Addis Ababa University

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School of Graduate Studies

PREPARATION AND IMPLEMENTATION OF CONSTRUCTION WORKS PROGRAM IN ERA ROAD PROJECTS

BY

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DECLARATION

"I declare that this research report entitled ***"Preparation and Implementation of Construction Works Program in ERA Road Projects"*** is original work of my own, has not been presented for a degree of any other university and that all sources of material used for the thesis have been duly acknowledged."

Signature:

Name of candidate: **Dereje Ermias Ado**

Date :

DEDICATION

I dedicate this work for my loving families who supported me all the way.

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ABSTRACT

One of the most important responsibilities of construction project management is the planning and scheduling of construction projects. The problem of using improper construction works program in ERA road projects is one of the causes for delay of projects and these have a debilitating effect on parties to a contract in terms of a growth in adversarial relationships, distrust, litigation, arbitration, cash-flow problems, and a general feeling of apprehension towards each other.

This study focused on the preparation and implementation of construction works program in ERA road projects. The objectives of the study were achieved through a desk study, interview and questionnaire survey to identify the ways of preparation and implementation of construction works program, challenges and to seek the improvement methods.

A ranking system using the Relative Index (RI) method had been adopted to find the most significant factor for each section in questionnaire.

Most important tasks identified for the preparation of construction works program were to define the scope of work to be performed using work breakdown structure, estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work, defining working calendars, develop activity dependency.

During implementation the most important were work program should be updated to recognize delay, using construction time effectively and applying proper efficiency is critical and proper resource utilization is used to avoid cost overrun.

According to the findings from the questionnaire responses, desk study and interview the major challenges in preparation and implementation of construction works program were cash flow problem of contractors, delay in site mobilization by contractor, the climatic condition at site, design change and right of way problem.

The results of this study indicated that the most recommended improvement methods were contractor should manage his financial resources and plan cash flow, there should be a continuous, proper planning before construction, so that resources and time are sufficient and there should be a good attitude among professionals regarding construction works program.

This study is therefore, to suggest improvement methods which can help to use construction works program properly in road projects.

Key words: Preparation and implementation, challenges, improvement, ERA road projects.

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LIST OF ABBREVATIONS

ERA	Ethiopian Roads Authority
CPM	Critical path method
PERT	Program Evaluation and Review Technique
FIDIC	Federation Internationale des Ingenieurs-Conseils: a French acronym interpreted in English as International Federation of Consulting Engineers
PPA	Public Procurement Agency
WBS	Work break down structure
AON	Activity on node
AOA	Activity on arrow
GDP	Growth Domestic Product
QRA	Quantitative Risk Analysis
FS	Finish to Start
FF	Finish to Finish
SS	Start to Start
SF	Start to Finish
BoQ	Bill of quantity
ES	Early start
EF	Early finish
LS	Late start
LF	Late finish.
GERT	Graphical Evaluation and Review Technique
NASA	National Aeronautics and Space Administration
SACPCMP	South African Council for Projects and Construction Management Profession

CHAPTER ONE

INTRODUCTION

1.1 Background

Construction is a major industry through the world, accounting for a sizeable proportion of most countries' Growth Domestic Product (GDP).

Furthermore; the importance of the construction sector is not only related to its size but also to its role in economic development. Also in Ethiopia construction industry plays great role in economy. Now a day, there are a lot of problems in construction industry that occur due to lack of planning and a poor understanding regarding construction works program.

The term construction program is also used to describe the actual or planned sequence of work as distinct from any document that might record the actual or planned sequence. Differences in opinion occur between employers and contractors on many issues. However, both will agree that completing the project as quickly as possible is a common goal, albeit for different reasons. The employer generally wants to have a project completed quickly so that the facility can be put to use as soon as possible. There are circumstances in which an employer may not want to have a project completed earlier than planned for financial or other business reasons; in such a case the employer simply wants the project delivered on time.

The contractor, on the other hand, wants to complete the project as quickly as is economical because every day spent on site costs money. Furthermore, cash flow is the lifeblood of the contractor; without it he will not survive. Achieving the scheduled monthly progress helps the contractor to meet his cash flow requirements. While employers and contractors have similar goals, they have differing needs and expectations from the schedule.

Moreover, the construction program might be created once and exist for the whole of the contract, but it is more common for the construction program to be regularly altered to reflect past progress and future expected or hoped-for progress. Sometimes construction program is used ambiguously to refer to the several written documents, each being a separate construction program (Gibson, 2007)

The principal aim of scheduling in project management is to plan the sequence of work so that activities can be systematically arranged towards the end of completion of the project (Moneke, 2012).

1.2. Statement of the problem

The way in which the client, contractors and consultants currently plan and schedule the work is one of the causes for delay of construction projects. Beside this using improper work program is the factor for low quality of work and dispute happen.

When we consider the practice of using works program in Ethiopian construction industry is not well developed. As stated in the contract, submission of construction works program is one of the requirements. Completion of project on time and minimizing cost over-runs are the most important factors for project success.

Construction industry benefited from properly prepared and implemented construction works program and there is a chance to construct other projects.

This research assessed the main concerns and problems associated with construction works program on the performance of construction works and suggest improvement methods.

1.3 Objective of the study

The General objective is to study the current practices and challenge associated with preparation and implementation of construction works program in ERA road projects in order to suggest improvement methods.

The Specific objective is:

i. To identify the practices of preparing & implementing construction works program in ERA road projects.
ii. To assess the challenges associated with construction works program on the performance of construction works.
iii. To recommend improvement methods how construction works program be prepared and implemented.

1. 4 Research questions

The research guided by the following research questions:

1. How do work programs are prepared & implemented in ERA road projects?
2. What are the challenges faced in ERA roads projects, concerning construction works program?
3. How can the preparation and implementation of construction works program be improved?

1.5 Scope of the study

There are many road projects which are currently under construction in Ethiopia. The research focused on Federal Road projects currently under construction in Southern part of the country and managed by

Southern Contract Management Directorate. The study is limited due to budget constraint, time, and location of the project and only assesses the road projects under construction in Southern part of the country. The study discussed issues related to the preparation and implementation of construction works program in ERA road projects. The study closes with conclusions and recommendations.

1.6 Significance of the study

Since using improper work program is one of the causes for delay of projects, the study intends to analyze and promote a better understanding on preparation and implementation construction works program in road projects. This study will offer some practical ideas, based on actual construction experience, to assist contractors in developing proper construction works program.

The points presented in this research will also assist owners in evaluating the performance of contractors that can able to complete the project in scheduled time.

1.7 Structure of the research

This thesis contains five main categories. These are the introduction, literature review, the research methodology, analysis, findings and discussions, and conclusion and recommendations.

Chapter One: Introduction: This chapter explained the background of the study, statement of the problem, objectives of the study, research questions, scope of the study, significance of the study and structure of the research.

Chapter Two: Literature Review: Under this chapter, the ways of preparation and implementation of construction works program, challenges and improvement in ERA Road Projects were discussed.

Chapter Three: Research Methodology: This chapter described the methodology used and procedures applied. The main topics included are research strategy, population and sampling, data collection and method of data analysis.

Chapter Four: Analysis, Findings and Discussions: This chapter comprised the analysis of data gathered with the research instruments. It analyzed data from the desk studies and survey.

Chapter Five: Conclusion and Recommendations: This is the last chapter of the research in which conclusions and recommendations were drawn. Further recommendations for future studies are also included in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 General

Planning for construction projects involves the logical analysis of a project, its requirements, and the plan (or plans) for its execution. This will also include consideration of the existing constraints and available resources that will affect the execution of the project. Considerable planning is required for the support functions for a project, material storage, worker facilities, workforce space, temporary utilities, and so on. Planning with respect to the critical path method, involves the identification of the activities for a project, the ordering of these activities with respect to each other, and the development of a network logic diagram that portrays the activity planning (Twort & Rees, 2004).

The project plan and schedule must clearly defined individual responsibilities, schedules, budgets, and anticipated problems (Oberlender, 2000)

Wubishet (2010) stated planning concepts in the following ways:

- Basic and Administrative Planning- The first planning devised for any works and services can be considered as Basic Planning and the one which reigns over the whole processes is Administrative Planning.
- Every plan shall consider
  - the existing reality called capacity;
  - the environment which can be understood as planning within and around; and the required demand or need called the development
- Planning shall also trade off the two important performance characteristics; process and result
- Planning shall look into and balance the five needs - impact based cycle performance criteria.

These are; relevance, efficiency, effectiveness, sustainability and impact

- Planning requires to define
  - Scope of works or services;
  - Construction methods and approaches selected
- Planning also requires defining schedules and resources assigned for the Highway Development services and works.
- Planning is used for evaluation purposes. Consequently, it possesses three dimensional benefits. These are tracking, accountability and learning.

2.2 Definition of work program

The construction program is defined by SACPCMP (2009) that cited in the works of Windapo(2013),as the program for the works indicating the logic sequence and duration of all activities to be completed by contractors, subcontractors and suppliers, in appropriate detail, for the monitoring of the progress of work. Chappel, Cowlin and Dunn (2009) defined a program as a schedule or chart showing stages in a scheme of work.

Project programming or scheduling: identify individual tasks, assign resources and budgets to each, create a baseline which determines the earliest and latest allowable start and finish times for each activity, the available float to each activity, and the critical path through the project (Keane & Caletka, 2008).

2.3 Types /methods of work program

The construction industry uses a number of different types of program to manage construction. Different terms are commonly used for the same types of program, much of which is historic and practical relevance. There are two types of program in most common use-the Bar Chart and the Linked Bar chart (Gibson *et al*., 2007)**.** In addition to those methods Keane *et al*. (2008) stated another method. These are**:** Project Evaluation and Review Technique (PERT), line balance method and Graphical Evaluation and Review Technique (GERT).

2.3.1 Gantt charts (Bar charts)

A Gantt chart is a horizontal bar chart that displays the duration and intended sequence of the tasks represented. Gantt charts have been around since the early 1900s and are frequently used in business to scope projects. The chart is named after its inventor, Henry Laurence Gantt, an American engineer and social scientist. The Gantt chart is the most widely used method of illustrating project sequences and plans and is still relevant today (Keane *et al*., 2008).

According to Obrlender (2000), bar chat has limited application for detailed construction work because the many interrelationships of activities, which are required for construction work, are not defined**.**

A Gantt chart with logical relationships is also known as a ‘time scaled logic diagram’ (Keane & Caletka, 2008).

According to Uher (2003), bar chart is a simple, visual scheduling tool that is easy to use. It displays planning information graphically in a compact format to a time-scale.

Bar charts can be made more elaborate to include updated information such activity as planned represents the estimated work-in-place for activities in progress, and the shading shows completed activities with the actual time required as stated by (Abebe *et al*., 2003).

2.3.2 The Critical Path Method (CPM)

The CPM was first used in Great Britain in the mid-1950s on the construction of a central electricity-generating complex. Its full potential was later realized by Walker of Du Pont and Kelley of Remington Rand, in the USA. Their critical path method was based on a graphic network commonly referred to as the 'arrow method'. It was driven by a computational process requiring no more than additions and subtractions (Uher *et al*., 2003).

The benefits of critical path scheduling were quickly realized by a wide range of organizations including construction firms, many of whom have successfully implemented it in their planning. The advent of the CPM computer software in the 1970s has made the CPM a universal scheduling technique.

Terms that are used in context of a CPM network include:

(1) An Arrow or line is used to represent one activity;
(2) A Node or Event which represents the beginning and ending point of an activity;
(3) A Milestone is typically a significant event that the owner or contractor wants to track;
(4) A Link which represents the path between two Nodes;
(5) A Dependency is the relationship between two different activities as they related to the commencement and completion of those activities;
(6) A Predecessor activity is an activity that restrains (refer to as a restrain) a subsequent depend activity;
(7) The restrained activity that follows a Predecessor activity is a Successor activity;
(8) Job logic refers to the necessary time and order of specific activities in relationship to the whole project; and
(9) Float represents the number of days an activity can be delayed without delaying the project, with a critical activity having no float.

- The critical path is computed in two steps. The first step involves a forward pass calculation of the activities; starting with the first activity on day one of the project. During the forward pass calculation the early start and early finish for that activity is calculated.
- The second step is the backward pass calculation. It involves calculating the late start dates and late finish dates for each activity. While the late start date is the latest date an activity can start without delaying the project completion, the late finish date is the latest date an activity can finish without delaying the project.

The Critical Path is the longest continuous chain or series of activities through the CPM network. The completion of project is delayed when one of the critical path activities is not started on time, not finished

within the allotted time, or not finished on time. If a non-critical activity exceeds its float time, that activity will become critical

2.3.2.1 Network Programs

The CPM network diagram is prepared to show the sequencing and interdependences of the activities in the WBS (Oberlender *et al*., 2000).

According to Atkinson (2001), network programs are a model not only of the activities and their durations, but of their interdependence. They represent the time characteristics of the project, not just each individual activity. The construction logic represents those factors which define the construction sequence of the project and include:

- **the method of working**, showing how the project is to be carried out and the sequence of activities;
- **the construction constraints**, which may be access dates for parts of the site or release dates for information or delivery dates for work by others;
- **the resource restraints**, which recognize the limited availability of plant, equipment, labor and supply of materials. The resource restraint is usually modeled by the sequential linking of activities which use the same resource. Experience shows that the resource restraint is often not appreciated when delay analysis is carried out.

2.3.2.2 Drawing Project Network

Elbeltagi *et al*. (2012) mentioned that network is a graphical representation of the project activities and their relationships. A project network is a set of arrows and nodes.
There are two ways that are commonly used to draw a network diagram for a project:

1. Activity on Arrow (AOA) representation.
2. Activity on Node (AON) representation

Activity on arrow network (AOA*)* in this method, the arrows represent activities while the nodes represent the start and the end of an activity (usually named as events). The length of the arrow connecting the nodes has no significance and may be straight, curved, or bent.

Activity-on-Node (AON) in the Arrow-on-Node Program each node is an activity with duration and the arrows represent the logic link between the activities. The Program uses finish to start relationships or links which are the same as used in Activity-on-Arrow Program.

2.3.3 PERT: Project Evaluation and Review Technique

PERT is a project management technique which schedules, organizes, and coordinates event tasks within a project. PERT was developed by the US Navy in the 1950s to manage the Polaris submarine missile program. A similar methodology, the CPM, was developed for project management in the private sector at about the same time. Some key features of a PERT network are:

- events must take place in a logical order;
- activities represent the time and the work it takes to get from one event to another;
- no single event can be considered to be finished until all activities leading to the event are completed; and
- no activity may be completed until the event preceding it has been finished.

According to Oberlender *et al*. (2000), PERT is applicable for projects where there is a high degree of uncertainty about how long any given activity will take to complete.

When applying PERT calculations one applies the same approach as CPM, with the exception that the planner calculates three possible durations for each task, the 'most likely', 'pessimistic', and 'optimistic' durations (Keane *et al*., 2008).

- **Most Likely Time** – the best estimate of the time period in which the activity can be accomplished. (This is the equivalent duration which would be used in traditional CPM calculations.)
- **Optimistic Time** – the minimum time period in which the task can be accomplished, i.e. the time it would take to complete the task if everything proceeded better than expected.
- **Pessimistic Time** – the maximum time period it would take to accomplish the task.

Firstly, a planner should assume the work will be done within the industry norm, for example, with a standard crew size, no overtime and in ideal conditions. This duration is the 'most likely' duration. The planner then makes aggressive and conservative duration assessments, referred to as 'optimistic' and 'pessimistic' durations respectively.

2.3.4 Line of Balance Method

The line of balance technique is a planning technique used to program production of repetitive construction units. It was originally developed during the Second World War by the US Navy for planning and controlling mass production process (Cormican, 1985). According to Atkinson (2001), Line of Balance program allows the different rates of productivity of parts of an activity to be modeled,

depending on its location on site or the period of year when the activity is carried out. It also allows the inter-relation between different trades in an area to be modeled.

2.3.5 Graphical Evaluation and Review Technique (GERT)

Graphical Evaluation and Review Technique (GERT) were developed by Alan Pritsker in 1966 as a part of Rand's work for NASA on developing automatic check-out procedures for Apollo (Hadju & Morris, 1997).

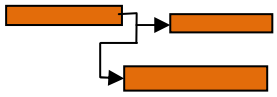
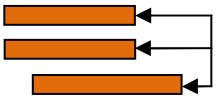
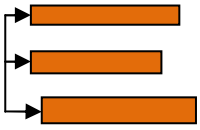
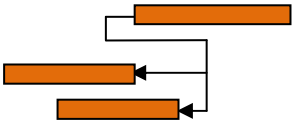
According to Haugan *et al.*(2002),GERT is a net work analysis methodology that allows for non-sequential activities, such as loops or conditional branches. GERT combines signal flow chart theory, probabilistic net works, PERT and decision trees all in a single frame work.

2.4 Types of activities relationship

Four types of relationships among activities can be defined as described in the table below.

Typically, relationships are defined from the predecessor to the successor activity (Elbeltagi *et al*., 2013).

Table 2.1: Types of relationships

No.	Links	Descriptions	Pictorial Representations
1	**Finish to Start (FS)**	The successor task can't start until the predecessor or task finishes.	
2	**Finish to Finish (FF)**	The successor task can't finish until the predecessor or task finishes.	
3	**Start to Start (SS)**	The successor task can't start until the predecessor or task starts.	
4	**Start to Finish (SF)**	The successor task can't finish until the predecessor or task starts.	

