JIMMA UNIVERSITY
JIMMA INSTITUTE OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR

ASSESSMENT OF CONSTRUCTION CONTRACT DURATION IN ROAD PROJECTS OF ETHIOPIAN ROAD AUTHORITY WEST DISTRICT

A Thesis submitted to School of Graduate Studies, Jimma University, Jimma Institute of Technology, Faculty of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree Master of Science in Construction Engineering and Management

by

Mohammed Aman Abajobir

November, 2020
JImma, Ethiopia

JIMMA UNIVERSITY
JIMMA INSTITUTE OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR

ASSESSMENT OF CONSTRUCTION CONTRACT DURATION IN ROAD PROJECTS OF ETHIOPIAN ROAD AUTHORITY WEST DISTRICT

A Thesis submitted to School of Graduate Studies, Jimma University, Jimma Institute of Technology, Faculty of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree Master of Science in Construction Engineering and Management

Advisor: Engr. Alemu Mosisa (Assistant Professor) _____

Co-Advisor: Engr. Ahmed Nuredin _____

November, 2020
Jimma, Ethiopia

DECLARATION

I declare that this research entitled "Assessment of Construction Contract Duration in Road Projects of Ethiopian Road Authority West District" is my original work and has not been submitted as a requirement for the award of any degree in Jimma University or elsewhere.

Mohammed Aman Abajobir _____ _____

NAME SIGNATURE DATE

As research Adviser, I hereby certify that I have read and evaluated this thesis paper prepared under my guidance, by Mohammed Aman Abajobir entitled "ASSESSMENT OF CONSTRUCTION CONTRACT DURATION IN ROAD PROJECTS OF ETHIOPIAN ROAD AUTHORITY WEST DISTRICT" and recommend and would be accepted as a fulfilling requirement for the Degree Master of Science in Construction Engineering and Management.

Advisor: Engr. Alemu Mosisa (Assistant Professor) _____ _____

NAME SIGNATURE DATE

Co - Advisor: Engr. Ahmed Nuredin _____ _____

NAME SIGNATURE DATE

ABSTRACT

In the construction industry the contract time is the most determinant issue. In road projects specially, the contract time is very crucial and needs proper estimation. The construction contract (CC) should therefore carefully organize the duration of the project.

The Ethiopian construction projects are subjected to lack of well-planned CC duration. The study attempted to assess the construction contract duration (CCD) of road projects in case of Ethiopian road authority. The specific objectives of the study were to identify the current practice of Ethiopian road authority (ERA) in CCD, to find out the major types of factors affecting CCD in the authority, and to investigate the effect of social and environmental issues related to CCD in the study area.

The design of the study has employed qualitative research method. The study area was road projects in ERA-WR (ERA- West District) area and the sample was taken from managers and experts in ERA, Ethiopian Road Research Center (RRC) in Addis Ababa, and other contractor and consulting companies that are currently undertaking road projects with ERA in the study area. The sampling technique used was non probability purposive sampling technique to select the companies as well as the sample respondents in the respective companies.

The primary data collection technique that used in this study was depth interview and document consultation for mining additional data and for triangulation purpose was also employed. The data has been analyzed by employing qualitative analysis approach, and that involving some descriptive statistical computations and presentations for sorting out, demonstrating and interpreting the results appropriately.

Hence, the practice of ERA to set construction contract duration is almost similar through all the districts and determined by plan and program office without considering the engineering value. Concerning the factors affecting CCD, there are many but the top five factors are weather condition, terrain (topography) of the area, type of the project (road), poor site management and type of soil. Furthermore these factors extremely affect the CCD of the study area by extending the contract duration greater or equal to two folds of the planned duration.

Key words: - Construction projects, factors affecting CCD, Road construction.

ACKNOWLEDGMENT

I would like to express my gratitude to my respected advisors Engr. Alemu Mosisa (Assistant Prof.) and Engr. Ahmed Nuredin for their thoughtful support in the preparation of this research. I would also thank head office workers, especially West district office, of Ethiopian road authority for their cooperation on interview and on giving useful materials that were valuable for the investigation of the expected outcomes. I also do not like to forget my dear Mr. Million Kebede for his initiated impact on choosing proper research topic. Finally, I know it is difficult to list those who participate in preparing this paper in advising, interviewing (consultants and contractors), giving direction, writing and publication of the document and funding the budget; I really want to thank you all.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ABBREVIATION

AC	Asphalt Concrete
CAL	Client Access License
CC	Construction Contract
CCD	Construction Contract Duration
CDSCo	Construction Design Share Company
CGC	China Gansu Construction
CPM	Critical Path Method
DAECo	Dana and Associates Engineering Company
DST	Double Surface Treatment
ECWCo	Ethiopian Construction Works Corporation
ERA	Ethiopian Road Authority
ERA-WD	Ethiopian Road Authority - West District
FIDIC	Fédération Internationale Des Ingénieurs-Conseils (International Federation of Consulting Engineers)
GCC	General Conditions of Contract
GDP	The Growth and Development Program
GM	General Manager
GTPs	Growth and Transformation Plans
MCE	MIDROC -Construction Ethiopia
MIDROC	Mohammed International Development Research and Organization Companies
PERT	Program Evaluation Review Technique
PM	Project Manager
QARISM	Quality Assurance Road Inspection And Safety Management (ERA)
RRC	Road Research Center (ERA)
RSDP	Road Sector Development Program
VDOT	Virginia Department of Transport
WD	West District

CHAPTER ONE

INTRODUCTION

1.1 Background

Construction is the process that sets up a portable plant, brings material to the site, and on completion of the work, and moves the plant away leaving its outputs standing. These outputs are all immobile structures; buildings, dams, road and tunnels, power plants, airports, municipal treatment plants, pipelines, etc. Each of these construction processes broadly divided into different types and different sections with each section requires its own budget and duration. Construction projects are the organized effort to construct any of the above constructions.

A contract is simply an agreement between two or more parties in which one party agrees to perform a specific task or provide goods or a service to another in exchange for something in return (Darwish,2017). A construction contract (CC) is an agreement of executing the proposed construction project between the client (owner) and the contractor.

There are different types of contracts in construction project. These different types of contract (lump sum, unit price, cost plus a fee, incentive, guaranteed maximum price contract and design-build contract, etc.) determines the cost of the project as well as its duration.

Contract time is the maximum time allowed in the contract for completion of all work contained in the contract documents (Atreya, 2007). Estimating realistic construction time becomes increasingly an essence because it often serves as bench mark for assessing the progress and performance of a project as well as the efficiency of the organization. One of the critical issues at the early stage of the project is determining the contract duration. Although many owners require fast completion, a thorough study must be made to determine the contract duration.

Seuk et al. (2008) stated an accurate forecast of contract time is crucial to contract administration as the predicted duration and associated cost form a basis for budgeting, planning, monitoring, and even litigation purpose. Where unrealistic contract duration is imposed, this will obviously force the contractor either to accelerate the progress of the

works and neglect the desired quality, or to perform the works as required but not on time.

Atreya (2007) noted that, the determination of contract time affects not only the actual duration of the construction project, but also such aspects of construction such as costs, resource planning, selection of contractors and traffic problems. It was also pointed that an accurate estimation of contract time reduces the impact of a delayed project on the local economy and provides justification to contractors during construction claims.

The determination of the duration of an activity in the construction field is a relatively complex event because of the different variables that may intervene and affect the realization of the activity. Thus, the completion time of an activity is dependent on many factors. Some of these factors can be somewhat controlled, such as production rate of construction, while others are uncontrollable such as weather condition, intensity of traffic as well as the size of the project, or location of the construction site (urban vs. rural areas), effectively produced variations in the completion time of a construction project.

Furthermore, the financial condition of the contractor or the timely/untimely delivery of material may affect the completion date of some activities or even the entire project, (Jaraiedi and Iskander, 2008).

This study assessed the major factors affecting in setting construction contract duration (CCD), and suggested recommendations related to the practice of setting CCD for Ethiopian Road Authority projects in West District (ERA-WD).

1.2 Statement of the Problem

Delays in construction projects due to improper estimation of the project time as Sambasivan and Soon, (2007) stated is a global phenomenon.

R. Barbosa and A. E. Jungles, (2016), investigated 70%(of the construction projects in United Kingdom were delivered late from the planned schedule. Especially in Africa, the CCD adopted traditionally and almost all the road projects practiced 100% timeoverrun.

The CCD that is implemented in road construction projects of the country was not well planned in proportion to the magnitude of the work. In most road projects, equal amount of duration/ time of completion is planned for different magnitude of work (for instance, length of road) and for different amount of budget. This is one of the points that have initiated to conduct this study.

This study also motivated by the unavailability of no researches on conducted on factors that affect CCD in specifically in road construction in this study area. However, there have been conducted several studies on delay of the construction projects, Tolera E. (2018) and Birhan B. (2018) and time overrun of given projects, Siraw Y. (2015) in our country, there was not found researchs to assess the proportional relationship between the planned time and allocated budget or magnitude of the project with respect to the CCD. Therefore, this study tried to cover this study gap.

According to Gondy and Hildreth, (2007) the reasonableness of the contract time included in contracts is important. They also discussed that if time is insufficient, bid prices may be higher, and there may be an unusual number of time overruns and contractor claims.

1.3 Research Questions

In order to study the identified problem in ERA, the following questions were raised.

- What is the problem in current practice of CCD determination of ERA?
- What are the major factors affecting CCD?
- How much these factors affect CCD of the study area.?

1.4 Objectives

1.4.1 General Objective

The main objective of the study was to assess the Construction Contract Duratiom in ERA road construction projects.

1.4.2 Specific Objectives

1) To identify the problems in the current practice of CCD determination of ERA projects
2) To find out the major factors affecting CCD and
3) To investigate the effects of some especial factors in the study area.

1.5 Scope of the Study

Construction is the high risk-full industry. It is concerned in both building construction and road/ bridge construction. It is difficult to complete these projects in the proposed time. But it is possible to minimize the delay. This particular research concentrated only on the CCD practice of ERA-WD part that was selected among ten (10) districts of the authority.

1.6 Significance of the Study

The outcome of this study is valuable to the client (ERA) as it provides proper basis to make a reliable budget planning and a dependable performance evaluation, it is significant to the contractor as it is a sound ground in making proper resource, budget and time scheduling for completing the project as intended, and it also has importance to the consultant as it minimizes or avoids claims arise from both the client and the contractor as a result of improper CCD.

Similarly, it has significant to the road users to get a realistic duration for the project service opening. The study may also fill a certain gap on setting future contract duration in the ERA projects. Furthermore, the study output will provide other studies in the area as initial information for further detail research work.

CHAPTER TWO

LITERATURE REVIEW

2.1 Construction Contract Duration

According to the Civil Code of Ethiopia, Art.1675, and contract is an agreement whereby two or more persons as between themselves create, vary or extinguish obligations of a proprietary nature. Design Build FIDIC (current version is the fourth edition, 2006, reprinted in 2010 with further amendments.) defines contract as Conditions of the Specification, the Drawings, the Bill of Quantities, the Tender, the Letter of Acceptance, the Contract Agreement (if completed) and such further documents as may be expressly incorporated in the Letter of Acceptance or Contract Agreement (if completed).

Contract time is the maximum time allowed in the contract for completion of all work contained in the contract documents, (Atreya, 2007). Contract time is defined as the number of working days needed to complete a highway construction project. A working day is defined as eight continuous construction hours within a calendar day.

A reasonable contract time for a given highway construction project should be specified so that the contractor can complete the project in time under normal conditions. The contract time depends on the magnitude and complexity of the highway construction project and therefore should be set accordingly (Jiang, 2014).

Contract duration can simply be considered as the time agreed upon by the makers in order to complete the terms of the contract. While this sounds simple, many lawsuits have been filed over the interpretation of contract durations. Most often the lawsuits rise out of the confusion of when contract time starts. As stated earlier from Gondy and Hildreth (2007), contract time is usually defined as a specified number of calendar days indicated in the Invitation for Bids (federal government) or the Public Notice for Bids (city, state, and private projects). This is by far the most popular method of indicating the duration for a lump sum contract.

CC may be formed between a contractor and a proprietor, between a contractor and subcontractors, between a principal and a designer. The relationships, both contractual and otherwise, between the various parties in the building process have become complex

and in many cases quite obscured. It is likely that some co-ordination and contractual problems are bound to occur, resulting in claims and disputes.

Because the contractual relationships between the parties to a building contract are not likely to become less complex in the future, every effort should be made to minimize the number of claims and disputes and the impact they may have on the cost of the project. To achieve this, the parties to a contract should know the legal principles governing the formation of contracts (Thomas and Philip, 2002). There is numerous contract types used in construction depending on owner and project requirement.

2.2 Construction Contract Documents

As cited in Selamawit (2016), Mohammed, R.E., (2007) defined contract document as, the written and graphical documentation which communicates in a professional manner and in compliance with regulations and laws for the tendering purpose all needs, wants, and knowledge of the project stakeholder to contractor(s) for the purpose of construction of the project and which enable the client and/or designer a smooth and effective administration during the construction stage within the set objectives of time, cost, and quality.

As civil engineering works are often complex, involving the contractor in many hundreds of different operations using many different materials and manufactured items, including employment of a wide variety of specialists, the documents defining the contract are complex and comprehensive.

The task of preparing them for tendering therefore warrants close attention to detail and uniformity of approach, so as to achieve a coherent set of documents which forms an unambiguous and manageable contract (A.C. Twort et al.,2004).

2.2.1 Elements of Construction Contract

According to American Institute of Architects (AIA, 2006), main parts of contract document are the specification, the contract drawings, bill of quantities or schedule of prices, and conditions of contract.

A. ***The Specification:*** The specifications are that portion of the contract documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the work, and performance of related services. "Specification" means the document entitled specification, as included in the

contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works. (FIDIC, 2010)

B. ***The contract drawings:*** The Drawings are the graphic and pictorial portions of contract documents showing the design, location and dimensions of the work, generally including plans, elevations, sections, details, schedules and diagrams. "Drawings" means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract (FIDIC, 2010).

C. ***Bill of quantities or schedule of prices:*** "Bill of Quantities", "Day work Schedule" and "Schedule of Payment Currencies" mean the documents so named (if any) which are comprised in the Schedules. (FIDIC,2006) Bills of Quantities consist of a schedule, defined as "a list of items giving brief identifying descriptions and estimated quantities of work comprising the execution of the works to be performed".

D. ***Conditions of a contract:*** The general conditions include which outlining the rights, responsibility, and duties of owner and contractor as well as others involved in the construction process (including the designer). Special condition of contract is generated from the general condition of the contract but for specified projects.

2.2.2 Factors Affecting Construction Durations

Higher production rates will certainly result in shorter construction durations. It is obvious that construction durations will be affected by all the factors that would affect highway production rates. Productions rates are influenced by such factors as construction firms, locations of projects, and weather conditions. Construction durations are also affected by these factors because the direct relationship between production rates and construction durations.

Moreover, construction durations include not only the days when construction activities were actually performed, but also the days when construction activities could not be performed because of adverse weather conditions/ any other reasons. Thus, number of non-working days, which is not reflected in production rates, is also part of construction duration (Moselhi, 2001).

The actual construction duration of a highway construction project is greatly affected by the specified contract time in the contract. A contract time is determined primarily by the

magnitude and complexity of the highway construction project. Furthermore, other factors, such as the type of highway and traffic volume, are also considered in setting contract times in order to minimize the construction effects on motorists and adjacent businesses. To complete a construction project within the required contract time, a contractor may have to utilize extra resources if necessary, including extra working hours per day, equipment, materials and manpower (Lee et al., 2002).

