, and more importantly minimize the risk that such delays will occur, depends largely on how the construction contract was drawn up. Based on several studies of project success factors and rectification of delays in construction project, a total of 14 methods have been identified as follows:

	Delay minimizing methods
	1. Frequent progress meeting Majid, (2006)
	2. Use up-to-date technology utilization Majid, (2006)
	3. Use proper and modern construction equipment

METHODS OF MINIMIZING AND MANAGEMENT OF DELAY	Majid, (2006)
	4. Use appropriate construction methods Majid, (2006)
	5. Effective strategic planning Majid, (2006)
	6. Proper material procurement Majid, (2006)
	7. Clear information and communication channels Majid, (2006)
	8. Frequent coordination between the parties involved Majid, (2006)
	9. Proper emphasis on past experience Majid, (2006)
	10. Proper project planning and scheduling Majid, (2006)
	11. Complete and proper design at the right time Assaf, (2006)
	12. Site management and supervision Long, (2008)
	13. Collaborative working in construction Kumaraswamy,(1997)
	14. Compressing construction durations Long, (2008)

FIG 2 The design conceptual frame work looks like



## **CHAPTER THREE**

### **RESEARCH DESIGN AND METHODOLOGY**

This chapter briefly presents the methodology applied in the course of the study. Design of the research, sources of data, data collection technique, population of the study, sampling technique, sample size, and ethical considerations are highlighted.

#### ***3.1. RESEARCH DESIGN***

The methodology applied for this study was a quantitative research method with descriptive theme. The rationale for the use of these methods is that such studies are more helpful to describe and interpret the result of facts that exist. It was also aimed to better meet the objectives of the study set out under the first chapter.

#### ***3.2 SOURCE OF DATA***

The study used primary and secondary data source. Primary source of data obtained from currently performed road construction. The secondary source of data collected from different source like books, reports, Journals and different articles from the internet.

#### ***3.3. DATA COLLECTION TECHNIQUES***

Contractors in the company and consultants of the project were communicated to collect the relevant data by means of primary data collection methods (questionnaire). The questionnaires were addressed in both close and open ended form Lykert type scale of measurement was used to determine the level of agreement.

### ***3.4 POPULATION, SAMPLING TECHNIQUE AND SAMPLE SIZE***

#### ***3.4.1. POPULATION OF THE STUDY***

The pools of population for this study were road construction workers and consultants who had contribution on Rama construction company road constructions projects that are consultant, project Manager, Site Manager, engineer, and Project member are involved. The numbers of permanent employees, working at Rama Construction Company are 963 from this number only 162 or 17% of employees are engineers and foreman engaged in the building and road construction work. Out of the total engineers and foreman only 38% or 62 employees are engaged in road construction. In this study only construction workers who had experience for more than one road construction were included.

#### ***3.4.2 SAMPLING PROCEDURE***

Non-probability (deliberate or purposive) sampling techniques were applied for this study. The method applied because of the population or the numbers of staffs involved in the road construction were small that means twenty eight engineers who had experience of more than one road construction project and 21 members involved in the consultant work.

### ***3.5 METHODS OF DATA COLLECTION***

A questionnaire survey designed based on the objectives of the study, which are factors for causes of construction delays, effects of construction delays and the method minimization of construction delays. Most of the road construction workers are field workers across the country; so that the questioner distributed through head office. The questionnaire survey will be developed to get understanding and opinion from the experienced respondent regarding to the delay of construction work. The questioner classified in these four sections that a respondent background, factors for construction effects of construction delays and method of minimizing construction delays.

### **3.5.1. RESPONDENT BACKGROUND**

In this part, trials will be made to obtain the respondents' information. The questionnaire includes the position of the respondent in the company and the experience of the respondent in the construction project.

### **3.5.2. CAUSES OF CONSTRUCTION DELAYS**

The second part of the questionnaire focused on causes of construction delay. The respondents were asked to indicate their response on forty nine well-recognized construction delay factors identified by Theodore, (2009). These causes were categorized into the following seven major groups:

1. Client related factors: finance and payments of completed work, delay to furnish and deliver the site, slow decision making and Change orders by owner during construction
2. Contractor related factors: delays caused by subcontractor, delays in site mobilization, improper construction methods, improper planning and errors during construction, and inadequate contractor experience.
3. Consultant related factors: Inadequate experience of consultant, preparation and approval of drawings, lack of advanced engineering design software and insufficient data collection and survey before design.
4. Material related factors: shortage in material, Changes in material types and specifications during construction and damage of sorted material while they are needed urgently.
5. Equipment related factors: Shortage of equipment, low level of equipment-operator's skill, low productivity and efficiency of equipment and Lack of high-technology mechanical equipment
6. Labor related factors: labor supply, labor productivity, working permit of labors and personal conflicts among labors
7. External factors: weather condition, regulatory changes, delay in providing services from utilities (such as water, electricity), problem with neighbors and unforeseen site condition

The questionnaire is mainly based on Likert's scale of 5 ordinal measures from 1 to 5 according to level of contributing.

(5) = Very high contributing

(4) = High contributing

(3) = Medium contributing

(2) = Low contributing

(1) = Very low contributing

### **3.5.3. EFFECTS OF CONSTRUCTION DELAYS**

This section used for the respondent to evaluate the effect of construction delay based on their experience and judgment. There are consists of 6 impacts of construction delays, i.e.

1. time overrun,
2. cost overrun,
3. dispute,
4. arbitration,
5. litigation,
6. Total abandonment.

The questionnaire is mainly based on Likert's scale of 5 ordinal measures from 1 to 5 according to level of contributing.

(5) = Always

(4) = Mostly

(3) = Sometimes

(2) = Seldom

(1) = Never

### **3.5.4. METHODS OF MINIMIZING CONSTRUCTION DELAY**

This section identifies methods that minimizing construction delay. There are a total of 15 methods identify in this paper. The questionnaire is mainly based on Likert's scale of 5 ordinal measures from 1 to 5 according to level of contributing.