2.5 The importance of a program

The process of planning and programming the project includes determining the overall approach to the job, organizing and planning the labour and equipment resources, procuring subcontractors and materials (Gibson *et al*., 2007). However, as well as being used to plan and monitor project performance, a contractor's program has another key function; that is as a reference and measurement tool for a

contractor's entitlement to an extension of time and additional payment for delay and/or disruption(Gibson,2007).

2.5.1 The program as a plan for the works

It is advisable that the contract administrator should at the very least accept the program albeit with comments. The program should then be used by all parties to the project as the means for monitoring and measuring progress and performance.

The usefulness of a program can be enhanced by the addition of resource and cost information. This can have considerable benefits in the administration and monitoring of a project. In particular, if these principles are followed through into other documentation it becomes a much easier task to demonstrate the link between cause and effect relative to any single event.

2.5.2 The program; in a claim situation

The program is an essential document in determining the extent of any extension of time and/or compensation for delay. It is the benchmark or measuring tool in these situations. The roles of a program as a reference and measuring tool for both contractors and employers in delay situations are:

- for a contractor's entitlement to additional time for completion of the works or for sections of the works, in accordance with the contract;
- for a contractor's entitlement to additional payment for delay and/or disruption, in accordance with the contract;
- for a contractor's entitlement to additional payment for instructed acceleration, in accordance with the contract or on the terms agreed;
- for the employer's right to deduct liquidated damages for the contractor's failure to complete the works on time;
- for the employer's right to terminate the contractor for his failure to comply with the obligation to progress the works.

According to Windapo (2013), the purpose of construction programs:

a. To record agreed intentions with the client
b. To supply a time table for coordinating the issue of drawings and information, the placing of orders and delivery of materials and the operations of plant and sub-contractors,
c. To prepare a basis for the introduction of payments by results or other incentives
d. To show the sequence of operations and the total output rates required of labour and plant,

e. Provide a yardstick for progressing,
f. To furnish the client with the likely financial requirements,
g. To discourage changes in design by indicating the natural consequences, whilst at the same time facilitating amendments and minimizing their harmful effects should contingencies arise.

According Windapo (2013), the construction program can be used in preparing:-

- Budgets and cash flow statements /financial graphs,
- Materials requirement schedules;
- Labour requirement schedules.
- Plant requirement schedules
- Information requirement schedules

2.6 Preparation of Construction Works Program

The preparation of construction work program will be prepared by considering different points. Keane & Caletka (2008) list tasks in the preparation of a Baseline Program as follows:

1. De-scope the project into work packages to ensure that:
    - all elements of the BoQ are accounted for;
    - all elements on structural drawings, architectural plans and elevations are accounted for;
    - all elements and constraints defined in specifications, contract documents, planning conditions and tender documents are accounted for; and
    - all elements are defined as 'tasks' or date constraints (with a duration, quantity of measurable work content or deliverable)
2. Define the work breakdown structure;
3. Allocate each activity to both the activity code structure and the lowest WBS level;
4. Identify required construction sequences 'hard logic' (i.e. the natural sequence of identified tasks or sequence dictated by the design, absent any outside influences, constraints or imposed milestones);
5. Identify preferential sequences and constraints 'soft logic' (i.e. sequences imposed on the project by resource constraints, plant selection, imposed constraints or imposed intermediate milestones);
6. Identify required procurement durations for long lead items to prioritize design tasks;
7. Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods;

8. Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work; and
9. Define working calendars.

When preparing a baseline, it is recommended that an 'activity data sheet' is created to document relevant assumptions made when establishing the activity duration and logic, including:

- Relevant specifications and drawings
- Assumed quantities
- Duration calculations
- Calendar assignments
- Time risk allowances
- Assumed production/outputs
- Assumed resource allocation
- Assumed cost allocations
- Successor activities
- Applicable completion date, key date or milestones

2.6.1 Event date calculations

Once the tasks and their durations have been identified and the logical relationships between them is established, the time required to achieve project completion (and each task's early and late start and finish date) can be determined by simple mathematical calculations.

As described above, the event times associated with each task are: early start (ES), early finish (EF), late start (LS), and late finish (LF).These are established through what is referred to as the 'forward pass' and 'backward pass'.

The ultimate purpose of a CPM program is to determine event dates, and float values for each task on the program (Keane & Caletka, 2008).

Total float is the most common float value referred to, but there are actually four types of float a project planner should be familiar with when analyzing CPM programs. These are:

- Total float - the amount of time by which a task may be delayed or lengthened without impacting upon the calculated earliest finish of the project completion date [ES - LS, or EF - LF].
- Free float -the amount of time which a task may be delayed or lengthened without impacting upon the early start date of any of its successor activities.

- Independent float-the amount of time which a task may be lengthened or delayed without impacting upon the early start date of any of its successors nor impacting the latest start time of any of its predecessors.
- Interfering float – the amount of time that, if expended, would decrease the float available to its successors.

Each of these 'float times' are clearly related and basically indicate how much flexibility, or contingency, each task has. In all cases, total float will always equal or exceed free float, while independent float will always be less than or equal to free float (Keane & Caletka, 2008).

2.6.2 Work Breakdown Structure (WBS)

According to Elbeltagi *et al*. (2012), the Work Breakdown Structure is described as a hierarchical structure which is designed to logically subdivide all the work-elements of the project into a graphical presentation. The full scope of work for the project is placed at the top of the diagram, and then sub-divided smaller elements of work at each lower level of the breakdown. At the lowest level of the WBS the elements of work is called a work package.

A list of project's activities is developed from the work packages.

The WBS identifies the tasks and activities that must be performed, but doesn't provide the order in which they must occur (Oberlender, 2000).

2.6.2.1 Project Activities

The building block (the smallest unit) of a WBS is the activity, which is a unique unit of the project that has a specified duration. An activity is defined as any function or decision in the project that: consumes time, resources, and cost. Activities are classified to three types (Elbeltagi *et al*., 2012):

Production activities*:* activities that involve the use of resources such as labor, equipment, material, or subcontractor. This type of activities can be easily identified by reading the project's drawings and specifications. Examples are: excavation, formwork, reinforcement, concreting, etc. each production activity can have a certain quantity of work, resource needs, costs, and duration.

Procurement activities: activities that specify the time for procuring materials or equipment that are needed for a production activity.

Management activities: activities that are related to management decisions such as approvals, vacations, etc.

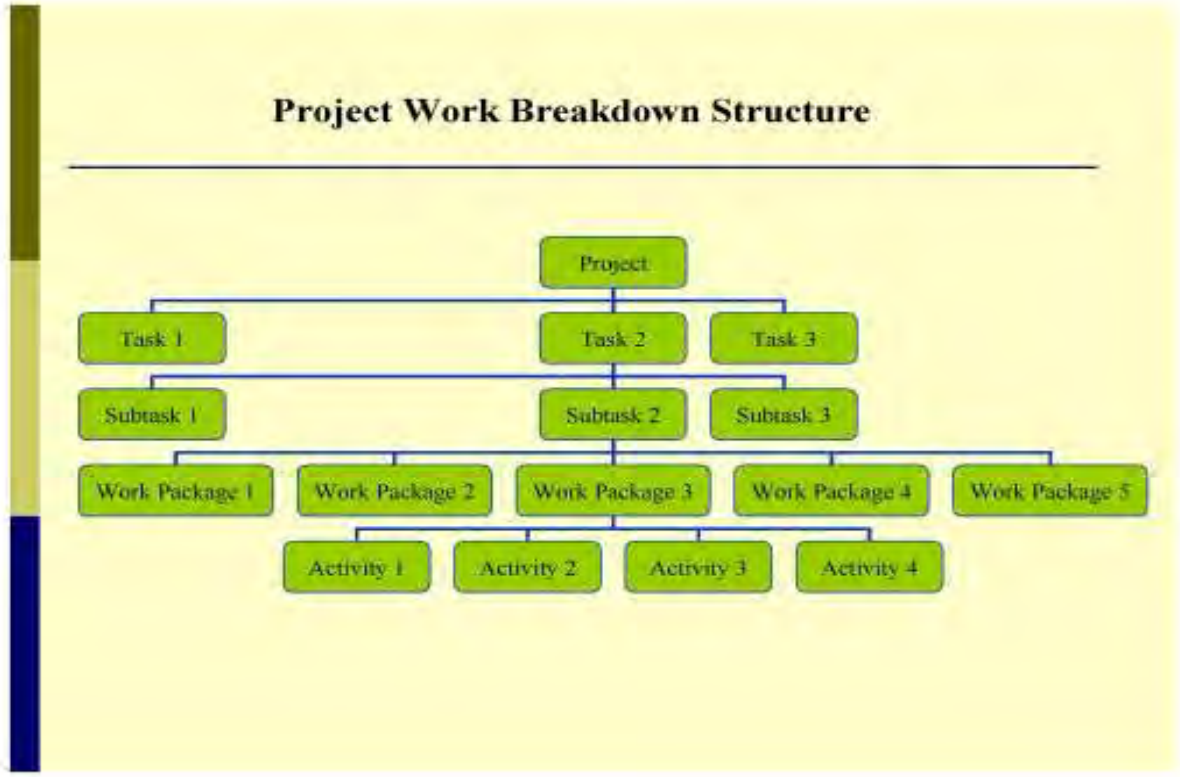


Figure 2.1: Typical Project Work Break down Structure

2.6.3 WBS Coding

A project code system provides the framework for project planning and control in which each work package in a WBS is given a unique code that is used in project planning and control. The coding system provides a comprehensive checklist of all items of work that can be found in a specific type of construction. Also, it provides uniformity, transfer & comparison of information among projects (Elbeltagi, 2012).

2.6.4 Management Techniques used in Preparing Construction Program

Windapo (2013) stated management techniques used in preparing the construction program as follows:

- Planning
- Forecasting and
- Organizing

According Windapo (2013), the master or overall construction program covers the full contract period and includes the complete works in broad, overall terms.

Bakouros and Kelessidis (2000) stated project management tools and principles provide the means for

- project breakdown into tasks and sub-tasks
- finding interdependencies between the tasks
- allocating resources, human and material and smoothing resources
- estimation for total project duration and budget
- monitoring more efficiently project progress

Information required for preparing the construction program includes:

1. List of project activities
2. Activity precedence
3. Scope of project activity
4. Activity start and finish date
5. Activity duration

The program outline can then be sketched in the following:-

- Accepted trade practice for building work,
- Experience and
- Innumerable practical considerations.

2.6.5 Construction Method Statement

This can be said to be a definite expression in writing of the procedure that will be adopted for accomplishing each activity identified in a construction project. It is a document prepared by the contractor and submitted along with other tender documents while tendering for a project. If the contractors win the contract, it becomes part of the contract documents that serves as a basis for agreement b/n the client and the contractor (Windapo, 2013).

2.6.5.1 The purpose of the Construction Method Statement

The method statement is used to:

a. Record agreed intensions with the client
b. Predict the anticipated project quality, risk and health, safety and environmental requirements
c. Assess the adequacy of the project time stipulated by the contractor and the contractor's knowledge of planning.
d. It gives the client a tool to assess the contractor's knowledge/know-how of the project
e. Determine how realistic the contractor's bid is

2.6.6 Software Tools used in the Preparation of the Construction Works Program

The software tool commonly used in the preparation of construction program is Microsoft office Project. Microsoft Office Project is a powerful tool used in project management that helps construction mangers to:

- Standardize and document the project plan
- Outline project phases, activities, tasks and milestones
- Analyze a project with work breakdown structures
- Scheduling a project based on the start or finish date
- Save time and effort
- Control and deliver
- Flexible and powerful
- Easier to see and share
- Evaluate possibilities
- Grow capabilities
- Enhance performance

2.6.7 Construction Works Program under FIDIC (1999) and PPA (2006) Condition of Contract

2.6.7.1 Contractor's program

The contractor must submit to the engineer for his approval a program showing the order of procedure in which he proposes to carry out the works.

"The contractor shall submit a detailed time program to the engineer within 28 days receiving the notice under sub clause 8.1 (commencement of work). The contractor shall also submit revised program whenever the previous program is inconsistent with the actual progress or with the contractor's obligations. Each program shall include:

a) The order which the contractor intends to carry out the works, including the anticipated timing of each stage of designs (if any), contractor documents procurement, manufacturing plant, delivery to the site, construction, erection and testing.

b) Each of these stages for work each nominated sub contractor (as defined in clause5 (Nominated sub contractor)

c) The sequence and timing of inspection and testes specified in the contract and

d) A supporting report which include:

i. a general description of the methods which the contractor intends to adopt, and of the major stages, in the execution of the works, and
ii. details showing the contractor's reasonable estimate of the number of each class of the contractor's personnel and of each type of contractor's equipment, required on the site of each major stage.

Unless the engineer within 21 days after receiving program gives notice to the contractor stating the extent to which it does not comply with the contract, the contractor shall proceed in accordance with the program, subject to his other obligation under the contract. The employer's personnel shall be entitled to rely upon the program when planning their activities.

The contractor shall promptly give notice to the engineer of specific probable future events or circumstances which may adversely affect the work increase the contract price or delay the execution of the works. The engineer may require the contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under sub clause 13.3 [variation procedure].

If, at any time, the engineer gives notice to the contractor that a program fails to the extent stated to comply with the contract or to be consistent with actual progress and the contractor's stated intentions, the contractor shall submit a revised program to the engineer in accordance with this sub-clause." (FIDIC 1999 condition of contract, clause-8.3)

As stated in PPA (2006) condition of contract clause 27, "within the time stated in special condition of contract, the contractor shall submit to the engineer for approval a program showing the general methods, arrangement, order, and timing for all the activities in the works. An update of the program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities

The contractor shall submit to the engineer for approval an updated program at intervals no longer than submit the period stated in special conditions of contract. If the contractor does not submit an updated program within this period, the engineer may with hold the amount stated in the special condition of contract from the next payment certificate and continue to withhold this amount until the next payment after the date on which overdue program has been submitted.

The engineer's approval of the program shall not alter the contractor's obligations. The contractor may revise the program and submit it to the engineer again at any time. A revised program shall show the effect of variations and compensation events.

2.6.8 Constraints

According to Keane & Caletka (2008), a final consideration when calculating earliest start and finish dates may be the imposition of a date constraint to certain tasks. These are the tasks which must be constrained for various valid reasons, some of which are listed below:

- to represent interim contractual milestone dates;
- to represent when access to a certain part of the site may be provided;
- to represent when a long lead item is expected from a manufacturer;
- to represent when employer furnished equipment will be available; or
- to represent when staff will be migrating into or out of certain parts of the works.

There are many valued uses of constraints, but they are not a substitute for logical relationships to determine early and late start event times for each task.

Over-use of constraints prevents the project network from calculating auditable or sensible critical paths to completion.

There are six primary types of date constraints:

- Start-on date;
- Start-no-earlier than;
- Start-no-later than;
- Finish-on date;
- Finish-no-earlier-than; and
- Finish-no-later-than.

Each of these affects the program and task float calculations differently.

The constraint ‘start/finish-no-earlier-than’ affects only the early date (the forward pass) calculations. The constraint ‘start/finish-no-later-than’ only affects the late date calculations (backward pass).

The ‘start/finish on’ constraint is a combination of ‘no-earlier-than’ and ‘no-later-than’ constraints and over-rides both the early and late date calculation. These, and other constraints, provide useful functions in programming but their over-use is an indication of ‘lazy logic’ and should not be a substitute for actual network logic to determine early and late event times for activities.

Table 2.2: Constraint forms

Constraint	Usage
Start on	Forces the activity to start on the constraint date
Start on or after	Use this constraint to set the earliest date an activity can begin.
Start on or before	Forces the activity to start no later than the constraint date.
Finish on	Forces the activity to finish on the constraint date
Finish on or after	Forces the activity to finish no earlier than the constraint date.
Finish on or before	Use this constraint to set intermediate completion points in the project.
Must be finished by	Use when an overall project deadline must be met.
As late as possible	Possible Delays an activity as late as possible without delaying its successors.
Mandatory start and finish	Forces early and late dates to be equal to the constraint date.
Zero total float constraint	This forces an activity to have the same early dates and late dates, and forces the total float of the activity to be equal to zero. This is the simplest method to sequester available fl oat to an activity.

2.6.9 Program approval

Finally, when all of these factors have been considered by the project management team, a draft CPM program can be circulated for final review by the contractor's in-house staff. The final review and input from in-house staff provide a last chance to ensure that the resulting program is contractually compliant and allows the works to be constructed within the tender sum. This final, internal review will often consider (Keane & Caletka, 2008):

- the final means and methods of construction to ensure that method statements for key tasks are in accordance with the final CPM before it is submitted for approval;
- the resulting 'critical path' to ensure that it is logical and consistent with intuition and the experience of the contractor's senior staff; the program level of detail and coding to ensure that it is consistent and relevant to the project controls systems, WBS and cost coding structure, and that all tasks have budgeted costs, and resources; and
- each task to ensure that it has a clear 'owner', whether that be a subcontractor or an individual sector manager.

2.6.10 Project baseline

Once the project program is prepared and the project needs are estimated, the original program is saved as a 'baseline' program. A baseline program allows the plan to be communicated to all parties.
Various methods are available for representing the resulting network and to assist in how the above process results in a useful tool for managing the works.