According to Moselhi (2001), the effects of type of highway, traffic volume, and weather condition on construction durations are examined as follows:

a) Type of Highway: Practically, there are no identical highway construction projects in terms of design, magnitude, and complexity. To compare the construction durations of different construction projects, there must be a common basis for the projects to be comparable. It was found that total construction costs could be used as a reasonable common basis for construction duration comparisons, because construction costs are directly related to the magnitude and complexity of construction projects.

The type of highway is an important factor of construction durations because it is considered to set contract time so that the impact of highway construction on motorists' safety, traffic delay, and business operations can be controlled. Construction projects on highways with higher traffic volumes are often required to have shorter contract times to minimize traffic interruptions caused by construction activities. Consequently, the specified contract times influence the actual construction durations because the contractors would utilize their resources according to the contract times (Moselhi, 2001).

b) Weather Conditions: The natural environment strongly influences the progress of construction. Probably the most common cause of project delay is inclement weather. Weather conditions such as snow, cold temperatures, and high winds can substantially affect the times required to do certain types of construction work and often cause non-working days (Moselhi, 2001).

Gondy and Hildreth (2007) underlined the application of written procedures for the determination of contract time is important so that production rates and other considerations are applied uniformly. Written procedures should address how to classify projects based upon appropriate factors such as high traffic volumes.

These procedures should also account for significant geographic and climatic differences, which could affect contractor productivity rates. The fact that some types

of work can or cannot be undertaken during certain times of the year should also be addressed. Where applicable, the effect of working under traffic also needs to be considered. Experience and judgment of scheduler are also important elements in the final contract time determination.

The reasonableness of the contract time included in contracts is important. If time is insufficient, bid prices may be higher and there may be an unusual number of time overruns and contractor claims.

Consideration shall be taken on the available contractors and their workload. Contractors should be able to schedule work to maximize efficiency of equipment and labor, and if contract time is too short, these efficiencies are more difficult to obtain resulting in higher prices. If the time allowed is excessive, there may be cost inefficiencies by both VDOT and the contractor. The public may be inconvenienced unnecessarily and subjected to traveling on a roadway where safety is less than desirable for an extended period of time.

In establishing contract time, VDOT should strive for the shortest practical traffic interruptions to the road user. If the time set is such that all work on a project may be stopped for an extended period (not including necessary winter shutdowns) and the contractor can still complete the project on schedule, it means the contract time allowed was excessive, (Gondy and Hildreth, 2007).

Atreya (2007) marked a contract time that is estimated using any technique remains inaccurate unless it has been adjusted to take into consideration project specific factors. This is required due to the fact that every project is unique in nature.

Atreya (2007) also showed that weather and seasonal effect has an impact on CCD. Weather conditions being a prominent influence in high way construction must be factored into the contract time estimation process by specifying taking into account months that prevent construction works due to adverse weather conditions. During such period, the construction work is suspended (Atreya, 2007).

Weather conditions being a prominent influence in high way construction must be factored into the contract time estimation process by specifying taking into account months that prevent construction works due to adverse weather conditions. During such period, the construction work is suspended.

Similarly, the following factors are showed by Atreya (2007) in order of their importance:

c) ***Location of the project:*** A project located in an urban area is found to take more time than a similar project in a rural area. On other occasions, a rural project might take a longer duration due to long mobilization times and great distances.

d) ***Traffic impact:*** There is a marked difference in construction time when work is performed in high-volume traffic areas than that of low-volume traffic areas.

e) ***Relocation of construction utility:*** If it's included in the contract time, it's one of the several tasks that need to be accomplished during the project, but it is a complex process.

f) ***Type of project:*** Project types that were found to have consistent effect on contract time were urban versus rural, flat terrain versus mountain project, bridge projects, rehabilitation projects, etc.

g) ***Special items:*** Any special item that has a long lead time before it reaches the job site must be factored properly into the contract time; items such as asphalt, steel, electromechanical systems.

h) ***Night/ weekend work:*** Projects involving night or weekend work require longer duration than projects that are completed during normal daytimes since the production rates during these times falls dramatically as the focus shifts more onto safety precautions.

i) ***Dominant activities:*** Some of complex construction projects have been found to have one or few dominant activities, phases, or controlling operations that influence or controls the total contract time.

j) ***Environmental:*** Whenever concerned projects deals with environmental sensitive factors, additional time must be factored into the current time by the scheduler to mitigate its adverse impacts on the contract time. e.g.: hazardous materials to be environmentally sensitive.

k) ***Material delivery time:*** Timely delivery of certain special items (fabricated steel, signals, signs, etc.) has influence on contract time.

l) ***Mobilization and assembly time:*** Mobilization time is usually added into the contract time estimate as a common practice. An ideal mobilization time needs to be estimated based on factors such as project size, location, complexity, and equipment needs.

m) ***Conflicting construction operation:*** Certain activities in a construction project if not properly planned starts to overlap one another causing a conflict not only in the concerned area but also on other following area (ripple effect). Two or more

contractors working on the same limited work front at the same time, slows the progress of each party thereby causing a conflict. The scheduler needs to properly adjust the schedules to avoid any kind of overlapping by proper phasing before letting the projects and even during the construction process.

n) Permits: Certain permits may be required. The time required to obtain such permits will vary depending on the nature of the permit and the authority granting the permit.

o) Waiting and delay time: There are various activities that need to the proper amount of time allotted for in order to have an accurate time. These activities include items such as review of shop drawings, settlement of earth work over burden (if needed) and curing of concrete pavement and structures.

p) Budget and contract payment control: When a project is backed by a huge budget, contract time can be reduced to complete the work faster than using normal conditions.

q) Others:

- Commitment by all parties to complete the contract within the deadline.
- Effect of community institutions and events on the project.
- Availability of access roads for emergency situations
- Cash flow of all parties involved.
- Marine and railroad traffic.
- Review time needed for shop drawings, constructability analysis
- Legal aspects

The survey also indicated that no factor could be singled out and isolated and all of the factors overlap each other on more than one occasion, (Atreya, 2007). Gondy and Hildreth (2007) showed for most projects the essential elements in determining contract time include: (1) establishing production rates for all items; (2) adopting production rates to a particular project; (3) understanding potential factors such as business closures, environmental constraints: and (4) computation of contract time with a progress schedule or other techniques.

Generally, the factors/ variable that affect the planned CC time of a given project could be summarized as the practice of CCD (data that showed the current practice of CCD in the district that were gathered from the respondents, from the document and from the progress report), different factors of CCD (under the different types of factors affecting

the duration of road projects, the most high ranking top fife factors), the effects of some especial factors in the area (such as weather condition, type of soil and right of way).

2.2.3 Contract Duration Estimation

Contract times can be estimated based on the results of production rates and construction durations. A specified contract time affects many aspects of a highway construction project, such as costs, construction management and planning, contractor selection, traffic control strategies, and work zone layout. A proper contract time is critical for highway agencies, contractors, motorists, and local businesses. It is because highway construction activities exert impact on traffic conditions, travel delays of motorists, construction schedules, and safety of motorists and construction workers. Contract time sets a time limit for a contractor to complete a highway construction project and therefore directly affects the actual construction duration (Baker, 2016).

As the highway system ages, there are an increasing number of highway construction projects every year, including highway resurfacing, restoration, and rehabilitation and bridge rehabilitation and replacement. In the meantime, traffic volumes are consistently increasing on most of the highways, especially on federal and state highways. Thus, most highway construction activities are being carried out adjacent to traffic, resulting in an increase in the exposure of construction workers and motorists. Consequently, longer contract time or construction duration would create more safety concerns of motorists and construction workers (Baker, 2016).

In general, contract time can be measured in several different ways:

- Working days, the time that the contractor will be working on the project, excluding weekends, holidays, and adverse weather related non-working days.
- Calendar days, elapsed time without regard to the contractor's necessarily being on the job.
- Completion dates, a specific date in the calendar year by which the project is to be completed.

2.2.4 Production Rate and Construction Contract Duration

A. Establishing Production Rates

A production rate is the quantity produced or constructed over a specified time period. Estimating realistic production rates is important when determining appropriate contract completion time. Productions rates may vary considerably depending on project size,

geographic location, and rural or urban setting, even for the same item of work, (Federal High Way Administration, 2002).

Production rate ranges have been established in the VDOT's written procedures based on project size, geographic location, project type (grading, structures, etc.), size location, and complexity for all items of work. This enables VDOT to assign the production rate accordingly part of this procedure for determining contract completion dates; VDOT has established "Guidelines for Production Rates and Chart for Contract Duration." This document contains a set of production rates for many of the activities that occur in highway/bridge construction projects. Production rates for all possible activities are not included nor are all production rates used in each construction job.

The production rates may have to be supplemented with information from other sources and should be adjusted with good engineering judgment and past experience with similar work, (Gondy and Hildreth, 2007).

B. Adapting Production Rates to a Particular Project

Gondy and Hildreth (2007) stated before durations for individual work items computed, certain project specific information should be determined and some management decisions made. The relative urgency for the completion of a proposed project should be determined. The traffic volumes affected as well as the effect of detours should be analyzed. The size and location of the project should be reviewed, in addition to the effects of staging, working double shifts, nighttime operations, and restrictions on closing lanes. The availability of material for controlling items of work should be investigated. For example, it might be appropriate to consider the need for multiple crews on a specific item to expedite the completion when there are exceptionally large quantities or when there is a large impact on traffic.

Procedures to accelerate project completion should be considered when construction affects traffic substantially or when project completion is crucial. This is especially important in urban areas with high traffic volumes. When accelerating contract time for time sensitive projects, production rates should be based on an efficient contractor working more than eight hours per day, more than five days per week and possibly with additional workers. The development and application of a separate set of production rates for critical projects is recommended, (Gondy and Hildreth, 2007).

C. Computation of Contract Time - Developing a Progress Schedule

The contract time for most construction projects can be determined by developing a progress schedule. A progress schedule shows the production durations associated with the chosen production rates for the items of work. The time to complete each controlling item of work included in the progress schedule is computed based on the production rates applicable to that project. Items should be arranged by chronological sequence of construction operations. Minor items that may be performed concurrently should be shown as parallel activities.

In determining a progress schedule, it should be remembered that the start and end dates for each controlling item need to be based on the earliest date for which work on that item will begin and how long it will take to complete. The earliest start date for each activity will be determined by the completion of preceding activities, and should allow for the fact that some activities can begin before the preceding activity is entirely completed. Additional time should be also allowed in the contract for initial mobilization, (Gondy and Hildreth, 2007).

2.3 Models Related to Construction Contract Duration

2.3.1 Mean Production Rate Model

The construction duration of a highway construction project is directly affected by the construction firm's production rates of the construction activities. Therefore, if the construction activities in the critical path of the construction process can be identified, the time needed for the construction project can be determined using the mean production rates. For a given construction activity, the number of days needed to complete it can be estimated as follows:

Equation 1: *Mean Production Rate Model*

$$\mathbf{T = \frac{Q}{P}}$$

Where:

T = duration of the activity (working days)

Q = quantity for the activity

P = mean daily production rate of the activity

The key for this method is to appropriately determine the sequence of construction activities in the critical path of the construction process. The sequence of construction

activities in the critical path varies from project to project. Therefore, it is impossible to provide the sequences of highway construction activities for all types of projects.

2.3.2 Techniques to Calculate Contract Time

Contract time determination techniques quoted by Gondy and Hildreth (2007) includes: estimated cost method, bar chart method, CPM scheduling, PERT (program evaluation review technique), and Microsoft project.

A. Estimated Cost Method

As Gondy, and Hildreth, (2007) indicated the Estimated Cost Method is applicable for projects in which there is primarily one (1) type of work and that work type / component will be performed in a linear fashion. The project should also have a well-defined scope of work resulting in minimal risk and uncertainty.

The Estimated Cost Method of contract time determination utilizes a comparison of dollar value to time. Based on historical information, tables illustrating project cost versus project time are developed for different project types, traffic volume, and geographic location. Examples of such project types include new construction, reconstruction, overlay and widening projects, pavement repair, and bridge construction. Contract time is essentially determined based solely on the amount of the engineer's estimate.

For non-complex projects and projects affecting small volumes of traffic, this procedure may be appropriate. The estimated cost method is not recommended for use on projects where completion time is a major factor. Many items affecting the completion of a project are not taken into consideration when applying this method. Any special features that are unique to a specific project cannot easily be accounted for when using this very simplistic procedure, (Gondy, and Hildreth, 2007).

Example of an Estimated Cost Method type for Contract Time Determination, for example: from historical data and past experience on projects of similar types/conditions, let’s estimate that $2 Million of construction work was accomplished in 80 calendar days. Current Engineer’s estimate shows that the project construction cost to be around $3 Million.

Calculate ratio using interpolation:

- 80 days / $2M = x days / $3M, where “x” is the Contract time
- 80 days = x days
- $2 M $3 M

By cross multiplying the calculation indicates the Contract Time (x) = 120 days. Add 120 days to Notice to Proceed / Construction Start to get the Contract Completion date, (Gondy, and Hildreth, 2007).

B. Bar Chart

Gondy, and Hildreth, (2007) underlined the Bar Chart Method is applicable for use with projects in which there is relatively few work components with easily understandable relationships between the components. The project should also have a well-defined scope of work. A level of uncertainty unlikely to result in significant changes may be present.

Bar charts or Gantt charts are graphical representations of projects with specific completion dates and activities. Bars or lines are drawn proportional to the planned duration of each activity. Gondy, and Hildreth, (2007) pointed that a brief description of the procedure used to develop a bar chart to determine contract time is as follows:

The first step in developing a bar chart is to break a project down into separate activities necessary for project completion. Once all the activities necessary to complete a project have been listed, the duration of each activity needs to be determined based on production rates. With this data established, the bar chart can be prepared. A line or bar is drawn showing the time when work will be performed for each activity. The resulting diagram will represent a project, showing when each activity will be undertaken and completed.

With bar charts, the progress of a project may be monitored for each activity by drawing a line below the original scheduled performance to show the actual duration as it is completed. Bar charts are advantageous in that they are simple to develop and easy to understand, and a good method of determining contract time. Some disadvantages are that they do not show the interrelationship and inter-dependency among the various phases of work. Bar charts are difficult to properly evaluate when construction changes occur.

Also, controlling items are shown in the same manner as minor items, thus making it more difficult to determine which items actually control the overall time progress of the project. The use of bar charts is not recommended for contract administration and project management of large or complex construction projects, (Gondy, and Hildreth, 2007).

C. Critical Path Method (CPM)

Gondy and Hildreth (2007) quoted that the Critical Path Method is appropriate for projects with several components with complex relationships. These projects exhibit a

reasonable potential for significant changes and uncertainty that may result in sequence modifications and/ or scope adjustments.

Also Gondy and Hildreth (2007) stated the Critical Path Method (CPM) focuses on the relationship of the critical activities, those which must be completed before other activities are started. Working from the project's beginning and defining individual project tasks and the number of days to perform each task, a logical diagrammatic representation of the project is developed. A CPM depicts which tasks of a project will change the completion date if they are not completed on time.

The evaluation of critical tasks allows for the determination of the time to complete projects. Because of the size and complexity of most projects, this method is most often applied using a computer software program. Within the CPM software, the ability to use a Precedent Diagramming Method (PDM) provides a breakdown of each activity to boxes. This enables the user to view the connection of relationships to each activity. CPM software also has the ability to display the contract time in a bar chart view as well, (Gondy and Hildreth, 2007).

According to Gondy and Hildreth (2007), the application of CPM includes the following methodology: The first step in applying the CPM method is to break a project down into separate tasks or operations necessary for project completion. Each of these separate operations or processes is called an activity. The completion of an activity is called an event.