(5) = Very high effective

(4) = High effective

(3) = Effective

(2) = Low effective

(1) = Very Low effective

### 3.6 METHODS OF DATA ANALYSIS

The analysis determine to establish the relative importance of the various factors that contribute to causes of construction delays, effects of construction delays, and methods rectification of construction delays. It consists of three steps to analyzing the data:

- Calculating the Relative Importance index (RI)
- Ranking of factors in each category based on the Relative Importance Index(RI)
- Determine degree of correlation on ranking the factors among the two groups

#### 3.6.1 RELATIVE IMPORTANT INDEX

Calculation of relative importance of factors Odeh and Battaineh (2002), used the relative importance index method to determine the relative importance of the various causes and effects of delays. The same method was adopted in this study within various groups (i.e. consultants or contractors). The five-point scale ranged from 1 (Very high contributing) to 5 (Very low contributing) was adopted and transformed to relative importance indices (RII) for each factor as follows:

$$I = \frac{\sum W_i X_i}{\sum X_i}$$

Where:

i = response category index

W<sub>i</sub> = the weight assigned to ith response = 1, 2, 3, 4, 5, respectively.

X<sub>i</sub> = frequency of the ith response given as percentage of the total responses for each factors.

(1)

Odeh and Battaineh (2002), to determine the ranking of different factors from the viewpoint of contractors and consultants, the Relative Importance Index (I) was computed as:

The RII was used to rank (R) the different causes. These rankings made it possible to cross-compare the relative importance of the factors as perceived by the two groups of respondents (i.e. consultants and contractors).

Each individual cause's RII perceived by all respondents were used to assess the general and overall rankings in order to give an overall picture of the causes of construction delays in Rama construction industry.

### **3.6.2 THE SPEARMAN'S RANK CORRELATION COEFFICIENT**

Spearman's rank correlation coefficient is a nonparametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman's correlation of +1 or -1 occurs when each of the variables is a perfect monotone function of the other. The value of the Spearman's rank correlation coefficient ranges from +1 (perfect positive correlation), to 0 (no correlation), to -1 (perfect negative correlation).

### **3.7. Ethical research Considerations**

The researcher made use of different data collection instruments from different sources. Utmost effort was exerted to acknowledge materials referred & the researcher takes the responsibility to keep confidentiality of respondents' opinions & unanimity of the rest of the information.

## **CHAPTER FOUR**

### **DATA PRESENTATION ANALYSIS AND INTERPRETATION**

This chapter presents analysis of the data collected from respondents using questioner. In order to identify and analyze the real cause of road project delay and its effect, forty sets of questionnaires were distributed to the targeted consultants and contractors. The questionnaire survey was completed by project managers, project engineers, site manager, designers/engineer, and supervision engineers.

#### **4.1. QUESTIONNAIRES DISTRIBUTED AND COLLECTED**

A total of 40 questionnaires were distributed among different groups of employees at the Rama Construction currently involved at the project and those ex-project staff in the company. From the total questionnaires 30 (75%) were returned.

Table 2: Questionnaires distributed and collected

Description	Number of distributed	Number of respondents	% of number of response
Consultant	20	14	70
Contractor	20	16	80
	40	30	75

#### **4.2 DATA PRESENTATION AND ANALYSIS**

The objective of conducting the analysis for this section is to establish the groups of causes identified from the literature review and the ranking according to their significant influence towards construction project delays. A ranking method was used to achieve this objective and the significance of using these methods is that it can reveal the most influential causes within each category of delays. The causes related to client, contractor, consultant, materials, equipment, labors and external factors were analyzed and presented as follows:

#### 4.2.1 CLIENT RELATED DELAY

Among different factors that cause delay in road construction which related to client are many in number but I have picked eight major factors in the questioner I have had distributed to my respondents. Thus, table 3 depicts the results of questioner analysis of factors of client related delays. Depending on relative importance index, the factors that cause delay in road construction on behalf of client were ranked accordingly between groups of respondent of contractor and consultant. Referring the below mentioned table 3, late in revising and approving design documents was the most contributing factor for client related delays by consultants, the design documents is needed as a reference for the project and also act as a permit so that contractor does not proceed the construction without permission and wasting money for unnecessary site activity and it is the second most contributing factor for client related delays by contractors. Change orders by owner during construction was the most influencing factor for the client related delays by contractors. This is because, change orders in frequent might extend the site activity and affect the whole project scheduling which comes unable to complete the project on time. Delay in progress payments are the third most contributing factor for road construction delay both for consultant and contractor respondents

Table 3: Client related delay

	consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Delay in progress payments by owner	4.07	0.8143	3	4.31	0.77	3	4.19	0.791	4
Delay to furnish and deliver the site	4.29	0.8571	2	4.19	0.74	5	4.24	0.801	3
Change orders by owner during construction	4	0.8	4	4.75	0.84	1	4.38	0.822	2
Late in revising and approving design documents	4.5	0.9	1	4.63	0.82	2	4.56	0.861	1
Poor communication and coordination	3.79	0.7571	5	3.69	0.66	6	3.74	0.706	6
Slowness in decision making process	3.71	0.7429	6	4.25	0.76	4	3.98	0.749	5
Conflicts between joint-ownership of the project	3.07	0.6143	7	2.38	0.42	8	2.72	0.518	7
Suspension of work	2.5	0.5	8	2.44	0.43	7	2.47	0.467	8

#### 4.2.2 CONTRACTOR RELATED DELAY

In table 4 below, the ten factors related to contractor for the delay of road construction that distributed in form of questionnaires to the group of contractors and consultants of respondents were analyzed and ranked depending on relative importance index. As per this measurement, both groups of respondents gave the first two ranks for improper construction methods implement and ineffective planning and scheduling of project respectively. This implies that, the contractors accepted the pitfall they caused by using improper construction methods they implement for the delay of road construction. Apart from the above agreement between the two groups of respondents, for consultants delay in site mobilization was second influencing factors in addition to ineffective planning and scheduling of project and it was the third affecting factor for contractor respondents. Besides to above agreement between the two groups of respondents, they also agreed up on the fourth and fifth factors that cause road construction delay on behalf of contractors which are poor qualification of contractors technical staff and difficulties in financing project by contractor respectively. Finally, consultant respondents put the delays in sub contractors work and frequent change of sub contractors as the least contributing factor for the delay of road construction where as for the contractor respondents conflicts between contractor and other parties labeled as the least contributing factor.