2.7 Implementation of Construction Works Program

Haule and Pilly (2010) in their study stated that implementation of a road construction project is guided by the program of work which is prepared by the contractor and approved by the supervisor (consultant).Depending on the circumstances that arise during the implementation of the project, the program of work may be revised from time to time with or without affecting the agreed completion date and the project budget. (i.e. by extending the project duration).
Problems with delays, cost overrun and quality

a. Problem concerns time management, i.e. road works are not completed within the agreed time and benefits of the works to the public are delayed.
b. problem concerns cost overrun, i.e. additional but avoidable costs to the decided budgets for varying reasons, and
c. Problem concerns the weaknesses in quality control system of the road works which results into early wear and tear necessitating repair and maintenance.

Previous studies was done by Moneke (2012**)** shows that many work schedules and work plan have failed to produce successful results with respect to timing, resource utilization and reliability of the schedule. Also work schedule errors have lead to cost overrun, low quality standard and poor schedule performance index.
Contractor is entitled for extension of time if he can prove that he had used his best endeavor and had tried his best to avoid the delay. He is also must proved that he is doing the works with regularly and diligently (Idris, 2006).

According to Keane & Caletka (2008), contractors update program for many reasons.

- ❖ It is often a contract requirement and may be required for payment purposes.
- ❖ It identifies the changing critical path and identifies out-of-sequence working, which may require an adjustment to the plan for completing the remaining work.
- ❖ It identifies progress, or lack thereof, and can predict a more accurate completion date as of the date the project status is measured.

Gibson (2007) also stated that program updates should be performed on a regular basis for the purpose of gathering progress information and revising program logic as appropriate.

2.8 Challenges and Problems of Construction Works Program on the Performance of Construction Works

Previous study was done by Divakar and Subramanian (2009) shows the role of project participants, planning, monitoring and feedback, decision making, approval and implementation are the critical factors on the performance of construction works.

According to Keane & Caletka (2008), a properly managed pre-construction phase can substantially reduce the risk of any unforeseen or unallocated scope emerging which was not clearly assigned to a work package or a member of the employer's professional team.

While traditional delay analysis approaches tend to focus on the design and construction phase, delays and inefficiencies can often result due to circumstances which occur long before the first drawing is produced. Although these early factors are more difficult to identify as delay 'events', typical factors which can result in programs containing inherent delays before the first delay event culminates on-site include:

- poor project definition;
- use of an inappropriate form of contract;
- inappropriate contract packaging strategy;
- ambiguities present in specifications, contract drawings, bills, employer's requirements;
- the appointment of inexperienced managers and supervisors;
- insufficient budget allowances or contingencies (e.g. cost and time) for unforeseen events and design development;
- poor plant selection;
- failure to communicate plans/intentions to local authorities;
- ineffective site logistics planning; and/or
- incorrect assumptions regarding neighboring sites, land-owners or other interested stakeholders.

Any of these risks can add unnecessary hurdles while contributing to a breakdown in project execution. Examples of the above factors can be identified, but pin-pointing the impact of each, or any combination of one or more, often proves difficult.

2.8.1 Activity durations

According to Oberlender (2000), the assignment of the duration that is required to accomplish an activity will vary depending on many factors: quantity and quality of work, number of people and /or equipment that is assigned to the activity, level of work skills, availability of equipment, work environment, effectiveness of the work and other conditions. Estimating activity durations requires experience, judgment and knowledge of the means and methods intended to carry out the works; in effect, activity durations are subjective in nature (Keane & Caletka**,** 2008)

2.8.2 Factors affecting project performance

Previous studies were done by different researchers on critical factors affecting the construction performance. Tat *et al.* (2009) identified 33 factors categorized in four groups namely:

1. Project specific factors
2. Project management factors
3. Working condition factor
4. External Environmental

Project Specific Factors

Project Specific factors which were affecting the preparation of better construction work schedule was the type of project which is undertaken, the nature of the project, complexity of the project and size of the project

Working Condition

This factor comprises attributes like scope and nature of work and also the climatic condition at site.

External Environment

The attributes under this factors includes the economic environment, social environment, political environment, physical environment, industry relation environment and technical advancement.
Saqib *et al*. (2008) in his study he identified seventy seven (77) factors categorized in seven (7) groups namely:

1. Project Management Factors;
2. Procurement-related Factors;
3. Client-related Factors;
4. Design team-related Factors;

5. Contractor-related factors;
6. Project Manager-related Factors; and
7. Business and Work Environment-related factors

1. Project Management Factors

Project management action is a key for project success (Hubbard 1990). According to Jaselskis and Ashley (1991) cited in the work of Saqib (2008) they suggested that by using the management tools, the project managers would be able to plan and execute their construction projects to maximize the project's chances of success. Then, the variables in project management include adequate communication, control mechanisms, feedback capabilities, troubleshooting, coordination effectiveness, decision making effectiveness, monitoring, project organization structure, plan and schedule followed, and related previous management experience (Belout 1998; Chua *et al.* 1999; Walker and Vines 2000). A number of attributes will affect this factor, including the communication system, control mechanism, feedback capabilities, planning effort, organization structure, safety and quality assurance program, control of subcontractors' works, and finally the overall managerial actions.

2. Procurement-related Factors

According to Dissanayaka and Kumaraswamy (1999), cited in the work of Saqib (2008), defined the scope of procurement as the framework within which construction is brought about, acquired or obtained. Therefore, two attributes are used to measure this factor; they are procurement method (selection of the organization for the design and construction of the project) and tendering method (procedures adopted for the selection of the project team and in particular the main contractor).

3. Client-related Factors

Walker (1995) considered influence of client and client's representative as a significant factor on construction time performance. The client related factors concerned with client characteristics, client type and experience, knowledge of construction project organization, project financing, client confidence in the construction team, owner's construction sophistication, well-defined scope, owner's risk aversion, client project management (Chan and Kumaraswamy 1997; Songer and Molenaar 1997; Dissanayaka and Kumaraswamy 1999).

4. Design team-related Factors

Designers play a vital role as their work involves from inception to completion on a project. Chan and Kumaraswamy (1997) considered that design team-related factors consist of design team experience, project design complexity, and mistakes/delays in producing design documents.

5. Contractor-related Factors

The main contractor and subcontractors start their main duties when the project reaches the construction stage. The variables include contractor experience, site management, supervision and involvement of subcontracting, contractor's cash flow, effectiveness of cost control system, and speed of information flow (Chan and Kumaraswamy 1997; Dissanayaka and Kumaraswamy 1999).

6. Project Manager-related Factors

The project manager is another key stakeholder in a construction project and his competence is a critical factor affecting project planning, scheduling, and communication (Belassi and Tukel 1996). Variables under this factor consist of the skills and characteristics of project managers, their commitment, competence, experience, and authority (Chua *et al*., 1999).

A construction project requires team spirit; therefore team building is important among different parties. Team effort by all parties to a contract-owner, architect, construction manager, contractor, and subcontractors-is a crucial ingredient for the successful completion of a project (Hassan 1995).

7. Business and Work Environment-related Factors

Akinsola *et al*. (1997) further described ''environment'' as all external influences on the construction process, including social, political, and technical systems.

The attributes used to measure this factor are economic environment, social environment, political environment, physical environment, industrial relation environment, and level of technology advanced.

2.9 Methods of Improvement in Preparing Construction Works Program

Tat (2009) stated some points which help to improve and prepare better and good construction work program listed as follows:

1. Project team leaders should keep good relationship with all project participants.
2. Continuous and proper planning before construction, so that resources and time are sufficient.
3. Giving prompt feedback/action when any matter arises.
4. Contractor should manage his financial resources and plan cash flow.
5. Learning more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity

6. Material supply should be readily preserved to avoid insufficient or depleted resources.
7. Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness. It is better to give information in written form rather than verbal instruction or information.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology used and procedures applied in achieving this study. The main topics included in this chapter are research strategy, population and sampling, data collection and method of data analysis.

3.2 Research strategy

The research strategy is the way in which the research objectives can be questioned. Two types of research strategies were used during studies, quantitative and qualitative research. Quantitative approach is used to gather factual data and to study relationships between facts and how such facts and relationships accord with theories and the findings of any research executed previously, but the qualitative approach seek to gain insights and to understand people's perception.

3.3 Population and sampling

The population of this research included client, consultants and contractors. Wood and Haber (1998) defined the sampling as the process of selecting representative units of a population for the study in research investigation. A sample is a small proportion of a population selected for observation and analysis. The samples were selected based on the progress report of the project during conducting questionnaire. During the study period, there were a total of thirty four (34) road projects which were under construction in Southern part of Ethiopia and managed by South Region Contract Management Directorate. Among them fifteen (15) road projects sample was taken for the study based on the progress report which have more than 40 % and out of fifteen five(5) upgrading road projects which have more time elapsed were selected for desk study. Since the number of new road projects is less and their progress status is below 40% could not be selected. The construction of roads are being undergoing by two foreign and three local contractors. **(See Appendix D)**

3.4 Data Collection

The data collection approach adopted in this study were includes both primary and secondary sources. Questionnaire, interview, and desk study provide the primary data for this research while the secondary data sources include journals and internet sources.

3.4.1 Desk Study

In order to have enough information five road projects were carefully selected and different data's were investigated. The sources of data's were master work schedule, weekly, monthly and annual progress report and different formats used at project site. Depending on the data and information gathered the cases discussed regarding the preparation and implementation of construction works program in ERA road projects.

3.4.2 Survey

3.4.2.1 Interviews

Interviews are a type of survey where questions are delivered in a face-to-face with the interviewee asking questions selected individuals. In this study semi-structured interview were conducted with senior counterpart engineer, resident engineers, project managers and senior office engineer for seeking information regarding how construction works program are prepared and implemented, challenges in preparation and implementation in ERA road projects. Improvement methods in preparation and implementation works program were also asked.

3.4.2.2 Questionnaire

A questionnaire was developed to assess the perceptions of owners, consultants, and contractors using the Relative Index (RI) technique. The variables were identified from a literature review and the questionnaire was distributed for selected professionals (**See Appendix A**). The participants were requested to rate the questions on the given five-point scale of five ordinal measures as shown in **Figure 3.1** below. The questionnaire was structured in four sections as shown below:

Section 1: The first section shows name of Organization, position of the respondents in the company and experience of the respondents. Under this section there are four questions.

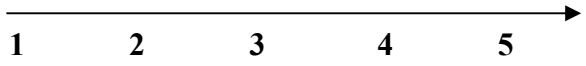
Section 2: The second section comprises the questions the indicating the preparation and implementation of construction works program. Under this category a total of 23 required responses.

Section 3: The third section comprises the questions the indicating challenges in preparing and implementing construction works program. Under this category a total of 50 required responses.

Section 4: The fourth section would be the proposed methods of improvement when preparing and implementing construction works program in ERA road projects. Under this category a total of 7 required responses.

For all questionnaires under section two up to four the ranking of the responses was by using Likert's scale of five ordinal measures which are arranged in ascending order from 1 to 5.

Ordinal scale of 1 to 5



Increasing degree of contribution from 1 to 5

Figure 3.1: Five ordinal measures of agreement by Likert Scale

3.5 Method of Data Analysis

The responses to the questionnaire were based on Likert's scale of five ordinal measures which was from 1to 5 arranged in ascending orders according to the degree of contribution to each question. The collected data were analyzed by using the Relative Index (RI) technique.

The responses are analyzed using the Microsoft Excel software package. The analysis included ranking the factors in terms of degree of effecting. In the computation of the relative index the following equation was used;

$$RI = \frac{(5n_5 + 4n_4 + 3n_3 + 2n_2 + n)}{5(n_5 + n_4 + n_3 + n_2 + n)} \quad \ldots\ldots\ldots \quad \textbf{Equation 3.1}$$

Where:

RI: Relative Index

n5, n4, n3, ... : number of responding indices.

The Spearman (rho) rank correlation coefficient is used for measuring the differences in ranking between two groups of respondents scoring for various factors (i.e. clients versus consultants, clients versus contractors, and consultants versus contractors).

The Spearman (rho) rank correlation coefficient for any two groups of ranking is given by the following formula:

$$\text{Rho } (\rho_{cal}) = 1 - \frac{6 \times (\sum d_i^2)}{N \times (N^2 - 1)} \quad \ldots\ldots\ldots \quad \textbf{Equation 3.2}$$

Where

Rho (ρ_{cal}) : r is the Spearman rank correlation coefficient between two parties;

d_i: the difference between ranks assigned to variables for each of factors; and

N: number of factors (variables).

The correlation coefficient varies between *-1* and *+1*. A correlation coefficient of *+1* implies perfect positive relationship (agreement), *0* implies no correlation and while *-1* results from a perfect negative relationship (disagreement).

CHAPTER FOUR

ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

This chapter describes the results and discussion of questionnaires, desk study and interviews. The collected data from questionnaire were tabulated and analyzed using the Relative Index (RI) based on their ranking. In addition to questionnaire the responses of interviews from client, consultants and contractors are presented together with observation from the desk study. The collected data used to achieve the prescribed objectives mentioned in **Chapter 3**.

4.2 Analysis of data from the desk study

During the study period five (5) upgrading road projects which have more time elapsed were selected for desk study in order to identify the practices, challenges in preparation and implementation of construction works program and to suggest the improvement methods. The construction of roads are being undergoing by two foreign and three local contractors. The list of selected road projects is as shown in **Table 4.1**.

Table 4.1: List of selected Road projects from Ethiopian Roads Authority for Desk Study

SOUTH REGION CONTRACT MANAGEMENT DIRECTORATE
General status of the project reporting month of 30th June 2014

No.	Project name	Contract amount (Birr)	Total length (Km)	Contract duration	Contract sign date	Commencement date	Completion date	Time elapsed in%
1	Alaba – Sodo – Arbaminch, Contract II: Humbo –Arbaminch	380,204,197.21 (Original) 407,071,291.26 (Revised)	100	912days (Original) 2336days(Revised)	23th Nov.,2007	1st Jan, 2008	July 2, 2010 (Original) January 20, 2014 (Revised)	262% of original duration
2	Aposto-Wendo-Negele Road Upgrading project Contract 1- Aposto-IrbaModa	660,938,029.00 (Original) 647,339,241.45(Revised)	94.10	1095days (Original) 1400days(1stRevised) 1900 days(2nd	9thDec.2009	28th April, 2009	April 27, 2012 (Original) February1,2013(1st Revised June 29,2104(Revised)	173.52% of original duration
3	Aposto-Wendo-Negele Road Upgrading project Contract II-IrbaModa-Wadera Road project	617,731,977.13(Original) 675,912,859.40 (Revised)	108.46	1095days (Original) 1546(1st Revised) 2058(2nd revised)	24thDec.2008	1st April, 2009	March 31, 2012 (Original) June 25,2013(1st Revised) Nov.19,2014(2nd Revised)	174.89% of original duration
4	Aletawondo-Daye Road Upgrading Project	279,878,093.55(Original) 331,134,979.89(Revised)	51	910days(Original) 1075(1st Revised) 2070 (2nd Revised)	7th August 2008	5thSep. 2008	March4,2011(Original) Dec.4,2012(1st Revised) May 9,2014(2nd Revised)	180.33 % of original duration
5	Arbaminch-Kemba-Sawula Road Project Contract 1: Arbaminch –Belata(60 Km)	562,946,553.21 (Original) 521,410,076.01 (Revised)	60	1095calendar days (Original) 1186 calendar days(1st Revised) 1602 calendar days(2nd Revised)	10thFeb.2010	12thApril, 2010	April10,2013 (Original) Nov. 4 , 2013(1st Revised) August 30.2014(2nd Revised)	140.82% of original duration

4.2.1 Desk study No 1: Construction of Humbo –Arbaminch upgrading road project

The project road is located in the southern part of the country in Southern Nations and Nationalities People State. The total length of the project is 100 km upgrading existing DBST road to Asphalt Concrete standard with contract amount ETB 380,204,197.21(Original).The original contract duration is 912(Original) calendar days and the original completion date is July 2,2010. The construction is being undergoing by local contractor. From the current physical progress during the June, 2014 report the total to date executed km about 86.14 (86 %).

The progress in the execution of all activities is unsatisfactory as compared to the schedule and to the time elapsed so far. The main reasons are insufficient mobilization of construction equipments within the mobilization period as per the master work program, high flood around corridor, design change, Contractor cash flow problem, turnover of skilled workers, low productivity of labor, poor site management and supervision by contractor, inappropriate construction methodology, late payment approval to contractor and resource allocation problem has affected the to-date progress of the work.

In the table above shown the time elapsed from original duration is an extremely high and 1424 calendar day an extension of time was granted to contractor. As observed from the document, the contractor prepared the master schedule using Ms-Project and daily log book also used but the implementation is not as planned.

4.2.2 Desk study No 2: Construction of Aposto-IrbaModa upgrading road project

The project road is located in the southern part of the country in Southern Nations and Nationalities People State and Oromia Regional State. The total length of the project is 94.10 km upgrading existing gravel road to Asphalt Concrete standard with contract amount ETB 660,938,029.00 (Original).The original contract duration is 1095 calendar days and the original completion date is April 27, 2012.The construction is undergoing by foreign contractor. From the current physical progress during the June, 2014 report the total to date executed km about 93.62(99.49 %).