Once all the activities necessary to complete a project have been listed, the relationship of these activities to one another needs to be determined. In some instances, several activities can be undertaken concurrently, and at other times, certain activities cannot be undertaken until others have been completed. Generally, when determining the sequence of operations, some questions need to be asked such as: "What needs to be done before proceeding with this activity" or "what can be done concurrently?" Every activity has a definite event to mark its relationship with others with respect to completing a task.

In working with this procedure, a diagrammatic representation of the project is developed showing the correct sequence and relationship of activities and events. Each activity is shown as an arrow leading to a node, which indicates the completion of an event or the passage of time. The start of all activities leaving a node depends on the completion of all activities entering a node. Therefore, the event represented by any node is not achieved

until all activities leading to the node have been completed. The resulting diagram will be a schematic representation of a project, showing all the relevant activities and events in correct sequence.

An actual time can be set to each activity based on production rates and other appropriate factors. The time to complete each activity is then shown on each arrow to indicate the duration. The "early start" for each activity is the earliest point in time that an activity can start, provided that all activities before it have finished. This is not necessarily the point in time that it will start; however, it is the earliest time that it can start.

Gondy and Hildreth (2007) cited the "early finish" for an activity is merely the duration of the activity after its early start. As is the case with the "early start," this is not necessarily the point in time that the work represented by the activity will be over, but is the earliest point in time that it can occur. A "finish" date in CPM is the first day after the physical completion of the activity. The completion time of a project is the sum of the longest time path leading to completion of the project.

The optimum time and cost for performing the project can be evaluated by assigning resources i.e. equipment, labor hours, and materials to each activity. The diagrammatic representation of the project then provides a means to evaluate the costs incurred with respect to the completion activities.

As Gondy and Hildreth (2007) indicated, advantages of using the CPM include: It is an accurate technique for determining contract time and verifying that the project constructed as designed and with identified construction sequences; It is a useful tool for project managers in monitoring a project, especially when relationships of work items with respect to time; and

Activities responsible for delays can be identified and corrective measures to keep on schedule can be determined.

Also Gondy and Hildreth (2007) listed Disadvantages of using the CPM include: the CPM requires experienced and knowledgeable staff to be used effectively; they require regular updates to assure that the contractor's operation is accurately represented. Does not account for uncertainty, it is best used in projects where the activity time estimate can be predicted fairly accurately.

D. PERT (Program Evaluation Review Technique)

A PERT chart is a project management tool used to schedule, organize, and coordinate tasks with in a project. Review technique, methodology developed by the U.S. Navy in the 1950s to manage the Polaris submarine missile program (searchsoftwarequality.techtarget.com).

A PERT chart presents a graphic illustration of a project as a network diagram consisting of numbered nodes (either circle or rectangles) representing events, or milestones in the project linked by labeled vectors (directional lines) representing tasks in the project. The direction of the arrows on the lines indicates the sequence of tasks (techtarget.com).

According to brighthubpm.com steps in the PERT planning process:

1. Identify the specific activities and milestone.
2. Determine the proper sequence of the activities
3. Construct a network diagram
4. Estimate the time required for each activity
5. Determine the critical path
6. Update the PERT chart as the project progresses

PERT is best used in projects where the activity time estimate cannot be predicted fairly accurately. In other words, it accounts for uncertainty. PERT in its pure form cannot be used for time/cost trade off analysis. PERT Network uses a probabilistic approach to estimating for each activity. To estimate for an activity, the following formula is used.

Equation 2: *PERT probabilistic approach to estimating activity time*

$$\textbf{Expected time} = \frac{\textbf{optimistic} + \textbf{4} * \textbf{most likely} + \textbf{pessimistic}}{\textbf{6}}$$

Where,

Optimistic = lower probability (Approximately 1%) that the activity will be complete

Most likely = the highest probability of completing the activity in this time

Pessimistic = the longest possible time.

E. Microsoft Project

Microsoft office project, also referred to as Microsoft project, is a suite of tools for more efficient project and portfolio management. Project is used in a variety of industries including construction, manufacturing, pharmaceuticals, government, retails, financial services and health care.The main modules of Microsoft Project include project work and

project teams, schedules and finances. Microsoft Project is designed to help users set realistic goals for project teams and customers by creating schedules, distributing resources and managing budgets.

The Project Guide helps users create projects, track tasks, and report results. The software helps contractors gain control over their resources and finances by simplifying the assignment of resources to tasks and budgets to projects. Microsoft project also comes with a customizable wizard that walks users through the process of project creation, from assigning their tasks and resources to reporting the final results. Microsoft Project management software is closely integrated with Microsoft Office suite and also includes a Client Access License (CAL) that allows easy connection with Office Project Server.

2.3.3 Steps for Scheduling for Determination of Contract Time

Gondy and Hildreth (2007) mentioned establishing a project's duration will be accomplished with the following steps for all categories: review the project plans and specifications. Analyze and determine special factors that are controls affecting completion or phasing of the work. If the project has more than one phase, determine what work can be done in each of the phases; list the required activities for each phase; list each quantity of the unit of work that will be used as a basis for estimating the duration activity, e.g. for storm sewers this would be the number of linear feet of pipe, etc.

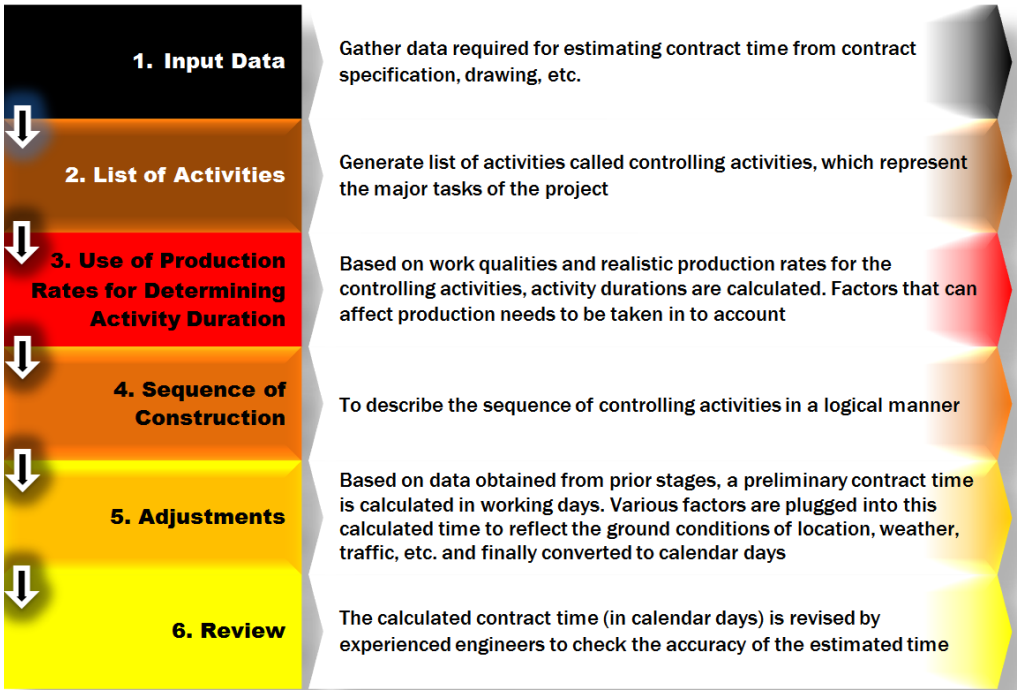
On a project with more than one phase use only that quantity associated with that phase. List of pay items shows, for instance, 10,000 cubic yards of excavation for a project, two phases, that have approximately the same amount on each phase, put 5,000 as the unit of work for excavation in Phase 1 and 5,000 cubic yards as the unit of excavation in Phase 2. Extreme accuracy is not required. It is only necessary that of activities sum to the whole, but a percent or two of error on any phase will not affect the results.

Use the production rates to convert the units of work into work days. Do this for each phase.

Enter activities to draw the Bar Chart for Estimating Contract Time. Conversion from working days to calendar days will be made by use of the Dura Lator worksheet. Winter shut down due to seasonal limitations will be addressed if the contract duration requires the work to occur during two or more construction seasons.

Status of utility report from the Right of Way Division will be checked to determine if any time adjustments are needed before the project is advertised or the Contractor will be start work. Also a determination should be made for coordination with utilities for any concurrent utility relocation work required. Seuk et al. (2008) stated that usually the responsibility for determining contract time is designated to a scheduler who gathers all data required for estimating contract time referring the design drawings, specifications, bill of quantities and all other relevant data. After browsing through all the data, the scheduler prepares a list of controlling activities that represent the major tasks of the project. The scheduler then starts calculating the duration for each controlling activity in the list using production rates and estimated work quantities. Seuk et al. (2008) put summarized form of the contract time determination process in the following chart.

Figure 1: Contract time determination process



Once the durations are calculated, the scheduler tries to logically sequence the activities and show the interdependency or independency between the various activities. The sequence is prepared either using bar chart or critical path method (CPM) to finally derive a preliminary project completion time. This process is done by hand or by using various scheduling software packages such as Microsoft project, primavera, etc.

The scheduler then uses experienced engineers and project manager's opinion to identify site specific conditions that are likely to affect the project and have an impact on the contract duration and incorporate in the calculated preliminary contract time. This

adjusted contract time in work days is then converted to calendar days or completion days. After reviewing this adjusted contract time by experienced personnel and obtaining the final approval, the final contract time is incorporated in the bid documents and become part of the contract between the contractor and the owner, (Seuk et al. 2008).

2.4 Empirical Studies

CCD is one of the major research interests in construction management and it has given a better emphasis in abroad than local studies. This study will focus only on some related studies that would achieve the objectives of the study in filling the gap illustrated in the statement problem of this proposal, i.e. the lack of local studies in the issue.

Concerning construction duration and CCD, Dursun and Stoy(2012) has shown that time, cost, and quality are the three most significant parameters determining the overall success of a construction project, in their studies. Similarly, Skitmore (2003) in their study revealed that several factors lead to time overrun, e.g., poor performance of contractor, faulty design, change orders, client's excessive delay in decision making, or unforeseen ground conditions and inclement weather.

According to Dursun and Stoy (2012), in practice, there are two common methods for estimating construction duration: based on the client's time constraints; and by way of a detailed analysis of the work required and resources available, the accuracy of which largely relies on the estimator's experience and judgment to interpret the project and site information in order to make the best possible decision. Both studies (Dursun and Stoy, 2012 and Skitmore, 2003) are agreed in that due to the competitive nature of the construction industry, contract durations, which are mainly imposed by clients, are kept to a minimum.

Several studies also reported that poor prediction ability of the model in others, however the recorded success of applying the time-cost model to predict project durations in specific geographical settings. For instance, Aiyetan et al. (2012) revealed that, due to the differences in socioeconomic and political conditions, construction business environment, weather and geophysical conditions, and technological advancements between one country and another, it becomes necessary to validate the model before it can be successfully applied within a particular environment (Aiyetan et al. 2012).Therefore, this study will consider some of these factors (socioeconomic and political conditions,

construction business environment, weather and geophysical conditions, ...) as variables of the study.

Additionally, Czarnigowska and Sobotka (2013) investigated the applicability of the time-cost model to predict road construction duration and confirmed its predictive ability. They developed a multiple regression model that integrated underground site conditions, project management works, estimating works, competency of subcontractors, completeness of design, and owner's financing capabilities. Therefore, this study will attempt to implement these models in the analysis of the study, in the assessment of CCD in the study area, ERA. Seuk et al. (2008) also stated an accurate forecast of contract time is crucial to contract administration as the predicted duration and associated cost form a basis for budgeting, planning, monitoring, and even litigation purpose.

Atreya (2007) noted the determination of contract time affects not only the actual duration of the construction project, but also such aspects of construction such as costs, resource planning, selection of contractors and traffic problems. Atreya (2007) also pointed an accurate estimation of contract time reduces the impact of a delayed project on the local economy and provides justification to contractors during construction claims. Atreya (2007) marked a contract time that is estimated using any technique remains inaccurate unless it has been adjusted to take into consideration project specific factors. This is required due to the fact every project is unique in nature. Atreya (2007) also indicated that no factor could be singled out and isolated and all of the factors overlap each other on more than one occasion, (Arreya, 2007).

2.5 Documents of Sample Companies and Other Sources

Additional data were also reviewed and collected through document consultation technique from local reports and media outlets that are compiled by the effort of the research of this study. In this regard, the following qualitative data was added to main collection of data of this study.

Ethiopia has gone through unprecedented road construction experience and has spent over $ 3.6 billion on road construction over the last decade and its expenditure will amount to 29 billion birr in a year (2013/2014). In speech to Ethiopia's parliament, the country's Prime Minister Haile Mariam Desalegn said that the biggest portion of the 2013/2014 budget will go into road construction

Public spending on road construction of the country indicated well in the some programs assessment of the authority. One of the key goal of the government of Ethiopia's current five-year development plan (2010/11 – 2014/15), the growth and transformation plan (GTP), which is geared towards fostering broad-based development in sustainable manner to achieve the MDG is "the roads network increment from 49,000km to 64,500km by 2015,The above figures show the important role road construction is playing in Ethiopia's economy. Stemming from this fact, RSDP IV (Road Sector Development Program – IV) is prepared as part of Governments' overall Growth and Transformation Plan. Implementation of RSDP IV is a major strategic pillar of the Growth and Transformation Plan and is intended to transform the road sector by setting implementation policy and strategy during RSDP IV. They include:

- Increasing rural Accessibility
- Improving Condition, Integration and Reach of the Road Network
- Cost minimization and improved efficiency
- Strengthen domestic construction industry
- Increase training and skills enhancement
- Improve management and approach, (Ethiopian Roads Authority, 2011)

The above facts and ambitious GTP require timely completed projects, hence; this shows the importance of setting accurate and realistic CCD.

2.5.1 Laws and Regulations

According to Art 3174(1) of Eth. Civil Code "Each contracting party shall perform his obligations within the time fixed by the contract." Public tendering on construction is governed by "Government procurement proclamation" which includes 80 articles establishing the basic rules for government tendering. This legislation was issued by the Ethiopian Federal Government Procurement and Property Administration Proclamation No. 649/2009 dated 9th September, 2009.

Public Procurement Manual English version, (December 2011) article 8.26 sub-articles 8.26.1 states that "Delivery of goods, construction works, and the performance of services should be completed by the supplier or contractor in accordance with the time schedule prescribed in the schedule of requirements"

As far as CCD is concerned there is no reference in the above regulations regarding the setting of CCD. This issue seems to be left to the project proponent to decide. However,

once the CC is signed by the government and the contractor, the CCD specified in the contract becomes binding and enforceable. It is not within the authority of the Government Agency (project owner to change it.)

Aside from setting CCD, in Ethiopia we can observe a number of standard forms of CC for the procurement of works that contain clauses related to CCD:

a) ***The Standard Bidding Document:*** This standard bidding document for procurement of works was issued by PPA/ Public Procurement Agency (NCB/ National Competitive Bid, August 2011) and it comprises of the following elements. These are General Conditions of Contract (GCC) 27: Liquidated Damage, GCC 71: Commencement, GCC 72: period of execution of works, GCC 73: Extension of Intended Completion Date, GCC 75: Acceleration, GCC 78: Delays in Implementation of Tasks, and GCC 88: Defect liability.
b) ***The Standard Conditions of Contract:*** This standard condition of contract of civil work projects was authored by Ministry of Works and Urban Development in December 1994. And it contains the following elements related to CCD. These are, Clause 43: time for completion, Clause 44: extension of time for completion, Clause 46: rate of progress, and Clause 47(1): liquidated damage for delay.
c) ***The FIDIC 1987 (Red Book) Conditions of Contract for Works of Civil Engineering:*** FIDIC 1987 (Red Book) Conditions of Contract for Works of Civil Engineering; International Federation of Consulting Engineers (commonly known as FIDIC, acronym for its French name Fédération Internationale Des Ingénieurs-Conseils) is an international standards organization for the construction industry, best known for the FIDIC family of contract templates. These are, Clause 43.1: time for completion, Clause 44.1: extension of time, Clause 46.1: rate of progress, and Clause 47.1: liquidated damage.