Table 4: Contractor related delay

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Difficulties in financing project by contractor	3.93	0.786	4	3.81	0.678	5	3.87	0.732	5
Conflicts in sub-contractors schedule in execution of project	3	0.6	5	2.88	0.511	6	2.94	0.556	6
Conflicts between contractor and other parties (consultant and owner)	2.93	0.586	6	2.13	0.378	12	2.53	0.482	8
Ineffective planning and scheduling of project	4.29	0.857	2	4.25	0.756	2	4.27	0.806	2
Improper construction methods implement	4.57	0.914	1	4.94	0.878	1	4.75	0.896	1
Delays in sub-contractors work	2.21	0.443	10	2.5	0.444	7	2.36	0.444	11
Inadequate contractor's work	2.43	0.486	8	2.5	0.444	7	2.46	0.465	10

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Frequent change of sub-contractors	2.21	0.443	9	2.38	0.422	11	2.29	0.433	12
Poor qualification of the contractor's technical staff	4.14	0.829	4	3.88	0.689	4	4.01	0.759	4
Delays in site mobilization	4.29	0.857	2	4.19	0.744	3	4.24	0.801	3

#### 4.2.3 CONSULTANT RELATED DELAY

In Table 5 shows the results of questionnaires analysis of causes related to consultant with regard to road construction delay. This table shows the manipulation of factors rank using relative importance index. Accordingly, the consultant respondent group boldly marked the delays in producing design documents as the number one factor that causes road construction delay. Design documents are the source of reference for the consultancy service. Thus, if these documents not produced and provided timely for the consultant it highly cause road construction delay. This group of respondents, ranked mistakes and discrepancies in design documents and unclear and inadequate details in drawings as the second and the third factor respectively. In case of contractor respondents, delay in approving major changes in the scope of work and delays in producing design documents ranked as first. Whatever the case, both respondent groups reached consensus on their least contributing factor which is unuse of advanced engineering design software.

Table 5: Consultant related delay

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Delay in approving major changes in the scope of work	3.57	0.714	4	4.19	0.744	1	3.88	0.729	3
Poor communication and coordination	3.00	0.600	5	3.63	0.644	4	3.31	0.622	5
Inadequate experience of consultant	2.86	0.571	6	3.56	0.633	5	3.21	0.602	7
Mistakes and discrepancies in design documents	3.86	0.771	2	3.81	0.678	4	3.83	0.725	4
Delays in producing design documents	4.00	0.800	1	4.19	0.744	1	4.09	0.772	1
Unclear and inadequate details in drawings	3.79	0.757	3	4.13	0.733	3	3.96	0.745	2
Insufficient data collection and survey before design	3.00	0.600	5	3.50	0.622	6	3.25	0.611	6
Un-use of advanced engineering design software	2.29	0.457	7	2.88	0.511	7	2.58	0.484	8

#### 4.2.4 MATERIALS RELATED DELAY

There are six causes that contributed to the delay of road construction related to materials. In table 6, these causes were ranked from consultant and contractor point of view depending on the relative importance index. From consultant perspective, late procurement of materials leads in terms of causing road construction delay from material angle. Delay in material delivery was the second cause. Beside to this, shortage of construction materials in market was the third cause. For contractor respondents, both delay in material delivery and late procurement of materials labeled as the leading cause where as changes in material types and specification during construction was the third. Both groups of respondents point out that damage of sorted material while they are needed urgently were the least cause of road construction delay.

Table 6: Materials related delay

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Shortage of construction materials in market	3.64	0.729	3.00	3.56	0.633	4	3.60	0.681	4
Changes in material types and specifications during construction	3.57	0.714	4.00	3.75	0.667	3	3.66	0.690	3
Delay in material delivery	4.14	0.829	2.00	4.44	0.789	1	4.29	0.809	2
Damage of sorted material while they are needed urgently	2.86	0.571	6.00	3.50	0.622	6	3.18	0.597	6
Delay in manufacturing special building materials	3.29	0.657	5.00	3.69	0.656	5	3.49	0.656	5
Late procurement of materials	4.64	0.929	1.00	4.44	0.789	1	4.54	0.859	1

#### 4.2.5 EQUIPMENT RELATED DELAY

As the table 7 describe below the ranking of equipment related factor for the two group respondent are similar. Low level of equipment-operator's skill would be the most influential among all the causes that able to affect the construction delays. This indicates that most of our country equipment operators lack technical knowledge. Low productivity and efficiency of equipment is the second and equipment breakdown is the least contributor for the two groups. The last but not the least, both groups labeled lack of high technology mechanical equipment.

Table 7: Equipment related delay

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Equipment breakdowns	3.36	0.671	4.000	2.88	0.511	4	3.12	0.591	4
Shortage of equipment	3.79	0.757	3.000	3.50	0.622	3	3.64	0.690	3
Low level of equipment-operator's skill	4.71	0.943	1.000	4.63	0.822	1	4.67	0.883	1
Low productivity and efficiency of equipment	4.29	0.857	2.000	4.50	0.800	2	4.39	0.829	2
Lack of high-technology mechanical equipment	2.79	0.557	5.000	2.75	0.489	5	2.77	0.523	5

#### 4.2.6 LABOR RELATED DELAY

As shown in Table 8 there are five factors of labor related delays that were ranked, based on relative important index from the perspective of contractors and consultants. Low productivity level of labors was ranked first for both contractors and consultants. In similar fashion both groups of respondents, pointed out that shortage of labor as the second. In addition to shortage of labor, the contractor respondents equally put the personal conflicts among labors as second. Apart from their difference, both groups of respondents figured out working permit of labor as the least cause of road construction delay.