The progress in the execution of some activities is unsatisfactory as compared to the schedule and to the time elapsed so far. The main reasons are insufficient mobilization of construction equipments within the mobilization period as per the master work program, design change, late approval of design, turnover of skilled workers, right of way problem, low speed of Ethiopian customs regulation to release construction machineries, adverse weather condition and late payment approval to contractor has affected the to-date progress of the work.

In the table above shown the time elapsed from original duration is so high and the contractor was granted 963 calendar days an extension of time was granted to contractor. As observed from the document, the contractor prepared the master schedule using Ms-Project and construction methodology was also submitted. In this project time space diagram, proposed construction progress with ‘‘S’’ curved used, planned cash flow and project organization chart also developed in a good manner.

4.2.3 Desk study No 3: Construction of IrbaModa-Wadera ugrading road project

The project road is located in the Oromia Regional State. The total length of the project is 108.46km upgrading existing gravel road to Asphalt Concrete standard with contract amount ETB 617,731,977.13(Original).The original contract duration is 1095 calendar days and the original completion date is March 12, 2012 (Original).The construction is undergoing by foreign contractor. From the current physical progress during the June, 2014 report the total to date executed km about 105.26(97 %).

The progress in the execution of some activities is unsatisfactory as compared to the schedule and to the time elapsed so far. But the implementation is not as planned. The main reasons are insufficient mobilization of construction equipments within the mobilization period as per the master work program, land slide problem, design change, late design approval turnover of skilled workers, low speed of Ethiopian customs regulation to release construction machineries, right of way problem and late payment approval to contractor has affected the to-date progress of the work.

In the table above shown the time elapsed from original duration is so far and 805 calendar day an extension of time was granted to contractor. As observed from the document, the contractor prepared the master schedule using Ms-Project and construction methodology was also submitted. In this project Time space diagram, Proposed construction progress with ‘‘S’’ curved used, planned cash flow and project organization chart also developed in a good manner.

4.2.4 Desk study No 4: Construction of Aleta Wondo-Daye upgrading road project

The project road is located in the southern part of the country in Southern Nations and Nationalities People State. The total length of the project is 51 km upgrading existing gravel road to DBST standard with contract amount ETB 279,878,093.559(Original) and the contract amount increased to ETB 331,134,979.89 due to the client order additional work. The original contract duration is 910 calendar days and the original completion date is March 4, 2011. The construction is undergoing by

local contractor. From the current physical progress during the June, 2014 report the total to date executed km about 36.21 (70 %).

The progress in the execution of all activities is unsatisfactory as compared to the schedule and to the time elapsed so far. As observed from the document, the contractor prepared the master schedule using Ms-Project and Construction methodology was also submitted. But the implementation is not as planned. The main reasons are insufficient mobilization of construction equipments within the mobilization period as per the master work program, contractor cash flow problem, design change, alignment change, adverse weather condition(long time of rainy season), inappropriate construction methodology, turnover of skilled workers, low productivity of labor, poor site management and supervision by contractor, right of way problem, late approval of design especially on the major structure, late payment approval to contractor and resource allocation problem low awareness of the community has affected the to-date progress of the work.

In the table above shown the time elapsed from original duration is an extremely high and 1160 calendar day an extension of time was granted to contractor. Even if the revision of the program done the performance of the contractor can't complete the project in May 9, 2014. As observed from the document, the contractor prepared the master schedule using Ms-Project and daily log book also used but the implementation is not as planned

4.2.5 Desk study No 5: Construction of Arbaminch –Belta upgrading road project

The project road is located in the southern part of the country in Southern Nations and Nationalities People State. The total length of the project is 60 km upgrading existing gravel road to DBST standard with contract amount ETB 562,946,553.21.The original contract duration is 1095 calendar days and the original completion date is April 10, 2013. The construction is undergoing by local contractor. From the current physical progress during the June, 2014 report the total to date executed km about 34.74(57.91%).

The progress in the execution of all activities is unsatisfactory as compared to the schedule and to the time elapsed so far. As observed from the document, the contractor prepared the master schedule using Ms-Project and construction methodology was also submitted. But the implementation is not as planned.

The main reasons are insufficient mobilization of construction equipments within the mobilization period as per the master work program, land slide problem, design change, contractor cash flow problem, turnover of skilled workers, right of way problem, low productivity of labor, poor site

management and supervision by contractor, adverse weather condition, inappropriate construction methodology, late payment approval to contractor and resource allocation problem has affected the to-date progress of the work.

In the table above shown the time elapsed from original duration is an extremely high and 507 calendar day an extension of time was granted to contractor. Even if the revision of the program done the performance of the contractor is still low to complete the project in August 30, 2014. As observed from the document, the contractor prepared the master schedule using Ms-Project and daily log book also used but the implementation is not as planned.

Summary of Physical and Financial Progress of the selected projects for desk study

Table 4.2: PHYSICAL PROGRESS in km

Project	2008 G.C		2009 G.C		2010 G.C		2011 G.C		2012 G.C		2013 G.C		2014 G.C	
	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom
1	27	3.87	36	8.38	36	14.67	-	8.2	-	7.84	-	21.37	-	21.81
2			1.17	1.07	5.47	5.32	11.27	10.98	3.42	3.78	27.33	27.05	24.20	22.43
3			11.10	6.03	32.22	7.56	30.80	17.61	41.36	29.90	28.05	26.37	26.30	17.79
4			6.80	2.00	17.90	3.47	8.81	4.61	24.78	5.72	4.72	2.71	17.20	10.19
5							9.37	7.96	28.33	8.80	22.26	6.21		6.82

Table 4.3: FINANCIAL PROGRESS ETB in Million

Project	2008 G.C		2009 G.C		2010 G.C		2011 G.C		2012 G.C		2013 G.C		2014 G.C	
	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom	Plan	Accom
1	83.67	15.77	111.2	34.1	111.66	59.73	-	33.36	-	31.93	-	86.99	-	88.77
2			7.72	7.05	36.09	35.10	74.41	72.48	200.80	216.37	180.50	178.56	160.12	148.02
3			63.2	34.35	183.53	43.1	175.44	100.32	235.54	170.31	159.75	150.17	149.80	101.31
4			44.41	13.10	116.40	22.65	57.53	30.14	161.87	37.34	30.81	17.67	112.34	66.56
5							70.41	59.77	212.79	66.14	167.21	46.65		44.77

4.2.6 Findings from the Desk Study

The document study was applied to five selected road projects in order to know how the preparation and implementation of construction works program done. In addition the challenges also assessed from the document and site observation. The study of document referred Master schedule, monthly schedule, weekly schedule, site log book, monthly and annual physical and financial progress report and other additional documents on project site office.

4.2.6.1 Preparation and implementation of construction works program

The summary of tasks shown below in the **Table 4.4(A)** which used in preparation and **Table 4.4(B)** ways of implementation of construction works program as found from the document and site observation on selected five projects. From the desk study found eleven (11) tasks used in preparation and ten (10) tasks of implementation of construction works program in answering the first objective. Most of them were identified in literature review.

Table 4.4(A): Summary of Preparation of Construction Works Program from the desk study

S.N	**Preparation of Works Program**
1	Identify scope of the work
2	Identify activities and sequence of work
3	Using proper construction time calendar
4	Assigning resource
5	Draw net work diagram
6	Identify the critical path
7	Update CPM diagram
8	Planned cash flow
9	Develop Project Organization chart
10	Proposed construction progress with ‘’S’’ curve
11	Develop time space diagram

Table 4.4(B): Summary of Implementation of Construction Works Program from the desk study

S.N	**Implementation of Works Program**
1	Approval of working drawing
2	Claim for cost compensation
3	Using of time space diagram for follow up daily progress
4	Using ‘S’ curve to control accomplishment as per the planned
5	Using daily log book
6	Project organization chart
7	Updating work program according to current situation
8	Request and granted extension of time
9	Approval of variation order
10	Design review

4.2.6.2 Challenges in Preparation and Implementation of Construction Works Program

The summary of challenges in preparation and implementation of construction works program observed as shown in **Table 4.5**. From the desk study found fourteen (14) challenges in preparation and implementation of construction of construction works program in answering the second objective. Most of them were identified in literature review.

Table 4.5: Summary of Challenges in Preparation and Implementation of Construction Works Program from the desk study

S.N	Challenges in Preparation and Implementation of Construction Works Program
1	Cash flow problem of Contractors
2	Delay in site mobilization by Contractor
3	Adverse weather conditions
4	Design problem /inadequate details in drawings Design
5	Right of way problem
6	Improper construction methods implemented by contractor
7	Shortage of construction materials
8	Turnover of technical Staffs from Contractors and Consultants
9	Poor site management & supervision by Contractor
10	Payment delay to the contractor
11	Slow decision-making by owners
12	Low productivity of Contractor labour
13	Unforeseen ground conditions/land slide problem
14	Rework due to errors during construction

4.3 Interviews

4.3.1 Introduction

The interviews were conducted to selected senior professionals from client, consultants and contractors who are currently involved in the selected ERA road projects. Three interviews were conducted, namely with a senior counterpart engineers (I) from client, resident engineers (II) from the consultants', and project managers and senior office engineers (III) from the contractors' group**. (See Appendix C)** The general aim of interview is to identify the way of preparation & implementation,

challenges in preparation and implementation of construction works program and to know the recommendation of three groups on improvement.

4.3.2 Findings from the Interview

4.3.2.1 Preparation and Implementation of Construction Works Program

As identified from the interview seventeen (17) tasks from three groups which used in preparation and implementation of construction works program in answering the first question.

As the result found from the interviews, scope of work identified, sequence of work and activities identified, working duration proposed, resource allocated according to the volume of work, net work diagram drawn ,critical path identified, proper construction methodology developed, proper labour crew formation assigned on site, request time of extension may approved depending on works program submitted, approval of variation order, working drawing approved a head before execution, site diary checked and approved daily , develop time space diagram resource, proposed construction progress with ‘’S’’ curve , and organization chart evaluated as per the crew formation were the important tasks used during preparation and implementation of construction works program.

4.3.2.2 Challenges in Preparation and Implementation of Construction Works Program

From the interview conducted eighteen (18) major challenges in preparation and implementation of construction works program were identified. These are: cash flow problem of contractor, poor equipment management, poor work methodology, improper use of advance payment, lack of coordination on site ,turnover of technical staffs ,overestimation of productivity during submission ,insufficient mobilization of resource of contractor, shortage of construction materials, capacity of contractor completion schedule delay, lack of personnel training and management support, adverse weather condition, right of way problem, design change, change of work order by client, quality design problem, late approval of payment and working drawing and customs procedures.

4.3.2.3 Improvement methods in Preparation and Implementation of Construction Works Program

The interviewee also recommended seventeen (17) improvement methods which used for the preparation and implementation of appropriate construction works program. According to the interviewee, contractor should manage his financial resource and plan cash flow, the work program should prepared by the project’s future manger, the project manager should fully authorize by the

company to take the necessary action which bring positive change at any time, all the management staff should be assigned in such a manner to take responsibility for the implementation of the project work as planned , contractor's staff quality required ,designer quality is must, experienced and skilled power of client, right of way problem should be solved ahead of time, the contract duration for the project should be realistic ,the system of Ethiopian customs should be revised ,it is better to update design and specification of ERA standards with recent technology, controlling & evaluation of work program should assesses daily, monthly weekly and quarterly, contract duration should be considered according to the current situation of site, timely follow up from the client is must, review and correct the approved designs drawings prior to execution of works.

4.4 Analysis of Data from the Questionnaires

4.4.1 Type of respondent's organization and rate of response

In this study, 14 % (5) client, 43 % (15) contractors, 43 % (15) consultants participated in the questionnaire as shown in table 4.6. The general response rate for client consultants and contractors was 77 % and the total number of respondents for the three parties was 27 out 35 respondents.
The response rate of client was 100 % (5 respondents), for contractors 80 % (12 out of 15 respondents), and 67 % (10 out of 15 respondents) for consultants.

Table 4.6: Distribution and responses of questionnaires

Group	Number of Questionnaires distributed	Number of Questionnaires Returned	Response Rate (percent)
Client	5	5	100
Consultant	15	10	67
Contractor	15	12	80
Total	**35**	**27**	**77**

4.4.2 Respondents' Background

Among the five responses received from client, three (60%) of them were lead engineers supervisors and two (40%) were office engineers. Among the ten responses received from consultants, five (50%) of them were resident engineers and five (50%) were assistant resident engineers. And among the twelve responses received from contractors, three (25%) of them were project managers, seven (58%) of them were office engineers, two (17%) were assistant project manager. **Figure 4.1** below shows the position of respondents within the company.

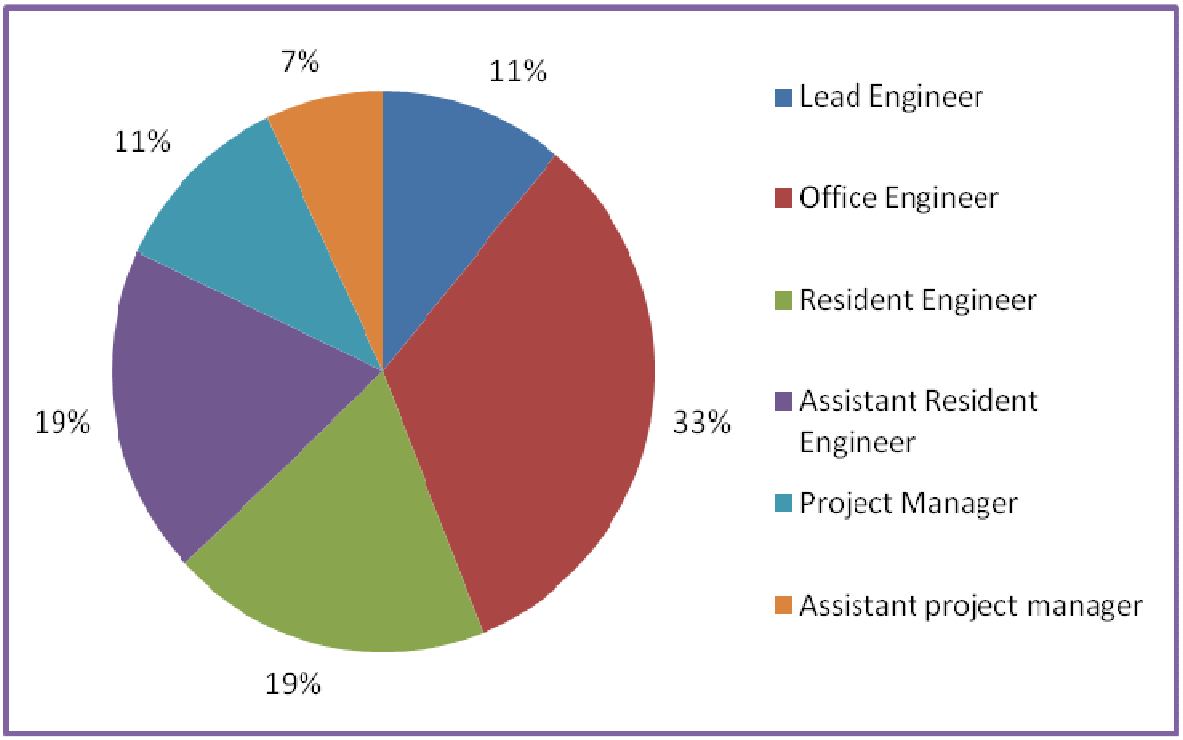


Figure 4:1 Position of Respondents

4.4.3 Experience of respondents

Table 4.7 shows the respondents' working experience in the construction industry. A majority of them, 51.8 %(14) have experience between 5 to 10 years, 29.63 %(8) of the respondents have more than 10 years of working experience in the field and 18.52 % (5) of the respondents have less than 5 years of experience.

Table 4.7: Respondents' Experience

Experience in Road Projects	Client	Consultant	Contractor	Total
Less than 5 years	2	0	3	5
5 to 10 years	3	4	7	14
10 years and above	0	6	2	8

4.5 Findings from the Questionnaires

The finding from questionnaire survey concerning preparation and implementation of construction works program in Ethiopian Roads Authority (ERA) projects which was conducted to client, consultants and contractors were analyzed using Microsoft Excel soft ware.

Sixteen tasks used in preparation of works program, seven points considered during implementation, fifty lists of challenges in preparation and implementation of construction works program and seven improvement methods in preparing and implementing construction works program were identified from literatures review. A ranking system using the Relative Index (RI) method was calculated to find the most significant factor for each section. The value of RI ranges from 0.2 to 1. The value 0.2 represents the lowest strength and the value 1 representing the maximum strength.

4.5.1 Preparation of Construction Works Program

The frequency of the preparation of construction works program were identified by using a 5 point Likert scale, namely Unimportant = 1; Less important = 2; Important = 3; Very important = 4; and Very high important = 5. Preparation of works program was ranked by comparing their relative index.

4.5.1.1 Clients' Point of View

Table 4.8 shows that respondents client ranked define mile stone (RI=0.92) as the most important task in preparation of construction works program. Define working calendars and define the scope of work to be performed using work breakdown structure were ranked as the second major important tasks with the same value (RI =0.88).Assign appropriate activity code structure, develop activity dependency (identify preferential sequences and constraints 'soft logic') and outline project phases, activities, tasks and milestones with the same value (RI =0.80) were ranked as the third important tasks.

Determine construction crews, estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work and prepare work program using CPM(RI=0.76) were ranked as the fourth important tasks used in preparation of construction works program.

