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

ASSESSMENT OF PLANNING AND SCHEDULING IN LOW VOLUME ROAD PROJECT: A CASE STUDY OF BENCH-MAJI ZONE.

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

By

Cherinet Benti

APRIL 2021

JIMMA ETHIOPIA

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Advisor: Engr**. ALEMU MOSISA** (Assistant Professor) _____

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APRIL 2021

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DECLARATION

I declare that this research entitled **"**ASSESSMENT ON EFFECTIVENESS OF PLANNING AND SCHEDULING IN LOW VOLUME ROAD PROJECT: A CASE STUDY OF BENCH-MAJI ZONE." is my original work and has not been submitted as a requirement for the award of any degree in Jimma University or elsewhere.

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Cherinet Benti Tifo _____ _____

Name Signature Date

As research adviser, I hereby certify that I have read and evaluated this paper prepared under my guidance, by **Cherinet Benti** entitled **ASSESSMENT ON EFFECTIVENESS OF PLANNING AND SCHEDULING IN LOW VOLUME ROAD PROJECT: A CASE STUDY OF BENCH-MAJI ZONE.** and recommend and would be accepted as a fulfilling requirement for the Degree Master of Science in Construction Engineering Management.

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

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Co-Advisor Engr. Teshome Boja _____ _____

Name Signature Date

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ACRONYMS

CPM	Critical Path Method
DC	Data Collectors
DEC	Data Entry Clerk
ETB	Ethiopian Birr
IC	International Contractor
JIT	Jimma Institute of Technology
LVRPC	Low Volume Road Project Construction
PI	Principal Investigator
PMBOK	Project Management Body of Knowledge
PMI	Project management Institute
RA	Research Assistant
U.S	United State
4D CAD	Design- Computer Aided Design
SADC	Southern African Development Community

ABSTRACT

Low volume roads are defined as those roads carrying up to about 300 vehicles per day and Less than about 1 million equivalent standard axles. It is believed that meaningful low volume rural road project success in Bench-Maji Zone requires careful study of the projects planning and scheduling before the project will be undertaken or implemented. The objective of this study was assessing the effectiveness of planning and scheduling in low volume project construction in case of Bench-Maji zone in focus. The study was conducted to examine the problems of planning and scheduling in low volume road project construction and also their challenges. Descriptive research designs techniques were used for tabulations and executing the study. The targeted groups of the study were consultants, contractors and the clients who were related to the process, function and decision making of scheduling and planning at the project construction of Bench-Maji zone in low volume road work. And consisting of 19 respondents were participated. Accordingly, the study technique was purposive sampling. And Primary data was collected using questionnaires and interview as well as observation. And this research study was focused on the effectiveness of planning and scheduling of low volume road project construction without including advanced mechanism of planning and scheduling that was not deserved right now at this moment. Furthermore the implication of this study was at the limit of studying on the planning and scheduling of low volume rural road construction projects in Bench-Maji Zone. Here the five likert scale strongly disagreed (1), disagreed (2) neutral (3), agreed (4) and strongly agreed (5) were employed in this research study. In this study calculation of the Relative Importance Index (RII), formula was used.

Finally the findings of this research were using old planning and scheduling tools and techniques like GANT CHART were used, extension of network and poor communication between the planner and other parties are under the first objective, lack of effective managing and controlling system, poor supervision and poor professional management are the high ranking causes of delay due to poor planning and scheduling. Furthermore, mostly updated tools and technique in planning and scheduling are Program Evaluation and Review Technique (PERT), 4D CAD Visualization Techniques and Common Point 4D

Key Words: *Construction Project, planning and scheduling*

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CHAPTER ONE

INTRODUCTION

1.1 Background

Roads are a vital part of the infrastructure of societies and are used by most people in the daily pursuits of their lives. Successful projects including low volume road development always lead to increase in profit in a construction business. Delivering projects successfully is one of the key responsibilities of construction project management, and it involves planning and scheduling of construction projects (Li et al., 2012; Hancher, 2003). In addition, thorough planning and scheduling is of utmost significance to both building and civil works (Chau et al., 2005). Planning is the mother-activity of all construction works from which all other tasks follow or depend (Li et al., 2012). However, planning is onerous, complicated and above all time-consuming. Due to its complex nature low volume road project plans are loosen to accommodate future changes. This is perhaps summarized by Li et al. (2012; p2) in the statement "even experienced construction planners find it impossible to road building/design a comprehensive and faultless master construction plan at the first attempt".

A Low-Volume Roads Engineering Best Management Practices Field Guide was developed to address those key practices. Roads that are not well planned or located, not properly designed or constructed, not well drained, not well maintained, or not made with durable materials often produce negative impacts, most of which are preventable with good, engineering and road management practices.

Construction inspection of low volume roads, when conducted, typically requires the measurement of the in-place density of the sub grade and base. However, the strength of a soil or aggregate is determined by more than just its density. The strength is affected by the gradation and plasticity of the material. These components of strength are significant factors in the design of the LVR. Therefore, the use of in-place density testing may not be an adequate indication of the support a sub grade and base provide for the pavement (Clemen, 2016).

Current practices in the road construction industry show that the level of attention to planning and scheduling in road construction is inefficient and projects are often subject to time and cost overrun (Castro, et al., 2005). Project managers use only their experiences gut and feeling to plan

and manage the process. In order to have efficiency and deliver projects on time and budget, more innovative tools and techniques are needed to assist managers in planning and scheduling road construction projects. Also, there is a need for tools that will be able to assist project managers to study and compare all possible strategies and methodologies for the execution of the works and without this comparison there will be no evidence that the planner's choice corresponds to the most advantageous possibility (Chotchai, 2002).

Planning and scheduling highway construction projects are vitally important tasks in highway construction organizations (wang and chou, 2003). A construction planning outlines how resources and cash flows are deployed overtime and any deviation from the stated schedule often should bring a quick response from the stakeholders. When project was delayed due to poor planning and scheduling highway construction organization`s loss creditability and time. On the other hand, if the highway construction and consulting organizations can produce realistic planning and scheduling especially at the beginning of decision –to– build time stage that it is able to abide by then project delays due to weak planning and scheduling would be avoided (Chotchai, 2002).

Wubishet 2010 declares that road construction projects are very expensive and highly influenced by unpredictable factors, like weather, type of soil, environmental issues, and other factors. This has led to difficulties in developing accurate construction plans and modeling the construction operation using a traditional simulation system. In this context, the aim of this research is to create a knowledge driven road construction planning and scheduling to assist project managers in generating accurate and reliable road construction plans to identify the causes of non-excusable delays in order to make remedies in avoiding their effects. Road construction operations, rules governing the actions and interactions of the resources should be identified, developed, classified and modeled through a comprehensive analysis of several road construction projects. For every road construction operations (activities), project templates in advance should be defined and developed.

Through the template, which summarize productivity, factors influencing the productivity of resources and the sequence of works, the basics towards complete executions of planning and scheduling was achieved (Wubishet 2010). Generally, the main goal of this study was to assess

the effectiveness of planning and scheduling in low volume road project construction with Bench-Maji zone in focus.

1.2 Statement of the Problem

As point out by U.S. department of transportation (2015), a project schedule is often confused with or referred to as a project plan. From the saying above, it can be seen that the project schedule, at the same time as a key deliverable, is only one component of a project plan. The project plan assists a project manager in communicating with business work streams and gaining support for the project. A business manager with no technical knowledge should be able to understand the essence of the project through the project leader, the project concept and the project plan.

At the side of the above concept and as many researchers justified it nowadays, low volume road project construction cannot complete on time due to gross negligence on proper planning and scheduling that rise from inability of the three parties (client, consultant and contractor) to cope up with dynamic nature of contractual matters(Allen and Smallwood, 2008).

Failure of standard planning and scheduling procedure will brings significant schedule delay beyond the completion time granted in contract and subjected to variation order (unwise economical utilization of project resources) as well as extension of time. Hence, grievance increased in low volume road users due to increased travel time, benefits and health issues. Additionally, construction processes are becoming more complex and logistically challenging (Allen and Smallwood, 2008).

The intense period of earthworks and the topography involved in road construction projects further makes the construction process, although seemingly simple, yet more complex (Li et al., 2012). Unlike building projects that contained discrete time-linked objects such as columns and slabs (Platt, 2007), in road construction clear identification and linkage with such discrete schedule activities is not possible (Li et al., 2012; Hancher, 2003). With these gaps identified, the study will seek to explore construction scheduling practices and methods identified in the Road Construction Industry.

In all the above cases the researcher will be believed that meaningful low volume rural road project success in Bench-Maji Zone requires careful study of the projects planning and

scheduling before the project will be undertaken or implemented. Therefore, this study will identifies and assesses project planning and scheduling problem areas and its role in project outcome in the region / country to take remedial action and prevent project failure**.** Hence in order to solve the above major problems the following research objectives will be developed.

1.3 Research Questions

The research questions are as follows

- What was the current major problems of planning in the construction of low volume road project activity`s in Bench-Maji Zone?
- What are the causes of delay due to improper planning and scheduling in the construction of low volume road project activity`s in Bench-Maji Zone?
- How to develop the best practice for planning and scheduling involved in low volume road construction project?

1.4 Objective of the Study

1.4.1 General Objective

The general objective of this study was assessing on effectiveness of planning and scheduling in low volume road construction project: in case of Bench-Maji zone.

1.4.2 Specific Objectives

The specific objectives of this study were:

- To investigate the major problems of planning and scheduling in the project construction of low volume road in Bench-Maji Zone
- To identify the causes of delay due to improper planning and scheduling projects of Low Volume Road.
- To develop the best effective planning and scheduling involved in low volume road construction project.

1.5 Significance of the Study

Throughout the extant literature there are enough convincing reasons to undertake this study. This is mostly evident in the overarching theme of efficiency and productivity in the increasing

complexity of low volume road construction project. So in view of this the advanced countries have dedicated the last decade to finding ways of streamlining construction activities, especially in bridges and in low volume highways construction projects. However, study of such nature is lacking in our part of the world. The results from the advanced countries are more convincing to ignore. But its application in the construction project in Ethiopia is practical because of the need background, among other things. Like by saying if the low volume road is constructed in our rural area the day to day existence would be facilitated. This notion fueled this study. Hence good low volume road project construction planning and scheduling were depend on two basic principles: proper use of a motor grader (or other grading device) and use of good surface low volume. In line with the above concept the primary merits of the study go to the importance of basic starting research studies. Since this study is very important, it gave a comprehensive supporting point for more studies in project management, regarding the assessment of planning and scheduling. On the other hand any types of project construction was got important concepts on this study assessment of planning and scheduling processes in low volume road project construction and was create awareness.

Therefore, the significance of this study was to recommend a knowledge driven assessing planning and scheduling trends which was helped to avoid risk factors that are associated with non-excusable delays that finally was assisted project managers generate accurate and reliable low volume road construction plan and schedule. In order to secure the optimality of the project objectives planning and scheduling is very critical activity.

Furthermore the significance of this study was limited on the assessment of planning and scheduling of low volume rural road construction projects in Bench-Maji Zone. Moreover, the significance of this research work was attempted to assess the current project time estimating practices in low volume road construction projects in Bench-Maji Zone. Likewise for other low volume road Construction projects in Ethiopia, this may serve as get up call about the methods that could improve the overall planning and scheduling estimating accuracy and management of risk factors to extremely delay in regional low volume road construction project.

1.6 Scope and Limitation of the Study

This study was conducted in the selected areas of LVR construction projects found in Bench Maji Zone that, they were expected to carry over design life an average of up to about 300 vehicles per day and less than about 1.0 million equivalent standard axles in one direction. The functional classifications of low volume road (LVR) are feeder roads, collector roads and main access roads (Ethiopia Roads Authority, 2011).

This study mainly focuses on the assessment on effectiveness of planning and scheduling of low volume rural road projects, and most of the information is applicable to all types of roads.

The scope of the study was, therefore, limited to the assessment on effectiveness of planning and scheduling trends in low volume rural road projects in Bench-Maji Zone. Due to time limitation and financial constraint, this research was concerned with low volume rural road construction projects found in Bench-Maji Zone only and did not take into account the other district projects /organizations/ in Debub Region. The focus of this study was the assessment of low volume road Construction project. But the entirety of construction road scheduling and planning practices and methods are not covered under this study. Also since construction project Managers, Engineers, Consultants, clients and planners are usually the major personnel involved in construction planning, they are the main focus for data collection. Hence the research will be focused on planning and scheduling of low volume road construction without including advanced mechanism of planning and scheduling that were not deserve right at this moment.

1.7 Project Organization

The structure of the study talks about how the work is organized into chapters. This work is divided into five chapters. Chapter one which is on introduction begins by describing the background to the study, research questions, problem statement, the objective of the study, research methodology, its significance, scope, limitations and organization. It moves on to literature review in Chapter two. Research Methodology is discussed in chapter three; the work presents how data was analyzed. Research Findings is discussed in chapter four. Finally, chapter five gives the conclusion remarks and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definitions of Selected Concepts

2.1.1 Project

According to oxford dictionary definition a project is an enterprise carefully planned to achieve a particular aim a proposed or planned undertaking, a piece of research work by a school or college student. Roads need to be built with appropriate design standards to balance road user needs, costs, and environmental impacts. Roads need to be well planned, designed, constructed, and properly maintained to have minimum adverse impacts and to be cost effective in the long term with acceptable maintenance and repair costs. Gordon K (2003)

According to Gordon K (2003), rural, low-volume, farm-to-market access roads, roads connecting communities and roads for logging or mining are significant parts of any transportation system. They are necessary to serve the public in rural areas, to improve the flow of goods and services, to help promote development, public health and education, as well as to aid in land and resource management.