Table 8: Labor related delay

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Shortage of labors	2.21	0.443	2.00	2.19	0.389	2	2.201	0.416	2
Working permit of labors	1.71	0.343	4.00	1.75	0.311	4	1.732	0.327	4
Low productivity level of labors	4.36	0.871	1.00	4.19	0.744	1	4.272	0.808	1
Personal conflicts among labors	2.00	0.400	3.00	2.19	0.389	2	2.094	0.394	3
	2.57	0.514		2.58	0.458		2.575	0.486	

#### 4.2.7 EXTERNAL FACTORS RELATED DELAY

There are eight external related causes that contributed to the delay of road construction projects. They ranked based on relative important index from both contractors and consultants perspective as shown in Table 9, Both Consultants and Contractors have ranked the obtaining permits from municipality and effects of subsurface conditions like soil, high water table etc as the first and second respectively. Hot weather effect on construction activities was ranked as the third affecting cause for contractors it was the same for consultants. Accident during construction was the least causes of road construction delay for the consultant respondents whereas it was the fourth for contractor.

Table 9: External factors related delay

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Effects of subsurface conditions (e.g. soil, high water table, etc.)	3.07	0.614	2.00	3.00	0.533	2	3.04	0.574	2
Delay in obtaining permits from municipality	3.21	0.643	1.00	3.19	0.567	1	3.20	0.605	1
Hot weather effect on construction activities	2.57	0.514	3.00	2.25	0.400	7	2.41	0.457	4
Traffic control and restriction at job site	2.29	0.457	5.00	2.31	0.411	6	2.30	0.434	6
Accident during construction	1.57	0.314	8.00	2.56	0.456	4	2.07	0.385	8
Changes in government regulations and laws	2.36	0.471	4.00	2.69	0.478	3	2.52	0.475	3
Delay in providing services from utilities (such as water, electricity)	2.21	0.443	6.00	2.56	0.456	4	2.39	0.449	5
Delay in performing final inspection and certification by a third Party	2.07	0.414	7.00	2.50	0.444	5	2.29	0.429	7

#### ***4.2.8 INDIVIDUAL CAUSE ANALYSIS BY RELATIVE IMPORTANCE INDEX***

Depending on the aforementioned tables and the amalgamated table 10 below, a total of forty nine causes that contributed to the delay of road construction project were identified, ranked and analyzed. For consultant respondents, based on relative importance index the five top ranked causes were low level of equipment-operator's skill, late procurement of materials, improper construction methods implement, late in revising and approving design documents and Low productivity level of labors. From this we conclude that for consultant respondents, the delay that caused by equipment given the fore front rank and succeeded by the material related delay. For contractor respondents, based on relative importance index the five top ranked causes were improper construction methods implement, change orders by owner during construction, low level of equipment-operator's skill, late in revising and approving design documents and low productivity and efficiency of equipment. From this we deduce that for contractor respondents, the delay that caused by themselves given the fore front rank and the cause by clients given the second rank.

As shown on Annex 3, the total of forty nine causes that contributed to the delay of road construction project was identified, ranked and analyzed using average relative importance index. Consultant respondents in combination with contractor respondents regardless of their difference on the causes of road construction, depending on the average relative importance index the top ten causes are improper construction methods implement, low level of equipment-operator's skill, late in revising and approving design documents, late procurement of materials, low productivity and efficiency of equipment, change orders by owner during construction, delay in material delivery, low productivity level of labors, ineffective planning and scheduling of project, delay to furnish and deliver the site, delays in site mobilization. From this it is possible to say that the contractor related cause play a pivotal role for delay of road construction and labor related cause was the least contributing factor.

#### 4.2.9 GROUP CAUSE ANALYSIS BY RELATIVE IMPORTANCE INDEX

In this study, as it was stated in literature review, the causes of construction delay were categorized in to seven. All of them analyzed and ranked by group using relative importance index. As depicted by table 11 below, for consultant respondents equipment related delay, client related delay and material related as first, second and third respectively. Contractor respondents on their behalf ordered material related causes as first, client related causes as second and consultant related as third. In general, for both group of respondents material related causes, client related causes and equipment related causes got the first three ranks consecutively.

Table 11: Group Cause analysis by relative importance index

No.	Group	Consultant		Contractor		Average	
		RII	Rank	RII	Rank	RII	Rank
1.	Material	0.738	3	0.693	1	0.715	1
2.	Client	0.7482	2	0.6806	2	0.714	2
3.	Equipment	0.757	1	0.649	4	0.703	3
4.	Consultant	0.659	5	0.664	3	0.661	4
5.	Contractor	0.660	4	0.569	5	0.614	5
6.	Labor	0.514	6	0.458	7	0.486	6
7.	External	0.484	7	0.468	6	0.476	7

#### 4.2.10 GROUP ANALYSIS BY SPEARMAN'S RANK CORRELATION COEFFICIENT

Spearman's rank correlation coefficient is a nonparametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman's correlation of +1 or -1 occurs when each of the variables is a perfect monotone function of the

other. The value of the Spearman's rank correlation coefficient ranges from +1 (perfect positive correlation), to 0 (no correlation), to -1 (perfect negative correlation). From table 12 below, there is negative correlation between contractor and consultant. Generally, all groups of causes affect each other whether negatively or positively.