According to the respondents of this category, identify activities incapable of direct time duration estimation such as provisional sum day works (RI=0.56) was ranked as the least task used in the preparation of construction works program.

Table 4.8: Frequency of preparation of construction works program from the clients' view

Factor Description	RI Client	Ranking
Define mile stone	0.92	1
Define working calendars	0.88	2
Define the scope of work to be performed using work breakdown structure	0.88	3
Assign appropriate activity code structure	0.8	4
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	0.8	5
Outline project phases, activities, tasks and milestones	0.8	6
Determine construction crews	0.76	7
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0.76	8
Prepare work program using CPM	0.76	9
Identify own force and outsourced activities	0.72	10
Develop and assign construction methods to appropriate activities	0.72	11
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0.72	12
Develop resource (production and deliveries)dependences	0.72	13
Standardize and document the project plan	0.72	14
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0.6	15
Identify activities incapable of direct time duration estimation such as provisional sum day works	0.56	16

4.5.1.2 Consultants' Point of View

Table 4.9 shows that respondents consultants ranked define working calendars (RI=0.92) as the most important task in preparation of construction works program.

Define the scope of work to be performed using work breakdown structure was ranked as the second major important task (RI=0.90).Define mile stone (RI=0.88) were ranked as the third important task. Prepare work program using CPM (RI=0.86) were ranked as the fourth important tasks used in preparation of construction works program.

According to the respondents of this category, identify activities incapable of direct time duration estimation such as provisional sum day works (RI=0.62) was ranked as the least task used in the preparation of construction works program.

Table 4.9: Frequency of preparation of construction works program from the consultants' view

Factor Description	RI Consultant	Ranking
Define working calendars	0.92	1
Define the scope of work to be performed using work breakdown structure	0.90	2
Define mile stone	0.88	3
Prepare work program using CPM	0.86	4
Develop and assign construction methods to appropriate activities	0.82	5
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0.8	6
Assign appropriate activity code structure	0.78	7
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	0.78	8
Determine construction crews	0.78	9
Develop resource (production and deliveries)dependences	0.76	10
Outline project phases, activities, tasks and milestones	0.76	11
Identify own force and outsourced activities	0.74	12
Standardize and document the project plan	0.74	13
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0.7	14
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0.7	15
Identify activities incapable of direct time duration estimation such as provisional sum day works	0.62	16

4.5.1.3 Contractors' Point of View

As shown in **Table 4.10** the respondents contractor ranked estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work (RI=0.933) as the most important task in preparation of construction works program.

Develop and assign construction methods to appropriate activities and develop activity dependency (Identify preferential sequences and constraints 'soft logic') was ranked as the second major important task with the same value (RI=0.90).

Develop resource (production and deliveries) dependences, define working calendars Standardize and document the project plan and outline project phases (RI=0.867) were ranked as the third important tasks used in preparation of construction works program.

According to the respondents of this category, identify activities incapable of direct time duration estimation such as provisional sum day works (RI=0.717) was ranked as the least task used in the preparation of construction works program.

Table 4.10: Frequency of preparation of construction works program from the contractors' views

Factor Description	RI Contractor	Ranking
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0.933	1
Develop and assign construction methods to appropriate activities	0.90	2
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	0.90	3
Develop resource (production and deliveries)dependences	0.867	4
Define working calendars	0.867	5
Standardize and document the project plan	0.867	6
Outline project phases, activities, tasks and milestones	0.867	7
Determine construction crews	0.850	8
Prepare work program using CPM	0.850	9
Define the scope of work to be performed using work breakdown structure	0.833	10
Define mile stone	0.833	11
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0.80	12
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0.80	13
Identify own force and outsourced activities	0.783	14
Assign appropriate activity code structure	0.767	15
Identify activities incapable of direct time duration estimation such as provisional sum day works	0.717	16

Table 4.11 shows the spearman correlation between client, consultant and contractor. From correlation coefficient result it can be concluded that there is a strong and significant relationship between the attitudes of the respondents in all the three groups. This means that most of the respondents have the same opinion about the preparation of construction works program.

Table 4.11: Summary of correlation test on the ranking of preparation of construction works program

Respondents	$\text{Rho}(\rho_{cal}) = 1 - \frac{6x(\sum d_i^2)}{N \times (N^2 - 1)}$	Relation of the respondents
Client Vs Consultant	1.000	strong
Consultant Vs Contractor	0.999	strong
Client Vs Contractor	0.997	strong

4.5.1.4 Overall Point of View

Table 4.12 shows the combination responses of all respondents. From the listed tasks the most ranked was estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work(RI=0.903). Define working calendars (RI=0.889) was ranked as the second major important tasks in preparation of construction works program.

Develop activity dependency (Identify preferential sequences and constraints 'soft logic') was ranked as the third important task with (RI=0.883). Define the scope of work to be performed using work breakdown structure, define mile stone and develop and assign construction methods to appropriate activities were ranked as fourth important tasks with the same value(RI=0.867). Identify activities incapable of direct time duration estimation such as provisional sum day works (RI=0.69) was the least ranked task in preparation of construction works program.

Table 4.12: Overall frequency of preparation of construction works program

Factor Description	Overall RI	Ranking
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0.903	1
Define working calendars	0.889	2
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	0.883	3
Define the scope of work to be performed using work breakdown structure	0.867	4
Define milestone	0.867	5
Develop and assign construction methods to appropriate activities	0.867	6
Outline project phases, activities, tasks and milestones	0.855	7
Develop resource (production and deliveries)dependences	0.841	8
Standardize and document the project plan	0.841	9
Determine construction crews	0.834	10
Prepare work program using CPM	0.834	11
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0.786	12
Assign appropriate activity code structure	0.778	13
Identify own force and outsourced activities	0.772	14
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0.770	15
Identify activities incapable of direct time duration estimation such as provisional sum day works	0.690	16

4.5.2 Implementation of Construction Works Program

The implementation of works program in ERA road projects was determined using a 5 point Likert scale, namely Strongly Disagree=1; Disagree =2; Neutral=3; Agree=4 and Strongly Agree=5. Implementation of works program was ranked by comparing their relative index.

4.5.2.1 Clients' Point of View

Table 4.13 shows that respondents client ranked using construction time effectively and applying proper efficiency is critical in implementing works program(RI=0.96) and with the same value work program should be updated to recognize delay were ranked as the most important element in implementation of construction works program. Availability of resources on site are more common for successful construction works program and the program of works may be revised from time to time with or without affecting the agreed completion date and the project budget with the same value (RI=0.88) were ranked as the second important task.

Proper resource utilization is used to avoid cost overrun and quality control system is used to implement works program accordingly were ranked as third important task in implementation of works program. According to the respondents of this category extension of time requested and granted based on construction works program (RI=0.76) was ranked as the least task used in the implementation of construction works program.

Table 4.13: Frequency of implementation of construction works program from clients' point of view

Factor Description	RI Client	Ranking
Using construction time effectively and applying proper efficiency is critical in implementing works program	0.96	1
Work program should be updated to recognize delay	0.96	2
Availability of resources on site are more common for successful construction works program	0.88	3
The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget	0.88	4
Proper resource utilization is used to avoid cost over run	0.8	5
Quality control system is used to implement works program accordingly	0.8	6
Extension of time requested and granted based on construction works program	0.76	7

4.5.2.2 Consultants' Point of View

As it can be seen from **Table 4.14** below the respondents consultants ranked work program should be updated to recognize delay were ranked (RI=0.94) as the most important task in implementation of construction works program. Using construction time effectively and applying proper efficiency is critical in implementation of construction works program (RI=0.84) was ranked as the second important task in implementation of works program.

Quality control system is used to implement works program accordingly (RI=0.82) was ranked as third important task in implementation of construction works program.

Availability of resources on site are more common for successful construction works program and the program of works may be revised from time to time with or without affecting the agreed completion date and the project budget with the same value (RI=0.80) were ranked as the fourth important task.

According to the respondents of this category proper resource utilization is used to avoid cost overrun and extension of time requested and granted based on construction works program with the same value(RI=0.78 were ranked as the least task in implementation of construction works program.

Table 4.14: Frequency of Implementation of construction works program from the consultants' view

Factor Description	RI of Consultant	Ranking
Work program should be updated to recognize delay	0.94	1
Using construction time effectively and applying proper efficiency is critical in implementing works program	0.84	2
Quality control system is used to implement works program accordingly	0.82	3
The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget	0.8	4
Availability of resources on site are more common for successful construction works program	0.8	5
Proper resource utilization is used to avoid cost over run	0.78	6
Extension of time requested and granted based on construction works program	0.78	7

4.5.2.3 Contractors' Point of View

Table 4.15 shows that respondents contractor ranked proper resource utilization is used to avoid cost overrun (RI=0.967) was ranked as the most important task in implementation of construction works program.

Using construction time effectively and applying proper efficiency is critical in implementing works program (RI=0.95) was ranked as the second important task.

Work program should be updated to recognize delay and availability of resources on site are more common for successful construction works program with the same value (RI=0.883) were ranked as third important task in implementation of construction works program.

According to the respondents of this category quality control system is used to implement works program accordingly, extension of time requested and granted based on construction works program and the program of works may be revised from time to time with or without affecting the agreed completion date and the project budget with the same value (RI=0.867) were ranked as the least tasks used in the implementation of construction works program.

Table 4.15: Frequency of implementation of construction works program from the contractors' view

Factor Description	RI of Contractor	Ranking
Proper resource utilization is used to avoid cost over run	0.967	1
Using construction time effectively and applying proper efficiency is critical in implementing works program	0.950	2
Availability of resources on site are more common for successful construction works program	0.883	3
Work program should be updated to recognize delay	0.883	4
The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget.	0.867	5
Extension of time requested and granted based on construction works program	0.867	6
Quality control system is used to implement works program accordingly	0.867	7

Table 4.16 shows the spearman correlation between client, consultant and contractor. From correlation coefficient result it can be decided that there is a strong and significant relationship between the attitudes of the respondents in all the three groups. This means that most of the respondents have the same opinion about the implementation of construction works program.

Table 4.16: Summary of correlation test on the ranking of implementation construction of works program

Respondents	Rho(ρ_{cal}) = $1 - \frac{6x(\sum d_i^2)}{N x (N^2 - 1)}$	Relation of the respondents
Client Vs Consultant	0.999	strong
Consultant Vs Contractor	0.995	strong
Client Vs Contractor	0.999	strong

4.5.2.4 Overall Point of View

As it can be seen from **Table 4.17** below the respondents of all groups ranked work program should be updated to recognize delay were ranked (RI=0.919) as the most important task in implementation of construction works program.

Using construction time effectively and applying proper efficiency is critical in implementing works program (RI=0.911) was ranked as the second important task in implementation of works program.
Proper resource utilization is used to avoid cost overrun (RI=0.87) was ranked as the third important task.
Quality control system is used to implement works program accordingly (RI=0.852) was ranked as third important task in implementation of works program.

According to the combination response of all groups extension of time requested and granted based on construction works program (RI=0.815) was ranked as the least task in implementation of construction works program

Table4.17: Overall frequency of Implementation of construction works program

Factor Description	Overall RI	Ranking
Work program should be updated to recognize delay	0.919	1
Using construction time effectively and applying proper efficiency is critical in implementing works program	0.911	2
Proper resource utilization is used to avoid cost over run	0.867	3
Availability of resources on site are more common for successful construction works program	0.852	4
The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget	0.837	5
Quality control system is used to implement works program accordingly	0.837	6
Extension of time requested and granted based on construction works program	0.815	7

4.5.3 Challenges in Preparation and Implementation of Construction Works Program

The frequency of recommended strategies to minimize variation orders on building projects was identified using a 5 point Likert scale, namely Strongly Disagree=1; Disagree =2; Neutral=3;Agree=4 and Strongly Agree=5. Challenges in preparation and implementation of construction works program were ranked by comparing their relative index.

4.5.3.1 Clients' Point of View

Table 4.18 shows that respondents client ranked contractor's cash flow, complexity of the project ,technical capability of project manager and commitment of all parties to the project with the same value(RI=0.96) as the most challenge in preparation and implementation of works program.

Coordination effectiveness, developing an appropriate organization structure, the nature of the project, the climatic condition at site, design team experience, project design complexity, site management, project manager's authority to take day-to-day decisions, leadership skills of project manager, project manager's adaptability to changes in project plan and physical work environment were ranked as the second major factors with the same value (RI=0.92).

Decision making effectiveness, project monitoring, scope, nature of work, timely decision by owner/ owner's representative, contractor experience, supervision, effectiveness of cost control system, project manager's ability to delegate authority, social environment and administrative approvals environment with the same value (RI=0.88) were ranked as third factors in preparation and implementation works program.

Influence of client/ client's representative and extent (Involvement) of Subcontracting with the same value (RI=0.68) were ranked as the least factors in preparation and implementation of construction works program.

Table 4.18: Frequency of challenges in preparation and implementation of construction works program from the clients' view

Factor Description	RI of Client	Ranking
Contractor's cash flow	0.96	1
Complexity of the project	0.96	2
Technical capability of project manager	0.96	3
Commitment of all parties to the project	0.96	4
Coordination effectiveness	0.92	5
Developing an appropriate organization structure	0.92	6
The nature of the project	0.92	7
The climatic condition at site.	0.92	8
Design team experience	0.92	9
Project design complexity	0.92	10
Site management	0.92	11
Project Manager's authority to take day-to-day decisions	0.92	12
Leadership skills of project manager	0.92	13
Project manager's adaptability to changes in project plan	0.92	14
Physical work environment	0.92	15
Decision making effectiveness	0.88	16
Project monitoring	0.88	17
Scope of work	0.88	18
Nature of work	0.88	19
Timely decision by owner/ owner's representative	0.88	20
Contractor experience	0.88	21
Supervision	0.88	22
Effectiveness of cost control system	0.88	23
Project manager's ability to delegate authority	0.88	24
Social environment	0.88	25
Administrative approvals environment	0.88	26
Communication system	0.84	27
Control mechanism	0.84	28
Size of the project.	0.84	29
Client's experience	0.84	30
Nature of client (privately funded vs. publicly funded)	0.84	31
Client's knowledge of construction project organization	0.84	32
Owner's clear and precise definition of project scope	0.84	33
Owner's risk attitude (willingness to take risk)	0.84	34

Client's emphasis of quick construction	0.84	35
Mistakes/ delays in producing design documents	0.84	36
Speed of information flow	0.84	37
Constructability program	0.80	38
Client's confidence in construction team	0.80	39
Client's emphasis on high quality of construction	0.80	40
Economic environment	0.80	41
Technology availability	0.80	42
Implementing an effective quality assurance program	0.76	43
Size of client's organization	0.76	44
Client's emphasis on low construction cost	0.76	45
Adequacy of plans and specifications	0.76	46
Implementing an effective safety program	0.72	47
Political environment	0.72	48
Influence of client/ client's representative	0.68	49
Extent (Involvement) of Subcontracting	0.68	50

4.5.3.2 Consultants' Point of View

Table 4.19 shows that respondents consultants ranked the climatic condition at site and leadership skills of project manager with the same value (RI=0.94) as the most challenge in preparation and implementation of construction works program.

Control mechanism, coordination effectiveness, project monitoring, contractor experience, site management, contractor's cash flow, effectiveness of cost control system, project manager's authority to take day-to-day decisions, technical capability of project manager, project manager's ability to delegate authority and commitment of all parties to the project with the same value(RI=0.92) were ranked as the second major factors.

Decision making effectiveness, complexity of the project, size of the project, timely decision by owner/ owner's representative, design team experience and supervision were ranked with the same value (RI=0.88) as third factors that affect preparation and implementation of construction works program.

Extent (Involvement) of Subcontracting (RI=0.66) was ranked as one of the least factors in preparation and implementation of works program.

Table 4.19: Frequency of Challenges in preparation and implementation of construction works program from the Consultants' view

Factor Description	RI of Consultant	Ranking
The climatic condition at site.	0.94	1
Leadership skills of project manager	0.94	2
Control mechanism	0.92	3
Coordination effectiveness	0.92	4
Project monitoring	0.92	5
Contractor experience	0.92	6
Site management	0.92	7
Contractor's cash flow	0.92	8
Effectiveness of cost control system	0.92	9
Project Manager's authority to take day-to-day decisions	0.92	10
Technical capability of project manager	0.92	11
Project manager's ability to delegate authority	0.92	12
Commitment of all parties to the project	0.92	13
Decision making effectiveness	0.90	14
Complexity of the project	0.90	15
Size of the project	0.90	16
Timely decision by owner/ owner's representative	0.90	17
Design team experience	0.90	18
Supervision	0.90	19
Developing an appropriate organization structure	0.88	20
Nature of work	0.88	21
Client's emphasis on high quality of construction	0.88	22
Project design complexity	0.88	23
Project manager's adaptability to changes in project plan	0.88	24
Technology availability	0.88	25
Communication system	0.86	26
Implementing an effective quality assurance program	0.86	27
Influence of client/ client's representative	0.86	28
Adequacy of plans and specifications	0.86	29
The nature of the project	0.84	30
Client's knowledge of construction project organization	0.84	31
Mistakes/ delays in producing design documents	0.84	32
Speed of information flow	0.84	33
Economic environment	0.84	34

Constructability program	0.82	35
Scope of work	0.80	36
Owner's clear and precise definition of project scope	0.80	37
Owner's risk attitude (willingness to take risk)	0.80	38
Client's emphasis on low construction cost	0.80	39
Social environment	0.80	40
Client's experience	0.78	41
Client's confidence in construction team	0.78	42
Administrative approvals environment	0.78	43
Political environment	0.77	44
Implementing an effective safety program	0.76	45
Nature of client (privately funded vs. publicly funded)	0.76	46
Size of client's organization	0.76	47
Physical work environment	0.76	48
Client's emphasis of quick construction	0.74	49
Extent (Involvement) of Subcontracting	0.66	50

4.5.3.3 Contractors' Point of View

Table 4.20 shows that respondents contractor ranked timely decision by owner/ owner's representative, owner's risk attitude (willingness to take risk), adequacy of plans and specifications and contractor's cash flow with the same value (RI=0.933) as the most challenge in preparation and implementation of construction works program.