Best Management Practices or “BMPs” are those principals and engineering design practices that will protect water quality as well as the function of the road when properly applied. The Best Management Practices presented herein are a compilation of ideas and techniques that can be used in road management to reduce or eliminate many of the potential impacts from road operations and protect water quality.

Key Road Issues should be addressed during the planning phase of a road project, prior to construction or upgrading roads. These key issues involve changes or impacts to an area that a road can cause that may be significant, irreversible, or difficult to mitigate. The benefits of a road project must be weighed against the long-term costs and impacts of that project. Once a road is built into an area, it can lead to long-term land use changes and unplanned growth, as shown in Figure 3.1. Sediment from roads can also be a direct source of water pollution. Figure 3.2 shows some of the ways that roads directly contribute sediment to nearby streams when they are close

by and "hydrological connected". Thus the social, environmental and fiscal cost-effectiveness of the road need to be examined. Gordon K (2003)

A project is a dream with a deadline and a problem scheduled for solution. Each dream with a deadline or an opportunity we want to realize is a project. And that project defines the problems we face. And when we face those problems and solve them, that's a project, too and projects come in all sizes PMI (2004).

In the latest edition of the Project Management Body of Knowledge, or PMBOK GUIDE (2008) the project management institute defines a project as "a temporary endeavor undertaken to produce a unique product, service, or result." Temporary means that every project has a definite beginning and end. Unique means that this product, service, or result is different from others that may have preceded it PMI (2004).

PMI (2004) describes projects as a means of organizing activities that cannot be addressed within the organization's normal operational limits. Projects are, therefore, often utilized as a means of achieving an organization's strategic plan, whether the project team is employed by the organization or is a contracted service provider.

Projects are basically operations of some verified tasks there are different views from the whole process of continual tasks. Organizations perform work to achieve a set of objectives (PMI, 2004). Generally, work can be categorized as either projects or operations, although the two sometimes overlap. The common characteristics shared include, performed by people, constrained by limited resources, and they are planned, executed, and controlled. Projects and operations differ primarily in that operations are ongoing and repetitive, while projects are temporary and unique (Ibrahim, 2011).

When projects are said to be temporary endeavors, temporary means that every project has a definite beginning and a definite end. It does not necessarily mean short in duration; many
Projects last for several years. In every case, however, the duration of a project is finite. Projects are not ongoing efforts. Also when it is said to be unique products, services or results, it is referring to a project creates unique deliverables, which are products, services, or results. Uniqueness is an important characteristic of project deliverables (PMI, 2004).

For example, many thousands of office buildings have been constructed, but each individual facility is unique, different owner, different design, different location, different contractors, and so on. The presence of repetitive elements does not change the fundamental uniqueness of the project work (Ibrahim, 2011).

Figure 2- 1 The project site road

According to Ethiopian Roads Authority (2016), low volume roads in Ethiopia typically carry less than 300 vehicles per day and provide important links from homes, villages and farms to markets and offer the public access to health, education and other essential services. These roads also provide important links between Woreda Centers and the Federal road network. Many aspects of the design and construction of roads in Ethiopia, has stemmed from technologies and practices emanating from Europe and the USA some 40 years ago. These practices have to some extent been modified in the intervening years, but the basic philosophy of road provision has remained the same. There is no connection between each paragraph.

Table 2- 1 Road classes in Ethiopia Source: ERA, Low volume road design,

Road Functional Width (m) Design Speed(km/hr) Classification					Design Standard	Design Traffic Flow (AADT)	Surface Type	Design Speed (km/hr)						Urban/ Peri-Urban
								Carriageway	Shoulder	Flat	Rolling	Mountainous	Escarpment	
				TRUNK	DS 1	10000-150000	Paved	Dual 2x7.3	See T.2-2	120	100	85	70	50
			LINK		DS 2	5000-10000	Paved	7.3	See T.2-2	120	100	85	70	50
					DS 3	1000-5000	Paved	7.0	See T.2-2	100	85	70	60	50
		MAIN ACCESS			DS 4	200-1000	Paved	6.9	See T.2-2	85	70	60	50	50
	COLLECTOR				DS 5	100-200	Unpaved	7.0	See T.2-2	70	60	50	40	50
Feeder					DS 6	50-100	Unpaved	6.0	See T.2-2	60	50	40	30	50
					DS 7	30-75	Unpaved	4.0	See T.2-2	60	50	40	30	50
					DS 8	25-50	Unpaved	4.0	See T.2-2	60	50	40	30	50
					DS 9	0-25	Unpaved	4.0	See T.2-2	60	40	30	20	40
					DS 10	0-15	Unpaved	3.3	See T.2-2	60	40	30	20	40

Hassanein and Moselhi (2004) stated that road projects can be classified as a linear repetitive project. Though the projects might have the presence of repetitive elements, it does not change the fundamental uniqueness of the project work (PMI, 2004). Repetitive projects can be classified into two broad categories: linear (such as highways and pipelines) and nonlinear (such as high rise and multiple housing constructions) (Vorster, et al., 1992 cited by Hassanein and Moselhi, 2004). While the former are repetitive due to their geometric layout, the latter are repetitive as crews repeat the same task in all units. For linear projects, assigning crews to non-adjacent units prolongs the construction schedule and increases total cost (Saleh, 2005).

Thus a road project is a linear repetitive engineered construction project requiring an external organization for its implementation and is a temporary endeavor undertaken to produce a unique product, the road infrastructure (Ibrahim, 2011).

Compared to buildings, low volume road construction has fewer activities and crew notwithstanding, the degree of complexity in road construction is similar to buildings (Li et al., 2012). Additionally, highway projects of any magnitude have become increasingly difficult due

to the highly competitive environment and complexity of the decisions of management involved (Shah, 2008). Therefore, for many years, efforts have been made to plan, direct and control project activities to ensure success (Li et al., 2012; Hancher, 2003). Until recently, there was no generally accepted procedure of managing projects. The management depended on the level of experience of Project Managers and their personal judgments. As a result, each Project Manager had a different system, which usually included the use of the Gantt chart or bar chart (Li et al., 2012; Hancher, 2003). However, as projects became more complex the need to develop complex tools that encapsulate the complex demand of projects became apparent. The network analysis was consequently developed. Since then there have been several attempts to even develop more complex tools that satisfy modern project requirements in low volume road project construction.

However, much research in recent years has focused on simulating and visualizing road construction plans to reduce the time and problems involved in low volume road construction.

For instance, El-Rayes (2001) and Hassan and Moselhi (2004) have developed an object-oriented model for planning and scheduling highway construction Classified as repetitive construction project, road construction projects involve repeating the same work in various locations of the projects (Hyari and El-Rayes, 2006). As a result available schedule methods focused on crew work continuity that enabled each crew (team) to finish work in one location of the project in order to minimize interruptions (Hyari and El-Rayes, 2006). Surprisingly, it was later observed that methods that allowed interruptions on projects have the ability of achieving early project completion i.e. minimized durations.

Considerable research has been carried out in the region showing that lower volume roads can be built successfully using local materials that do not meet the standard specifications found in most design manuals. According to U.S. department of transportation (2015), two-thirds of the highway systems in the United States and more than 90 percent of all the roads in the world are un surfaced, or lightly surfaced low volume roads. In Ethiopia, more than 19,000 miles of local roads have gravel (low volume road) surfaces. As U.S. department of transportation forwarded it most local roads were not designed with the same considerations used in the design of state and interstate highways. Most have evolved from primitive trails. Paths of least resistance first created by wild animals were later used by settlers. As needs and traffic increased, these traveled ways became roads which were gradually improved with gravel or crushed rock. Little

engineering went into these improvements. Using available materials and "keeping them out of the mud" were the extent of efforts to maintain a road. As road surface occurred, the tendency was to make minor modifications to the foundations of the evolved low volume road and to seal or pave the surface. As a result, many low volume roads in Kentucky now have continual maintenance problems because of inadequate base support in addition to alignment and drainage problems. To add to the problem, roads throughout Kentucky are experiencing ever-increasing weights and volumes of traffic. Population growth and tourism make traffic demands. Coal trucks and other commercial vehicles are carrying heavier loads than ever before.

These higher volumes and greater weights are putting a steadily increasing strain on local road maintenance and reconstruction budgets Hassan and Moselhi (2004) Relative to other sector in Ethiopia, construction industry was in fast growing mode which plays great role in the economic development of the country.

The government of Ethiopia has planned in terms of meeting Millennium Development Goals and in its five year growth and transformation plan was implementing the expansion of rural road service: in its vision to free the country's rural peoples from their access constraints, reduce rural poverty, improve welfare and opportunity, stimulate agro-productivity and share growth - a growth in which poor people benefit (Teferi, 2010). Bench maji zone in the last five years has experienced a rapid development of road network in the district to enhance the socio-economic lives of rural communities. In the construction of this low volume rural road service inexperienced local consultant and contractors has to be participated to meet this objective. As it is the first plan in the country the situation has led to poor planning and scheduling with inadequate design resulting in many changes to plans, specifications and contract terms which resulted in schedule delay and change orders. Construction planning and scheduling tasks are fundamental and challenging activities in the management of executing construction projects. It involves choice of construction technologies, definition of work tasks, estimation of the required resources and durations for individual tasks, and identification of any interactions or constraints among the different tasks. A good construction plan is the basis for developing the project budget and the schedule of work. Poor estimates or schedules can easily result in large construction cost increases or delays (Chotchai, 2002).

2.1.2 Construction Project

Construction is one among many types of project-based production systems (Ballard and Howell, 2003). According to Chitkara's (2020) definition, construction project refers to a high-value, time bound and special construction mission with predetermined performance objectives. He further explains that the project mission is accomplished within complex project environments, by putting together human and non-human resources into a temporary organization, headed by a project manager.

The major construction projects can be grouped into Building Construction, Infrastructure Construction, Industrial Construction and Special-purpose projects. Due to the limited scope of this research, only Building Construction will be further addressed.

Building construction constitute the largest segment of the construction business. Building works include residential and commercial complexes, educational and recreational facilities, hospitals and hotels, warehouses and marketing facilities. The building business serves mankind by providing shelter and services for its habitation, educational, recreational, social and Commercial needs. The Building works are mostly designed by the Architect / Engineering firms, and are financed by public and private sector and individuals (Chitkara, 2020).

Table 2- 2 *Typical Low-Volume Road Design Standards*

TYPICAL LOW-VOLUME ROAD DESIGN STANDARDS		
Design Element	Rural Access Road	Collector Road
Design Speed	25-35 kph	45-60 kph
Road Width	3.5-4.5 m	4-5.5 m
Road Grade	15% max	12% max.
Curve Radius	15 m min	25 m min.
Crown/Shape	Out slope/in slope (5%)	in/out slope or crown (5%)
Surfacing Type	Native or gravel,	Gravel cobble stone or pavement

2.1.3 Project management

According to PMBOK (2008) definitions project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements (PMI, 2004).

Project management deals mainly with coordinating resources and managing people and change. Generally "Managing a project includes: Identifying requirements, Establishing clear and achievable objectives, Balancing the competing demands for quality, scope, time and cost; Adapting specifications, plans, and approach to the different concerns and expectations of the various stakeholders PMBOK (2008).

2.1.4 Project management process

According to PMBOK (2008the functions of project management include defining the requirements, establishing the extent of work, allocating the resources required, planning the execution of the work monitoring the progress and adjusting deviations from the plan (Munns and Bjeimi, 2015). As described in Project Management Body of Knowledge Guide there are five types of management processes: initiating, planning, executing, controlling and closing (PMI, 2004). These processes are described below.

- **Initiating Process** includes defining and authorizing a project or project phase. To initiate a project or just a concept phase of a project, someone must define the business need for the project, must sponsor the project and take on the role of project manager.
- Initiating processes take place during each phase of a project. Therefore, it cannot equate process group with project phases. Even though there can be different project phases, all projects will include all five process groups.
- **Planning Processes** include devising and maintaining the workable scheme to ensure that the project addresses the organization's needs. There normally is no single "project plan". There are several plans, such as the scope management plan, schedule management plan, cost management plan, procurement management plan, and so on, defining each knowledge area as it relater's to the project at that point.
- **Executing Processes** include coordinating people and other resources to carry out the various plans and produce the products, services, or results of the project or phases.

- **Monitoring and Controlling Processes** include regularly measuring and monitoring progress to ensure that the project team meets the project objectives. The project manager and staff monitor and measure progress against the plans and take corrective action when necessary. A common monitoring and controlling process is performance reporting, where project stakeholders can identify any necessary changes that may be required to keep the project on track.
- **Closing Processes** include formalizing acceptance of the project or project phase and ending it efficiently. Administrative activities are often involved in this process group, such as archiving project files, closing out contracts.