Table 12: Group analysis by Spearman's rank correlation coefficient

		CLIENT	CONTRACTOR	CONSULTANT	MATERIAL	EQUIPMENT	LABORS	EXTERNAL_FACTORS
CLIENT	C. Cof	1.000	.460	-.230	.189	.038	.215	.124
	Sig.		.073	.391	.483	.890	.423	.646
CONTRACTOR	c.cof	.460	1.000	-.155	.219	-.216	.117	.138
	Sig.	.073		.567	.414	.421	.667	.610
CONSULTANT	c.cof	-.230	-.155	1.000	.589*	-.268	.018	.554*
	Sig.	.391	.567		.016	.316	.947	.026
MATERIAL	c.cof	.189	.219	.589*	1.000	-.158	.206	.535*
	Sig.	.483	.414	.016		.560	.444	.033
EQUIPMENT	c.cof	.038	-.216	-.268	-.158	1.000	.280	-.076
	Sig.	.890	.421	.316	.560		.294	.781
LABORS	c.cof	.215	.117	.018	.206	.280	1.000	.169
	Sig.	.423	.667	.947	.444	.294		.531
EXTERNAL_FACTORS	c.cof	.124	.138	.554*	.535*	-.076	.169	1.000
	Sig.	.646	.610	.026	.033	.781	.531	

#### 4.3 EFFECTS OF DELAYS

According to Arditi et al in 1985 construction industry depended on other sectors either at the input stage or output stage. This was due to products of construction industry in term of input was bought from other sectors. In term of output, road used by almost all other sectors of economy. Therefore, delay in road not only affected construction industry only but it also influenced economy of the country in overall.

Based on the questioner, respondents give their own response on the six major effects of construction delay, that are time overrun; cost overrun; dispute; arbitration; total abandonment;

and litigation as shown in Table 13. The questioner distributed to targeted group in order to get the perception of contractor and consultant about the effect of delay in the road construction. Based on the ranking of relative important index time overrun and cost overrun are the most preferred effects of delay perceived by all the respondents were time overrun (RII=0.898), and cost overrun (RII=0.89). The first impact of delay is time overrun as indicated in the table 13 below to time, it consequence comes to cost overrun. Contractor will bear additional cost of rental for office, administration, clerical and others.

Table 13: Effects of delays

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Time overrun	4.64	0.93	1	4.88	0.867	1	4.759	0.898	1
Cost overrun	4.57	0.91	2	4.88	0.867	1	4.723	0.89	2
Dispute	2.36	0.47	3	2	0.356	3	2.179	0.413	3
Arbitration	1.93	0.39	5	1.69	0.3	4	1.808	0.343	5
Total abandonment	1.86	0.37	6	1.5	0.267	6	1.679	0.319	6
Litigation	2.14	0.43	4	1.69	0.3	4	1.915	0.364	4

#### **4.3.1 CAUSE AND EFFECT ANALYSIS BY SPEARMAN'S RANK CORRELATION COEFFICIENT**

Spearman's rank correlation coefficient is a nonparametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. The value of the Spearman's rank correlation coefficient ranges from +1 (perfect positive correlation), to 0 (no correlation), to -1 (perfect negative correlation). From table 14 below, time overrun and cost overrun highly associated with client related causes relative to others. Besides, dispute and arbitration effects highly related to consultant related causes.

**Table 14: Relationship on Cause and effect analysis by Spearman’s rank correlation coefficient**

Effects		Causes by group						
		CLIENT	CONTRACTOR	CONSULTANT	MATERIAL	EQUIPMENT	LABORS	EXTERNAL_FACTORS
Time overrun	Correlation Coefficient	0.298	0.143	-0.066	0.022	-0.288	-0.233	-0.069
	sig.	0.263	0.598	0.807	0.936	0.279	0.385	0.799
Cost overrun	Correlation Coefficient	0.298	0.143	-0.066	0.022	-0.288	-0.233	-0.069
	sig.	0.263	0.598	0.807	0.936	0.279	0.385	0.799
Dispute	Correlation Coefficient	-0.19	-0.309	0.155	-0.261	0	-.504*	-0.037
	sig.	0.481	0.245	0.566	0.33	1	0.047	0.891
Arbitration	Correlation Coefficient	-0.154	-0.153	0.016	-0.125	0	-.583*	0.214
	sig.	0.568	0.572	0.954	0.644	1	0.018	0.427
Total abandonment	Correlation Coefficient	0.286	0	-0.073	0.073	-0.048	-.540*	0.107
	sig.	0.282	1	0.788	0.79	0.861	0.031	0.694
Litigation	Correlation Coefficient	0.135	-0.153	0.016	0.047	0	-0.333	0.033
	sig.	0.618	0.572	0.954	0.863	1	0.208	0.904

#### 4.3.2 METHODS OF MINIMIZING CONSTRUCTION DELAYS

As shown in Table 15, a total of fourteen methods of minimizing construction delays were identified based on the literature review. The questionnaire was developed and distributed to the targeted two groups of respondents. Data from a questionnaire was analyzed and ranked based on relative importance index. Depending on the rank listed out using relative importance index, both contractor and consultant respondents prioritized different methods for minimizing construction delays. Consultant respondents on their behalf given use appropriate construction methods as the leading, proper material procurement as the second and complete and proper design at the right time as the third method. However, Contractor respondents put complete and proper design at the right time as first, use appropriate construction methods as second and proper material procurement as third. Even though both group of respondents given priority for

different methods, basically they agreed that use appropriate construction methods, complete and proper design at the right time and proper material procurement from the first top three methods minimizing construction delay.