Control mechanism, the nature of the project, project design complexity, effectiveness of cost control system and Political environment were ranked as the second major factors with the same value (RI=0.917).

Developing an appropriate organization structure, design team experience, mistakes/ delays in producing design documents, contractor experience, project manager's authority to take day-to-day decisions, Project manager's ability to delegate authority, commitment of all parties to the project and technology availability were ranked as third factors in preparation and implementation of construction works program with the same value (RI=0.90)

Extent (Involvement) of subcontracting (RI=0.783) was ranked as the least factor that affect preparation and implementation of construction works program.

Table 4.20: Frequency of Challenges in preparation and implementation of construction works program from the Contractors' view

Fact or Description	RI of Contractor	Ranking
Timely decision by owner/ owner's representative	0.933	1
Owner's risk attitude (willingness to take risk)	0.933	2
Adequacy of plans and specifications	0.933	3
Contractor's cash flow	0.933	4
Control mechanism	0.917	5
The nature of the project	0.917	6
Project design complexity	0.917	7
Effectiveness of cost control system	0.917	8
Political environment	0.917	9
Developing an appropriate organization structure	0.90	10
Design team experience	0.90	11
Mistakes/ delays in producing design documents	0.90	12
Contractor experience	0.90	13
Project Manager's authority to take day-to-day decisions	0.90	14
Project manager's ability to delegate authority	0.90	15
Commitment of all parties to the project	0.90	16
Technology availability	0.90	17
Coordination effectiveness	0.883	18
Project monitoring	0.883	19
Size of the project.	0.883	20
Nature of work	0.883	21
The climatic condition at site.	0.883	22
Site management	0.883	23
Speed of information flow	0.883	24
Leadership skills of project manager	0.883	25
Physical work environment	0.883	26
Implementing an effective safety program	0.867	27
Constructability program	0.867	29
Implementing an effective quality assurance program	0.867	28
Complexity of the project	0.867	30
Client's experience	0.867	31
Client's knowledge of construction project organization	0.867	32
Owner's clear and precise definition of project scope	0.867	33
Client's emphasis on high quality of construction	0.867	34
Supervision	0.867	35
Technical capability of project manager	0.867	36
Project manager's adaptability to changes in project plan	0.867	37
Decision making effectiveness	0.850	38
Scope of work	0.850	39

Client's emphasis of quick construction	0.850	40
Communication system	0.833	41
Influence of client/ client's representative	0.833	42
Social environment	0.833	43
Client's confidence in construction team	0.817	44
Client's emphasis on low construction cost	0.817	45
Economic environment	0.817	46
Administrative approvals environment	0.817	47
Nature of client (privately funded vs. publicly funded)	0.80	48
Size of client's organization	0.80	49
Extent (Involvement) of Subcontracting	0.783	50

Table 4.21 shows the spearman correlation between client, consultant and contractor. From correlation coefficient result it can be decided that there is a strong and significant relationship between the attitudes of the respondents in all the three groups. This means that most of the respondents have the same opinion about the challenges in preparation and implementation of construction works program

Table 4.21: Summary of correlation test on the ranking of challenges in preparation and implementation of construction works program

Respondents	**Rho(ρ_{cal}) = $1 - \frac{6x(\sum d_i^2)}{N x (N^2 - 1)}$**	**Relation of the respondents**
Client Vs Consultant	1.000	strong
Consultant Vs Contractor	1.000	strong
Client Vs Contractor	1.000	strong

4.5.3.4 Overall Point of View

As it can be seen from **Table 4.22** below the respondents of all groups ranked contractor's cash flow (RI=0.933) as the most factor that affect preparation and implementation of works program.

Lack of commitment of all parties to the project (RI=0.912) was ranked as the second major factors that affect preparation and implementation of construction works program.

The climatic condition at site, leadership skills of project manager, project manager's authority to take day-to-day decisions, effectiveness of cost control system and timely decision by owner/ owner's representative were ranked as third factors in preparation and implementation construction works program with the same value (RI=0.911)

Extent (Involvement) of subcontracting (RI=0.719) was ranked as the least factor that affect preparation and implementation of construction works program.

Table 4.22: Overall frequency of challenges in preparation and implementation of construction works program

Factor Description	Overall RI	Ranking
Contractor's cash flow	0.933	1
Lack of commitment of all parties to the project	0.919	2
The climatic condition at site.	0.911	3
Project Manager's authority to take day-to-day decisions	0.911	4
Leadership skills of project manager	0.911	5
Timely decision by owner/ owner's representative	0.911	6
Effectiveness of cost control system	0.911	7
Complexity of the project	0.904	8
Technical capability of project manager	0.904	9
Coordination effectiveness	0.904	10
Developing an appropriate organization structure	0.904	11
Design team experience	0.904	12
Project design complexity	0.904	13
Site management	0.904	14
Project monitoring	0.904	15
Nature of work	0.904	16
Contractor experience	0.904	17
Project manager's ability to delegate authority	0.904	18
Control mechanism	0.904	19
The nature of the project	0.889	20
Project manager's adaptability to changes in project plan	0.881	21
Supervision	0.881	22
Size of the project.	0.881	23
Decision making effectiveness	0.874	24
Owner's risk attitude (willingness to take risk)	0.874	25
Mistakes/ delays in producing design documents	0.874	26
Adequacy of plans and specifications	0.874	27
Technology availability	0.874	28
Speed of information flow	0.859	29
Client's emphasis on high quality of construction	0.859	30
Client's knowledge of construction project organization	0.852	31
Physical work environment	0.844	32
Scope of work	0.844	33
Communication system	0.844	34

Constructability program	0.844	35
Owner's clear and precise definition of project scope	0.844	36
Implementing an effective quality assurance program	0.844	37
Social environment	0.830	38
Client's experience	0.830	39
Economic environment	0.822	40
Political environment	0.822	41
Client's emphasis of quick construction	0.815	42
Influence of client/ client's representative	0.815	43
Administrative approvals environment	0.815	44
Client's confidence in construction team	0.80	45
Client's emphasis on low construction cost	0.80	46
Implementing an effective safety program	0.80	47
Nature of client (privately funded vs. publicly funded)	0.793	48
Size of client's organization	0.778	49
Extent (Involvement) of subcontracting	0.719	50

4.5.4 Recommended methods to Improve Preparation and Implementation of Construction Works Program

The frequency of recommended methods to improve preparation and implementation of construction works program were identified using a 5 point Likert scale, namely Unimportant = 1; Less important = 2; Important = 3; Very important = 4; and Very high important = 5. The methods to improve preparation and implementation of construction works program were ranked by comparing their relative index.

4.5.4.1 Clients' Point of View

Table 4.23 shows that respondents client ranked contractor should manage his financial resources and plan cash flow and continuous and proper planning before construction, so that resources and time are sufficient with the same value (RI=0.84) as the most methods to improve preparation and implementation of construction works program.

Project team leaders should keep good relationship with all project participants and give prompt feedback/action when any matter arises were ranked as the second important improvement methods with the same value (RI=0.72).

Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity and material supply should be readily preserved

to avoid insufficient or depleted resources with the same value (RI=0.68) were ranked as third important improvement methods.

Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information (RI=0.64) was ranked as the least method to improve preparation and implementation of construction works program.

Table 4.23: Frequency of recommended improvement methods from the clients' view

Recommended methods to improve construction works program	**RI of Client**	**Ranking**
Contractor should manage his financial resources and plan cash flow	0.84	1
Continuous and proper planning before construction, so that resources and time are sufficient	0.84	2
Project team leaders should keep good relationship with all project participants	0.72	3
Give prompt feedback/action when any matter arises	0.72	4
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity	0.68	5
Material supply should be readily preserved to avoid insufficient or depleted resources	0.68	6
Upgrade communication system used. Use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information	0.64	7

4.5.4.2 Consultants' Point of View

Table 4.24 shows that respondents consultants ranked contractor should manage his financial resources and plan cash flow (RI=0.92) as the most improvement methods in preparation and implementation of construction works program.

Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity (RI=0.90) was ranked as the second important improvement methods in preparation and implementation of construction works program.

Material supply should be readily preserved to avoid insufficient or depleted resources (RI=0.88) was ranked as the third important improvement method.

Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information (RI=0.74) was ranked as the least method to improve preparation and implementation of construction works program.

Table 4.24: Frequency of recommended improvement methods from the consultants' view

Recommended methods to improve construction works program	RI of Consultant	Ranking
Contractor should manage his financial resources and plan cash flow	0.92	1
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity	0.9	2
Material supply should be readily preserved to avoid insufficient or depleted resources	0.88	3
Continuous and proper planning before construction, so that resources and time are sufficient	0.86	4
Give prompt feedback/action when any matter arises.	0.82	5
Project team leaders should keep good relationship with all project participants	0.78	6
Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information	0.74	7

4.5.4.3 Contractors' Point of View

Table 4.25 shows that respondents contractors ranked learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity and continuous and proper planning before construction, so that resources and time are sufficient with the same value (RI=0.95) as the most improvement methods in preparation and implementation of construction works program.

Contractor should manage his financial resources and plan cash flow and material supply should be readily preserved to avoid insufficient or depleted resources were ranked as the second important improvement methods in preparation and implementation of construction works program with the same value(RI=0.933).

Give prompt feedback/action when any matter arises (RI=0.90) was ranked as the third important improvement method.

Upgrade communication system used;use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information (RI=0.683) was ranked as the least method of improvement in preparation and implementation of construction works program.

Table 4.25: Frequency of recommended improvement methods from the contractors' view

Recommended methods to improve construction works program	RI of Contractor	Ranking
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity.	0.950	1
Continuous and proper planning before construction, so that resources and time are sufficient.	0.950	2
Contractor should manage his financial resources and plan cash flow	0.933	3
Material supply should be readily preserved to avoid insufficient or depleted resources	0.933	4
Give prompt feedback/action when any matter arises.	0.90	5
Project team leaders should keep good relationship with all project participants.	0.850	6
Upgrade communication system used. Use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information	0.683	7

Table 4.26 shows the spearman correlation between client, consultant and contractor. From correlation coefficient result it can be decided that there is a strong and significant relationship between the attitudes of the respondents in all the three groups. This means that most of the respondents have the same opinion about the improvement methods of preparation and implementation of construction works program.

Table 4.26: Summary of correlation test on the ranking of recommended improvement methods

Respondents	$\text{Rho}(\rho_{cal}) = 1 - \frac{6x(\sum d_i^2)}{N \times (N^2 - 1)}$	Relation of the respondents
Client Vs Consultant	0.989	strong
Consultant Vs Contractor	0.998	strong
Client Vs Contractor	0.980	strong

4.5.4.4 Overall Point of View

As it can be seen from **Table 4.27** below the respondents of all groups ranked contractor should manage his financial resources and plan cash flow (RI=0.911) as the most improvement methods in preparation and implementation of construction works program.

Continuous and proper planning before construction, so that resources and time are sufficient (RI=0.890) was ranked as the second important improvement methods in preparation and implementation of construction works program.

Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity (RI=0.881) was ranked as the second important improvement methods in preparation and implementation of construction works program.

Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information (RI=0.696) was ranked the least method to improve preparation and implementation of construction works program.

Table 4.27: Overall frequency of recommended improvement methods

Recommended methods to improve construction works program	Overall RI	Ranking
Contractor should manage his financial resources and plan cash flow	0.911	1
Continuous and proper planning before construction, so that resources and time are sufficient	0.890	2
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity	0.881	3
Material supply should be readily preserved to avoid insufficient or depleted resources	0.867	4
Give prompt feedback/action when any matter arises.	0.837	5
Project team leaders should keep good relationship with all project participants	0.80	6
Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction	0.696	7

4.6 Discussion of Findings

In this section the discussion of the study findings from the questionnaires, the desk study and the interview presented in detail on the ways of preparation and implementation, challenges and improvement methods in preparing and implementing construction works program.

4.6.1 Preparation and Implementation of Construction Works Program

From the questionnaires, the desk study and interview, the most important tasks used in preparation of construction works program in ERA road projects were estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work and defining scope of the work. It is clear that before preparing any work program identifying what to be done and estimating tender quantities play great role to assign crew formation properly

The second most important task in preparation of construction works program was defining working calendars according to ranking of the overall view. During scheduling, defining calendar helps to identify working and nonworking days. From the interview defining working calendars was ranked as third important task.

Develop activity dependency was the third most important task in preparation of construction work program and this task also supported by interviewees. To know the completion time for the given task duration and dependency activities should be identified.

As stated in the work of Marmel (2007) dependencies exist because all tasks in a project rarely can happen simultaneously; usually, some tasks must start or finish before others can begin. Tasks overlap for many reasons, for example, the inability of resources to do more than one task at a time, the lack of availability of equipment, or the nature of the tasks themselves.

The fourth most important task in preparation of construction works program was defining the scope of work to be performed using work breakdown structure. The WBS is used to help in project planning and control as well as to develop a common understanding of the scope of the project. Effective use of the WBS will outline the scope of the project and the responsibility for each work package (Elbeltagi, 2012). According to the opinion of client and consultant define the scope of work to be performed using work breakdown structure ranked in second position.

During implementation from the combined result indicated in **Table 4.17** the most important task in implementation construction works program was work program should be updated to recognize delay.

It is clear that by updating the work program the time overrun identified and immediate action taken to avoid delay. In this case the crew formation assigned according to the updated work program.

The second important task in implementing construction works program was using construction time effectively and applying proper efficiency is critical in implementing works program. In the agreement done b/n client and contractor the obligation of contractor is to complete the project by the stipulated completion date.

The third most important task in implementation of construction works program was proper resource utilization is used to avoid cost overrun. Success on construction projects depends on the efficient utilization of limited and costly resources-labor, materials, and equipment. Contractors who minimize waste and re-handling materials, efficiently operate equipment, and maximize labor efficiency have a significant competitive advantage (Hildreth & Munoz, 2005).

The fourth important task in implementation of construction works program was availability of resources on site are more common for successful construction works program. The availability of recourses on site is very important in implementing the scheduled activities properly and help to minimize delay of project happen due to scarcity of resource.

4.6.2 Challenges in Preparation and Implementation of Construction Works Program

According to the findings from the questionnaire responses as shown and ranked in **Table 4.22**, desk study and interview cash flow problem of contractors is the first major challenge in preparation and implementation of construction works program. This indicates that the cash problem is more critical of any construction project than other variables in the group.

It is not simple to schedule and implement without enough cash flow that help to run the activities. As observed from the desk study the contractors don't use the advance payment taken for that specific project. If they can deploy sufficient resource with advance payment taken the cash flow problem does not happen.

According to the findings from desk study and interview conducted cash flow problem and delay in site mobilization by contractor and adverse weather condition were the major challenges in preparation and implementation of construction works program. Delivery of materials, machineries and man power on time is one of the main duties of contractors before commencement.

As indicated in the contract document and work program submitted the date of mobilization period shows when the contractor mobilizes every required resource to the site. It is clear that using proper mobilization period can minimize dispute and project delay. Therefore, each day of delay cost the contractor additional losses such as overhead cost and penalty. The delay of supplying necessary materials and equipment for the work, lead to time lost, hence the cost increases.

The combined result presented in **Table 4.22** shows that the poor commitment of all parties to the project ranked as the second major challenge in preparation and implementation of works program. Commitment of all parties was very important for project success. The commitment of all parties ensures quality of work that completed in the given duration of time and minimize dispute may occur between them. Therefore committed project team will shape the implementation of the project by applying roles and duties in the project. Lack of commitment is one of the causes for low productivity output on project site and the source of dispute.

From the overall questionnaires response the climatic condition at site was ranked as third major challenges for completion project in the given scheduled time. The adverse weather condition is one of the causes that affect work program and which results in taking additional time and cost. In this case the contractor entitled for Extension of time (EOT) depending on the evidence submitted to Engineer and approved by client.

The fourth major challenge in preparation and implementation of construction works program was design change as found from the interview and desk study. Inadequate and incomplete details drawing can lead to serious change order which results in taking additional time to complete the project. The combined result presented in **Table 4.22** show that project design complexity was ranked as the fourth major challenge in preparation and implementation of construction works program.

According to the response found from interview and the desk study, the rework of construction due to errors during construction has low effect. The occurrence of this case is very limited and has least influence on the construction works program.

4.6.3 Recommended Improvement Methods

As the response found from the interview and questionnaires in **Table 4.27**, the first most ranked recommended improvement method was that contractor should manage his financial resources and plan the cash flow. If the contractor manages his cash flow properly the scheduled activities could be

run in smooth way and there is tangible progress of the work on the site. This will help the contractor from any time and cost overrun.