In brief, it seems the current government regulations do not address the issue of setting CCD. Because of no one of the above standards put any clauses concerning how the agreement of CCD should be signed.

2.5.2 On the Geographical Profile of the Country

Ethiopia is one of the largest African countries with a land area of some 1.11 Million sq. km. The greater part of the country consists of high plateau and mountains between 2000m and 4000m in elevation. There are also extensive low land areas. The topography and the influence surrounding continental masses and oceans have the effect of making

the country's climate extremely varied. Mean annual temperature vary significantly ranging from 34.5^{o}C in the Danakil depression to below 10^{o}C in some parts of the highlands. Rainfall is also highly variable, (ERA, 2003).

From this observation, it could be summarized that the CCD practice of the country can be affected by the CCD factors such as terrain, bad weather condition, poor soil nature, and extreme temperature. This factors considered in the analysis of this study by integrating data also gained from interview, showed that these factors are one of the major factors especially in this study area due to the fact that this is the only district of all ERA districts which included the top forest covered areas and high rainfall areas of the country. This makes these factors are the main factors that affected CCD in the study area, and this is also shown in the results of interview in the following section in detail.

The overall Road Management in ERA summarized here from the data of the document consultation of this study here.

In 1951 when Ethiopian Roads Authority was established the total road network amounted to 6,400 km. This network was built mainly during Italian invasion. By 1997 the road network has grown to 26,550 km, of which 3,708 km were paved, (Ethiopian Roads Authority, March 2003). Since its inception in 1997, RSDP has focused on rehabilitation and expansion of the main paved and unpaved roads and important regional roads.

The total road network has expanded from about 26,550 km at the beginning of the RSDP to 99,522 km (increased by 275%) in 2014 including Woreda roads, increasing the road density from 24.1 to 90.5 km per 1000 sq. km and from 0.46 to 1.1 km per 1000 population. The growth of the Classified Road Network over the RSDP period is summarized in table below.

Table 1: Growth of the Classified Road Network and Change in Road Density (1997– 2014)

Year		**Road network in km**				**Growth Rate (%)**	**Road Density/ 1000 popn.**	**Road density / 1000sq. km**
	Asphalt	Gravel	Rural	Woreda	Total			
1997	3,708	12,162	10,680		26,550		0.46	24.14
1998	3,760	12,240	11,737		27,737	4.5	0.46	25.22
1999	3,812	12,250	12,600		28,662	3.3	0.47	26.06
2000	3,824	12,250	15,480		31,554	10.1	0.50	28.69
2001	3,924	12,467	16,480		32,871	4.2	0.50	29.88
2002	4,053	12,564	16,680		33,297	1.3	0.49	30.27

2003	4,362	12,340	17,154		33,856	1.7	0.49	30.78
2004	4,635	13,905	17,956		36,496	7.8	0.51	33.18
2005	4,972	13,640	18,406		37,018	1.4	0.51	33.60
2006	5,002	14,311	20,164		39,477	6.6	0.53	35.89
2007	5,452	14,628	22,349		42,429	7.5	0.55	38.60
2008	6,066	14,363	23,930		44,359	4.5	0.56	40.30
2009	6,938	14,234	25,640		46,812	5.5	0.57	42.60
2010	7,476	14,373	26,944		48,793	4.2	0.58	44.39
2011	8,295	14,136	30,712	854	53,997	10.7	0.66	49.09
2112	9875	14675	31550	6983	63083	16.8	0.75	57.30
2013	11301	14455	32582	27628	85966	36.3	1.0	78.20
2014	12640	14217	33609	39056	99522	15.8	1.1	90.5
		Average Road Network Growth				8.4		

For the last 17 years (1997 - 2014) including RSDP I(5 years), RSDP II(5 years), RSDP III (3 years) and RSDP IV (4 years progress) the Ethiopian Roads Authority invested ETB about 180.9 Billion (USD 12.2 billion).During this period of RSDP implementation 41.2% of the total RSDP expenditure was on rehabilitation and upgrading roads, 28.8% was on construction of link roads, 5.7% on maintenance of federal roads, 8% on regional road and 11.7% on Woreda roads and 2.8% was on institutional support projects and other activities at federal level. Around 79% of the RSDP financing over the last seventeen years came from internal sources (GoE, the Road Fund and the community). The remaining 21% was pooled from the development partners. The share of the government of Ethiopia was the highest (69.4%), followed by the Road Fund (7.7%), the IDA (7.3%) and the EU (4.5%),Annual disbursement by donors and the Government for execution of projects under the RSDP is given in Table 2 below,(Ethiopian Roads Authority, October 2014).

Table 2: Disbursement by Financiers (1997-2014), Disbursement in million ETB

Financier	**Disbursement during RSDP**					age contribution %
	I (5 yrs.)	**II (5 yrs.)**	**III (3 yrs.)**	**IV (4 yrs.)**	**Overall 17 yrs.**	
GOE	3,455.5	8,669.5	20,354.8	92958.5	125438.3	69.4
Road Fund	978.2	2,555.8	5,030.1	5274.5	13838.7	7.7
Community	0.0	884.8	683.5	1640.7	3209.1	1.8
World Bank	1,432.9	3,135.3	2,544.2	6180.0	13292.3	7.3
European Union	678.1	1,049.7	3,485.0	2989.0	8201.9	4.5
*China			1,252.7	6502.5	7755.2	4.3
AfDB	506.4	517.8	496.4	2560.3	4080.8	2.3

Japan	164.9	380.0	307.1	1317.7	2169.7	1.2
OFID	0.3	293.3	213.6	97.8	605.0	0.3
Germany	27.7	302.6	67.0	235.0	470.1	0.3
Saudi fund	0.0	39.3	123.2	45.2	442.5	0.2
BADEA	0.0	59.9	175.2	189.3	406.1	0.2
United Kingdom	23.2	135.1	58.6	17.7	193.6	0.1
Kuwait Fund			49.9	199.3	361.7	0.2
NDF	14.8	63.9	97.2	293.7	343.6	0.2
Ireland	2.6	20.9	19.3	0.0	42.8	0.02
Sweden	0.0	5.0		0.0	5.0	0.003
TOTAL	7,284.6	18,113.0	34,957.8	120501.2	180856.5	100.0

**Sector Budget Support contribution is considered*

For all Road projects, that ERA prepared to be constructed, there should be a contract agreement to be signed by the two parties (client which is ERA and the contractor.) This contract document is prepared and get ready by the procurement office based on the design manual of the organization. There are different types of design manuals for different structural works. There are also different editions of these manuals. The currently used manual for this purpose is ERA Design Manual 2013.

This manual is prepared mainly from its previous 2002 edition and based on the best practice of different countries like South Africa, Australia, and TRL from United Kingdom (UK), and AASHTO from United States of America/USA.

2.6 Delay due to Improper Estimation of Duration in Some Countries

The majority of planning, design, construction, management, and maintenance approaches used in the road sector in Ethiopia are based on practices and procedures developed in other countries and under conditions that are often dissimilar to those met in Ethiopia. Direct application of these international practices can lead to higher than necessary construction and maintenance costs and a sub-optimal road performance, (ERA, 2011).

Delay of construction projects is the worldwide issue nowadays. It is occurring in both developed and developing countries. The difference between the two is; in developed countries, the causes are limited to most of the unforeseen conditions such as design change, flow of finance between the parties, price escalation whereas the causes in developing countries, it is more related to planning and luck of preliminary investigation. For this the duration of most project were similar and the delays also twice and above.

“Many projects experience extensive delays and thereby exceed initial time and cost estimates.” (Ibrahim M. et al. 2012). They cited from (Ahmed et al. 2003), that the delays

on construction projects as a universal phenomenon. They also coated from the same source, that the delays were usually accompanied by cost overruns.

Saiful Islam1 and Trigunarsyah2 (2017) cited the duration as "The factors, delay in progress payment by owner, contractors' cash flow problem, improper planning and scheduling, poor site management, and change order by owner during construction, are acknowledged as critical causes of delay in developing countries." They also discussed the delay due to lack of improper management, delays may arise at feasibility stage of the project and continue till to the end of construction work. In the lifecycle of a construction project three parties e.g., owner, consultant, and contractor are closely involved.

2.7 International Practice of Construction Delay

Now a day, delay (time overrun) of the construction occur even in developed countries in the world. (González et al., 2013) discussed, although, the causes of delay in construction projects have been explored by many researchers and have been documented in the literature, construction projects across the world continue to suffer delays to varying magnitude.

A research conducted in Nigeria by Mohammed and Isah (2012) on the causes of delay in construction projects in Nigeria, identified 43 causes of delay frequently encountered in Nigerian construction industry. He also stated, among those, inappropriate planning, lack of communication, errors in design, shortage of resources supply etc. were top ranked factors, to lengthen the project schedule.

A number of causes delay of construction were identified in a previously studies. From these studies, Tafazzoli et al. (2007) studied factors causing delays in construction projects of United States of America/USA by conducting a nationwide survey and identified the critical level of 27 causes of delays. The results of the survey indicates that top causative factors of delays were modifications in the scope of project, delay in decision making, errors in design, delay in approval of design documents, unrealistic project schedule, poor communication among construction parties, delay in progress payment by the clients, inadequate contractor experience, poor site management, and mistakes in construction.

Sambasivan and Soon, (2007) stated delays in construction projects as a global phenomenon.

R. Barbosa and A. E. Jungles, (2016), investigated 70%(of the construction projects in United Kingdom were delivered late from the planned schedule. This occurred due to several factors such as external factors, project complexity, incompetent project management, and unrealistic estimates. In addition, as G. Saad et al (2016) discussed, 97% of the projects in Saudi Arabia encountered delay in the construction project scheduled especially for road and bridge construction projects.

Hesham Osman (August 2016) review the construction delay in the world as follows. Construction Delays Analysis of delay causes on construction projects is one of the more comprehensively investigated areas in construction research. This can be attributed to both the prevalence of construction delays on projects as well as the impacts delays have on project profitability, stakeholder relationships, and the overall image of the construction industry within the public eye. One of the earliest studies carried out was that by Baldwin et al. (1971) who identified 17 delay causes on construction projects in the U.S. From that point onwards, studies were conducted in various developed as well as developing countries.

Recent studies were particularly undertaken in developing countries and showed that there were severe CCD problems in developing countries especially in Africa such as Ghana (Fugar and Agyakwah-Baah, 2010), Lybia (Shebob et al., 2012), Benin (Akogbe et al., 2013), and Egypt (Ezeldin and Abdel-Ghany, 2013).

The construction delay and CCD problems also seriously damaged construction projects in middle east and far east countries such as Turkey (Kazaz et al., 2012), Pakistan (Gardezi et al., 2014), Iran (Pourrostam and Ismail, 2012), Taiwan (Yang et al., 2013), Malaysia (Tawil et al., 2014), India (Chaphalkar and Iyer, 2014), and Saudi Arabia (Assaf et al., 2013; Mahamid et al., 2015).

Similar to what has earlier been reported by Toor and Oguluana (2008), research findings in these different countries revealed a similar overall trend of construction delays that typically propagate from inadequate procurement systems, lack of resources, discrepancies between design and construction, lack of project management practices, variation orders, communication lapses, cultural issues, and different interests of project's stakeholders.

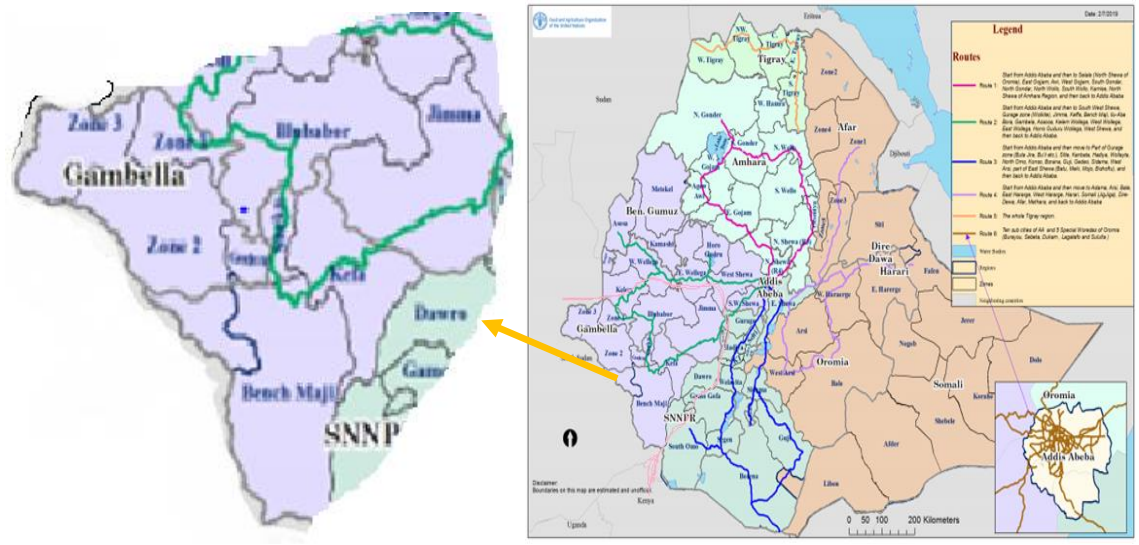
CHAPTER THREE

RESEARCH METHODOLOGY

3.1 The Study Area

The study area was Ethiopian Roads Authority West District (ERA-WD) different road projects which are bounded by different regions: some parts of Oromia region, some parts of South Nations and Nationality Peoples (SNNP) region, and Gambella region totally. Preliminary and supportive data and important information was provided by branch office of ERA at Jimma town. Since the study was investigating the CCD aspects of the authority particularly in its one of ten (10) districts, ERA-WD, the study findings indicated the trends of the road projects under the coverage of ERA-WD recent and active projects. Meanwhile the study tried to assess the CCD practice of ERA projects, it was necessary to collect appropriate data from both the district office and the head office of ERA at Addis Ababa. Therefore, some valuable data were collected from head office, where most of the data were accumulated there, and suitable and detailed data also gathered from the Road Research Center (RRC) at Addis.

Figure 2: Map of ERA west Region boundary



3.2 Study Period

The study period covers the whole time from the preparation of the first draft of the proposal to final submission of the research report after data analysis, and it is according to the JIT schedule. The overall study period covers about 8 months.

3.3 Study Design

This study was designed by using qualitative research methods. Qualitative research involves collecting qualitative data by way of in-depth interviews, observations, field notes, open-ended

questions etc. Results of such research are likely to be context specific and reporting takes the form of a narrative with contextual description and direct quotations from researchers (Ajai S. Gaur, Sanjaya S. Gaur, 2009). Qualitative research is aimed at gaining a deep understanding of a specific organization or events, rather than surface description of a large sample of population. It aims to provide an explicit rendering of structure, order, and broad patterns found among a group of participants. Tracy (2010) researched the use of criteria for research methodology and found in a review of the literature that there are opposing views on the matter.