Table 15: Methods of minimizing construction delays

	Consultant			Contractor			Average		
	Mean	RII	RANK	Mean	RII	RANK	Mean	RII	RANK
Frequent progress meeting	3.71	0.743		3.81	0.68	13	3.92	0.69	13
Use up-to-date technology utilization	3.64	0.729	10	3.5	0.62	14	3.57	0.675	14
Use proper and modern construction equipment	3.64	0.729	10	4	0.71	11	3.82	0.72	10
Use appropriate construction methods	4.79	0.957	1	4.56	0.81	2	4.67	0.884	1
Effective strategic planning	4.29	0.857	5	4.38	0.78	4	4.33	0.817	4
Proper material procurement	4.71	0.943	2	4.5	0.8	3	4.61	0.871	3
Clear information and communication channels	4.29	0.857	5	4.13	0.73	9	4.21	0.795	6
Frequent coordination between the parties involved	3.71	0.743	9	4.19	0.74	6	3.95	0.744	9
Proper emphasis on past experience	3.5	0.7	12	3.94	0.7	12	3.72	0.7	12
Proper project planning and scheduling	4.36	0.871	4	4.19	0.74	6	4.27	0.808	5
Complete and proper design at the right time	4.64	0.929	3	4.69	0.83	1	4.67	0.881	2
Site management and supervision Long	3.93	0.786	8	4.31	0.77	5	4.12	0.776	8
Collaborative working in construction	4.07	0.814	7	4.19	0.74	6	4.13	0.779	7
Compressing construction durations	3.36	0.671	13	4.13	0.73	9	3.74	0.702	11

The result of the previous finding made by Kang Sik Wei indicates that the site management and supervision, effective strategic planning, clear information and communication channels, collaborative working in construction and proper project planning and scheduling has made the

top five effective for overall ranked by contractors and consultants and also the finding of Ibnu Abbas Majid on 2005, the most effective methods of minimizing delays includes: site management and supervision; effective strategic planning; clear information and communication channels; collaborative working in construction; proper project planning and scheduling; frequent coordination between the parties involved; complete and proper design at the right time; use appropriate construction methods; accurate initial cost estimates; proper material procurement; and proper emphasis on past experience. Whereas in this study the top five construction delay minimizing road construction delay are use appropriate construction methods, complete and proper design at the right time and proper material procurement from the first top three methods minimizing construction delay.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSION AND RECOMMENDATION**

#### **5.1 INTRODUCTION**

The aim of this research is analyzing the major causes of road project delay, to analyze different delay problems with their effect and presenting way of minimizing construction delay.

#### **5.2 CONCLUSION**

##### **5.2.1 THE MAJOR CAUSE OF DELAY**

The study identifies a total of forty nine causes, from this 10 main causes identified using RII from the respondent selection, that includes improper construction methods implement, low level of equipment-operator's skill, late in revising and approving design documents, late procurement of materials, low productivity and efficiency of equipment, change orders by owner during construction, delay in material delivery, low productivity level of labors, ineffective planning and scheduling of project and delay to furnish and deliver the site. The top ten major causes of delay grouped in to seven major categories of causes client related delay takes the major share, the second major contributors are the three groups that are contractor, equipment and materials by the same percent and the least share take by labor related delay.

##### **5.2.2 THE COMMON EFFECTS OF DELAYS**

The next objective the study address the major effect of delay, six major effects i.e. time overrun, cost overrun, dispute, arbitration, total abandonment and litigation selected and ranked based on the respondent perception using RII. Time overrun, cost overrun and dispute are the top three effects of delay. In this part the two group respondent (contractor and consultants) agree to this ranking.

##### **5.2.3 THE METHODS OF MINIMIZING CONSTRUCTION DELAYS**

The study meets its objective by indicating methods of minimizing construction delay. Fourteen major methods for reducing construction delay forwarded for respondent to rank the best from the total methods. Based on the respondent, top best ways of reducing construction delay are use

appropriate construction methods, complete and proper design at the right time and proper material procurement from the first top three methods minimizing construction delay.

### ***5.3 RECOMMENDATION***

Even though all causes have had their own contribution for delay of construction project in general road construction in particular, the causes that emanates from contractor, client, equipment, material and labor have a lion share part. Whatever the case, this study suggests the following mitigating recommendations:

Firstly, contractors should have to use appropriate road construction method. Though it requires huge investment to create suitable construction method, it is possible to update the existing method. Besides, it is also possible from them to share best practices among themselves. They have to plot effective and efficient planning and scheduling of project. If it is possible, they have to employ qualified employee otherwise they have to train well in line with the construction.

Secondly, the client side delay of road construction can be minimized by avoiding late revision and approval of design documents. Like any projects road construction may require revision but the revision must be as fast as possible. Furnish and delivery of the site must be timely.

Thirdly, using modern equipment for construction help to overcome the up and down of using obsolete equipment and to timely deliver the road construction project.

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## Annex 1: Questioner

**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF COMMERCE**  
**DEPARTMENT OF PROJECT MANAGMENT**

Dear Respondents, I am Fikerte Wondimu, a graduate student at Addis Ababa University, school of commerce. Currently, I am undertaking a research to analyze causes of project delay in case of Rama Construction Company. The research paper is intended for the partial fulfillment of Master Degree in Project Management at Addis Ababa University. Your participation in this questioner is voluntary. The information you provide will be used only for the purpose of the study and will be kept strictly confidential. Please do not write your name or contact details on the questionnaire. Thank you in advance for your kind cooperation. For further information. *Tel: (+251)-911-442389*

### Part 1: Respondent background (please put a tick mark on the box)

1. State your position in the organization/company.
  - Consultant
  - Project Manager
  - Site Manager Engineer
  - Project member
  - Functional employee
2. Your work experience in the company

- < 5 years
  - 5 - 10 years
  - 11 - 15 years
  - 15 years
3. In how many road constructions project that you involved?
- 1 - 4 projects
  - 5 - 7 projects
  - 8 – 10 projects
  - 10 projects
4. In how many road projects you face project delay?
- 1-3
  - 3-5
  - 5-7
  - >7

**Part 2: Factors that Contributing to Causes of Construction Delays (please put a tick mark in the box)**

Each scale represents the following rating:

(5) Very high contributing      (4) High contributing (3) Medium contributing

(2) Low contributing (1) Very low contributing

**Question:**

Which of the following related factors stated below that contribute to causes of delays of Rama construction project?