The inappropriateness of traditional methods

- Traditional approaches to the provision of low-volume sealed roads have stemmed from technology and research carried out in Europe and the USA over 40 years ago in very different environments.
- Locally prevailing circumstances are usually very different in terms of climate, traffi c, materials and road users. It is therefore not surprising that many of the imported approaches, designs and technologies are inappropriate for application in the region.
- Technology, research and knowledge about LVSRs have advanced signifi cantly in the region and not only question much of the accepted wisdom on LVSR provision but also show quite clearly the need to revise conventional approaches.
- Unfortunately, there has been little effective dissemination and uptake of the results of research carried out in the region. (SADC 2003)

Moreover, reduction of prediction error of low volume road performance models could lead to substantial budget savings through timely interventions and accurate planning.

Improved accuracy of gravel road performance models achieved in this research has made a considerable difference in the scheduling of gravel road maintenance interventions

Forecasting of future condition is the basis of scheduling future maintenance strategies and making decision as to when maintenance interventions are necessary (Sirvio and Hollmen, 2008).

Low-Volume Roads Engineering Best Management Practices Field Guide is intended to provide an overview of the key planning, location, design, construction, and maintenance aspects of roads that can cause adverse environmental impacts and to list key ways to prevent those impacts. Gordon K. & James S. (2003)

2.2 Project Planning, Scheduling

Project planning can be defined in many ways. Four definitions of planning are shown in table 1 here below.

Table 2- 3 *Defining Planning*

References	**Definitions of planning**
(Kerzner, 2013)	"Planning can be defined as deciding what tasks must be performed to accomplish the goals of the project. This means establishing realistic schedules and budgets, coordinating resources to get the work done, and most importantly, make sure everyone knows what the plan of action is
(Chitkara, 2020)	"Planning involves deciding in advance what is to be done, how and in what order it is to be done in order to achieve the objectives. Planning aims at deciding upon the future course of action"
(Mubarak, 2010)	"The process of choosing the one method and order of work to be adopted for a project form the various ways and sequences in which it could be done"
(Kerzner, 2013)	"Planning, in general, can best be described as the function of selecting the enterprise objectives and establishing the policies, procedures, and programs necessary for achieving them. Planning in a project environment may be described as establishing a predetermined course of action within a forecasted

Kerzner (2013) explains that planning is determining what needs to be done, by whom, and when. Mubarak (2010) adds that planning also covers answering how, how much, why and where. Kerzner's (2013) nine major components of planning are:

Objective: a goal, target, or quota to be achieved by a certain time.

Program: the strategy to be followed and major actions to be taken in order to achieve or exceed objectives.

Schedule: a plan showing when individual or group activities or accomplishments will be started and/or completed.

Budget: planned expenditures required to achieve or exceed objectives.

Forecast: a projection of what will happen by a certain time.

Organization: design of the number and kinds of positions, along with corresponding duties and responsibilities, required to achieve or exceed objectives.

Policy: a general guide for decision-making and individual actions.

Procedure: a detailed method for carrying out a policy.

Standard: a level of individual or group performance defined as adequate or acceptable.

The four basic reasons for project planning are to eliminate or reduce uncertainty, improve efficiency of the operation, obtain a better understanding of the objectives and to provide a basis for monitoring and controlling work (Kerzner, 2013).

According to Persons (2012), Project planning is a process within program management. An integral stage of management, it results primarily in an overall program execution strategy. The overall strategy is documented in the project plan, which defines, among other things,

- Project scope;
- project objectives and requirements;
- stakeholders;
- organizational and work breakdown structures;
- design, procurement, and implementation; and
- risk and opportunity management plans.

Project planning is the basis for controlling and managing project performance, including managing the relationship between cost and time.

Scheduling is a distinct process that follows the planning process. The schedule is essentially a model of the project plan. It calculates the dates on which activities are to be carried out according to the project plan. As a model of time, the schedule incorporates key variables such as Nonworking calendar periods, contingency, resource constraints, and preferred sequences of work activities to determine the duration and the start and finish dates of activities and key deliverables. Planning and scheduling are continual processes throughout the life of a project. Planning may be done in stages throughout the project as stakeholders learn more details. This approach to planning, known as rolling wave planning, is discussed in Best Practice. Scheduling involves the management and control of the schedule over the project's life cycle. However, in no case should planning be concurrent with scheduling. In other words, work and strategies for executing the work must be planned first before activities can be scheduled (Persons, 2012).

PMI (2008) has a similar definition for the planning. "The planning process consists of those processes performed to establish the total scope of the effort, define and refine the objectives, and develop the course of action required to attain those objectives."

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 projects. Considerable planning is required for the support functions for a project, material storage, worker facilities, work force 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 and Rees, 2004).

The project plan and schedule must clearly define individual responsibility, schedule, 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 and 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 Defining; scope of works or services and 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 purpose. Consequently, it possesses three dimensional benefits. These are tracking, accountability and learning.

Therefore, in this study project planning is defined as the systematic arrangement of resources and processes of defining project objectives and determining the framework to achieve project objective.

2.2.1 Importance of Planning

- ✓ Planning increases the efficiency of an organization
- ✓ Increases the risks involved in modern business activities.
- ✓ It facilitates proper coordination within an organization.
- ✓ It aids in organizing all available resources.
- ✓ It gives a right direction to the organization.
- ✓ It is important to maintain good Control.
- ✓ It helps to achieve the objectives of the organization.
- ✓ It motivates the personnel of an organization.
- ✓ It encourages managers' creativity and It also helps in decision making.

According to Lemma (2014) there are different causes for project failure or to fall short of realizing its full potential. It is major and most common problem faced by many projects and

become abundant on some stage of its completion. Mostly, such problems result from a lack of planning. Annie and Anton (2003) said "If you don't know where you are going, you will probably end up somewhere else." A complex project will likely fail without a plan. Annie and Anton (2003) again stated that for who wants to satisfy customers' needs, that plan is a complete, consistent, and correct expression of the stakeholders' requirements. Planning can be a good way to achieve a goal, because without planning, we do not have a specific path to follow and our efforts can leads us towards undesired objectives or results. Without adequate planning, it is difficult to really understand what it will take to complete a

Project successfully. Planning is used to put the project back on track if it deviated from the plan and also it is used to control a project and establishing a base line with which to gauge progress. Without planning, there is no control (Prakash, 2008)

Bigelow (2001) claims that planning is the most important yet most undervalued element of project management. It is perceived as being the map that sets the direction for a project. It is critical to the project management process because it forms the basis for the project scope, schedule, resources, quality, risk and integration. (Griffith and Gibson, 1995) and (Griffith, et al., 1998) in their research have shown that greater project planning efforts lead to improved performance on projects in the areas of cost, schedule and operational characteristics. Hamilton and Gibson (1996) have shown the importance of project planning on projects and its influence on project success. Findings of their study have proven that higher levels of project planning effort can result in significant cost and schedule savings. Success in any endeavor requires careful preparation and planning and without proper planning and preparation, failure is almost guaranteed. Anyone who has ever undertaken a complex task already has learned the importance of careful planning. Good planning conserves resources, prevents wasted effort, and saves time and money, prevents small problems from becoming big problem, it establishes a solid foundation for the remaining managerial functions. The study by Cleland & King (1983) provides much evidence that a well-set project plan plays a vital role in project success. For any project, Keider's (1984) research indicated that the lack of good project planning is ranked as the most likely single cause of project failure. Effective planning is more than just setting up an elaborate plan at the start of a project.

According to Kerzner (2006) the primary driver behind project planning is uncertainty reduction which was supported by Zwikael and Sadeh (2007). Planning allows the project team to address different factors such as quality, cost, schedule, performance and support ability that determine project success or failure. Therefore proper planning is a key project driver for success. The success of any organization's project implementation depends on thoughtful planning. Tomlinson (2001) states "Without such planning, a project implementation can easily run over budget and still not provide any measurable benefits

2.2.2 Purpose of Planning

Planning seeks to calculate what risks that may occur in the project and how to deal with them during the project life time. The planning is also where the budget and the schedule are developed (Hendrickson, 1998). Maylor (2005) suggests that if the planning process is to be value adding, not just cost adding, benefits of the activity have to be shown. The benefits described are first of all the avoidance of costs generated by chaos due to unplanned activities. Secondly, it provides a basis for evaluation of different alternatives for filtering out those that is unprofitable. Finally, the planning process gives the planner the chance to identify problems in advance and resolve them on paper early in the project. Moreover, planning in construction is necessary to account for all the variables and situations that may arise during a construction project. It allows the contractor to be proactive rather than reactive to problems in the construction project (Awad et al., 2010).

One aspect that overlooked is the monitoring of the project during the on-going work. This may led to delays not being identified in time, which can be problematic and costly. Besides this the earlier a variance is identified the better it is, so that actions can be taken as soon as possible. Eklund (2002) describes four different actions that can be taken if management have control and are able to identify variances. These are to lower the level of ambition, add more resources, reorganize or allocate resources differently, or extend the time for the project.

The monitoring component of the planning can be very helpful to site managers to be able to change the on-going work pace and also to ensure a successful completion of the project

(Divakar and Subramanian, 2009). If the work can be monitored in a good way is dependent on the production plan, which is why it is related to the preconstruction planning.

According to Marttala and Karlsson (1999) there are four variables that should be taken into consideration when managing a project: time, cost, quality and scope. Even if a project is on schedule the costs can be higher than expected. Maylor (2005) described that on-going check-ups of possible variances is important, so that the costs not exceed the budget. Moreover, management should control that the scope of the work and the quality is according to the plan. Controlling the quality of works can be difficult because quality is such an abstract term.
However one way of dealing with this is to have checklists with expressed quality objectives (Marttala and Karlsson, 1999). Furthermore, Knausender (2005) describe the importance of doing regular project evaluations and have systems to maximize the use of them. This is advantageous as it may enable site managers to identify what the focus should be on. Moreover it is important that the follow-up on the projects are done when the project is still fresh and on the mind, otherwise there is a risk that knowledge is forgotten when project members are split up on new projects (Blome, 2004). Many times these aspects are not prioritized and gets over looked and studies have shown that follow-up's on projects are limited and are done so rarely that knowledge from the project is forgotten or just stays with the knowledge carrier (Knauseder, 2005).

2·3 Scheduling

2·3·1 What is scheduling?

The two terms, planning and scheduling, are often thought of as synonymous. However, they are not. Scheduling is just one part of the planning effort. Mubarak explains that schedules are the result of asking "when" during planning (Mubarak, 2010). Scheduling is part of the Project Time Management process (Project Management Institute, Inc., 2013). The table below shows four different definitions of scheduling.

Table 2- 4 Defining scheduling.

Reference	Definition of scheduling
(Popescu, 1995)	"Scheduling is defined as the process of assigning the schedule start and finish calendar dates to all or a group of activities that belong to a project."
(Project Management Institute, Inc., 2013)	„…the process of analyzing schedule activity sequences, schedule activity durations, resource requirements, and schedule constraints to create the project schedule".
(Mubarak, 2010)	"Scheduling is the determination of the timing and sequence of operations in the project and their assembly to give the overall completion time."
(McCarthy& McCarthy, 2010)	"…the real time of the activities and the project is determined as the result of the resources assigned to activities".

The purpose of scheduling is to provide a road map"" that represents the delivery of the project scope over time as defined by the project team (Project Management Institute, Inc., 2013). Kerzner explains that a schedule is a plan showing when activities or accomplishments will be started and/or completed. The primary objective of scheduling is to coordinate activities to complete the project with the: best time, least cost and least risk (Kerzner, 2013).

2.3.2 Developing Schedules

This subsection describes the process of developing a schedule, based on a practice standard developed by The Project Management Institute. The first steps are selecting a scheduling method and a scheduling tool. The schedule model is formed as specific project data is inserted into the scheduling tool. The model is then used to generate (print) project schedules. These aspects are explained separately below:

The *scheduling methods* provide the framework which schedule models are developed. Example of scheduling method is the Critical Path Method (most commonly used method).

The *scheduling tool* provides the means of adjusting various parameters and components that are typical in a modeling process. The scheduling tool includes the capability to:

- Select the type of relationship, such as finish-to-start or finish-to-finish
- Add lags and leads between activities
- Apply resources
- Add constraints
- Capture a specific schedule as a baseline or target schedule
- Change various parameters within the schedule model such as imposing a different project completion date in an attempt to shorten the overall project duration to analyze the impact that these changes would have on the project schedule
- Compare the most recent schedule against the previous one or against a target or baseline to identify and quantify trends or variances.

By inserting specific project data, such as activities, durations, and resources into the scheduling tool the *schedule model* is created. The schedule model then produces project schedules, which contains the planned dates for completing project activities.

In this way the schedule model provides a tool for analyzing alternatives. Once this model is developed, it should be updated on a regular basis to reflect progress and changes (Project Management Institute, 2007). This practice standard refers to the scheduling engine populated with project data as the schedule model. However, in general practice the printed schedule and the schedule model are both referred to as the schedule (Project Management Institute, Inc., 2013).

2.3.3 Types of Schedules

In the most case there are different types and formats of schedules. Examples of schedule formats are milestone charts, bar charts and project schedule network diagrams. These formats are briefly described as follows (Project Management Institute, Inc., 2013):

- A milestone chart is similar to bar charts, but it only identifies the scheduled start or completion of major deliverables and key external interfaces.

- A bar chart represents activities by applying bars which show activity start and end dates, as well as expected durations. Bar charts are relatively easy to read, and are frequently used in management presentations.
- A project schedule network diagram with activity date information, usually show both the project network logic and the project's critical path schedule activities.