Therefore, this study was planned to assess CCD in the study area by collecting qualitative data by interviewing selected officials from both the head office and the district office and from the consultation of documents and reports that showed about the study area from the Head office. In addition to this an association of the interview response with the consulted document also has done.

3.4 Sampling Process

Since the design of the study has employed qualitative approach for this cross-sectional descriptive study, the sampling was aimed to get comprehensive and detail data that would be suitable for qualitative analysis. In this regard, the depth interview was delivered to mine data in depth from high level managers and experts that are heavily concerned with CC, CCD and road construction project managing activities. The study area of road projects in ERA-WR (ERA- West District) area and the sample was taken from managers and experts in ERA, Ethiopian Road Research Center (RRC) in Addis Ababa, and other contractor and consulting companies that are currently undertaking road projects with ERA in the study area.

The sampling technique used was non probability purposive sampling technique to select the companies as well as the sample respondents in the respective companies. This technique is used because it is known to be representative of the total population, or it is known that it will produce well matched groups. The sampling process was undertaken by employing series of selecting and sampling steps. First, the main (client) and

supplementary organizations (contracting parties) were determined as ERA with RRC (clients) and six companies (contracting parties) respectively. About half of the respondents were selected from ERA.

The six supplementary organizations were selected by purposive sampling by considering categorization variables for selecting companies: (a) type (contractor, consultant),(b) ownership (public or private), and (c) area (local or international). In such way, one local public and two international private firms selected from contractor companies; as well as one local public, one local private and one international private firm selected from consultancies. The selected companies are indicated in table 4.2

The sample respondents also selected by purposive sampling from all eight organizations (2 from client: ERA and RRC; 6 from contracting parties) by setting selecting criteria in two major classes, namely: managers and experts (civil engineers). This way, 8 respondents selected from clients group by giving 66% share for managers and 33% share for experts. To compensate this,33% share given to select respondents from managers of contracting group and 66% share for selecting experts from contracting groups. This is because of two major reasons: one, since the client (ERA) is taking managerial and controlling responsibility in contracts, it is suitable to get more managerial information from them; two, because the contracting group consisted well experienced international firms who has good exposure to global CCD trend, more of experts selected from them. And the selecting ratio also compensates each other to keep the balance of data and increase the reliability.

3.5 Data Collection

The study used qualitative data collecting techniques. Because most of the results from the depth-interview were verbal and they could not interpreted as number. Likewise, the desk data from the document were very small (only two) and can simply be explained by qualitative techniques. Moreover the number of respondents also determines the type of data collecting techniques. Since the number of respondents of this study were only $14<45$, this technique should be used. The data was collected by consultation of documents and reports from the head office and by interviewing the selected officials.

3.6 Data Processing and Analysis

The data of this research were collected mostly by interviewing selected officials and consulting office documents. Since the number of respondents and the document

consulted were limited, qualitative method of data processes were used. Hence the date were processed, interpreted and analysed by using qualitative analysis approach.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Results

4.1.1 Socio-demographic Variables of Respondents

This study contained respondents that were selected systematically from the study area using non probability purposive sampling technique to get comprehensive and detailed data on the CCD aspects of the study. The main data were collected from ERA (66% of respondents directly taken from ERA and its researchers) and supplementary data were also collected from contractor/ consultancy companies that are currently undertaking projects with ERA in the study area.

Table 3: General Information of Respondents

S№	Variables	Class	Frequency(n)	%
1	Age (Yrs.)	<25		
		25-35	2	14
		36-45	10	72
		>46	2	14
		Total	14	100
2	Sex	Female	1	7
		Male	13	93
		Total	14	100
3	Educational Status	BA/ BSc	3	21
		MA/ MSc	11	79
		Total	14	100
4	Job Experience (Yrs.)	<2		
		2–5		
		5–10	5	36
		10–15	7	50
		>15	2	14
		Total	14	100

Most of the respondents that were participated in this study were in middle young age (72%) interval from 25 to 45 years old and dominantly male (there was only one female respondent (7%) sampled for this study due to the lack of female high level managers and experts almost in all eight/8 organizations in which the study was conducted). Only two/ elderly responders were participated in the study who are above 46 years. Their educational status was mainly second degree (79%) in civil engineering and business related subjects. Except two/ higher level managers, all other respondent had a job experience that ranges from 5 to 15.

The sample respondents of this research were managers and experts in client, contractor, and consultancy organizations. Moreover, these respondents also include local and international companies as well as public and private ones. The major client organization in this regard was ERA; however, RRC, the governmental research institution that dedicated to road related studies and supports ERA with its findings also taken as client agent. Thus, eight (8) different organizations (4 from public and 4 from private) those are working on road projects either locally (5) or internationally (3), were selected and detailed data collected from experts and directors/ managers of the respective organization through interview schedule.

Table 4: Organizations profile and Respondents responsibility

S №	**Organization's**				**Respondent's**	
	Type	***Ownership***	***Area***	***Name***	***№***	***Responsibility***
1	Client	Public	Local	ERA	1	WR Team Leader
2					1	WR Projects Supervisor
3					1	QARISM Director
4					1	QARISM Document Official
5					1	Procurement Expert
6					1	Plan & Program Manager
7					1	Plan & Program Expert
8				RRC	1	RRC Director
Total Client Respondents					***8***	
9	Contractor	Public	Local	ECWCo	1	Project Manager
10		Private	International	MCE	1	Supervisor
11		Private	International	CGC (China)	1	Office Engineer
Total Client Respondents					***3***	
12	Consultant	Public	Local	CDSCo	1	Supervisors
13		Private	Local	DAECo	1	Supervisors
14		Private	International	AECOM	1	General Manager
Total Client Respondents					***3***	
TOTAL					***14***	

KEY:

RRC*-road research center*
QARISM*-Quality Assurance Road Inspection and Safety Management of ERA*
ECWCo*-Ethiopian Construction Works Corporation*
MCE*-MIDROC construction Ethiopia*
CGC*-China Gansu Construction*
CDSCo*-Construction Design Share Company*
DAECo*-Dana and Associates Engineering Company*
AECOM*-Aspire AECOM consultancy, AECOM stands for Architecture, Engineering, Consulting, Operations and Maintenance Technology Corporation which is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government*

The eight (8) respondents from client organization (ERA) includes a WR team leader, WR road projects supervisor, a director of QARISM, a document official of QARISM,

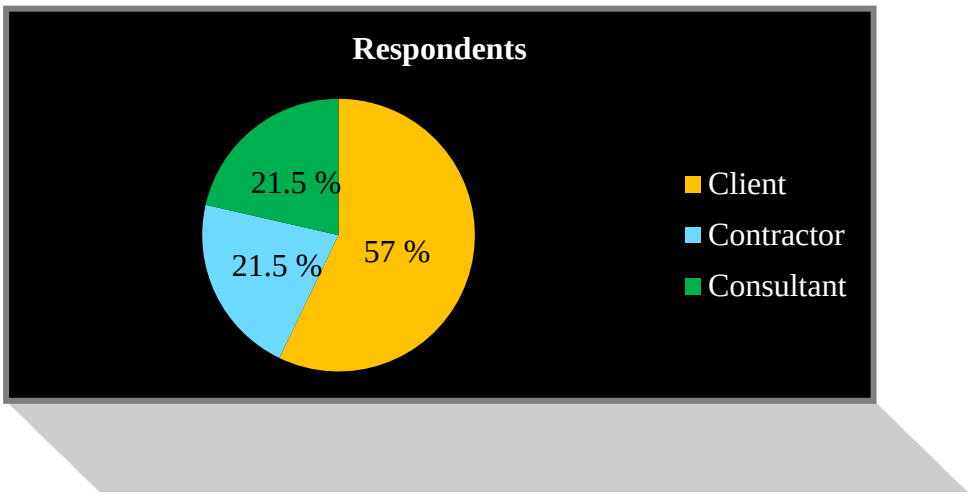
director of RRC, a professional from procurement office of ERA, and two respondents (a manager and a professional) from directorate of plan and program of ERA.

The other respondents were taken from contractors those comprised three organizations, namely: CGC which is the sister company under China Gansu International Corporation for Economic and Technology Cooperation (CGICOP), ECWCo, and MCE also the sister company under Mohammed International Development Research And Organization Company (MIDROC); international, public and local organizations respectively.

The job classifications of respondents from the contractors were office engineer, project manager, and supervisor from CGC, ECWCo, and MCE respectively. Likewise, respondents also taken from three (3) consultancy organizations: CDSCo, AECOM and DAECo those are also taken from public, international, and local organizations respectively. The job classifications of respondents from the consultancy organizations were two supervisors from CDSCo and DAECo, and a general manager from AECOM.

Generally, the proportion of respondents with respect to their sector summarized in the following pie chart for client and contractor/ consultant respectively:

Figure 3: Proportion of respondents from respective sector



4.1.2 The Practice of Construction Contract Duration determination

This study has involved the document consultation method as a secondary data collection way to collected recently recorded data on CCD in research center of ERA and other office documents directly related with CCD in the organization. The data gathered in a way has been important not only to add useful information on primary data but also used for triangulation purpose to increase the validity and reliability of the study.

In the document consultation technique of data collection, significant amounts of general and specific data were collected based on the checklist of the researcher that were derived from the research questions and specific objects of the study. In general, the document consultation checklist *(see the full checklist in appendices)* addressed the following guidelines, which were the specific objectives of the study, to collect data:

I. the problem in current practice of CCD determination of ERA-WR

II. the major factors affecting CCD and

III. the effects of some especial factors affecting CCD.

The results of document consultation that has been collected based on these guiding checklists were qualitatively sorted out, organized, categorized, and presented as follows.

i. Practice of Construction Contract Duration of ERA-WR

In this stage, according to the checklist of the document consultation of this study, three major variables were determined that are comprised in the analysis of the study. These variables are contract duration, budget, and length of the road segment. Additionally other variables such as type and width of the road also discussed, but they were skipped from analysis because of the scope of the study.

ii. Contract duration and contract budget

The comprehensive and large amount of data that was gained from ERA-WR sector, ERA head office, and RRC were dealt with in this stage of data collection. The data that collected on this point of the checklist was summarized in the following table (table 3).

Table 5: Ongoing Projects in ERA-WD

№	TYPE	W /m	L *km*	CONTRACT *In Eth,Birr*	% C.	PA	CMC D.	CPL D.	Du. *day*	Remark
1	DST76	7	76	960,130,378.57	57	44	7-Feb-17	21-Jul-20	1260	Design & Build
2	G125		125	823,635,801.75	58	73	16-Mar-09	15-Mar-13	1460	
3	A65		65	483,546,385.53	22	4	12-Jul-17	12-Jul-20	1096	Overlay
4	DST37		37	227,395,653.07	33	12	7-Mar-17	6-Mar-20	1095	Lot 1
5	DST69		69	731,580,244.21	19	13	1-May-17	30-Apr-20	1095	Lot 2
6	A65	7	65	669,093,905.35	96	62	7-Oct-11	4-Apr-14	910	
7	A51		51	610,019,724.02	71	29	15-Feb-13	15-Feb-16	1095	Lot 1
8	DST52		52	842,248,579.85	83	1	1-Apr-13	2-Oct-16	1280	
9	A62	7	62	648,530,585.91	78	49	7-Oct-11	4-Apr-14	910	
12	A60		60	926,796,267.23	64	38	16-Mar-15	14-Sep-17	913	
13	DST62		62	780,178,656.87	3	2	18-Sep-17	17-Sep-20	1095	
14	DST2		29	416,237,136.05	5	1	31-Jan-19	30-Jan-22	1095	

	9									
15	DST27	7	27	376,996,880.32	86	23	1-May-13	30-Apr-16	1095	
16	DST28	7	28	474,662,793.50	61	17	1-Aug-17	31-Jul-20	1095	
17				834,053,634.99			1-Apr-13	2-Oct-16	1280	ID
18	A103		103	1,310,919,268.99	11	12	17-Oct-17	26-Sep-21	1440	Design & Build
19	DST78		78	1,029,206,151.84	14	11	10-May-17	9-May-20	1095	
20				4,468,211,740.41			1-Jan-19	9-Jun-23	1620	Upgrading; ID
22	A79		79	1,305,603,429.10	1	0	1-Jan-19	30-Jun-22	1276	Upgrading
23	A107	7	107	686,101,954.83	93	100	21-Apr-08	20-Feb-11	1035	
24	A119	7	119	742,938,241.69	93	111	23-Apr-08	20-Feb-11	1033	Upgrading
25	DST79*	7	82	1,298,029,592.05	11	9	13-Nov-17	9-Nov-21	1457	
27	A92		92	1,120,703,012.90	78	9	23-Sep-13	22-Sep-16	1095	
28	A96	7	96	1,065,899,520.75	92	88	23-Feb-12	22-Feb-15	1095	Link upgrading
29	A86		86	1,210,599,884.42	9	8	15-Nov-16	15-Nov-24	2922	
30	A88		88	1,765,186,783.03	32	22	1-Nov-16	30-Oct-24	2920	
32	DST29		29	772,077,818.33	36	10	20-Feb-17	20-Feb-20	1095	Design & Build
33	A77		77	1,556,573,083.52	1	1	9-Oct-18	18-Sep-22	1440	
34	A48		48	1,246,200,728.58	5	2	26-Jan-18	25-Jan-22	1460	
35	G69	7	69	136,120,676.12	93	64	27-Jun-08	24-Dec-10	910	
36	DST28[1]	7	175	775,628,486.83	77	135	25-Sep-07	25-Mar-11	1277	Upgrading
37	A64		64	1,203,480,403.64	34	1	9-Mar-15	8-Mar-18	1095	Link upgrading
38	A3[2]		96	437,284,788.56	0	0	12-Mar-09	11-Mar-12	1095	
39	A81		81	1,142,567,660.95	27	1	28-Mar-14	27-Mar-17	1095	
40	A53		53	633,534,840.48	74	34	7-Oct-11	4-Apr-14	910	
41	G91		91	372,419,932.49	101	5	7-Jun-08	7-Jun-11	1095	

Key:

W=*Width in meter,* **L**=*Length in Kilometer,* **%C**=*Percent completed,* **PA**=*Physical Accomplishment,* **CMC D**=*Commencement Date,* **CPL D** =*Completion Date,* **Du**=*Duration,* **ID**=*incomplete data*

Names of the projects:

[1] *Additionally, G147type of road consisted in the project*
[2] *Additionally, DST93type of road consisted in the project*

Names of the road projects are separately listed under this table hereafter with similar numbering as a list number of the table. Data for some projects (10, 11, 21, 26, and 31) was not available at data collection phase and they did not listed here, the missing projects are indicated by zigzag line. Among the projects that did not listed hereafter, 11, 21, 31 were not in the coverage of the study area (ERA-WD). The road project listed in №. 10 (Guba-Begondi Cont. 1 Aysid-kong/DB), 26 (Lare-new jikawo-Ninighang) and 42 (Agamsa-Bure, type A85, length 85km) skipped because they lack contract amount and/ or other essential value of the data.

The Guba-Begondi/Aysid-kong road project (10) is G75 type road with a width of 7m and length of 79km; its physical accomplishment was reported as 59, its commencement date was 10-March-2015 and completion date9-Mar-2018 (1095 days' duration) but the project is not completed still now and at the data collection time of this study about 80% of the project has been accomplished.

The three major variables that were used in this stage were also sorted out systematically organized to make it suitable for analysis stage as follows:

- Contract Duration:
  - Estimated Duration
  - Completion Duration
- Contract budget
  - Estimated Budget
  - Completion Budget
- Length of the road is the same in both estimation and completion cases.