The second most recommended method is there should be a continuous and proper planning before construction, so that resources and time are sufficient. A good construction plan is the basis for developing the budget and the schedule for work. Baskar(2007) stated that construction planning is a fundamental and challenging activity in the management and execution of construction projects. It involves the choice of technology, the definition of work tasks, the estimation of the required resources and durations for individual tasks, and the identification of any interactions among the different work tasks.

The third most improvement method is learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity. Human resource department in any construction should be strong to handle professionals. Therefore training and developing the skill of workers is one of motivating method that improves productivity.

Material supply should be readily preserved to avoid insufficient or depleted resources is the fourth most improvement method. Any material supply on the site should be used properly according to the scheduled. Therefore the contractors should give attention to avoid mismanagement of materials on site.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Under conclusion the main findings from questionnaires distributed, interviews and desk study concluded according to the objective of the research study. The recommendation part focus on the improvement methods and recommends further research studies on different topics.

5.1.1 Preparation and Implementation of Construction Works Program in ERA Road Projects

The first objective of this study was to identify the practice of preparation and implementation of construction works program in ERA road projects. It can be concluded that from the desk study of five road projects most important task in preparation was identifying scope of the work. The finding from the interview also confirmed identifying scope of the works as the one of the most tasks in preparation of construction works program. Regarding the implementation of construction works program the most top tasks from the research study conducted were, work program should be updated to recognize delay using construction time effectively and applying proper efficiency is critical in implementing works program

Among 16 elements identified from the literatures, the responses received from the clients' and consultant showed define mile stone, working calendars and the scope of work to be performed using work breakdown structure are the most important tasks in preparation of construction works program.

According to the respondents client, consultants and contractors the most important tasks during implementation of construction works program in ERA road projects were, using construction time effectively, applying proper efficiency is critical in implementing works program and availability of resources on site are more common for successful construction works program.

According to the contractors' opinion, the top three most tasks in preparation of construction works program were estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work, develop activity dependency (identify preferential sequences and constraints 'soft logic') and define workings calendars.

From the overall responses, it was concluded that estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work, define working calendars,

develop activity dependency (identify preferential sequences and constraints 'soft logic') define the scope of work to be performed using work breakdown structure, define mile stone, develop and assign construction methods to appropriate activities were the most important tasks in preparation of construction works program.

The values of the Spearman's rank correlation coefficients show that there is a strong relation between each two groups of parties in ranking the tasks in preparation and implementation of construction works program. From the strong correlation coefficient it can be concluded that most of the respondents have the same opinion concerning the tasks used in preparation and implementation of construction works program in ERA road projects.

5.2.2 Challenges in Preparation and Implementation of Construction Works Program

The second objective was to identify the challenges in preparation and implementation of construction works program in ERA road projects.

The result of study indicated there were challenges in ERA road projects during preparation and implementation construction works program. As it can be concluded from desk study of five projects the accomplished physical and financial progress of the projects shown in **Table 4.2** and **4.3** was below the planned. From the status of the projects indicated in **Table 4.1** time overrun and contract amount revised was common. The result from desk study confirmed that, project 1,2,3,4 and 5 has time elapsed 262%,173.52%,174.89%,180.33% and 140.82% of original contract duration respectively. Those delay practices affect socio-economy of the country. Due to delay completion of the project, the community along the corridor and others may not get access of transportation and incurred for additional cost. From the finding of the desk study and interview, cash flow problem of contractors, delay in site mobilization by Contractor, adverse weather conditions, design problem /inadequate details in drawings, right of way problem were the major challenges in preparing and implementing construction works program in ERA road projects.

Under this objective fifty (50) challenges in preparation and implementation of construction works program were identified from literature review. Among them, contractor cash flow problem ranked by client and contractor as one of the major challenges in preparation and implementation construction works program. While the respondents of consultant ranked in second position.

The next major challenges that agreed by client and contractor were the nature of the project and project design complexity.

According to the opinion of respondents of consultant, the climatic conditions at site and leadership skills of project manager were ranked in first position.

According to the respondents of client and consultants project manager's authority to take day-to-day decisions and coordination effectiveness ranked in second position and supervision in the third position.

The respondents of consultants and contractors agree that design team experience was the third major challenges in preparation and implementation of construction works program. While the client ranked in second position.

From the overall responses, it was concluded that the most major challenges in preparation and implementation construction works program were contractor's cash flow, commitment of all parties to the project and the climatic condition at site or project manager's authority to take day-to-day decisions or leadership skills of project manager or timely decision by owner/ owner's representative or effectiveness of cost control system.

The values of the Spearman's rank correlation coefficients show that there is a strong relation between each two groups of parties in ranking the challenges in preparation and implementation of construction works program. From the strong correlation coefficient it can be concluded that most of the respondents have the same opinion concerning the challenges of preparation and implementation of works program in ERA road projects.

5.2.3 Recommended Improvement Methods in Preparation and Implementation of Construction Works Program

The third objective was to recommend improvement methods used in preparation and implementation construction works program in ERA road projects.

From the literatures, seven (7) improvement methods used in preparation and implementation of construction works program were identified. Here the conclusion was based on the questionnaire survey and the interview conducted that recommended improvement methods in preparation and implementation of construction works program in ERA road projects. No recommended methods were found from the document study.

The respondents' client and consultants agree that contractor should manage his financial resources and plan cash flow was the first improvement method in preparation and implementation of construction works program. The weak financial liquidity problem of contractor affects the work program and one of the causes for delay.

According to the respondents of contractor the most recommended improvement methods in preparation and implementation construction works program were learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity ,continuous and proper planning before construction, so that resources and time are sufficient, contractor should manage his financial resources and plan cash flow and material supply should be readily preserved to avoid insufficient or depleted resources. All these mentioned recommended improvement methods are most important for successful project completion by avoiding delay of project.

From the overall responses received, it was therefore concluded that the following recommended improvement methods from the most important to the least important one to improve the preparation and implementation in ERA road projects.

1. Contractor should manage his financial resources and plan cash flow
2. Continuous and proper planning before construction, so that resources and time are sufficient
3. Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity.
4. Material supply should be readily preserved to avoid insufficient or depleted resources
5. Give prompt feedback/action when any matter arises.
6. Project team leaders should keep good relationship with all project participants.
7. Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information

5.2 Recommendations

The following points can be recommended to all parties in order to improve preparation and implementation of construction works program in road projects.

Contractors recommended to the following factors

- Scope of the work should be clear and identified well in order to minimize time and cost overrun.
- Contractors are advised to prepare a method statement and the schedule for the project that take into consideration both reality and project type.
- Contractors should have qualified technical staff with appropriate experience that able to prepare and implement construction works program in a given duration.

- Contractors should have to mobilize resource and commence the work according to schedule in order to avoid delay.
- Contractors should have to set equipment management system on project site in order to increase productivity.
- Work program should be updated depending on the nature of the project to avoid time and cost overrun.
- Contractor should manage his financial resources and plan cash flow by utilizing progress payment.

Consultants recommended to the following points:

- Consultants are advised to hire a qualified technical staff to manage the project in a good way, so he would be able to overcome any technical or management problems that happen.
- Consultant should follow the progress of activities according to the work program submitted. This helps to complete project on time.
- Consultant should solve design problem on time

Client should give special attention to the following recommended factors:

- Right of way problem should be solved before mobilization to avoid time and cost overrun.
- Client should determine the required duration of project and impose realistic duration to avoid time and cost overruns
- Client should recommend to have experienced counterpart engineers who are able to give solution for problems happen on site.
- Client should play great role in creating smooth communication and coordination with consultant and contractor to ensure quality of work and avoid any dispute happen.
- Low speed of Ethiopian customs regulation to release construction machineries should be revised to avoid delay

The following areas of study are suggested for further future studies are as follows:

- Assessment of construction works program practices in building projects.
- A detail study on analyzing impact of improper construction works program on socio-economy of the country.
- Assessment of actual liquidated damages due to using improper construction works program in road projects.

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APPENDICES

APPENDIX A: QUESTIONNAIRE FORM

AAiT
Addis Ababa University
Addis Ababa Institute of Technology
School of Graduate Studies
Department of Civil and Environmental Engineering

Q U E S T I O NN A I R E

Preparation and Implementation of Construction Works Program in ERA Road Projects

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This research study titled **"Preparation and Implementation of Construction Works Program in ERA Road Projects"** is undertaken by Dereje Ermias at the Addis Ababa Institute of Technology, Civil and Environmental Engineering Department to assess the **Preparation and Implementation of Construction Works Program in ERA Road Projects**. Please answer all questions.

Thanks in advance for your co-operation and help!
Sincerely,
Dereje Ermias

SECTION A: ORGANIZATION AND RESPONDENT'S PROFILE

1. Which of the following best describes your company?

Company	**Tick one**
Client	
Consultant	
Contractor	
Other	

2. If your answer above was other, please specify:_____

3. Your current position in your organization:_____

4. Experience (please tick one):

☐ Less than 5 years

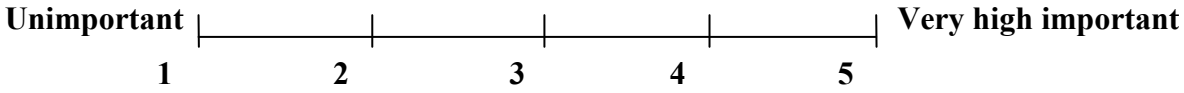
☐ 5 to 10 years

☐ 10 years and above

SECTION B: Preparation of Construction Works Program

This section aims to show the lists used in preparing construction works program.

Please indicate your level of agreement with the following questions on a scale 1 to 5.



Indicator: 1 = Unimportant

2 = Less important

3 = Important

4 = Very important

5 = Very high important

i. The following are lists used in preparation of construction works program. From your experience how are works program prepared & implemented in ERA Road Projects?

S.N	Preparation of works program	Unimportant	Less important	Important	Very important	Very high important
	Define the scope of work to be performed using work breakdown structure					
	Assign appropriate activity code structure					
	Identify activities incapable of direct time duration estimation such as provisional sum day works					
	Identify own force and outsourced activities					
	Develop and assign construction methods to appropriate activities					
	Define mile stone					
	Develop activity dependency (Identify preferential sequences and constraints 'soft logic')					
	Identify and include activities for long lead items taking thirty days or more in					
	Consider administrative dependences (Identify tasks for required contractual					
	Develop resource (production and deliveries)dependences					
	Determine construction crews					
	Estimate durations for each defined task using tender quantities, expected crew-					
	Define working calendars					
	Prepare work program using CPM					
	Standardize and document the project plan					
	Outline project phases, activities, tasks and milestones					
	If any other lists which can help in preparation of construction works					

	program, please specify					

ii. The following are points that can be considered during implementing construction works program. From your experience how construction works program implemented?

S.N	**Implementation of works program**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
	Work program should be updated to recognize delay					
	Quality control system is used to implement works program accordingly					
	Proper resource utilization is used to avoid cost over run					
	Extension of time requested and granted based on construction works program					
	The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget.					
	Availability of resources on site are more common for successful construction works program					
	Using construction time effectively and applying proper efficiency is critical in implementing works program					
	If any other implementation ways, please specify					

SECTION C: Challenges of preparing & implementation of construction works program

Please use the scale below to rate the degree of consent of the following statement based on your experience.

Strongly Disagree —— **Strongly Agree**

1 2 3 4 5

Indicator: **1 = Strongly Disagree**

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

3. Following are list of challenges of preparing & implementation of construction works program. From your experience, what are the challenges of preparing & implementation of construction works program in ERA Roads projects?

S.N	List of challenges in preparation and implementation of construction works program	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
1	**Management factors**					
	Communication system					
	Control mechanism					
	Coordination effectiveness					
	Decision making effectiveness					
	Project monitoring					
	Developing an appropriate organization structure					
	Implementing an effective safety program					
	Implementing an effective quality assurance					
	Constructability program					
2	**Project Specific Factors**					
	The nature of the project					
	Complexity of the project					

	Size of the project.					
3	**Working Condition**					
	Scope of work					
	Nature of work					
	The climatic condition at site.					
4	**Client Related Factors**					
	Influence of client/ client's representative					
	Client's experience					
	Nature of client (privately funded vs. publicly funded)					
	Size of client's organization					
	Client's knowledge of construction project organization					
	Client's confidence in construction team					
	Owner's clear and precise definition of project scope					
	Timely decision by owner/ owner's representative					
	Owner's risk attitude (willingness to take risk)					
	Client's emphasis on low construction cost					
	Client's emphasis on high quality of construction					
	Client's emphasis of quick construction					
5	**Design Team-Related Factors**					
	Design team experience					
	Project design complexity					
	Mistakes/ delays in producing design documents					
	Adequacy of plans and specifications					
6	**Contractor-Related Factors**					
	Contractor experience					
	Site management					
	Supervision					
	Extent (Involvement) of Subcontracting					
	Contractor's cash flow					
	Effectiveness of cost control system					
	Speed of information flow					

7	**Project Manager Related Factors**					
	Project Manager's authority to take day-to-day					
	Technical capability of project manager					
	Leadership skills of project manager					
	Project manager's adaptability to changes in project					
	Project manager's ability to delegate authority					
8	**Business and Work Environment Related Factors**					
	Economic environment					
	Social environment					
	Political environment					
	Physical work environment					
	Administrative approvals environment					
	Commitment of all parties to the project					
	Technology availability					
	If any other factors, please specify					

SECTION D: Improvement Methods in Preparing and Implementing Construction Works Program

Please indicate your level of agreement with the following questions on a scale 1 to 5.

Unimportant ——— **Very high important**

1 2 3 4 5

Indicator: 1 = Unimportant

2 = Less important

3 = Important

4 = Very important

5 = Very high important

4. Following are suggested methods can help to improve preparation and implementation of construction works program. From your experience, what are the best methods help in improving preparation and implementation of construction works program?

S.N	Improvement methods in preparation & implementation of construction works program	Unimportant	Less important	Important	Very important	Very high important
1	Project team leaders should keep good relationship with all project participants.					
2	Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity.					
3	Contractor should manage his financial resources and plan cash flow					
4	Continuous and proper planning before construction, so that resources and time are sufficient.					
5	Material supply should be readily preserved to avoid insufficient or depleted resources					
6	Upgrade communication system used. Use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information					
7	Give prompt feedback/action when any matter arises.					
	If you have any other improving methods in preparation and implementation of construction works program, please specify					
8						
9						
10						
11						
12						

End of Questionnaire

Thank you!

APPENDIX B: SURVEY RESULTS

SECTION I

Client responses for Preparation of construction works program

Factor Description	Frequency Analysis (FA)				
	Unimportant	Less important	Important	Very important	Very high important
Define the scope of work to be performed using work breakdown structure	0	0	0	3	2
Assign appropriate activity code structure	0	0	1	3	1
Identify activities incapable of direct time duration estimation such as provisional sum day works	0	2	2	1	0
Identify own force and outsourced activities	0	0	2	3	0
Develop and assign construction methods to appropriate activities	0	1	2	0	2
Define mile stone	0	0	1	0	4
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	0	0	1	3	1
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0	0	2	3	0
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0	3	0	1	1
Develop resource (production and deliveries)dependences	0	1	2	0	2
Determine construction crews	0	0	2	2	1
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0	0	2	2	1
Define working calendars	0	0	1	1	3
Prepare work program using CPM	0	0	2	2	1
Standardize and document the project plan	0	0	2	3	0
Outline project phases, activities, tasks and milestones	0	0	2	1	2

Consultants' responses for Preparation of construction works program

Factor Description	Frequency Analysis (FA)				
	Unimportant	Less important	Important	Very important	Very high important
Define the scope of work to be performed using work breakdown structure	0	0	1	3	6
Assign appropriate activity code structure	0	1	2	4	3
Identify activities incapable of direct time duration estimation such as provisional sum day works	0	4	2	3	1
Identify own force and outsourced activities	0	0	4	5	1
Develop and assign construction methods to appropriate activities	0	1	1	4	4
Define mile stone	0	0	1	4	5
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	1	2	0	1	6
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0	1	4	4	1
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0	1	4	4	1
Develop resource (production and deliveries)dependences	0	0	3	6	1
Determine construction crews	0	0	3	5	2
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0	1	1	5	3
Define working calendars	0	0	1	2	7
Prepare work program using CPM	0	0	3	1	6
Standardize and document the project plan	0	0	5	3	2
Outline project phases, activities, tasks and milestones	0	1	3	3	3

Contractors' responses for Preparation of construction works program

Factor Description	Frequency Analysis (FA)				
	Unimportant	Less important	Important	Very important	Very high important
Define the scope of work to be performed using work breakdown structure	0	0	4	2	6
Assign appropriate activity code structure	0	0	6	2	4
Identify activities incapable of direct time duration estimation such as provisional sum day works	0	1	4	6	1
Identify own force and outsourced activities	0	0	4	5	3
Develop and assign construction methods to appropriate activities	0	0	1	4	7
Define mile stone	0	0	2	6	4
Develop activity dependency (Identify preferential sequences and constraints 'soft logic')	0	0	1	4	7
Identify and include activities for long lead items taking thirty days or more in the work break down structure	0	0	3	6	3
Consider administrative dependences (Identify tasks for required contractual allowances: employer review of drawings, inspections, testing, approval and commissioning periods.)	0	0	4	4	4
Develop resource (production and deliveries)dependences	0	0	2	4	6
Determine construction crews	0	0	3	3	6
Estimate durations for each defined task using tender quantities, expected crew-size and historical outputs for similar work.	0	0	0	4	8