Examples of schedule types are baseline schedules, detailed schedules, master production schedules, look ahead schedules and weekly work plans. These schedule types are briefly explained as follows:

- A *baseline schedule* is a schedule usually prepared by the contractor before the start of the project and used for performance comparison (Mubarak, 2010).
- Detailed schedules are prepared for almost every activity. Each and every detailed schedule should fit into one master schedule to verify that all activities can be completed as planned.
- A master production schedule is a statement of what, how many and when the different units will be made. It is a production plan, not a sales plan (Kerzner, 2013).
- A look ahead schedule helps the project team to detect issues a few weeks ahead before it becomes a problem. The look ahead window (the period of time one chooses to look ahead) is typically 3 to 12 weeks, depending on project characteristics, the reliability of the planning system, and the lead times for acquiring information, materials, labor, and equipment (Ballard, 2000b).

A weekly work plan is a detail level schedule to hand out assignments, which typically yields multiple assignments for each activity (Ballard, 2000b).

There are many other types of plans and schedules as well for budgets, logistics, transportation, procurement, and quality assurance to name a few. However, those plans will not be addressed here. For further information on the matter see Kerzner‟s book: Project Management: A Systems Approach to Planning, Scheduling, and Controlling.

2.3.4 The Tripod of Good Scheduling

Mubarak "tripod of good scheduling *system* describes three important factors to consider when scheduling. He states that if anyone of the three "legs" is missing, the system will fail. The *tripod* of good scheduling system is defined as follows (Mubarak, 2010):

(1) The Human Factor: A proficient scheduler or scheduling team that understands the concepts, Definitions, and applications or project scheduling

(2) The Technology: A good scheduling computer system (software and hardware) along with Capable IT support

(3) The Management: A dynamic, responsive, and supportive management that believes in the Use of scheduling as part of the management effort

Kerzner explains that every scheduling technique has its advantages and disadvantages. However, there are some scheduling problems that can impact all scheduling techniques. These include (Kerzner, 2013):

- Using unrealistic estimates for effort and duration
- Inability to handle employee workload imbalances
- Having to share critical resources across several projects

  Overcommitted r
- Continuous readjustments to the WBS primarily from scope changes

  Unforeseen bottlenecks

The Project Management Institute explains that developing an acceptable schedule is often an iterative process. This development often requires the planners to review and revise their duration estimates and resource estimates to create an acceptable schedule. In fact, to maintain realistic schedules it is necessary to review and revise those throughout the project (Project Management Institute, Inc., 2013).There are five techniques commonly used for scheduling compression. These are overtime, additional resources, reducing scope, outsourcing and doing series work in parallel. However, Kerzner explains that each of these compression techniques have significant limitations that perhaps makes them more of a myth than reality. This is explained in the table below, based on Kerzner"s description (Kerzner, 2013).

Table 2- 5 Scheduling compression

Compression Technique	Myth	Reality
Use of overtime	Work will progress at the same rate on overtime.	The rate of progress is less on overtime: more mistakes may occur; and prolonged overtime may lead to burnout.
Adding more resources	The performance rate will increase due to the added resources.	It takes time to find the resources; it takes time to get them up to speed' the resources used for the training must come from the existing resources.
Reducing scope	The customer always requests more work than actually needed.	The customer needs all of the tasks agreed to in the statement of work.
Outsourcing	Numerous qualified suppliers exist.	The quality of the suppliers' work can damage your reputation: the supplier may go out of business: and the supplier may have limited concern for your scheduled dates.
Doing series work in parallel	An activity can start before the previous activity has finished.	The risks increase and rework becomes expensive because it may involve multiple activities.

2.3.5 Scheduling: Research Framework

This research will use the following objectives (criteria) as the standard by which scheduling success or failure will be judged. These objectives for scheduling are mainly based on Kerzner"s descriptions (Kerzner, 2013):

Applying realistic estimates: complete on time, within cost, and with minimum risk. If the objectives above are met, scheduling will be viewed as successful.

2.4 The Low Volume Road Construction Project

The low volume Road Construction built-up (RCB) is necessary for momentous development of an economy. For example, the last few years saw the Indian economy in a phase of unparalleled growth of about 8-10% per year, making it one of the fastest growing economies in the world. Sustaining this rate of growth invariably demands huge investments in physical infrastructure such as roads (Chilipunde and Kadangwe, 2013;

Bandyopadhyay et al, 2008). Such investments in roads further underscore the significance of the RCI. The RCI is categorized under the engineering division of the overall construction industry (ABS, 2003). In most developing countries, roads are the dominant mode of transport and constitute the single largest government asset as a large amount of money is invested in this endeavor (Chilipunde and Kadangwe, 2013; Thillai et al., 2010; AddoAbedi 1997) In addition to the construction of new roads, other roads are rehabilitated or routinely maintained, in order to accelerate development. It is estimated that over 90% of all international freight and passenger traffic is handled by road transport, while 70% of internal freight and 99% of passenger traffic relies heavily on road transport (Ministry of Transport and Public Infrastructure, MOTPI, 2011). In spite of the significance of the road networks, development of the road sector contributes towards environmental degradation and global warming (Chilipunde and Kadangwe, 2013).

Owing to its significance, governments in developing countries especially Africa are continually looking for ways of rehabilitating road networks, maintaining existing ones an d building new road networks (Brushett and Kumar, 2001). According to a World Bank report, Ghana‘s road transport indicators are strong (Foster and Pushak, 2011). Same can be made about the RCI because the two are inextricably linked. Ghana meets almost all of the best practice guidelines for road sector institutions (Foster and Pushak, 2011).

In contrast to other African countries, Ghana allocates its road fund resources much more evenly across the different road networks rural and urban roads receive 30 and 25 percent of the total, respectively. Overall, Ghana has allocated substantial resources to the road sector in recent years; it spends on average 1.5 percent of GDP on roads, one of the highest shares in West Africa (Foster and Pushak, 2011).

The Indian road construction industry is highly unorganized and fragmented (Bandyopadhyay et al, 2008). According to them, an insignificant number of contractors in India can be classed as medium to large firms (based on the number of people employed per firm). They further argued that many of the medium and large construction firms are still family owned and lack professional management and work culture. This situation in India is similar across many developing countries which Ghana is not an exception. This situation has fueled the inefficiency' associated with the Road Construction Industry. The industry is noted for delays and cost

overruns. According to Ubani and Ononuju (2013) concerted and efficient management processes are required for the avoidance of delays and cost overruns.

2.4.1 Overview of Low Volume Road Construction Planning and Scheduling

Project success ultimately is the key to successful profit making in any construction organization (Hancher, 2003). In view of this, efforts have been made over the years, to direct, plan, and control the numerous low volume road construction activities to achieve optimum project performance. However, the incessant abandonment and the proliferation of delays and cost overruns on construction projects (see AhiagaDagbui et al., 2014) only suggest a lack of integration of advanced construction planning and scheduling in the construction industry. This might be the reason for Allen and Smallwood (2008) assertion that clients and stakeholders alike are not satisfied with the results of the industry. Accurate cost estimating and control are the essential elements to ensuring project success (Elbeltagi et al., 2014). Essentially, the controlling cost and the accurate estimating of projects is intertwined with planning and scheduling. This places a demand on project planners and in some instances, project managers to integrate planning and scheduling in the Road Construction Industry.

More so unprecedented growth and the general shortages of skills (Allen and Smallwood, 2008), in the industry further underscore the need for a more rethinking of construction planning and scheduling in the low volume Road Construction project, since the existing practices are failing to produce the desired results (Allen and Smallwood, 2008).

Owing to the fragmented and unorganized nature of the industry, the roles of construction planners in the realm of construction are not appreciated (Allen and Smallwood, 2008). Indeed, in the Road Construction Industry in Ghana such a title is virtually non-existing. The role of construction planners is mostly assumed by the project managers. This confirms the assertion by Allen and Smallwood (2008) that the Industry is limited in terms of the number of competent construction planners and in consequence less qualified personnel is being thrust the responsibility of construction planning .Throughout history the construction industry‘s clients have consistently and progressively demanded for higher standards, and as a result construction planners are at the forefront of these developments (Proverbs et al., 1996). Unfortunately, it

Appears the industry has not planned adequately to meet the competing demand of the clients. Hence the clients are dissatisfied with the outputs of the industry and the productivity of the industry is low (Allen and Smallwood, 2008; Proverbs et al., 1996).

The unpredictability of the construction delivery time, budgets, inter alia are the manifestations of the gaps that exists in the current practice of planning and scheduling in the industry. Accordingly, making the industry attractive to both investors and potential recruits requires the stringent application or integration of technology to improve working efficiency and existing practices (Allen and Smallwood, 2008). The thrust of this achievement is the construction planning process. And this has been the focus of this section. The succeeding subsections highlight the theoretical developments of construction planning and scheduling and the techniques.

2.4.2 Difference between Planning and Scheduling

Planning and Scheduling, most often are used concurrently and as a joint term. However, the two tasks are distinct. This is manifested in the argument of Fischer (2002). Fischer (2002) pointed out the apparent differences between a construction plan and construction schedule. He contends that a plan shows the logical relationships of construction project activities. However, on a plan that start and end dates are missing because activities do not communicate that.

Whereas a schedule shows the start and end dates that helps in the definition of project duration. Planning, according to Hancher (2003), includes the consideration of the existing constraints and available resources that impact on project execution. Planning is essential in the following support

Functions: project, materials storage, office space, temporary utilities, etc. Planning involves;

- Identification of the activities for a project
- Ordering of these activities with respect to each other, and
- Development of a logic relationship

Development of a construction plan is critical to the success of projects (Heesom and Mahdjoubi, 2004), however, it is by far the most difficult task (Hancher, 2003). Here, the project is built on paper.

Scheduling, although distinct, is commonly acknowledged as part of the construction planning process. According to Heesom and Mahdjoubi (2014), in scheduling, planners, project managers and site mangers altogether simulate various construction processes required to build the project. It is this stage of the construction process that requires the adoption of computer-based tools. Scheduling basically involves the determination of the timing of each work item, activity, in a project within the overall project duration (Hancher, 2003).

Altogether, planning and scheduling are two separate processes involving the performance of different tasks. However, the planning and scheduling processes normally overlap (Hancher, 2003).

Recommended Practices

- Design and locate main skid roads and trails before logging operations begin.
- Design and locate skid roads to follow the contour of the natural terrain.
- Winch logs from the SMZ or areas of steep slopes to avoid equipment movement in this area.
- Locate skid roads and trails in such a way that water from the skid trail is not concentrated into the log landing or into creeks (Photo 3.9).
- Cross natural drainages at right angles with skid roads.
- Construct skid roads with rolling grades and breaks in grade.
- Stabilize skid roads and trails with water bars and cover the bare ground with logging slash after operations cease to minimize erosion from exposed soils (Photo 3.8).
- Construct skid roads on grades of 15% or less except for short distances (20 meters) where 30% pitches (grades) are acceptable.
- Decommission or close skid roads after timber removal operations.

2.4.3 Theoretical developments of Construction planning and scheduling

The last two decades have seen a growing interest in technological advancement (e.g. Four dimensional computer aided design, 4D CAD) for construction planning and scheduling (Heesom and Mahdjoubi, 2004; Chau et al., 2003). Hitherto, construction planning and scheduling was mundane involving basic tools and practices. There was no generally accepted formal procedure to help in the management of projects (Hancher, 2003). The procedure varied from project to project and from manager to manager. However, there was one thing peculiar to

all projects or sites. Construction professionals on a typical project communicated through paper based working drawings, and the planning staff formulated their schedules in the same way involving paper based working drawings (Chau et al., 2003).

This presented the planning team with an unenviable and herculean responsibility of formulating project schedules. The arduous Task was the consideration of resource requirements for human, plant, materials, etc. Not only that, planners also faced the challenge of incorporating in their minds logical construction sequence, and economic resources utilization (Chau et al., 2003). The construction industry is multifarious, and involves huge number of resources. Achieving the desired results using human intuition was bound to fade out.

The increasing complexity of construction fueled the obsolescence of the heavy reliance on human intuition 'in planning and scheduling.

This development led to the adoption of computer based tools for planning and scheduling. Chau et al. (2003) argued that where computer based tools were utilized they were utilized as bar charts or critical path networks. This was limited in that they were not able to show spatial construction features as well as the detailed resource and workspace requirements. This had to be envisioned in the minds of the planners (Chau et al., 2003). So although there have been improvements in the form of computer based tools, the critical tasks were still left to the intuition of the planners. Moreover, their intuit on was only limited to the extent of information that can be gleaned from the design documents. As a result, Chau et al. (2003) concluded that the computer has not been explored enough.

Exploiting the optimal assistance from computers fueled the upsurge of concerted research efforts on the concept of visualizations (i.e. 4dimensional models). The fourth dimension has to do with time. As aforementioned the research focus in the last two decades has been on the development of more stringent approaches to effective construction planning and scheduling. For instance, Retik et al. (1990) developed and outlined possible features of tools for construction scheduling using computer graphics. Also, Williams (1996) graphically represented construction plan with a 4D Planner to improve project visualization, simulation and communication needs. In the same way, McKinney et al. (1996) developed a 4D CAD tool that also enhances visual communication, but was limited to the construction design process. AdjeiKumi and Retik (1997)

using a library based 4-D model, proviso`s, for planning reported visualization of construction plan in a virtual reality.

Moving on, Kamat and Martinez (2001) proposed a general purpose 3D visualization system on low volume road construction operations.