There were also other variables dealt with in this study stage, such as physical accomplishment, width and type of the road (A, G, DST asphalt, gravel, and double surface treatment)and percentage completion.

4.1.3 The Current Practice of Contract Duration Determination

Contract time is the maximum time allowed in the contract for completion of all works contained in the contract document, (Atreya, 2007). ERA undertake several projects with varied size and type across the country under different climatic, geographical, geological conditions. The desk study and discussion made with some of ERA employees at head office (Regional Directorate Directors and Team leaders, Plan and Program director, Design and Management office and Procurement Department) indicates the time set on the contract document for the majority of projects is more or less similar, which is about three years. Some of these officials pointed that sometimes the contract duration put on some contract documents is two years or less based on the urgency of the project and type of budget allotted. Additionally, few of them pointed there were projects which had been completed with almost 100% time overrun. Also some said mostly this duration is determined and placed on the contract document by the consultants who are responsible to provide consultancy service. Others said they do not know how and who set contract

time. But all the officials that I interviewed believe almost all the durations given were not enough and even not logical.

Due this fact and other reasons the majority of the projects are not completed within the stipulated time, leading to time overrun and open room for unnecessary claim for time and extra cost which creates social and economic inconvenience.

Indeed until I interviewed these officials and collected the necessary data, the project duration were formulated by the Plan and Program office which is under the ERA head office. This may be done to fulfill the request of the society by some prioritization methods and the expected internal economic rate of return (IRR).

In my discussion with these department officials, I realized that, the duration for different magnitude project works and for different conditions, is almost the same (three years) because, they believed that, as long as the performance of the contractor is good, he/she can execute whatever the tough work within three years and if the project is simple, it may give for the employer (ERA) a relax on using the predetermined budget.

Furthermore, I realized that the engineering estimation techniques are not used to determine the contract duration. And also these officials pointed that there is no updated production rate which plays useful role in determining contract duration.

The above discussion shows the setting of contact duration for ERA projects does not take in to account different fact.

4.1.4 Factors Affecting Construction Contract Duration

Delay of a project occurred by different causes. The main causes for a delay of the project to occur are the factors affecting the construction projects. Below are some existing factors that were frequently occurring in the study area. Except few of the factors, most of them are the same to the other district region of the country and even in most parts of the world. The table tried to show these factors with additional information about whether they were considerably viewed by the client or not.

The effect of the delay of the project is directly related to the destruction of the country. Because, a project delayed in any of the factors means, its load on the contractor and opening time increases which is the service time go far. So that; the cost directly paid to the project increases or the income due to the service of the road (indirectly) loses. Therefore the duration of the project must be determined by deeply studying the area of the project and at least the most affective factors of the project.

Based on the respondents of the interview and the consulted documents during the study, the factors that affect CCD were summarized in the appendix- and only the top five factors were discussed as follows.

- Type of highway: - which is highly affect the duration of the road project. It is known that as the type of the road becomes new or upgrade, asphalt or gravel it requires its own duration with great variability.
- A weather condition was the second affective factor of the construction duration. This showed whether the weather-condition is rainy or sunny it determined the length of the construction duration.
- The third affective factor of the CCD was magnitude of the projects (road length and width) and scope of the project. Because as the width and length of the road increase, the contract duration also increased.
- Right-of-way as per the respondents view was the very inconsiderable effective factor. But it was not taken as the great effect.
- Availability of back fill material and its hauling distance:- this also taken as effective factor for the construction duration

4.1.5 The Effects of main factors affecting CCD

According to the behavior of the project site, there are very many factors that can affect the duration of the road projects. The effects of these factors may broadly differ one from the other. Some factors greatly affect the project and even made it not to continue (to stop). Some are very simply resolved but requires appropriate follow up.

Most of the affective factors can be managed by proper supervision. If the supervision fails, the project tends to take more time and even caused for the cost overrun.

The factors of CCD may be grouped under stakeholders related, weather condition and topographical, managerial, availability of construction materials, public concern, and legal issue. Each of the above categories may consists of several factors.

4.2 Discussions

4.2.1 Results of Interview for Practice of Construction Contract Duration

- Concerning the question what contract document was, who prepare it and what material/documents they used to prepare it; almost all the parties replied that it was the document that consists of all the necessary information about the given project and signed between the client and the contractor and the section that prepare the

contract document, as all the parties agreed, was the procurement office, and also the material they used to prepare was ERA Design manual. This may be logical and accepted in all situations and everywhere.

- Regarding the construction contract duration (CCD); all of the respondents agreed that it was the time for a given project from the commencement date up to the provisional acceptance date. Whereas they differ on responding which department fixes the CCD? But again all of them agreed that the CCD fixed based on the factors affecting construction projects.
- Relating to using different duration for the different parts of the country, most of the respondents (> 80%) agreed that no different duration and only some said that there is. In the West region especially because of the weather condition.
- About Manual preparation, only ERA officials responded that the manual was prepared based on some East African countries and South Africa model. This is because their terrains are almost similar with our country Ethiopia and they said that this manual is updated based on the up going new construction technology and the logical request from the parties.
- Concerning the main factors that affect road construction contract duration, the top ten factors according to the respondents are type of road, weather condition, magnitude of the road (length and width of the road), right-of-way, availability and distance of back fill materials, Cost of the project, Topography of the environment, Site characteristics, Poor design of the project and capacity and performance of the contractor, unforeseen ground condition.
- "Right-of-way" is the most informally affecting factor of CCD road projects. It is informal because the client ERA gives it little consideration. But in most road projects in the study area, the case extended to the dispute between the client and the contractor.
- In relating to the contractor, he/she did not force to observe the alignment route before the agreement is signed and to present how he/she executes the work. He/she had freewill to observe. But he/she must prepare the master schedule after already signed. The way of bidding system may cause this gap. In contrast, the contractor did not want to comment on the contract duration. Because they fear they may lose the project.

- Finally almost all the consultant and contractors that were interviewed accomplished road projects in other parts of the country than this study area. So they provided valuable suggestion to determine or to fix realistic duration for a given road projects in a specific area. From these; type of road, weather condition, right-of-way, magnitude of the road (length and width of the road), capacity and performance of the contractor, availability and distance of back fill materials are some of the conditions that require deep investigation.

4.2.2 Results for Completed Projects from Document Consultation

Among the completed road projects dealt in this study area, seven of them were taken as a sample. These were selected because, they were last to be completed. The duration and budget relationship of these projects that has been undertaking contract with the client, ERA is presented here to analysis.

The major variables that are focused for the analysis are CC, contract budget and length of the road.

Table 6: Completed Road projects in ERA-WR

S №	Segment Name	Type	L (km)	E.D. (d)	E.B. (Mil Br)	C.Du (d)	C. B. (Mil Br)
1	Bedele-Metu	AC	50.7	1095	610	1973	650.7
2	Metu-Gore	AC	26	1096	123.7	1218	123.7
3	Gore-Gambella	AC	143.4	1097	817.6	1537	-
4	Jimma- Bonga	AC	107.2	1034	686.1	2445	696.8
5	Bonga- Mizan	AC	120.2	1036	742.9	2929	742.9
6	Gambella-ItangJikaw	AC	121.7	1175	446.6	1248	832.8
7	Dembi-Bedele	AC	62	730	204.7	2180	259.7

Source: *Team 1 Road project supervision Department*

Key:L (km) *=Length in kilometer*

E. Du. (d) *=Estimated Duration in calendar days*

E. Bgt. (Mil Br) = *Estimated Budget in million Ethiopian Birr*

C.Du (d) *= Completed Duration in calendar days*

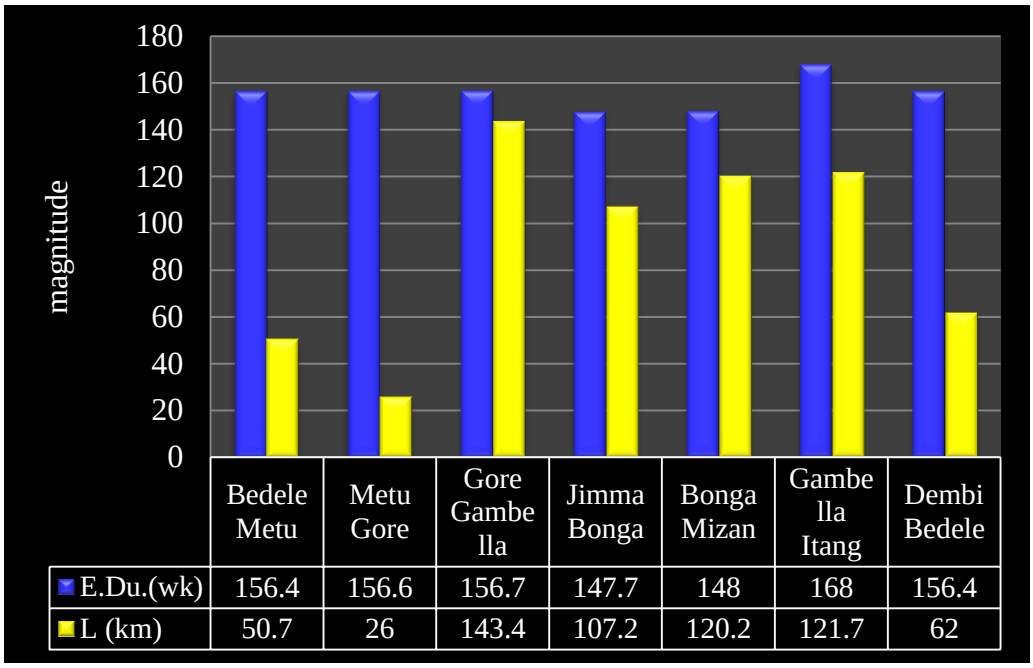
C.B. (Mil Br) *= Completed Budget in million Ethiopian Birr*

Referring the above table, it was tried to investigate the following points. The table shows completed road projects in the district. All these projects delayed (completed out of the estimated duration). Even some of them performed with a 100% delay and above.

The common features these seven (7) projects were type of road, terrain, weather condition and the client company. But, the other variables such as duration, budget, and length showed different degree of variation. Concerning the other variables such as

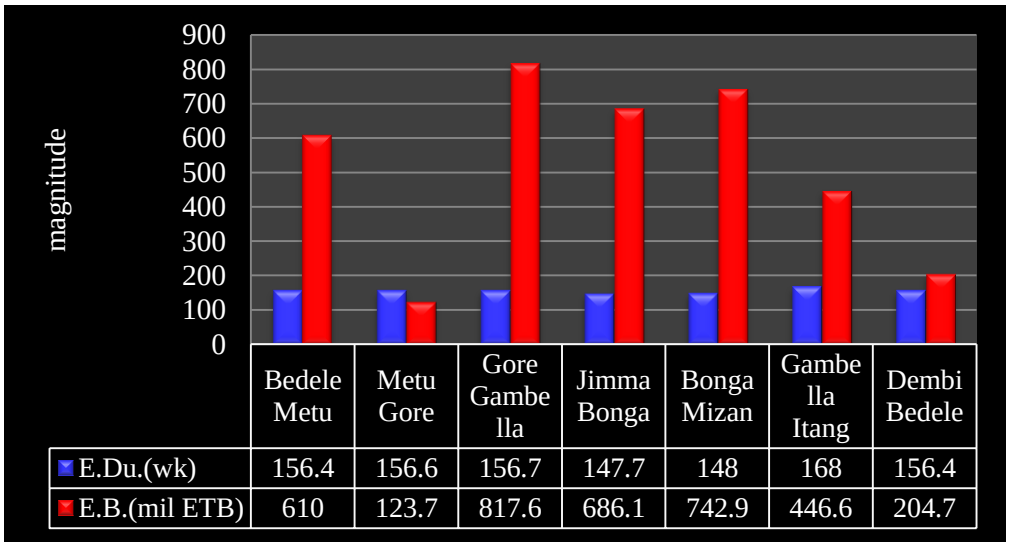
weather condition showed large degree of variation even in the projects that located in the same area.

Figure 4: Estimated Duration vs. Road length



Key:L (km) =Length in kilometer, E.Du. (wk.) = Estimated Duration in weeks
Note: estimated duration data that was collected has converted from "Day" unit in to "Week" for the convenience of visible presentation of the chart

Figure 5: Estimated Duration vs. Estimated Budget



As we have seen from the table, the duration given for the same type of work AC was an independent of length of the road budget. For example, a 143.4 km road had the same estimated duration with its at least fifth ratio (26kms). Whatever the tough work in the smallest kilometer road, it can never be compensated the largest one.

Even if it is thought that it was tough enough, their budget had to be more or less similar. So, the estimated duration for both roads seemed inconsistent. In addition to this their completion date showed, even the smallest length exceeds its estimated duration.

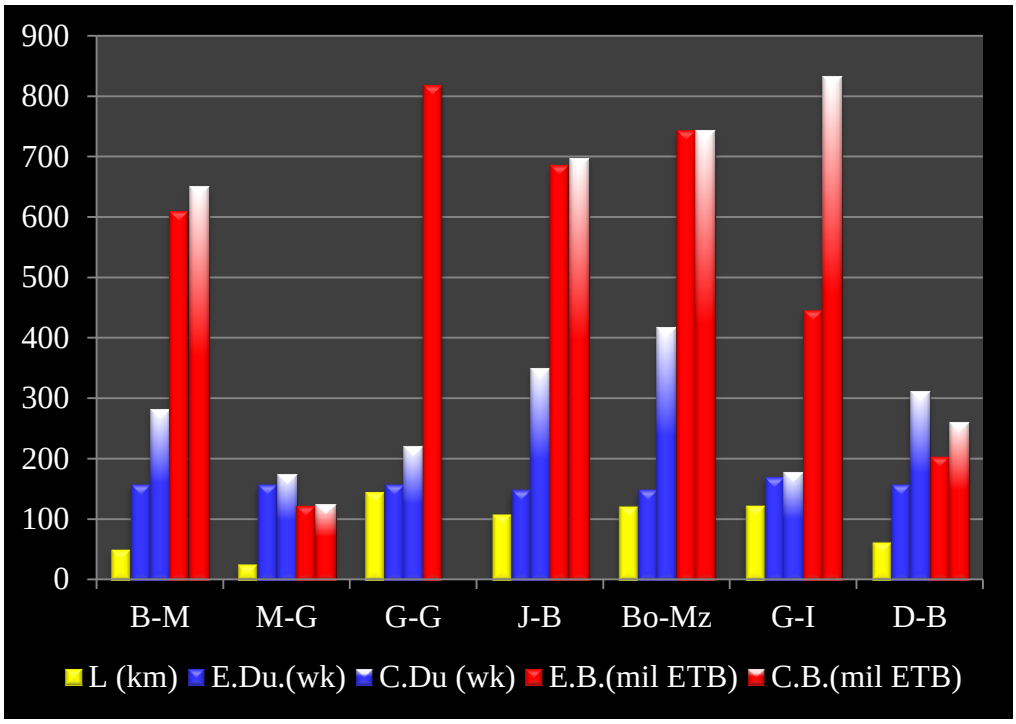
From the (figure 3 and 4), the relationship of contract duration with other two important CCD variables (estimated budget and length of the roads) are analyzed below.

Figure 3, indicated the relationship of contract duration and length of the roads. The time allocated or estimated for the projects were almost equal, but the length of the roads were quite different. This indicates that the contract duration practice of ERA-WR is giving less emphasis to allocate and estimate proportional time for respective length of road.

Figure 4, indicated the relationship of contract duration and estimated budget of the roads. The chart showed that for the almost equal time allocation, unbalanced and varying amount of budget was allocated. This indicates that the contract duration practice of ERA-WR is giving less emphasis to allocate appropriate budget for the respective estimated duration of projects.