Clients responses for implementation of construction works program

Factor Description	Frequency Analysis (FA)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Work program should be updated to recognize delay	0	0	0	1	4
Quality control system is used to implement works program accordingly	0	0	1	3	1
Proper resource utilization is used to avoid cost over run	0	0	1	3	1
Extension of time requested and granted based on construction works program	0	1	1	1	2
The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget.	0	0	1	1	3
Availability of resources on site are more common for successful construction works program	0	0	1	1	3
Using construction time effectively and applying proper efficiency is critical in implementing works program	0	0	0	1	4

Consultants' responses for implementation of construction works program

Factor Description	Frequency Analysis (FA)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Work program should be updated to recognize delay	0	0	0	3	7
Quality control system is used to implement works program accordingly	0	1	2	2	5
Proper resource utilization is used to avoid cost over run	0	1	2	4	3
Extension of time requested and granted based on construction works program	0	1	3	2	4
The program of works may be revised from time to time with or without affecting the agreed completion date and the project budget	0	1	1	5	3
Availability of resources on site are more common for successful construction works	0	1	2	3	4
Using construction time effectively and applying proper efficiency is critical in implementing works program	0	1	0	5	4

Contractors' responses for Implementation of construction works program

Factor Description	Frequency Analysis (FA)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Work program should be updated to recognize delay	0	1	0	4	7
Quality control system is used to implement works program accordingly	0	1	1	3	7
Proper resource utilization is used to avoid cost over run	0	0	0	2	10
Extension of time requested and granted based on construction works program	0	1	0	5	6
The program of works may be revised from time to time with or without affecting the agreed completion date and	0	0	0	8	4
Availability of resources on site are more common for successful construction works program	0	0	0	7	5
Using construction time effectively and applying proper efficiency is critical in implementing works program	0	0	0	3	9

SECTION II

Client responses for challenges in preparation and implementation of construction works program

Factor Description	Frequency Analysis (FA)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
1. Management factors					
Communication system	0	0	1	2	2
Control mechanism	0	0	0	4	1
Coordination effectiveness	0	0	0	2	3
Decision making effectiveness	0	0	0	3	2
Project monitoring	0	0	0	3	2
Developing an appropriate organization structure	0	0	0	2	3
Implementing an effective safety program	0	0	3	1	1
Implementing an effective quality assurance program	0	0	2	2	1

Constructability program	0	0	1	3	1
2. Project Specific Factors					
The nature of the project	0	0	1	0	4
Complexity of the project	0	0	0	1	4
Size of the project.	0	0	0	4	1
3. Working Condition					
Scope of work	0	0	0	3	2
Nature of work	0	0	0	3	2
The climatic condition at site.	0	0	1	0	4
4. Client Related Factors					
Influence of client/ client's	0	0	3	2	0
Nature of client (privately funded vs. publicly funded)	0	0	1	2	2
Size of client's organization	0	0	2	2	1
Client's knowledge of construction project organization	0	0	1	2	2
Client's confidence in construction	0	0	2	1	2
Owner's clear and precise definition of project scope	0	0	1	2	2
Timely decision by owner/ owner's representative Timely decision by owner/ owner's	0	0	1	1	3
Owner's risk attitude (willingness to take risk)	0	0	2	0	3
Client's emphasis on low construction cost	0	0	2	2	1
Client's emphasis on high quality of construction	0	0	2	1	2
Client's emphasis of quick	0	0	1	2	2
5. Design Team-Related Factors					
Design team experience	0	0	0	2	3
Project design complexity	0	0	0	2	3
Mistakes/ delays in producing design	0	0	0	4	1
Adequacy of plans and specifications	0	0	2	2	1
6. Contractor-Related Factors					
Contractor experience	0	0	0	3	2
Site management	0	0	0	2	3
Supervision	0	0	0	3	2
Extent (Involvement) of subcontracting	0	0	4	0	1
Contractor's cash flow	0	0	0	0	5
Effectiveness of cost control system	0	0	1	1	3

Speed of information flow	0	0	0	4	1
7. Project Manager Related Factors					
Project Manager's authority to take day-to-day decisions	0	0	0	2	3
Technical capability of project	0	0	0	1	4
Leadership skills of project manager	0	0	0	2	3
Project manager's adaptability to changes in project plan	0	0	0	2	3
Project manager's ability to delegate authority	0	0	1	1	3
8. Business and Work Environment Related Factors					
Economic environment	0	0	2	1	2
Social environment	0	0	0	3	2
Political environment	0	1	2	0	2
Physical work environment	0	0	0	2	3
Administrative approvals environment	0	0	0	3	2
Commitment of all parties to the	0	0	0	1	4
Technology availability	0	0	2	1	2

Consultants' responses for Challenges in preparation and implementation of construction works program

	Frequency Analysis (FA)				
Factor Description	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. Management factors					
Communication system	0	0	1	5	4
Control mechanism	0	0	0	4	6
Coordination effectiveness	0	0	0	4	6
Decision making effectiveness	0	0	1	3	6
Project monitoring	0	0	0	4	6
Developing an appropriate organization	0	0	0	6	4
Implementing an effective safety program	0	0	4	4	2
Implementing an effective quality assurance program	0	0	1	5	4
Constructability program	0	0	1	7	2
2. Project Specific Factors					
The nature of the project	0	0	0	8	2
Complexity of the project	0	0	0	5	5
Size of the project	0	0	1	3	6

3. Working Condition					
Scope of work	0	0	2	6	2
Nature of work	0	0	1	4	5
The climatic condition at site.	0	0	0	3	7
4. Client Related Factors					
Influence of client/ client's representative	0	0	2	3	5
Client's experience	0	0	3	5	2
Nature of client (privately funded vs. publicly funded)	0	0	2	8	0
Size of client's organization	0	0	3	6	1
Client's knowledge of construction project organization	0	0	0	8	2
Client's confidence in construction team	0	1	1	6	2
Owner's clear and precise definition of project scope	0	0	1	8	1
Timely decision by owner/ owner's	0	0	0	5	5
Owner's risk attitude (willingness to take risk)	0	0	1	8	1
Client's emphasis on low construction cost	0	0	2	6	2
Client's emphasis on high quality of	0	0		6	4
Client's emphasis of quick construction	0	2	1	5	2
5. Design Team-Related Factors					
Design team experience	0	0	0	5	5
Project design complexity	0	0	0	6	4
Mistakes/ delays in producing design documents	0	0	2	4	4
Adequacy of plans and specifications	0	0	1	5	4
6. Contractor-Related Factors					
Contractor experience	0	0	0	4	6
Site management	0	0	0	4	6
Supervision	0	0	1	3	6
Extent (Involvement) of subcontracting	0	3	2	4	1
Contractor's cash flow	0	0	0	4	6
Effectiveness of cost control system	0	0	0	4	6
Speed of information flow	0	0	1	6	3
7. Project Manager Related Factors					
Project Manager's authority to take day-to-day decisions	0	0	0	4	6
Technical capability of project manager	0	0	0	4	6
Leadership skills of project manager	0	0	0	3	7

Project manager's adaptability to changes in project plan	0	0	1	4	5
Project manager's ability to delegate authority	0	0	0	4	6
8. Business and Work Environment Related Factors					
Economic environment	0	0	1	6	3
Social environment	0	0	2	6	2
Political environment	0	0	4	6	2
Physical work environment	0	1	2	5	2
Administrative approvals environment	0	0	2	7	1
Commitment of all parties to the project	0	0	0	4	6
Technology availability	0	0	1	4	5

Contractors' responses for challenges in preparation and implementation of construction works program

	Frequency Analysis (FA)				
Factor Description	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. Management factors					
Communication system	0	0	0	10	2
Control mechanism	0	0	0	5	7
Coordination effectiveness	0	0	0	7	5
Decision making effectiveness	0	0	2	5	5
Project monitoring	0	0	0	7	5
Developing an appropriate organization	0	0	1	4	7
Implementing an effective safety program	0	0	1	6	5
Implementing an effective quality assurance program	0	0	0	8	4
Constructability program	0	0	1	6	5
2. Project Specific Factors					
The nature of the project	0	0	0	5	7
Complexity of the project	0	0	2	4	6
Size of the project.	0	0	1	5	6
3. Working Condition					
Scope of work	0	0	0	9	3
Nature of work	0	0	0	7	5
The climatic condition at site	0	0	0	7	5
4. Client Related Factors					

Influence of client/ client's representative	0	0	2	6	4
Client's experience	0	0	1	6	5
Nature of client (privately funded vs. publicly funded)	0	0	2	8	2
Size of client's organization	0	1	1	7	3
Client's knowledge of construction project organization	0	0	0	8	4
Client's confidence in construction team	0	1	0	8	3
Owner's clear and precise definition of project scope	0	0	0	8	4
Timely decision by owner/ owner's representative	0	0	0	4	8
Owner's risk attitude (willingness to take risk)	0	0	1	2	9
Client's emphasis on low construction cost	0	1	1	6	4
Client's emphasis on high quality of construction	0	1	0	5	6
Client's emphasis of quick construction	0	1	1	4	6
5. Design Team-Related Factors					
Design team experience	0	0	0	6	6
Project design complexity	0	0	0	5	7
Mistakes/ delays in producing design documents	0	0	1	4	7
Adequacy of plans and specifications	0	0	0	4	8
6. Contractor-Related Factors					
Contractor experience	0	0	0	6	6
Site management	0	0	0	7	5
Supervision	0	0	0	8	4
Extent (Involvement) of subcontracting	0	2	0	7	3
Contractor's cash flow	0	0	0	4	8
Effectiveness of cost control system	0	0	1	3	8
Speed of information flow	0	0	0	7	5
7. Project Manager Related Factors					
Project Manager's authority to take day-to-day decisions	0	0	0	6	6
Leadership skills of project manager	0	0	0	7	5
Project manager's adaptability to changes in project plan	0	0	0	8	4
Project manager's ability to delegate authority	0	0	0	6	6
8. Business and Work Environment Related Factors					
Economic environment	0	1	1	6	4

Social environment	0	0	2	6	4
Political environment	0	0	0	5	7
Physical work environment	0	0	0	7	5
Administrative approvals environment	0	0	2	7	3
Commitment of all parties to the project	0	0	0	6	6
Technology availability	0	0	1	4	7

SECTION III

Clients' responses for improvement of construction works program

	Frequency Analysis (FA)				
Factor Description	**Unimportant**	**Less important**	**Important**	**Very important**	**Very high important**
Project team leaders should keep good relationship with all project participants.	0	0	3	1	1
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity.	0	0	3	2	0
Contractor should manage his financial resources and plan cash flow	0	0	0	4	1
Continuous and proper planning before construction, so that resources and time are sufficient.	0	0	0	4	1
Material supply should be readily preserved to avoid insufficient or depleted resources	0	0	4	0	1
Upgrade communication system used;use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information	0	0	4	1	0
Give prompt feedback/action when any matter arises.	0	0	2	3	0

Consultants' responses for improvement of construction works program

Factor Description	**Frequency Analysis (FA)**

	Unimportant	Less important	Important	Very important	Very high important
Project team leaders should keep good relationship with all project participants.	0	1	1	6	2
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity.	0	0	0	5	5
Contractor should manage his financial resources and plan cash flow	0	0	0	4	6
Continuous and proper planning before construction, so that resources and time are sufficient.	0	0	2	3	5
Material supply should be readily preserved to avoid insufficient or depleted resources	0		1	4	5
Upgrade communication system used; use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information	0	1	3	4	2
Give prompt feedback/action when any matter arises.	0	0	2	5	3

Contractors' improvement of construction works program

Factor Description	Frequency Analysis (FA)				
	Unimportant	Less important	Important	Very important	Very high important
Project team leaders should keep good relationship with all project participants.	0	0	2	5	5
Learn more on managing human, because with good skill on human management and good motivating skill, motivated workers could improve productivity.	0	0	0	3	9
Contractor should manage his financial resources and plan cash flow	0	0	1	2	9
Continuous and proper planning before construction, so that resources and time are sufficient.	0	0	0	3	9

Material supply should be readily preserved to avoid insufficient or depleted resources	0	0	0	4	8
Upgrade communication system used. Use more technology when giving information for efficiency and more effectiveness such as email etc. It is better to give information in written form rather than verbal instruction or information	0	1	5	6	0
Give prompt feedback/action when any matter arises.	0	0	0	6	6

APPENDIX C: QUESTIONS FOR INTERVIEW & RESULTS

Questions	Interviewee I	Interviewee II	Interviewee III
From your experience how are works program prepared &implemented in ERA Road Projects?	▪ Scope of work identified • Sequence of work and activities identified ▪ Working duration proposed ▪ Resource allocated according to the volume of work ▪ Net work diagram drawn ▪ Critical path identified	▪ Scope of work identified • Sequence of work and activities identified ▪ Net work diagram drawn • The critical path identified • proper construction methodology developed ▪ proper labour crew formation assigned on site • Request time of extension may approved depending on work program submitted • Approval of variation order	▪ Scope of work identified ▪ Sequence of work and activities ▪ Using proper construction time calendar ▪ Assigning resource ▪ Net work diagram drawn Critical path identified ▪ Duration calculated ▪ Develop Time space diagram Resource ▪ Proposed construction progress with ‘’S’’ curve ▪ Organization chart evaluated as per the crew formation

		▪ Working drawing approved a head before execution ▪ Site diary checked and approved daily	
What are the challenges of preparing & implementation of construction works program in ERA Roads projects?	• Cash flow problem of contractor • Delay in site mobilization by Contractor • Poor equipment management • Improper use of advance payment • Lack of coordination on site • Overestimation of productivity during submission • Poor work methodology • Turnover of technical staffs	• Cash flow problem of Insufficient mobilization of resource of contractor • Shortage of construction materials • Adverse weather condition • Right of way problem • Capacity of contractor Completion schedule delay • Poor equipment management • Lack of personnel training and management support • Turnover of technical staffs	• Design change Delay of mobilization on time • Design change • Adverse weather condition • Right of way problem • Cash flow problem of contractor • Change of work order by client Shortage of construction materials • Late approval of payment and working drawing • Lack of professionals with adequate managerial skill • Customs problem

From your experience, what are the best methods help in improving preparation and implementation of construction works program?	▪ The contractor should manage his financial resource ▪ The work program should be prepared by the project's future manger ▪ The project manager should fully authorize by the company to take the necessary action which bring positive change at any time. ▪ All the management staff should be assigned in such a manner to take responsibility for the implementation of the project work as planned. ▪ Contractor's staff quality required ▪ There should be a good attitude regarding construction works program among professionals in the sector.	▪ The contractor should manage his financial resource ▪ Work program should be prepared by professionals Engineers ▪ Contract duration should be considered according to the current situation of site ▪ Timely follow up from the client is must ▪ Using proper work methodology ▪ To update Design and specification ERA standards with recent technology	▪ Cash flow should be managed properly ▪ Controlling & evaluation of work program should assesses daily, monthly weekly and quarterly ▪ Communication between parties should be better ▪ Review and correct the approved designs drawings prior to execution of works Designer quality should be checked ▪ Experienced and skilled power of client ▪ Right of way problem should be conducted ahead of time ▪ The contract duration for the project should be realistic ▪ The system of Ethiopian of customs should be revised ▪ To update Design and specification ERA standards with recent technology ▪ Accurate design drawings must approved

APPENDIX D: LIST OF ERA ROAD PROJECTS/POPULATION USED FOR THE STUDY

S.N	Projects	Total length km	Client	Consultant	Contractor	Remarks
1	Aposto –IrbaModa(Cont-1)	94.1	ERA	SAI Consulting Engineers	Keangnam	*Selected for case study*
2	Irba Moda –Wadera(Cont-2)	108.4	ERA	JBurrow South Africa pvt.ltd	Aydenez-KMZ JV	*Selected for case study*
3	Arbaminch -Belta	60	ERA	NET consulting Engineers	Berehe Hagos	*Selected for case study*
4	Aletawondo-Daye	51	ERA	NET consulting Engineers	Alemayehu Ketema	*Selected for case study*
5	Aleba-Alemgebeya-Wulbareg	68	ERA	UNICONE cons.Eng.	Sunshine	
6	Humbo-Arbaminch	100	ERA	ACEM Consulting Engineers.	DMC	*Selected for case study*
7	Agermariam-Yabelo(Cont-1)	94.5	ERA	Guaff Consulting	The Arab Contractors	
8	Yabelo-Mega(Cont-2)	97.8	ERA	RENARDET Consulting	China Tiesiju Civil	
9	Yabelo-Metagefersa-Obolo Lot 3	30	ERA	Transnational Engineers	Shed	
10	Seru-Shenenwonz-Shekussein Lot 1	20	ERA	STADIA	Samson Chernet	
11	Seru-Shenenwonz-Shekussein Lot 2	36	ERA	NICE infrastructure	Yosef Teketel	
12	Jinka Town	3.5	ERA	NICE infrastructure	MAN General Contractor	
13	Sawula-Kako Lot 1	22.6	ERA	ADERA consulting	Orchid	
14	Sawula-Kako Lot 2	29.8	ERA	ADERA consulting	Genet	
15	Kibre Mengist-Shakiso	17	ERA	YIDIDIYA Consulting	Flint Stone	