In spite of the fact that there have been improvements, incorporating visualizations of construction processes to aid planning and effective decision making the developments are often limited to building level. Chau et al. (2003) argued that the application lacks pragmatic site management features. They consequently proceeded to furnish a 4D graphical visualization capability for construction planning purposes. Currently, 4D CAD has been found to have a profound impact on communication in construction. It allows a more comprehensible intuition of the construction processes than the traditional 2D drawings and schedule information (Bergsten 2001 cited from Heesom and Mahdjoubi, 2004).

Surprisingly, the construction industry in developing countries including Ethiopia has historically neglected modern practices in planning and scheduling. This is evident in the conventional cost and time overruns, and lack of literature on the discipline in that regard.

2.5 Construction Planning and Scheduling Techniques in Low Volume Road Project

2.5.1 Traditional Planning Techniques

The era of traditional planning techniques dates back to the time of Henry Gantt‘s Work, Wages and Profits‘ in 1916.

2.5.1.1 Gantt Chart

The Gantt chart otherwise known as the bar chart is useful for the illustration of work items and their estimated times (Hancher, 2003). It was named after Henry Gantt, hence the name Gantt Chart‘. However, it was originally developed by Karol Adamiecki in 1896 (Bokor et al., 2011). He named it the harmonogram. Bokor et al. (2011) argued that the contradictory may come from the fact that the harmonogram was only popular in Poland, and until 1936 Karol Adamiecki had not published his work.

Basically, the Gantt chart is a bar graph with time on the horizontal axis and resources on the vertical axis. The chart has the advantages of easy to prepare, easy to interpret and understand. Compare to most planning tools, the Gantt chart is a very good communicative tool, especially in

the industry where most of the artisans are not highly educated. In view of this it is the most widespread way of displaying project plans (Bokor et al., 2011). In spite of these advantages the Gantt chart has some limitations. First, relationships or logic between activities cannot be shown on the chart. Also, the effect on the schedule is difficult to determine.

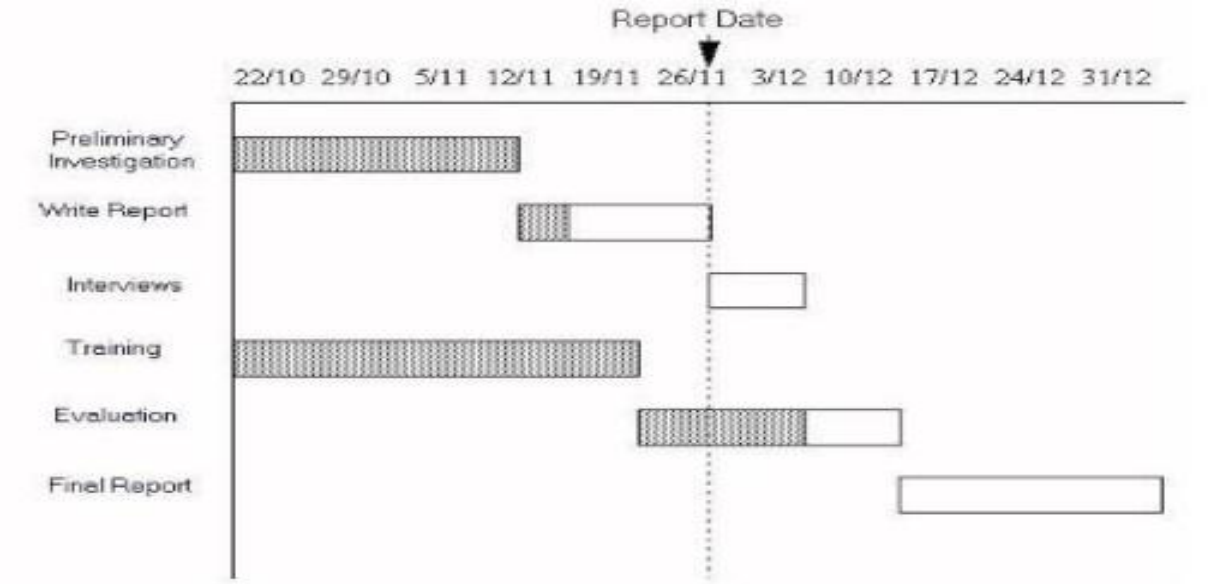

Figure 2- 2 *Gantt chart*

2.5.1.2 Cyclogram

The shortfalls of the Gantt chart led to the development of a more sophisticated tool that incorporates the downsides of the Gantt chart (Bokor et al., 2011). The Cyclogram was developed to overcome the technological challenges and spatial troubles. It has on the vertical axis the percent completion as the function of time. It is mostly used for displaying project plan for infrastructural projects like highway construction, etc. (Bokor et al., 2011). In such cases, cross-sections are represented on the vertical axis.

2.5.1.3 Network Planning Techniques

The growing complexity of projects fueled the need for a more advanced method of displaying project plans. In response the network planning techniques were developed. The techniques evolved with modern project management in 1959 (Bokor et al., 2011).

A characteristic of the Network Planning Techniques is that the activities duration are given in a deterministic way.

2.5.1.4 Critical Path Method

With the Gantt chart relationships between activities could not be displayed, they were only implied (Hancher, 2003). Hancher further noted that the complexity of the project even makes the displaying of the relationship virtually impossible. So the development of the Critical Path Method (CPM) provided a more formal and systematic way to project management (Hancher, 2003). Additionally, the critical activities could be determined using the Critical Path Method (CPM). The Critical Path is the longest path through the project, and that determines the project's duration. In a CPM network, events are represented by circles and activities are showed as arrows (Bokor et al., 2011). They are sometimes referred to as Activity-on-the-arrow diagrams.

Events represent the finishing and starting times of activities directed to and from them. For instance in the Figure 2.2 the numbers in the nodes show the early and late occurrence of the events. The red line also indicates the critical path of the project. Bokor et al. (2011) contend that the CPM is capable of storing logic that has been created, and in consequence allows easy modifications to the original plan. The CPM has been implemented successfully on several projects. Hancher (2003) noted that the success was not only peculiar to the construction industry, but project management in other disciplines. In summary, Hancher (2003) concluded that ―Today's construction manager who ignores the use of critical path methods is ignoring a useful and practical management tool‖. Surprisingly, Bokor et al. (2011) had a different view about the CPM. They noted its deficiency in handling multiple relationships.

2.5.1.5 Program Evaluation and Review Technique (PERT)

Program Evaluation and Review Technique (PERT) works the same way as the CPM and in fact evolved about the same time i.e. in the late 1950. However, the task durations, unlike, the CPM are determined stochastically (Bokor et al., 2011). Today, as in the past, project managers and planners have been preoccupied with PERT (Ika, 2009). Academics argue that uncertainties abound on projects and that is the major advantage of the PERT, and also the difference between the PERT and CPM – details of PERT are not known with certainty. In PERT the duration of the project is assumed to have a beta probability distribution given by the formula below:

$$\frac{0+4m+p}{6}$$

Where O= the Optimistic duration

M= the Most likely duration

P= the Pessimistic duration

2.5.1. 6 4D CAD Visualization Techniques

Conventional project planning techniques such as , Gantt Chart, etc. are disadvantaged in terms of adequate communication of the conceptual planning of the modern manager (Allen and Smallwood, 2008; Koo and Fisher, 1998). Additionally, relating information through these conventional techniques is more difficult and mistake prone. The result is that some problems remain inherent and elude the project planning stage. This phenomenon explains why variations or changes are commonplace in construction (Koo and Fisher, 1998). If project information could be visualized there is high possibility that most of these elusive problems would be detected at the planning stages. Advancing this principle evolved the theory of Visualization techniques in project planning and scheduling in construction. This subsection discusses the various visualization techniques in project planning and scheduling. Of particular importance in the 4-D CAD Visualization Techniques is the fact that the benefits cuts across the board. Designers and builders are able to communicate through design and construction information, which enhances collaboration and improves communication between the two entities (Koo and Fisher, 1998). In Contrast to the conventional techniques, users can also use the 4-D CAD to assess the cost, health and safety issues, or allocation of resources even before the completion of the facility.

2.5.2 Common Point 4D

This tool was developed by the Center for Integrated Facility Engineering at Stanford University, USA. The project ended in 1998. The limitations of the conventional planning and scheduling tools may have stimulated this work, since the authors compare this tool with the conventional tools (cf. Koo and Fisher, 1998). This tool, as in the tools aforementioned, also relies on AutoCAD; specifically 3D IFC complaint models (Heesom and Mahdjoubi, 2004). As in the case of the Schedule Simulator, the linking of tasks to 3D CAD objects is done manually.

However, a unique feature of the software is that it allows the grouping of objects manually and attached to one or group tasks (Heesom and Mahdjoubi, 2004).

2.6 Benefits of Low Volume Road Construction Planning And Scheduling Techniques

Throughout this study, it has been demonstrated that planning and scheduling is indispensable to low volume road project success, and ultimately the profit of construction companies. As a result interest in construction planning and scheduling techniques has grown considerably over the years, with academics and practitioners a like developing interest in the discipline. Surging interest in the discipline further reflected in the plethora of construction planning and techniques tools evolved over the years – from conventional to modern tools. The continuing trend toward the betterment of the available tools and techniques suggests a lot of inherent and explicit benefits. Under this section the benefits are highlighted. These benefits include but not limited to the following.

2.6.1 Allows visualization of information

Construction planning and scheduling techniques, particularly the 4D models, allows the information to be visually interrogated in advance before construction (Allen and Smallwood, 2008). This benefit is not only peculiar to the construction industry, but to other industries as well. Evidence exists in other disciplines such as sales and operation where planning and scheduling techniques provided a similar benefit (see Ivert and Jonsson, 2010). Due to the relatively large number of semi-literates on construction sites, it is important that information be visually presented to the understanding of all; and this is what planning and scheduling techniques offer. One site engineer, during the piloting of 4DSMM is reported to have accounted the importance of visualization in construction: locating equipment, analyzing carnage etc. (Chau et al, 2005).

2.6.2 Easy access to information

To some extent mental model possesses advantages over computer or graphical model in terms of its flexibility and processing of wide range of information presented in any form (Sterman, 1992). Nevertheless, mental models suffer from great disadvantages, particularly the

interpretation of the mind. This is where graphical presentation of construction plans is imperative in particular with projects of high complexity. Construction planning and scheduling tools like Gantt Chart, CPM, etc. present the construction idea into forms that are easily appreciated by the teams (Barati et al., 2013). In the absence of any of team members, information about the project may be accessed and in consequence ensure workflow.

2.6.3 Makes it possible to identify unexpected future outcomes

The traditional forms of construction planning and techniques made it difficult to discover problems at the initial stages and therefore variations are pervasive on construction projects (Koo and Fisher, 1998). However, recent advances in planning and scheduling make it possible to identify the inherent problems from the onset of the projects (Heesom and Mahdjoubi, 2004). For instance with the visualization tools such as the 4D CAD highlights minutes inconsistencies and problems that could have inherently been hidden from the experts.

2.6.4 Makes it possible to analyze unexpected future outcomes

This benefit is inextricably linked with the benefit immediately aforementioned. The identification of the unexpected future outcomes precedes the analysis of the outcome. Unlike the conventional planning tools that leaned much towards imagination and intuition, modern planning and scheduling tools provide users with interactive manipulation that enable the easy analysis of unexpected future outcomes that erupts (Chau et al., 2005; Koo and Fisher, 1998).

2.6.5 Results in a reliable delivery plan

The success of a project inevitably relies on a very realistic project plan (Heesom and Mahdjoubi, 2004). Corroborating to this, Hendrickson (2000 cited from Heesom and Mahdjoubi, 2004) argued that planning is a critical task in a project. That is to say chances are that a reliable delivery plan would lead to a successful project. It is of no secret that competent and experienced personnel are needed for the development of effective plans (Heesom and Mahdjoubi, 2004). Experienced managers are able to visualize the process in their heads (Koo and Fisher, 1998). However, they further argued that there is always a missing link from conveying the visualized information to second parties i.e. planners and other artisans. This is where planning and

scheduling tools fit into the problem. The experience and conceptualization of such information is carried out using planning and scheduling tools.

2.7 Challenges in the Adoption of Construction Planning

Construction planning and scheduling techniques present mouthwatering potentials (Azhar et al., 2008). Surprisingly, the construction industry in Ghana is lagging behind in terms of construction and planning techniques. For instance, 4D CAD is almost alien to many practitioners and academics in the construction industry. Many factors account for this slow adoption of construction and planning techniques. And that is the purpose of this section. In consequence the succeeding subsections discuss the challenges that impede the successful integration of construction planning and scheduling techniques.

2.7.1 Complexity of the tools

Complexity of the planning and scheduling tools serves as an impediment to the successful integration of planning and scheduling tools. Extensively this problem has been studied by many authors and indeed the problem is prevalent in any identified challenges studies across the world. For instance, Woo (2006) observed the difficulty students especially beginners faced in the use of similar construction planning tools. This barrier is not peculiar to the class alone, it transcends to sites. The difficulty in inputting data and the time involved in handling data are some effects of the complexity of tools (Chau et al., 2005).