These relationships can be summarized in the figure 5 to see the relations of all three variables. From this figure it can be seen that, generally completed budget and completed duration of all projects dealt in this study area were increased enormously, except Metu-Gore road project where the estimated and completed/ used budget and time was as the plan of the project successfully. From this result, it can be deduced that in most recently completed road projects on ERA-WR area there is no tangible implementation of CCD principles and there is huge difference between estimated and actual budget and time in the projects. Therefore there is poor practice of CCD in the study area.

Figure 6: Summary of Road Length and Estimated & Completed Duration and Budget



4.2.3 Result of CCD for Incomplete (ongoing) Projects

Below are some ongoing road projects in this study area, only 6 has completed and the other 34 are still under contract ongoing projects. The length of the roads, percentage completed portion of roads, commence and estimated end date was taken as evaluating variables for these projects.

Table 7: Incomplete (ongoing) Projects

SN	Project Type	L (km)	Completed %	Physical	Commence	Completion	Duration
1	DST 76	76	57/80	44	02/07/17	21-Jul-20	1260.00
2	G125	125	58/100	73	03/16/09	15-Mar-13	1460.00
3	AC65	65	22/80	14	07/12/17	12-Jul-20	1096.00
4	DST 37	37	33/90	12	03/07/17	6-Mar-20	1095.00
5	DST 69	69	19/90	13	05/01/17	30-Apr-20	1095.00
6	AC65	65	96/100	62	10/07/11	4-Apr-14	910.00
7	AC51	51	71/100	29	02/15/13	15-Feb-16	1095.00
8	DST 52	52	83/100	43	04/01/13	2-Oct-16	1280.00
9	AC62	62	78/100	49	10/07/11	4-Apr-14	910.00
10	G75	79	79/100	59	03/10/15	9-Mar-18	1095.00
11	AC60	60	64/100	38	03/16/15	14-Sep-17	913.00
12	DST 62	62	3/60	2	09/18/17	17-Sep-20	1095.00
13	DST 29	29	5/30	1	01/31/19	30-Jan-22	1095.00
14	DST27	27	86/100	23	05/01/13	30-Apr-16	1095.00
15	DST 28	28	61	17	08/01/17	31-Jul-20	1095.00
16	AC103	103	11/50	12	10/17/17	26-Sep-21	1440.00
17	DST 78	78	14/60	11	05/10/17	9-May-20	1095.00
18	AC 79	79	1/20	0	01/01/19	30-Jun-22	1276.00

19	AC 107	107	93/100	100	04/21/08	20-Feb-11	1035.00
20	AC119	119	93/100	111	04/23/08	20-Feb-11	1035.00
21	DST79	82	11/50	9	11/13/17	9-Nov-21	1457.00
22	AC92	92	78/100	9	09/23/13	22-Sep-16	1095.00
23	AC96	96	92/100	88	02/23/12	22-Feb-15	1095.00
24	AC 86	86	9/30	8	11/15/16	15-Nov24	2922.00
25	AC88	88	32	28	11/01/16	30-Oct-24	2920.00
26	DST 29	29	36/80	10	02/20/17	20-Feb-20	1095.00
27	AC77	77	1/24	1	10/09/18	18-Sep-22	1440.00
28	AC 48	48	5/40	2	01/26/18	25-Jan-22	1460.00
29	G 69	69	93/100	64	06/27/08	24-Dec-10	910.00
30	DST28,G147	175	77/100	135	09/25/07	25-Mar-11	1277.00
31	AC64	64	34/100	21	03/09/15	8-Mar-18	1095.00
32	AC3DST93	96	0/100	0	03/12/09	11-Mar-12	1095.00
33	AC81	81	27/100	21	03/28/14	27-Mar-17	1095.00
34	AC 53	53	74/100	34	10/07/11	4-Apr-14	910.00
35	G91	91	10/100	5	06/07/08	7-Jun-11	1095.00
Key: the names of the projects are listed under appendices							

According to table 5, almost all these projects practiced delay. Even if there are some other factors for the delay occurred, there is duration poor estimation will be seen. Because,

1. More than half the projects have been given the same three year construction period, without considering their entire length which is ranging 119- 27 = 92kms.
2. The table also shows the duration given to more than half of the projects already expired. This may implies there were no proportional times for the projects. Even those projects their completion dates are not yet finished are poor completion percentage.
3. Furthermore, when referring the progress report of the contractors, weather condition and Right-of-way, as if they are the inconsiderable factors by the client, are repeatedly pointed as the reason why the projects not to perform according to the schedule. This also showed the problems of estimating realistic duration by considering the zoning effect on the weather condition and giving the proper duration for right-of-way cases.

From the above two tables we can generalize that the way that the duration given to execute the road projects under ERA is not correct and it should be revised.

4.2.4 Result for the effects of factors affecting CCD

It is known that factors affecting CCD has great effect in the road construction projects. Especially in the study area, some factors like right-of-way, weather condition, and land-slide extremely affect the time given to the completion of the projects.

In conducting the study, it was shown that the study area had different natural features. For instance around Gambella region, the terrain is flat and even if it has small rainy seasons, it simply holds water for many months and it became difficult for road construction.

When other part of the study area was studied, which is a part from SNNP region, around Mizan and Tapy cities, there were adverse weather condition and there were a rain at least half a year. This leads to affect the construction of the road very high. In addition to this, these areas were known to have large land-slide problem. Hence what is constructed in a week may be destroyed in a single rainfall.

Almost all the interviwed contractors agreed that weather condition had great effect in some parts of the study area unlike other districts. But, evenif this severe weather condition occurred in the area, no or very little concideration was given in determining the project compleyion time. From this almost all road projects (whether completed or on going projects) that were assigned adopted unexoected time overrun.

Two of them out of the six contractors encountered unexpected land-slide while they were doing road projects in this area and a three years road project took above twelve years. This may because of directly for the slide case and indirectly for the dispute due to the variation asked because of the slide occurred.

Furthermore, all of the interviewed contractors agreed that this study area has been known for its high population. Hence the peoples occupied most of the land area as their property. So it is very difficult to keep road way free for the construction of new road projects; even for the upgrading of the existing roads. There is a very high Right-of-Way problem in the area. First of all the people are not volunteers to collaborate with the construction process, even if they had paid proper compensation fee and the public affairs were also not enforced them to do so. In addition to these, the client also not gave proper consideration for this event. These result for unexpected surplus time wastage.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

5.1.1 In the Practice of ERA Road Projects

The contract document is prepared by the procurement office. But the contract duration part is prepared by the Plan and Program office with only focusing the social need and the IRR. That is without sound Engineering thoughts. This may result for 100% delay to occur. Even if the countries different zones have different topographical arrangement, type of soil and weather conditions, ERA determine almost the same duration for these different zones.

Also ERA manual was prepared from the neighboring countries, by comparing the relative similarities in the countries terrain type, but these countries registering the delay in the road projects. Furthermore, ERA shouldn't enforce the competence contractors to visit the project site and comment on the duration given, and prepare them presentation of how they execute the project. In the practice, it seems ERA accepts the delay so that it funds additional budget for it.

5.1.2 Concerning the Factors of Construction Contract Duration

The duration of construction projects clearly affected by different factors; these factors are divided in to considerable and non-considerable factors. Factors that are mostly considerable by the client (ERA) are those factors that are directly affect the critical path of the road projects; such as type of the road, length and width of the road, location of the project, topography and weather condition of the area, type of the soil, availability and distance of sub grade materials and so on.

From the non-considerable factors, that affect the duration of the construction;

- The major one is Right-of-Way. But the client gives it no or little consideration.
- Time to remove utility obstructions; electric, water pipe, and telecommunication lines also not considered at all.
- The freedom of using the sub grade material and its hauling distance.
- Poor consideration of annual working period. Even if the weather conditions of this area is known as to be rainy

- Since this area has dense population, public desiccation about the project's security is very important. Because the contractor may puck-up (stop) for long time with different oppositions
- Cash flow between the parties; lagging of payment in client side, and improper use of released payment as in the contractor side.

5.1.3 Effects of Factors Affecting CCD

Generaly there are many factors that affect the duration of construction projects. Most of the factors that affect CCD are common in all parts of the world; such as magnitude of the road (length and width), type of the road that is going to be constructed and its design, topography of the area, communication between the three parties(client, contractor and consultant) etc.. There are also other factors limited to a certain area. These factors may differ from country to country and from place to place.

In our country also, even if certain generalization is made in determining the CCD determination, some factors are specific to a certain area. This may depending on their terrain type, weather condition of the area, availability of the construction materials, and even based on the number of population there in the area.

Hence, this study area was one which has high population; has an effect on right-of-way, has longer rainy season; which affect road construction, and some part of the study area has hazardous terrain type; which requires longer time to manage and may be a cause for land slide to occur.

5.2 Recommendations

- The realistic duration of road projects should focus on the engineering basis rather than focusing on the issues which are unrelated to their construction.
- The design manual of road projects should be prepared from less delay practiced countries and timely updated.
- Beyond the critical paths of road projects (basic procedures to construct), related works and conditions should be equally considered in determining the projects' duration.
- The contractors and engineers should argue and comment on the acceptability of the given project duration and once the contractor accept the duration; he/she should take the risk of the delay afterwards.

- In addition to the above conditions; ERA should investigate the project site weather condition, the topography, and population of the area before deciding the average annual working time.

5.3 Directions for Future Researchers

- This study is limited by its methodology in selecting samples by purposive sampling in small proportion. Due to this reason the result may not represent the actual phenomenon. Therefore, it would be appropriate to take large sample size from governmental and non-governmental (local and international) construction companies on the aspects of CCD in the future researchers.
- There is a potentially usable and organized independent road research center in Ethiopia. The researchers would get very valuable directions and data on road construction preferably before the beginning of the research, or at proposal preparation stage.

REFERENCES

Ahmad Saleh Al – Sultan(1989) Determination of Construction Contract Duration for public projects in Saudi Arabia, University of Petroleum and Minerals, Dhahran, Saudi Arabia.140 p.

Aiyetan, A., Smallwood, J., and Shakantu, W. (2012).“A linear regression modelling of the relationship between initial estimated and final achieved construction time in South Africa.”ActaStructilia, 19(1), 39–56.

Algahtany, and D. Kashiwagi, “Owners ’ perspective of factors contributing to project delay : case studies of road and bridge projects in Saudi Arabia,” Procedia Eng., vol. 145, no. 480, pp. 1402–1409, 2016.)

Berehan Bekele (2018) Assesment on Causes of Scheduling delay in Road Construction Projects, the

Case of Eshetu Lemma Road Consruction , Addis Ababa University, College of Business and Economics.

Charles D. Baker (2016)Dhcd Construction Handbook a Guide for Modernization and Development of State-Aided Public Housing. Construction Management Unit.Massachusetts

ChowdharyGondy, and John Hildreth. November 2007. Contract Time Determination Guidelines.Report.Virginia Tech, Virginia Polytechnic Institute and State University. 32 p. TR – 07-08, www.virginiadot.org/

Cothari (2011)ResearchMethodology, McHill Publishing.India

Czarnigowska, A., and Sobotka, A. (2013).“Time-cost relationship for pre-dicting construction duration.” Arch. Civ. Mech. Eng., 13(4), 518–526.

Dursun, O., and Stoy, C. (2012).“Determinants of construction duration for building projects in Germany.” Eng. Constr. Archit. Manage., 19(4), 444–468.

EI-Rayes, K. and Moselhi, O. (2001).Impact of Rainfall on the Productivity of Highway Construction. Journal of Construction Engineering and Management, ASCE, 127(2), 125–131.

Florida Department of Transportation (2010) Guidelines for Establishing Construction Contract Duration, 13 p. www.dot.state.fl.us/

G. Saad, A. Elawi, M. Algahtany, and D. Kashiwagi, "Owners ' perspective of factors contributing to project delay : case studies of road and bridge projects in Saudi Arabia," Procedia Eng., vol. 145, no. 480, pp. 1402–1409, 2016.

González, P., González, V., Molenaar, M. and Orozo, F. (2013).Analysis of Causes of Delay and Time Performance in Construction Projects. Journal of Construction Engineering and Management, 140(1): 1-9.

Osman, Hesham (August 2016). Causes of Construction Delays in Countries with High Geopolitical Risks. Article in Journal of Construction Engineering and Managemen, Cairo University 55 PUBLICATIONS 620 CITATIONS)

HyungSeuk "David" et al. September 2008. Development of an Improved System for Contract Time Determination (Phase I and II).Final Report FHWA-OK-08-02. School of Civil and Environmental Engineering, Oklahoma State University, Stillwater, Oklahoma.p148

Ibrahim Mahamid1; Amund Bruland2; and Nabil Dmaidi.(July 2012). Causes of Delay in Road Construction Projects. Article in Journal of Management in Engineering. DOI: 10.1061

Lee, E-B; Harvey, JT; Ibbs, CW; St. Martin, J. (2002). Construction Productivity Analysis for Asphalt Concrete Pavement Rehabilitation in Urban Corridors. Transportation Research Record, 1813, pp 285-294.

Lee, Eul-Bum, Ibbs, C. William, Harvey, T. John, and Roesler, R. Jeff. (2000). Construction Productivity and Constraints for Concrete Pavement Rehabilitation in Urban Corridors, Transportation Research Record, 1712, pp 13-22.

MajidJaraiedi and WafikIskander, May 9 to May 12, 2008. Annual Conference.A Procedure for Time Determination for High Way Construction Projects. La Jolla, California, U.S.A.10 p.

Minnesota Department of Transportation.Determination of Contract time.5 p.

Mohammed Darwish (2017) Fundamentals of construction contracts, The American University in Cairo

Mohammed, K. and Isah, A. (2012) Causes of delay in Nigeria construction industry. Interdisciplinary Journal of Construction Research in Business, 4(2), 785–795.

Muhammad Saiful Islam1, and BambangTrigunarsyah2(2017) Construction Delays in Developing Countries:KICEM Journal of Construction Engineering and Project Management, Online ISSN 2233-9582 page 1

R. Barbosa and A. E. Jungles, "Risk Level Assessment in Construction Projects Using the Schedule Performance Index," vol. 2016, 2016. 6- G. Saad, A. Elawi, M.

Sambasivan, M. and Soon, Y.W. (2007). Causes and effects of delays in Malaysian construction industry. International Journal of Project Management, 25(5): 517–526.

Siddharth K. Atreya. May 2007. Development of an Improved System for Contract Time Determination.M.ScThesis.Oklahoma State University.170 p.

Siraw Yenesew Tesfa (2015) Analisis of Factors Contributing to Time Overrun on Road Costruction

Projects Under A.A City Administration, ADDIS ABABA University, Department of Management, College of Business and Economics, Ethiopia

Tafazzoli, L.A., and Shrestha, P., "Investigating Causes of Delay in US Construction Projects", 53rd Annual International Conference of the Associated Schools of Construction, Seattle, Washington, pp. 611-621, 2007

Thomas, Jones, and Willenbrock, 1985

Tolera Eyasu (2018) An Assesment on Causes of Delay in Road construction Projects the ause of Ethiopian Road Authority, Addis Ababa University,College of Business and Economics.