Categories	Causes of delay	1	2	3	4	5
Causes of delay by client	1. Delay in progress payments by owner					
	2. Delay to furnish and deliver the site					
	3. Change orders by owner during construction					

	4. Late in revising and approving design documents					
	5. Poor communication and coordination					
	6. Slowness in decision making process					
	7. Conflicts between joint-ownership of the project					
	8. Suspension of work					
Causes of delay by contractor	1. Difficulties in financing project by contractor					
	2. Conflicts in sub-contractors schedule in execution of project					
	3. Conflicts between contractor and other parties (consultant and owner)					
	4. Ineffective planning and scheduling of project					
	5. Improper construction methods implement					

Categories	Causes of delay	1	2	3	4	5
		Causes of delay by contractor				
	6. Delays in sub-contractors work					
	7. Inadequate contractor's work					
	8. Frequent change of sub-contractors					
	9. Poor qualification of the contractor's					

	technical staff					
	10. Delays in site mobilization					
Causes of delay by Consultant	1. Delay in approving major changes in the scope of work					
	2. Poor communication and coordination					
	3. Inadequate experience of consultant					
	4. Mistakes and discrepancies in design documents					
	5. Delays in producing design documents					
	6. Unclear and inadequate details in drawings					
	7. Insufficient data collection and survey before design					
	8. Un-use of advanced engineering design software					
Causes of delay by materials	1.Shortage of construction materials in market					
	2. Changes in material types and specifications during construction					
	3. Delay in material delivery					
	4. Damage of sorted material while they are needed urgently					
	5. Delay in manufacturing special building materials					
	6. Late procurement of materials					

<b>Categories</b>	<b>Causes of delay</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Causes of delay by equipment	1. Equipment breakdowns					
	2. Shortage of equipment					
	3. Low level of equipment-operator's skill					
	4. Low productivity and efficiency of equipment					
	5. Lack of high-technology mechanical equipment					
Causes of delay by labors	1. Shortage of labors					
	2. Working permit of labors					
	3. Low productivity level of labors					
	4. Personal conflicts among labors					
Causes of delay by external factors	1. Effects of subsurface conditions (e.g. soil, high water table, etc.)					
	2. Delay in obtaining permits from municipality					
	3. Hot weather effect on construction activities					
	4. Traffic control and restriction at job site					
	5. Accident during construction					
	6. Changes in government regulations and laws					
Causes of delay by external factors	7. Delay in providing services from utilities (such as water, electricity)					
	8. Delay in performing final inspection and					



**Question:**

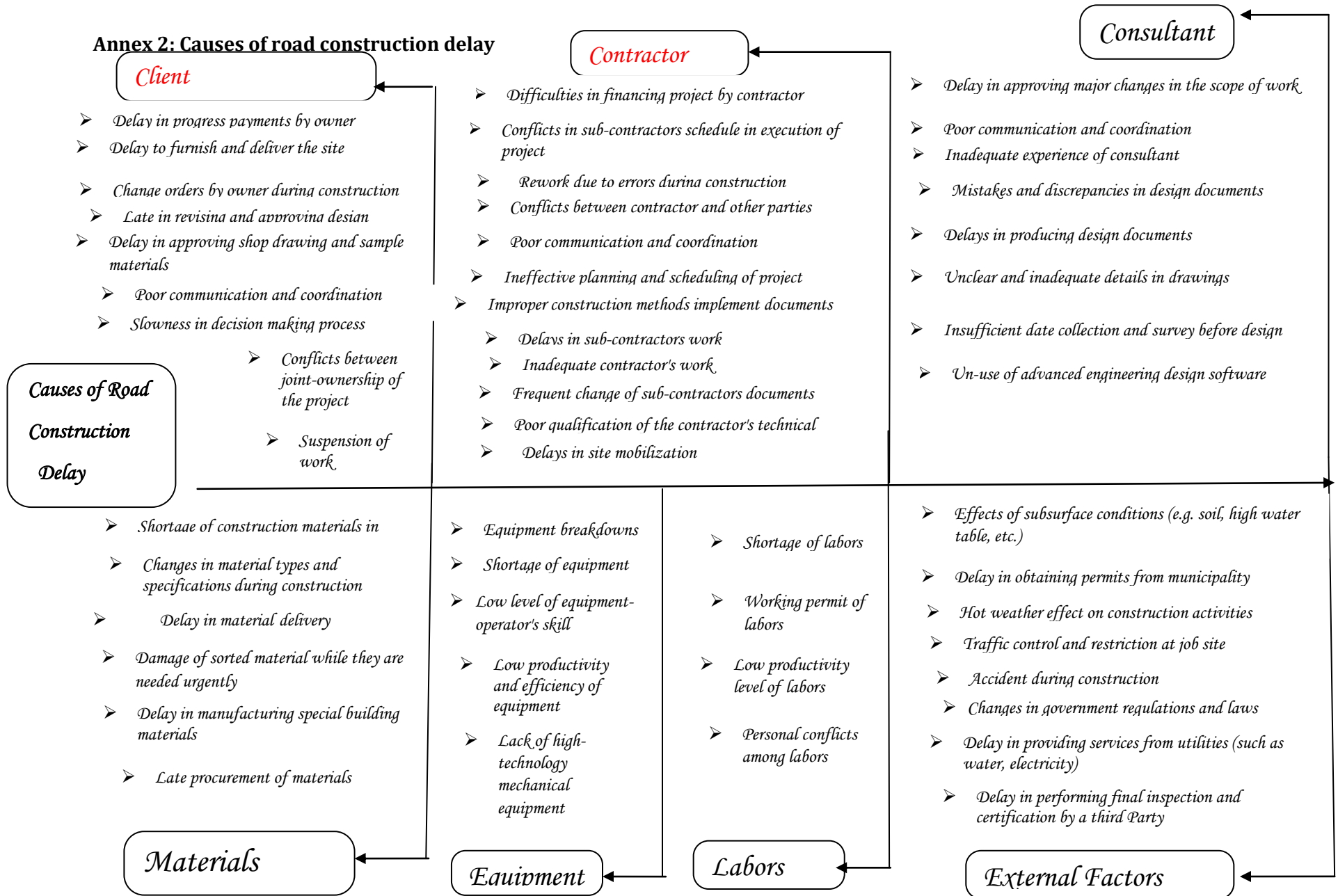
Which of the following methods will minimize the construction delays?