2.7.2 Unable to take into account spatial planning

Existing project planning and scheduling tools do not take into consideration the spatial needs of the construction sites (Winch, 2002). As a result, Heesom and Mahdjoubi (2004) argued that these planning and scheduling tools are considered one-dimensional. In research, integration of site-related practices of planning and scheduling has received little attention (Retik and Shapira, 1999). Over a decade, development in this field is still in the preliminary stages. This development led to the heavy reliance on intuition and personal experience of the professionals.

2.7.3 Technological challenges

In order to fully exploit the benefits of construction planning and scheduling tools interoperability is indispensable (Thurairajah and Goucher, 2013). Interoperability refers to the

smooth exchange of information across all disciplines. However, the fragmented and solitude nature of the construction industry (Arayici et al., 2012) impede this integration and inconsequence such incompatibility aggravate the adoption of modern construction planning and scheduling tools including 4D CAD (Olatunji, 2011). The conventional nature of the road industry makes it more difficult to implement these practices.

2.7.4 High computer illiteracy rate (High Skill is required)

Skill is relevant in the accurate and realistic development of construction plans and schedules using visualization tools (Chau et al., 2005). Modern construction planning and scheduling techniques require much knowledge in the manipulation of the tools. In the Ghanaian Construction Industry, most professionals are not modern construction tools savvy partly because the computer has not been fully integrated in the course. More so, there are limited reference materials on the discipline.

2.7.5 Traditional tools forces minds visualizations

A greater challenge with the conventional planning and scheduling tools is the heavy reliance on mind modeling (Chau et al., 2005). Although cognitive processes and intuition are indispensable in construction site co-ordination, situations such as complexity and multi-interrelated factors limit the capabilities of human in cognitive, reflective and analytical skills (Chau et al., 2005). Pervasive cost and time overruns, the ―90% syndrome‖ among others are some of the highlights of the disadvantages of mental visualization (Sterman, 1992). To overcome this construction planning and scheduling tools evolved.

However, those employed in the Construction Industry of Ghana has not been the solution to the problem but the problem itself. The reason is that the industry relies on conventional tools such as Gantt Chart, etc. that is one-dimensional (Heesom and Mahdjoubi, 2004) and in consequence forces mental visualization.

2.7.6 Cost of Modern planning and scheduling tools (Cost of Software)

Software and hardware upgrades are considered as significant barriers to planning and scheduling techniques, particularly for SMEs (McGraw-Hill Construction, 2012). Thurairajah and Goucher (2013) observed that considerable resources are expended on the implementation of

these techniques in the form of strong training requirement which in some situation turn out to be time-consuming.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

Bench-Maji Zone is 551km away from Addis Ababa. Mezanis one of the Debub region zones town, which geometrically lies in southern Ethiopia. The largest town, and the administrative center, of the Bench Maji Zone of the Southern Nation, Nationality, and People Region (SNNPR), and located about 196 kilometers southwest of Jimma,

Bench Maji zone has latitude and longitude of 7°0′N35°35′E Coordinates: 7°0′N35°35′E and an elevation of 1451 meters.

Based on the 2007 census conducted by the CSA, Mizan town has a total population of 34,080, of whom 18,138 are men and 15,942 women.

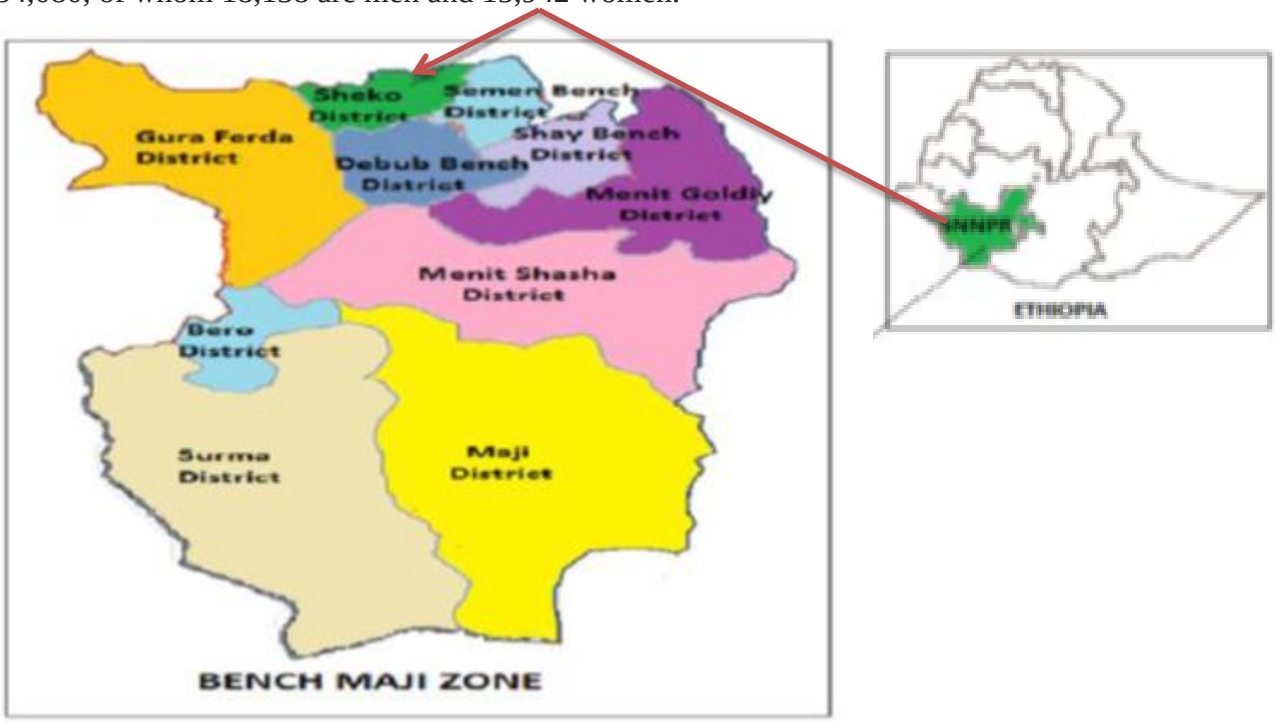

Figure 3- 1 Map of Mizan Bench Maji Zone

3.2 Research Design and Justification

This study was designed by using quantitative research methods. Quantitative research is explaining phenomena by collecting numerical data that are analyzed using mathematically based methods in particular statistics. In quantitative study, we collect numerical data (Aliaga and Gunderson, 2000).

Quantitative research involves collecting quantitative data through questionnaire results and computation of the effectiveness of planning and scheduling in low volume road related equations to examine the situation of the study area by implementing selected suitable formulas.

3.3 Target Respondents

The population in research setting refers to the measurement of interest or collection of all possible individuals or objects (Mason et al., 2009). Cooper et al., (2011) highlighted that population includes all the individuals whom the measurement is being taken. Hence this study population would include contractors, project managers, Engineers, consultants and the known clients in the study area of Bench-Maji Zone.

3.3.1 Population Definition

The research focuses on three construction project I Bench-Maji Zone. The thesis entails on three Gravel Road Construction project in Bench-Maji Zone named(Aman 12km, Shenkora ber 15km, Berged 8km). The selection of participants in terms of answering the questionnaires and interviews were just limited to contractors, project managers, Engineers, consultants and clients found in Bench Maji zone. The basis for this selection was respondents under these classes are easy to be located and they also have enough experience in the management of construction project on the assessment of scheduling and planning in low volume road by reason of the size as well as the type of projects they undertake. The entire populations were 19 as obtained from the sample calculation in Bench Maji zone.

3.3.2 Sampling technique and sample sizing

The study adopted a purposive sampling method. The samples includes 32% from contractor side,16% from consultant side and 52% from client side and the total sample of 100% is

taken for analysis. Purposive sample is one that comprises of subjects who are selected based on certain specific characteristics needed for a study and rules out subjects who do not meet this standard. The nature of the project is such that privilege and sensitive information is required. This necessitated the use of purposive sampling technique for the study.

A total of nineteen (19) using the Kish formula (2011) formed the basis on which the study was conducted.

3.4 Data Collection System

To achieve the research objective, a review of existing literature on the assessments of planning and scheduling in low volume road construction projects were conducted. Subsequently, for analysis purposes, closed-ended questionnaires and interviews were made available to respondents to elicit for information. At the initial stage of the data collection process, useful literatures on the definition of assessing scheduling and planning in low volume road construction projects were reviewed. The literatures gathered on these were studied to determine the actual assessment of these scheduling and planning through formulating questionnaire and the interview schedule (Saunders et al., 2007). Though, in formulating the review, information that supports empirical study results was considered in that, the evidence quality made available by unreliable data is weaker than that made available by empirical study (Aveyard, 2007).

Finally, information was gathered from the road Construction professionals (contractors, project managers, engineers, consultants and clients) who work with public road constructions and private organizations and consultancy firms in the Bench-Maji zone through closed-ended questionnaire and interview. Critical consideration was taken to ensure that the questionnaire reports the research objectives when preparing the questionnaires

3.5 Sampling Technique

In order to get a representative sample of the population, non-probability sampling is used. However, probability sampling heavily rely on a very accurate size of the population. Owing to the less accurate nature of the population gathered probability sampling was difficult, especially

simple random sampling, non-probability sampling, technique was thus used. In sampling from the population, the study utilized purposive sampling.

Purposive Sampling is a sampling technique whereby the researcher decides who to involve in the research. It was selected because of the reasons ascribed to its usage including, allowing information-rich issues that are important to the study to be added and also focusing on specifics rather than generics (Tuuli et al., 2007; Taylor-Powell, 2008). The choice was based on the professionals who have knowledge within the study. Hence their input was imperative in exploring the assessment of planning and scheduling techniques and practices within the Road Construction project.

3.6 Sources of Data and Data Collection

Basically, there are two types of data in research – primary and secondary. In this research both were considered. The primary data were from the field survey, whereas the secondary data were from literature review. Primarily, both data covered every aspect of the study. Neville (2007) argued that research should contain empirical research data. To him empirical data are essentially data from the field survey or the primary data, and they are imperative to any research endeavor. The primary data sources in this research include the information gathered from the professionals indicated in this study. Data were collected through a questionnaire survey and interview targeting those professionals. The response structure on the questionnaire included close-ended questions. Closed-ended questions were included because of its simplicity and ease in analysis.

The questionnaire sought to establish, the assessment of scheduling and planning techniques in the low volume Road Construction project at Bench-Maji zone. The questionnaire was broken down into Parts A and B. The Part A covered largely the general information and background of the respondent. Part B was tailored to address the specific objectives and thus included questions on the planning and scheduling in the low volume Road Construction project. A 5-point Likert scale was used to rate these factors. The questionnaires were designed using plain and simple language to facilitate easy understanding.

3.7 Data Presentation and Analysis

Questionnaires were coded and analyzed using tabulations. For each of the planning and scheduling techniques the ratings by the respondents ranged from 1 (strongly disagreed) and 5 (strongly agreed). In the analysis of the extent of the agreement of respondents on the usage of the tools and techniques, the Relative importance index cum standard deviation was utilized. The idea was to establish the usage of the various factors. The score of each tool or technique is calculated by summing up the scores given to it by the respondents (for instance see Waris et al., 2014; Badu et al., 2013; Fugar and Agyakwah-Baah, 2010). For a five-point response item, RII produces a value ranging from 0.2 – 1.0 (cf Badu et al., 2013; Ugwu and Haupt, 2007). In the calculation of the Relative Importance Index (RII), the known formula was used (Badu et al., 2013).

Data were mostly presented in Tables to aid easy comprehension. The outcome of the study was assessed with the research objectives. Relative Importance Index (RII) and descriptive statistics (standard deviation and mean) were used to analyses the data.

3.8 Ethical Issues Considered in This Study

Issues of ethics are central to any research. Therefore, the study was compiled with principles which aimed at protecting the privacy of every individual who, in the course of the research work was requested to provide personal or commercially valuable information about themselves (hereinafter referred to as a subject of the research). Before an individual becomes a subject, the person was notified of, the aims, methods, anticipated benefits and potential hazards of the research. No person becomes a subject unless the person is fully abreast or cognizant of the notice referred to in the preceding paragraph.

CHAPTER FOUR

DATA ANALSYIS, PRESENTATION AND INTERPRENTATION

4.1 Introduction

The purpose of this study was to identify the assessment of planning and scheduling in low volume road project at Bench-Maji zone.To achieve this purpose, data were collected from 19 knowledgeable and concerned respondents and the response rate is 100%. This commendable response rate was attributed to the data collection procedure, where the researcher personally administered questionnaires and waited for respondents to fill in, and picked the questionnaires once after had been fully filled. The response rate demonstrates a willingness of the respondents to participate in the study. On the other hand this study used a survey to explore the potential of criteria or factors adopted from the literature to make practical differences to practitioners on construction projects in low volume road.