Werkmeister, RF; Luscher, BL; Hancher, DE. (2000). Kentucky Contract Time Determination System. Transportation Research Record 1712, pp 185-195

Yi Jiang (2014) Highway Construction Production Rates and Estimation of Contract TimesDursun, O., and Stoy, C. (2012)."Determinants of construction duration for building projects in Germany." Eng. Constr. Archit. Manage., 19(4)

Webpages:

http://searchsoftwarequality.techtarget.com

http://www.brighthubpm.com

APPENDICES

Appendix 1

Interview Questions

1. What is contract document?
2. Who prepare the present contract documents?
3. What material/documents/manual/ they used to determine contract agreement?
4. What is construction contract duration (CCD)?
5. Which department is responsible to fix the contract duration?
6. How do they determine contract duration?
7. Do they use different duration for the different parts of the country?
8. If yes what are the basis to differentiate the duration?
9. Are there any special features to differentiate the contract duration for West district?
10. Which countries model shall ERA use to prepare Manual?
11. What is the basis to use those countries model?
12. Does the ERA manual modified? If yes, in what interval that it does modify?
13. What are the main factors that affect contract duration?
14. Does the contract document consider any duration for “right-of-way” cases?
15. Do the contractors observe the alignment route before the agreement is signed?
16. Does the contractor fully accept the contract duration? _____
17. Does the contractor present how he/she execute the project?
18. Do you think there are also inconsiderable factors while preparing the contract documents? (esp. in fixing duration of the project)
19. If yes what are they?
20. Have you ever done any projects with other districts than West district?
21. In your opinion, what should be done to plan the realistic construction period for the given road projects?

Appendix 2

Checklist/ Guidelines For Document Consultation

I. General background information related to road construction and CCD practice

1. Topography and climate
2. Terrain
3. Zoning
4. Type of fill material
5. Type of soil

II. The problem in current practice of CCD determination of ERA-WR

6. Estimated and Actual Duration of contract
7. Estimated and completion budget
8. Length of road
9. Type of road
10. Percentage completion

III. The major factors affecting CCD

11. Weather condition and other environmental factors
12. Administrative and organization factors
13. Contractors performance factors
14. Technical factors
15. Right of way

IV. The delay condition due to the improper estimation of road construction duration in some selected countries from which Ethiopian road standards and regulations are adopted by one or another way

16. Developed countries (from where most part of road standards adopted):
    USA, UK, Australia, Turkey
17. Developing countries (in far and middle east)
    Malaysia, India, Pakistan, Taiwan, Iran, and Saudi Arabia
18. Sub Saharan African countries
    Ghana,Libya,Egypt,andBenin
19. The African countries (from where Ethiopian contract manuals adopted)
    Tanzania, SouthAfrica, Kenya

Appendix 3

Complementary Documents

1. The names of the projects in table 5 of chapter 4 (results and discussions)

Road project № and name	Road project № and name
1=Abobo	**22=**Jimma-AgaroDedesa River
2=Adura-Akobo/ Burbe	**23=**Jimma-Bonga 1
3=Ambo-Gedo	**24=**Jimma-Mizan 2: Bonga -Mizan
4=Assosa-Daleti	**25=**KubitoMazoria-Meti
5=Assosa-Daleti	**27=**Mizan-Dima
6=Ayra-Chanka	**28=**Nekemte-Bedelle
7=Bedelle-Metu	**29=**Nekemte-Andhode
8=Bonga-Felegeselam	**30=**Nekmte-Bure; Lot2: Andhode-Agamsa
9=Chanka-Dembidolo	**32=**Omo-maji 2: Sai-Maji
12=Dima-Raad Bridge	**33=**Shishinda-Tepi
13=Diri-Masha, Lot 1: Gimbo	**34=**Tepi-mizan
14=Dongoro-Kingi-Mekebilla	**35=**Tongo-Gidami
15=Durgi-Gibe River Cont.1	**36=**Wacha-Maji
16=Durgi-Gibe River Cont.2	**37=**Ambo-Waliso
17=Felegeselam-Ameya-chida	**38=**AssosaKurmuk
18=Gambela-Abobo-Goog-Dima/pugnido	**39=**Gedo-Menebenga
19=Gambella-ilya	**40=**Mekenejo-Ayira
20=Gore-Masha-Tepi	**41=**Gidami - Mugi

2. Incomplete road projects in ERA-WR (from table 7 of chapter 4)

	Project № & Name		Project № & Name		Project № & Name
1.	**Abobo -km 76 Design and Build road project**	**13.**	Dongoro-Kingi-Mekebilla	**25.**	Nekmte-Bure;Lot2: Andhode-Agamsa
2.	**Adura-Akobo&Adura-Burbe Road Project**	**14.**	Durgi-Gibe River Cont.1:Durgi(km 71+200)-km 97+700	**26.**	Omo-maji contract 2: Sai-Maji Design and build road project
3.	**Ambo-Gedo Overlay Road project**	**15.**	Durgi-Gibe River Cont.2:Durgi(km 97+700)-km 125+400	**27.**	Shishinda-Tepi Road project
4.	**Assosa-Daleti Lot 1**	**16.**	Gambela-Abobo-Goog-Dima Road project;contract 1: Gambela-Abobo-pugnido Design and Build	**28.**	Tepi-mizan road project
5.	**Assosa-Daleti Lot 2**	**17.**	Gambella-ilya	**29.**	Tongo-Gidami

6. Ayra-Chanka	**18.** Jimma-AgaroDedesaRiverRoad upgrading project	**30.** Wacha-Maji road upgrading
7. Bedelle-Metu(lot1)	**19.** Contract 1: Jimma-Bonga Junction	**31.** Ambo-Waliso Link Road upgrading
8. Bonga-Felegeselam	**20.** Jimma-Mizan Road upgrading Project contract 2: Bonga -Mizan Junction	**32.** AssosaKurmuk
9. Chanka-Dembidolo	**21.** KubitoMazoria-Meti-km 76	**33.** Gedo-Menebenga
10. Guba-Begondi Cont. 1 Aysid-kong(DB)	**22.** Mizan-Dima	**34.** Mekenejo-Ayira
11. Dima-Raad Bridge,	**23.** Nekemte-Bedelle link Road Upgrading Project	**35.** Gidami – Mugi
12. Diri-Masha road project Lot 1: Gimbo-km 61+960	**24.** Nekemte-Andhode	

3. The ten (10) districts of Ethiopian Road Authority ERA

S №	DISTRICT NAME	REGIONS COVERED	REMARK
1	Jimma(West)	Oromia Gambela SNNP	Study area
2	Nekemt	Oromia	
3	AlemGena	Addis Ababa Oromia	
4	Shashemene	Oromia	
5	Sodo	SNNP	
6	Dire Dawa	Oromia Harari Somali	
7	Gonder	Amara	
8	Adigrat	Tigray	
9	DebreMarkos	Amara Benshangul-Gumuz	
10	Kombolcha	Amara Afar	

Note: *west district of era or Jimma that was previously known as south west district.*

Appendix 4

Result Of Interview For Construction Contract Duration

Table 8: Interview responses - Part 1

Q	Response	Respondent
1	Document that interconnect the two parties (client and contractor) in the construction project.	A&B
	A document that include all necessary things in construction projects and signed between the contractor and the client	C-F
	An agreement paper to execute a certain project	G&H
	An agreement document b/n client and contractor	I-K L-N
	An agreement document that is signed b/n a contractor and a client to execute a certain project	
2	Procurement Office	A-H
	Designer	I, N
	Client	J, K
	Consultant	L,M
3	ERA manual	all
4	The time for a certain project from the commencement date to the provisional acceptance	all
5	Consultant	A,C& D
	- Plan & programOffice	B,E,F&H
	- Design and Schedule	G-
	Procurement Office	I-K
	I don't Know	L,M
	-Consultant	N
6	By doing some investigation on the alignment.	A,C,D&G
	- I think by using some mathematical analysis formula highway development program (HDP) on the basis of Internal Rate of Return (IRR)	B
	- Considering the public demand and allocating the budget in a proper manner.	E,F
	- May be by certain investigation	H
	by studying the alignment route with their design engineers	I-N

7	Yes	A-I
	No	E,F, J-N
8	Weather condition and the topography of the environment	A-D, G-I

Table 9: Interview responses - Part 2

Q	Response	Respondent
9	Yes. The area has long season rainfall.	A-D, G&H
	Rainfall When we look at the topography of WD, there are a lot of land slide in the case of Jimma- Bonga- Mizan. So unexpectedly it will happen and take more time. Also these areas have more rainy seasons (six to eight Months). This also against what is given as construction periods (Eight Months) of the year. In the case of Gambella region, the terrain if flat. But even if there is little rain, it will take more time the flood to dry. By these and some other reasons the duration for the road construction of this district must be arranged than some Northern and Eastern districts.	I
10	South Africa, Tanzania, and Uganda. It also refer some international standards like: Australia standard, TRL from United Kingdom /UK, and AASHTO and ASTMfromUnited States of America/USA	A-D, G&H
11	Because their terrain are almost similar with our country	A-D, G&H
12	Yes. I think it depends on the new methods, technology, and modern construction materials developed and based on the request from the construction part	A-D, G&H
13	Whether condition, topography, type of the project(road), type of soil, availability and distance of fill materials, location of the project, performance of the contractor and supervision in behalf of the consultant	all
14	Yes. But very small time	A-J, L
	No	K, M, N
15	Yes	A-H
	No, but they do have obligation to see	I-K
	No	L-N
16	Yes	A-H
	Yes, They only see the rate that is given for the quantity	I-K
	No, They don't want to lose the work	L-N
17	No	A-K
	No, But we only asked to prepare Master schedule after the we signed	L-N

ASTM *=American Society for Testing and Materials. ASTM International, known until 2001 as the American Society for Testing and Materials (ASTM), is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. The organization's headquarters is in West Conshohocken, Pennsylvania, about 5 mi (8.0 km) northwest of Philadelphia.*

AASHTO*=American Association of State Highway and Transportation Officials, is a standards setting body which publishes specifications, test protocols and guidelines which are used in highway design and construction throughout the United States.*

TRL*= the Transport Research Laboratory, is a fully independent private company offering a transport consultancy and research service to the public and private sector. Originally established in 1933 by the United Kingdom/UK Government as the Road Research Laboratory (RRL), it was privatized in 1996.*

Table 10: Interview responses - Part 3

Q	Response	Respondent
18	Yes	I-N
19	Right-of-way or (Time to keep the road way free of public property) availability of material and its hauling distance, sometimes imported materials such as bitumen should not available as per needed, there is also a currency problem to import materials, adequate time for the preliminary investigation, on and offing of the contractor due to weather condition turnover of skilled manpower and so on	I-K
	Right-of-way, hauling distance of the material, public awareness on the desideration (necessity) of the project, time for preliminary study annual working period (rainfall area) and legal issue etc.	L-N
20	Yes	M, N
	Yes. Addis Ababa and Shashemenne	I
	Yes. Addis Ababa, Hawasa and Dirredawa	J
	No	K, L
21	I think ERA should not consider the weather conditions in WD. Here only five to six Months of working time and the rests are rainy. The right-of-way also the most affective factor of the delay of the road projects. Since this region has dense population, it should be given its own adequate time for right-of-way before the period for the construction is started. In addition to this the factors such are Load of the projects (length and width of the work, the difficulty in the specific area), weather conditions, and the Performance of	I-K

	the contractor should be considered.	

Key: *(see Q – Interview question items in appendices)*

A. *ERA-WD Team leader*
B. *ERA-WD Road projects supervisor*
C. *ERA-WD QARISM directorate director*
D. *ERA-WD QARISM document official*
E. *ERA-WD Plan & program director*
F. *ERA-WD Plan & program team leader*
G. *ERA-WD. Procurement office official*
H. *RRC Directorate director*
I. *CDSCo consulting Supervisor*
J. *AECOM Supervisor*
K. *MCE consulting Supervisor*
L. *ECWCo Manager*
M. *DAECo, G. Manager*
N. *China CGC Office Engineer*

Appendix 5

Result Of Interview

Table 11: Factors affecting construction contract duration

S. №	Factors Affecting Construction Contract Duration	Type of factor		Remark
		Considerable	Non-considerable	
1	Magnitude of the projects (road length and width) and scope	√		
2	Topography of the environment	√		
3	Adequate time for the preliminary investigation	√		
4	Weather conditions	√		
5	Availability of back fill materialand its hauling distance	√		
6	Right-of-way		√	
7	Imported material such as bitumen		√	
8	Cost of the project	√		
9	Currency problem for the imported materials		√	
10	Site characteristics	√		
11	Poor estimation of the project duration	√		
12	Poor management problem	√		
13	On and offing of the contractor (example due to rain)		√	
14	Turnover of skilled manpower		√	
15	Magnitude of obstructions		√	
16	The complexity of the project		√	
17	Early estimation of working time(8 Months a year)	√		
18	Rainfall		√	
19	Land slide	,	√	
20	Flood		√	
21	Type of Highway	√		

22	Labour productivity in the region/working area		√	
23	Delay of payment from the client		√	
24	Procurement methods		√	
25	Luck of finance of the contractor		√	
26	Cash flow of all parties involved		√	
27	Location of the project:	√		
28	Relocation of construction utility		√	
29	Material delivery time (cement, bitumen …)		√	
30	Special items:/unforeseen conditions		√	
31	Commitment by all parties to complete the contract within the deadline.		√	
32	Effect of community or institutions and events on the project		√	
33	Availability of access roads for emergency situations	√		
34	Legal aspects		√	
35	Excess quantity of earthwork in excavation than BOQ		√	
36	The type of Contract – Risk assessment and allocation		√	
37	The available of source of financing		√	
38	Past experience of the parties		√	
39	Scope and master plan of the project changed, so extra work carried out.		√	
40	Shortage of equipment		√	
41	Poor design of the project	√		
42	Design change		√	
43	Proper place for material storage.	√		
44	Capacity and performance of the contractor	√		

The above table is summarized below according to the factors' sequential effect from maximum to minimum. The sequence is based on the respondents of the interview and the consulted documents during the study.

Table 12: Factors affecting CCD from their high to low effects

S. №	Factors Affecting Construction Contract Duration	Type of factor		Remark
		Considerable	Non-considerable	
1	Type of Highway	√		
2	Weather conditions	√		
3	Magnitude of the projects (road length and width) and scope	√		
4	Right-of-way		√	
5	Availability of back fill material and its hauling distance	√		
6	Cost of the project	√		
7	Topography of the environment	√		
8	Site characteristics	√		
9	Poor design of the project		√	
10	Capacity and performance of the contractor	√		
11	Adequate time for the preliminary investigation	√		
12	Poor estimation of the project duration	√		
13	Poor management problem	√		
14	The complexity of the project		√	
15	Early estimation of working time(8 Months a year)	√		
16	Delay of payment from the client		√	
17	Magnitude of obstructions		√	
18	Labour productivity in the region/working area		√	
19	Rainfall		√	
20	Luck of finance of the contractor	,	√	
21	Cash flow of all parties involved		√	

22	Proper place for material storage	√		
23	Location of the project:	√		
24	The available of source of financing		√	
25	Material delivery time (cement, gravel, bitumen …)		√	
26	Turnover of skilled manpower		√	
27	Land slide		√	
28	Effect of community or institutions and events on the project		√	
29	On and offing of the contractor (example due to rain)		√	
30	Availability of access roads for emergency situations	√		
31	Procurement methods		√	
32	Design change		√	
33	Commitment by all parties to complete the contract within the deadline.		√	
34	Special items:/unforeseen conditions		√	
35	Imported material such as bitumen		√	
36	Currency problem for the imported materials		√	
37	Flood		√	
38	Legal aspects		√	
39	Past experience of the parties		√	
40	Scope and master plan of the project changed, so extra work carried out.		√	
41	Shortage of equipment	√		
42	The type of Contract – Risk assessment and allocation		√	
43	Excess quantity of earthwork in excavation than BOQ		√	
44	Relocation of construction utility		√	