	<b>Proposed Method</b>	1	2	3	4	5
1	Frequent progress meeting					
2	Use up-to-date technology utilization					
3	Use proper and modern construction equipment					
4	Use appropriate construction methods					
5	Effective strategic planning					
6	Proper material procurement					
7	Clear information and communication channels					
	<b>Proposed Method</b>	1	2	3	4	5
8	Frequent coordination between the parties involved					
9	Proper emphasis on past experience					
10	Proper project planning and scheduling					
11	Complete and proper design at the right time					
12	Site management and supervision Long					
13	Collaborative working in construction					
14	Compressing construction durations					

If there are any additional factors that have an impact on construction project delay, you can list on the space provided below. -----

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## Annex 2: Causes of road construction delay



### Annex 3: Individual cause analysis by relative importance index

Causes of construction delay	Consultant		Contractor		Average		
	Mean	RII	Mean	RII	Mean	RII	RANK
Improper construction methods implement	4.57	0.914	4.94	0.878	4.75	0.8960	1
Low level of equipment-operator's skill	4.71	0.943	4.63	0.822	4.67	0.883	2
Late in revising and approving design documents	4.50	0.9000	4.63	0.8222	4.56	0.8611	3
Late procurement of materials	4.64	0.929	4.44	0.789	4.54	0.859	4
Low productivity and efficiency of equipment	4.29	0.857	4.50	0.800	4.39	0.829	5
Change orders by owner during construction	4.00	0.8000	4.75	0.8444	4.38	0.8222	6
Delay in material delivery	4.14	0.829	4.44	0.789	4.29	0.809	7
Low productivity level of labors	4.36	0.871	4.19	0.744	4.272	0.808	8
Ineffective planning and scheduling of project	4.29	0.857	4.25	0.756	4.27	0.8063	9
Delay to furnish and deliver the site	4.29	0.8571	4.19	0.7444	4.24	0.8008	10
Delays in site mobilization	4.29	0.857	4.19	0.744	4.24	0.8008	10
Delay in progress payments by owner	4.07	0.8143	4.31	0.7667	4.19	0.7905	12
Delays in producing design documents	4.00	0.800	4.19	0.744	4.09	0.772	13
Poor qualification of the contractor's technical staff	4.14	0.829	3.88	0.689	4.01	0.7587	14
Slowness in decision making process	3.71	0.7429	4.25	0.7556	3.98	0.7492	15
Unclear and inadequate details in drawings	3.79	0.757	4.13	0.733	3.96	0.745	16
Difficulties in financing project by contractor	3.93	0.786	3.81	0.678	3.87	0.7317	17
Delay in approving major changes in the scope of work	3.57	0.714	4.19	0.744	3.88	0.729	18
Mistakes and discrepancies in design documents	3.86	0.771	3.81	0.678	3.83	0.725	19
Poor communication and coordination	3.79	0.7571	3.69	0.6556	3.74	0.7063	20
Changes in material types and specifications during construction	3.57	0.714	3.75	0.667	3.66	0.690	21
Shortage of equipment	3.79	0.757	3.50	0.622	3.64	0.690	21
Shortage of construction materials in market	3.64	0.729	3.56	0.633	3.60	0.681	23
Delay in manufacturing special building materials	3.29	0.657	3.69	0.656	3.49	0.656	24
Poor communication and coordination	3.00	0.600	3.63	0.644	3.31	0.622	25
Insufficient data collection and survey before design	3.00	0.600	3.50	0.622	3.25	0.611	26
Delay in obtaining permits from municipality	3.21	0.643	3.19	0.567	3.20	0.605	27

Causes of construction delay	Consultant		Contractor		Average		
	Mean	RII	Mean	RII	Mean	RII	RANK
Inadequate experience of consultant	2.86	0.571	3.56	0.633	3.21	0.602	28
Damage of sorted material while they are needed urgently	2.86	0.571	3.50	0.622	3.18	0.597	29
Equipment breakdowns	3.36	0.671	2.88	0.511	3.12	0.591	30
Effects of subsurface conditions (e.g. soil, high water table, etc.)	3.07	0.614	3.00	0.533	3.04	0.574	31
Conflicts in sub-contractors schedule in execution of project	3.00	0.600	2.88	0.511	2.94	0.5556	32
Lack of high-technology mechanical equipment	2.79	0.557	2.75	0.489	2.77	0.523	33
Conflicts between joint-ownership of the project	3.07	0.6143	2.38	0.4222	2.72	0.5183	34
Un-use of advanced engineering design software	2.29	0.457	2.88	0.511	2.58	0.484	35
Conflicts between contractor and other parties (consultant and owner)	2.93	0.586	2.13	0.378	2.53	0.4817	36
Changes in government regulations and laws	2.36	0.471	2.69	0.478	2.52	0.475	37
Suspension of work	2.50	0.5000	2.44	0.4333	2.47	0.4667	38
Inadequate contractor's work	2.43	0.486	2.50	0.444	2.46	0.4651	39
Hot weather effect on construction activities	2.57	0.514	2.25	0.400	2.41	0.457	40
Delay in providing services from utilities (such as water, electricity)	2.21	0.443	2.56	0.456	2.39	0.449	41
Delays in sub-contractors work	2.21	0.443	2.50	0.444	2.36	0.4437	42
Traffic control and restriction at job site	2.29	0.457	2.31	0.411	2.30	0.434	43
Frequent change of sub-contractors	2.21	0.443	2.38	0.422	2.29	0.4325	44
Delay in performing final inspection and certification by a third Party	2.07	0.414	2.50	0.444	2.29	0.429	45
Shortage of labors	2.21	0.443	2.19	0.389	2.201	0.416	46
Personal conflicts among labors	2.00	0.400	2.19	0.389	2.094	0.394	47
Accident during construction	1.57	0.314	2.56	0.456	2.07	0.385	48
Working permit of labors	1.71	0.343	1.75	0.311	1.732	0.327	49