In this regard, Oyedele (2013) asserts that a questionnaire-based survey is a positivist approach, especially for descriptive research seeking to investigate and analyze research problems within an area where theory has been adequately explored in the literature that is, the assessment of planning and scheduling. Moreover, a questionnaire-based survey was chosen because it enabled a large number of sources to be reached, as well as being time and cost effective (Fellows &Liu, 2009). As discussed earlier, a list of criteria or statements were developed based on the literature review by taking into account issues that are not explicitly addressed in previous Studies of the assessment project planning and scheduling. Researchers then utilized brainstorming, along with experiences from stakeholders and from contractors as well as from engineers in the construction of low volume road project, to develop a final set of questionnaire statements, which were categorized into three main topical areas. The questionnaires consisted of three main parts: the first part measured respondents' perspectives on the assessment of the usage of planning and scheduling techniques in the low volume road construction project; the second addressed respondents' levels of knowledge of planning and scheduling theory and roles; and the third addressed challenges confronting the assessment of planning and scheduling in the low volume road project construction**.**

In addition, the questionnaire involved a set of closed -ended questions for the sake of obtaining additional opinions from respondents regarding the examined research issues. Moreover this Chapter presents the data analysis procedure and the findings based on the data obtained from the surveys questionnaire and from interview. First, the overall demographic characteristics of the respondents are illustrated in detail. Then, the analysis is described using descriptive system by tabulations to address the research questions and meet its objectives. On the other hand the descriptive statistics were including frequencies and measures of central tendencies (SD.) were employed. It was found that descriptive statistics are the most appropriate statistics, since the nature of the study objectives and questions is to identify the assessment of planning and scheduling in low volume road project construction at Bench-maji zone.

4.2 Demographic Characteristics of the Respondents

A demographic characteristic of respondents is one factor which affects research result. This section presents the analysis on the demographic characteristics of the respondents, the purpose of which is to provide an overview of the expertise and experience of the respondents. Various issues regarding the demographic information were assessed because of the potential to affect the overall findings of the study as the demographic information somewhat provides confidence to the research findings (see Manu, 2012; Ankrah, 2007). Analyses of these demographic characteristics are shown below.

4.3.1 Gender

Gender of the respondents*:* Regarding gender, 68% of the respondents were males while 32% of the respondents were females.

4.3.2 Academic qualification

The level of the respondent's education was also part of the questions in the questionnaires. From

Table 4- 1 Education levels of respondents

Level of education	Frequency	Percent	Valid Percent
1st degree and below	14	74	74
2nd degree	5	26	26
Total	19	100	100

From the above Table 14(74%) have1st degree and have university graduate background the other 5(26%) are 2nd degree level. Therefore the Bench Maji zone low volume road project Engineers, contractors consultants and clients were educated and well enough to understand the questions and thus have given believable results.

4.3.3 Status of respondents at Bench Maji zone

Table 4- 2 Job status of respondents

Job status	Frequency	Percent	Valid Percent
1. Project managers	3	15.8	15.8
2 middle level managers	6	31.6	31.6
3. procurement staffs	10	52.6	52.6
Total	19	100	100

Source**2020 collected data**

The study requested the respondent to indicate whether they are from management level or from procurement staff in the organization. From the study findings majority of the respondents (52.6%) are middle level managers. The other (15.8%) were from top level manager and procurement staffs comprise 31.6%. These findings described that the knowledgeable about procurement process study management levels and procurement staffs in Bench Maji zone were represented in this table.

4.3.4 Service year of respondents

Table 4- 3 Service year of respondents at all in all

Service year	Frequency	Percent	Valid Percent
1.0 to 5 year	2	10.5	10.5
2. 6 to 10 year	5	26.3	26.3
3. 11 to 15 year	9	47.4	47.4
4.16 to 20 year	2	10.5	10.5
5. 21 year and above	1	5.3	5.3
Total	19	100	100

The study requested the respondent to indicate the number of years they had served in the organization at Maji-Bench zone low volume road project. From the research findings 10(47.4%) of the respondents involved in the study served in the low volume road project 11 to 15 years and the ones who served 1(5.3%)were 21 years and above , up to 5 years were only 2 (10.5%) respondents. Majority of the staffs served for quite a number of years (6 to 10 and 11 to 15 years). The ones who served 16 to 20 years comprise 2(10.5%). This implies that majority of the respondents in Bench-maji zone, had worked for a considerable period of time and therefore they were in a position to give credible information relating to this study.

4.3.4 Planning and Scheduling

Planning is a discipline for stating how to complete a project within a certain timeframe, usually with defined stages, and with designated resources. One view o project planning divides the activities into: setting objectives (these should be measurable) identifying deliverables.

Scheduling determines the timing and specific sequence of tasks necessary to carry out the plan. The schedule is a result of the planning process and reflects the selected plan. Therefore, an inability to schedule stems from a reluctance or incapacity to plan (Saleh, 2005).

4.3.5 Project Scheduling

- Scheduling is the allocation of resources
- Resources in conceptual sense are time & energy but in practical sense are the time, manpower, equipment applied to material.
- Scheduling is the process of formalizing the planned functions, assigning the starting and completion dates to each activity which proceeds in a logical sequence and in an orderly and systematic manner.

Essential aspects of construction planning include the generation of required activities, analysis of the implications of these activities, and choice among the various alternative means of performing activities.

In Scheduling, the following steps are followed.

- Detailed control information is to be calculated.
- Timings to events & activities are assigned
- Consideration must be given to resources generally concerned with those resources whose availability is limited and which there by impose a constraint on the project. Important ones are skilled, technical and supervisory manpower and capital investment
- Resource Allocation

4.5 ASSESSMENT OF THE USAGE OF PLANNING AND SCHEDULING TECHNIQUES IN THE LOW VOLUME ROAD CONSTRUCTION PROJECT.

Table 4- 4 Summary of the assessment of the usage of planning and scheduling

Statements of Techniques	**Rating Scale**	**Frequency**	**Percent**	**Valid Percent**	**RII adjus**	**SD**	**Mean.**	**Rank**
Q1 Traditional Planning Techniques	Strongly disagree	3	15.8	15.8	0.67	4.12	3.37	1
	Disagree	4	21	21				
	Neutral	1	5.3	5.3				
	Agree	5	26.3	26.3				
	Strongly agree	6	31.6	31.6				
	Total	19	100	100				
Q2.Gantt Chart	Strongly Disagree	3	15.8	15.8	0.66	5.15	3.29	2
	Disagree	3	15.8	15.8				
	Neutral	1	5.3	5.3				
	Agree	9	47.4	47.4				
	Strongly agree	3	15.8	15.8				
	Total	19	100	100				
Q3. Cyclogram	Strongly Disagree	3	15.8	15.8	0.62	5.07	3.18	4
	Disagree	4	21	21				
	Neutral	2	10.5	10.5				
	Agree	8	42.1	42.1				
	Strongly agree	2	10.5	10.5				
	Total	19	100.	100				
Q4. Network	Strongly Disagree	2	10.5	10.5				
	Disagree	5	26.3	26.3				

Planning Techniques	Neutral	2	10.5	10.5	0.64	4.76	2.94	3
	Agree	7	32.3	32.3				
	Strongly agree	3	15.8	15.8				
	Total	19	100	100				
Q5.Sufficiencyof Existing Methods In meeting scheduling needs in low volume road project	Strongly Disagree	4	21	21	0.60	4.59	2.74	5
	Disagree	2	10.5	10.5				
	Neutral	5	26.3	26.3				
	Agree	6	31.6	31.6				
	Strongly agree	2	10.5	10.5				
	Total	19	100	100				
Q6.Scheduling deadlines are met using existing methods in low volume road	Strongly Disagree	6	31.6	31.6	0.56	5.08	2.65	7
	Disagree	4	21	21				
	Neutral	3	15.8	15.8				
	Agree	6	31.6	31.6				
	Strongly agree	0	0	0				
	Total	19	100	100				
Q7. Accurate estimates Of schedule Un certainty using existing methods For low volume road project	Strongly Disagree	6	31.6	31.6	0.59	5.65	2.53	6
	Disagree	3	15.8	15.8				
	Neutral	3	15.8	15.8				
	Agree	6	31.6	31.6				
	Strongly agree	1	5.3	5.3				
	Total	19	100	100				
Q8. Skilled team used to implement limiting existing methods at low volume road project	Strongly Disagree	5	26.3	26.3	0.54	4.66	2.76	8
	Disagree	5	26.3	26.3				
	Neutral	2	10.5	10.5				
	Agree	5	26.3	26.3				
	Strongly agree	2	10.5	10.5				
	Total	19	100	100				
Q9.Existing methods considered suitable for continued use	Strongly Disagree	6	31.6	31.6	0.49	5.58	2.44	9
	Disagree	6	31.6	31.6				
	Neutral	2	10.5	10.5				
	Agree	2	10.5	10.5				
	Strongly agree	3	15.8	15.8				
	Total	19	100	100				

Table 4.5 provides a summary of the assessment of the usage of planning and scheduling techniques in the Low Volume Road Construction Project. For each of the planning and scheduling techniques the ratings by the respondents ranged from 1 (strongly disagree and 5 (strongly agree). In the analysis of the extent of the agreement of respondents on the usage of the tools and techniques, the Relative importance index with standard deviation was utilized. The idea was to establish the usage of the various factors. The score of each tool or technique is calculated by summing up the scores given to it by the respondents (for instance see Waris et al., 2014; Badu et al., 2013; Fugar and Agyakwah-Baah, 2010). For a five-point response item, RII produces a value ranging from 0.2 – 1.0 (cf Badu et al., 2013; Ugwu and Haupt, 2007). In the calculation of the Relative Importance Index (RII), the following formula was used (Badu et al., 2013)

$$RII = \sum \frac{W}{A*N} = \frac{5(n)_5 + 4(n)_4 + 3(n)_3 + 2(n)_2 + 1(n)_1}{A*N}$$

Where, W: weighting given to each statement by the respondents and ranges from 1 to 5;

A – Higher response integer (5), and

N –total number of respondents. Where variables have the same RII values the variable with the lowest standard deviation is assigned the highest ranking (Ahadzie, 2007) Standard deviation values of less than 1.0 indicate consistency in agreement among the respondents of the reported level of results (see for instance, Field, 2005). The comparison of RII with the corresponding level of usage is measured from the transformation matrix as proposed by Chen et al. (2010) as seen in Waris et al. (2014). Here the transformation was adapted to compare the level of usage as against the level of importance as proposed by the authors. Hence, the following derived usage levels from RII are used:

High (H) 0.66< RII < 1.0;

High-Medium (H-M) 0.64< RII <0.66

Medium (M) 0.55< RII < 0.6

Medium-Low (M-L) 0.51< RII < 0.55

Low (L) 0.49< RII < 0.51

Eqn. 4.4

$$\mathbf{SD} = \frac{\sqrt{\sum X - \mu 2}}{N}$$

Where ∑ means "sum of",

X is a value in the data set,

μ is the mean of the data set and

A – Higher response integer

N is the number of data points in the population.

Familiarity, Suitability, and Effectiveness of Scheduling Methods displayed the statements and results of responses related to the suitability and effectiveness of planning and scheduling methods. In regard to practitioners' familiarity with scheduling tools examined in this study, as represented by Q2, the schedulers still prefer to use traditional methods, such as Gantt charts, which was ranked first (RII adjust = 0.66. Existing methods considered suitable for continued use and accurate estimated of schedule uncertainty using existing methods for low volume road were ranked the lowest at (RII adjust = 0.49) and (RII adjust = 0.51 respectively.

This result may be due to the ease of use and understanding of scheduling principles within traditional methods, compared with network planning methods by Q4 (RII adjust = 0.59 through Q3 (RII adjust = 0.64). The easy adaptation and understanding of sufficiency of existing methods in scheduling projects received almost equal rank (RII adjust = 0.59), represented by Q5.Respondents indicated that there was less likelihood of meeting schedule deadlines using existing methods as represented by Q6 (RII adjust = 0.53) as well as less accuracy in estimating uncertainty (RII adjust = 0.51) as represented by Q7. The limitations in existing methods imply the need for a more skilled team (Q8, RII adjust = 0.55). Current methods were not highly rated for future use. This was reflected in Q9 (RII adjust = 0.49). The reason for this may be either a lack of specialized schedulers or insufficient awareness about the underlying theories of the scheduling concepts and methods as discussed earlier.

4.4.1 Discussion on Usage of Planning and Scheduling

From the Table 4.5 it is obvious that Gantt chart was the most widely used Scheduling tool in the Low Volume Road Construction Project. The plausible explanation is that majority of the contractors in the Bench Maji zone Road construction Project are well educated, so the need to adopt a technique that displays scheduling in a more easy-to-understand way. This perhaps corroborates the findings of Bokor et al. (2011) that the usage of Gantt chart is widespread especially in developing countries for obviously the same reason as aforementioned.

Although, the challenges associated with the Gantt chart led to the development of Cyclogram it appears; even though from the survey that the tool is also popular in the Low volume Road Construction Project in Bench-Maji zone and hence seen the low level of usage among the participants. Despite Bokor et al. (2011) argument that the tool is useful for road construction projects, the tool is rarely used on road construction.

Traditional planning techniques Methods were the second most widely used scheduling technique after the Gantt chart as agreed by the respondents' altogether. The popularity in the Project might be ascribed to the successes of the tool in the project management discipline. To the extent that Hancher (2003) concluded on the essence of the tool and consequently advised its usage in Low volume Road construction Project. The findings thus corroborate the position of Hancher (2003) that the tool is popular in the road construction Project

4.5 The Assessment of Challenges Confronting Planning and Scheduling In the Road Construction Project

Table 4-5 Assessment of Challenges facing Planning and Scheduling in the Low Volume Road Construction Project

Challenges of Statements	Rating Scale	Frequency	Percentage	Valid percen	RII Adj	SD	Mean	Rank
Q1.High Computer Illiteracy Rate	Strongly Disagreed	3	15.8	15.8	0.62	4.46	2.88	7
	Disagreed	4	21	21				
	Neutral	2	10.5	10.5				
	Agreed	8	42.1	42.1				
	Strongly Agreed	2	10.5	10.5				
	Total	19	100	100				
	Strongly Disagreed	1	5.3	5.3				

Q2. Complexity of Tools	Disagreed	2	10.5	10.5	0.96	6.30	3.97	1
	Neutral	1	5.9	5.9				
	Agreed	8	42.1	42.1				
	Strongly Agreed	7	36.8	36.8				
	Total	19	100	100				
Q3.Unable to take into account spatial planning	Strongly Disagreed	1	5.3	5.3	0.94	4.74	3.65	2
	Disagreed	2	10.5	10.5				
	Neutral	2	10.5	10.5				
	Agreed	8	42.1	42.1				
	Strongly Agreed	6	31.6	31.6				
	Total	19	100	100				
Q4. Traditional tools forces minds visualizations	Strongly Disagreed	1	5.3	5.3	0.77	5.46	3.76	4
	Disagreed	1	5.3	5.3				
	Neutral	3	15.8	15.8				
	Agreed	9	47.4	47.4				
	Strongly Agreed	5	26.3	26.3				
	Total	19	100	100				
Q5.Cost of modern planning and scheduling tools (Costof Software)	Strongly Disagreed	0	0	0	0.79	6.58	3.91	3
	Disagreed	2	10.5	10.5				
	Neutral	2	10.5	10.5				
	Agreed	10	52.6	52.6				
	Strongly Agreed	5	26.3	26.3				
	Total	19	100	100				
Q6. Technological Challenges	Strongly Disagreed	4	21	21	0.58	4.45	2.79	8
	Disagreed	4	21	21				
	Neutral	3	15.8	15.8				
	Agreed	6	26.5	26.5				
	Strongly Agreed	2	10.5	10.5				
	Total	19	100	100				
Q7. Fragmented nature of the Ethiopian Construction Project	Strongly Disagreed	2	10.5	10.5	0.73	4.72	3.44	5
	Disagreed	3	15.8	15.8				
	Neutral	2	10.5	10.5				
	Agreed	5	26.3	26.3				
	Strongly Agreed	7	36.8	36.8				
	Total	19	100	100				
Q8. Inadequate communication between contractors, engineers and with others	Strongly Disagreed	4	21	21	0.66	4.61	2.91	6
	Disagreed	2	10.5	10.5				
	Neutral	3	15.8	15.8				
	Agreed	8	42.1	42.1				
	Strongly Agreed	2	10.5	10.5				
	Total	19	100	100				

Table 4.5 summarizes the assessment of challenges confronting the application of modern scheduling and planning techniques in low volume road construction project. The ratings of the assessment of challenges ranged from 1 (i.e. strongly disagreed) to 5 (i.e. strongly agreed). Altogether, the respondents agreed that:- Complexity of the tools‖ is the major challenge hindering planning and scheduling in the Road Construction project with a mean rating of3.97(Std. Dev = 6.30). Similarly, the aggregated ratings indicated that:- Technological challenges unable to take into account spatial planning‖ is the least challenge with a mean rating of 2.79(Std. Dev. =4.45. From Table 4.6 the standard deviations are more than 1.00 and also medium when compared with the mean rating indicating that there is greater variability in the responses of the respondents. More so, they mean the data are fit for the study (Field, 2005 cited from Manu, 2012).

4.5.1 Discussion on Challenges Confronting Planning and Scheduling

As aforementioned, the major challenge is complexity of tools. The challenge cuts across the learning divide, and also both practice and academia. Woo (2006) identified the challenge in the classroom as impeding the operation of planning and scheduling tools. Conversely, Chau et al. (2005) identified the challenge among practitioners. It would therefore not to be unbelievable to conclude that the challenge is prevalent in the low volume road construction project at Bench-Maji Zone. The finding therefore corroborates the studies by both authors – Woo (2006) and Chau et al. (2005), and by extension the problem is also persistent in the Road Construction Project.

Complexity of tools is an association of technological challenges. It was therefore not surprising that the respondents ranked the challenge second after complexity of tools. Generally, the construction industry is considered to be fragmented and it is even worse in the developing countries. The challenge obtained a mean rating of 6.8, and a standard deviation more than 1.00 The finding largely concurs what is in literature that technological challenge is a major issue to deal with in planning and scheduling (cf. Olatunji, 2012).

With about 90% of the construction companies within the category of Small Medium Enterprises (SMEs) (Owusu-Manu et al., 2014), it was not therefore surprising that the cost of modern planning and scheduling tools is a challenge facing planning and scheduling in the Road

Construction project. This partially explains the over-reliance of the traditional planning and scheduling tools that are not highly sophisticated and thus not expensive. McGraw-Hill Construction (2012); and Thurairrajah and Goucher (2013) noted the considerable resources needed for such tools and how the SMEs struggle with it. This finding therefore confirms the studies by these authors.

4.6 The Assessment of Knowledge Based Planning and Scheduling

Knowledge-Based Planning and Scheduling Roles and Concepts Project contractors' and practitioners' perspectives on the required knowledge base needed for planning and scheduling practice was another critical area explored and measured in this survey.

The motivation of the planning and scheduling team (Q8), Planning and scheduling is a critical area where construction interacts with operation in the organization(Q1), Planning reflects all inputs and needs(Q2), Clients have understood the scope of planning and scheduling(Q10) and disciplined system of control is implemented top-down(Q12,) were ranked the highest with the RII adjust at 0.69,0.69, 0.67,0.67, and 0.67 respectively.

These higher values and ranks are consistent with previously discussed findings that illustrate lower levels of familiarity with the use of different scheduling methods. These findings related to project contractors and practitioner understanding of planning and scheduling concepts confirm previous study results (Mikulakovaet al., 2010; Smith et al., 2000) and highlight the importance of and the need for knowledge-based planning and scheduling concepts and methods. Two additional factors identified as significant include the selection of appropriate techniques or methods for managing a good schedule (Q7) and the exact identification of inputs and deliverables at the pre-tender stage of schedule (Q13). Both were evaluated with the same RII adjust at0.62

Potentially productive line of inquiry will be to consider supplementing planning and scheduling practices with other management strategies, which are highlighted in the following sections.

4.6.1 Discussion on Improving Current Practice of low volume road project

To gain more insight into other aspects, such as knowledge based planning and scheduling, each section of the questionnaire was supported by a number of open-ended questions seeking

suggestions for improvement to practices. In general, the suggestions provided by respondents can be used to determine whether or not the low volume road project construction contractor`s and practitioners have adequate awareness of knowledge-based planning and scheduling concepts. Respondents were asked how to overcome current short comings in planning and scheduling for future improvements with regard to: (1) management strategies needed to improve effectiveness of planning and scheduling and (2) knowledge requirements for successful planning and scheduling.

4.6.2 Survey of Completed L.V.R. Projects

The low volume road completed under the specific zone are:- Shenkoraber, Aman and Berged with corresponding distance in kilometers: 15kms, 12kms and 8kms. Each of the projects had their own drawbacks besides the inappropriate scheduling process. Summary of the above three projects shown in the table below.

Table 4-6 Data of Completed Projects

S.N	Projects	Total length (Km)	Surfacing type	Physical Prog. (Km)		% age	Contract time (days)	EOT granted (days)	% over	Remark
				Plan	Exec.					
1	Shenkora ber	15	GWC	15	12	80	250	150	60	Completed
2	Aman	12	GWC	12	12	100	180	125	69	Completed
3	Berged	8	GWC	8	7	87	240	100	42	Completed

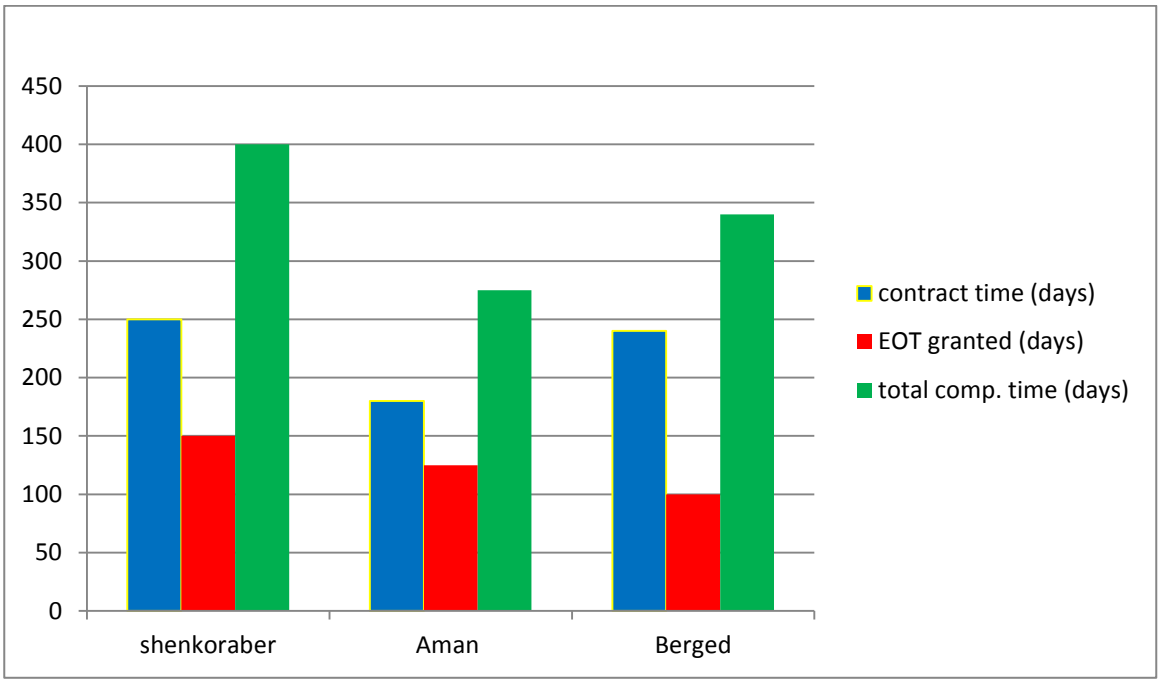

Figure 4- 1 Graphical representation of contract duration of the projects

Table 4-7 The Major Causes for Schedule Delay

Major causes for schedule delay	**Rank**
Lack of effective managing and controlling system	1
Poor supervision	2
Poor Professional Management	3
Poor communication between parties	4
Lack of Working on Program	5
Fluctuation of prices	6
Obtaining permit from municipality	7
Poor management of the project changes	8
Late deliveries of materials	9
Unfavorable Site conditions	10
Bad weather conditions	11

Negligence the contractors on completion time	12
Poor design	13
Risk response planning prepared	14
Foundation conditions encountered on site	15
Mistakes with soil investigations	16
Shortage of skilled labor	17
Accidents during construction	18

Delays of the projects are greatly caused by the poor scheduling methods and also by not using proper tools and techniques of the scheduling. Table 4.8 shows different causes of schedule delay in the specified study area from these causes some are very effective. The hierarchy shows from most affective to lower effective of the causes. According to the table like Lack of effective managing and controlling system, Poor supervision and Poor Professional Management as the most effective and even the one which is listed at the end (number 18) have their own effects for the delay of the projects.

4.7 Efficiency of Planning and Scheduling Theory and Methods

Some respondents suggested measures to improve planning and scheduling efficiency. In a broader sense, respondents highlighted the need to design more proactive planning for efficient control of scheduling. For example, a project manager from a private construction firm asserted:

Planning and scheduling are two of the most important elements for project success. Project planning is much more than simply well-established procedures. Proper proactive planning determines the direction, goals, scope, quality and ultimately the outcomes for any given project. The purpose of project scheduling is to define activities, durations, and relationship logic to implement the project plan and monitor, update and communicate the schedule to reflect current situation and the impact of project changes. Professional planning and scheduling provide project management team with the expertise to deliver the project in the most effective manner. [Project manager]

The same opinion was expressed by another project manager from a consultancy firm in low volume road construction project who stated:

In order to improve the efficiency of construction schedules, the project team must be proactive in identifying their focal points. [Project manager]

According to Alsakini, Wikström, and Kiiras(2004), proactive scheduling systems are considered more suitable than traditional approaches. This is because proactive scheduling allows project managers and planners the chance to incorporate future events and thus take proactive or corrective actions in advance and ahead of any deviations in schedules from the original plan. On the contrary, failure of project managers to proactively define good execution and control project plans will result in unrealistic scheduling and thus re-planning.

Respondents also addressed some concerns regarding the need for improving efficiency of schedule execution and control by overcoming shortcomings of currently-used tools and methods embodied in their own organizations for project scheduling and control. For instance, a risk manager engaged in a construction management firm revealed: Complexity of project schedules require monitoring very closely by identifying which control systems allow to do very well . . . better training and understanding of the tools and complexity of programming with a multi-level of construction activities especially for non-professional planners. [Risk manager]

Practitioner perspectives about ineffectiveness of traditional tools and methods in handing complex schedules appears to be a common issue among all involved in planning and scheduling. As noted by the risk manager, this shortcoming can be addressed by specific training and education programs on new tools and methods for teams involved in project planning. For example, a senior project engineer from a public construction organization pointed out:

The classical bar charts are simplistic approaches, which can be understood by all parties involved in a project.. . Improvement of planning needs to cover all involved by educating on new methods. [Senior project engineer]

This was aligned with comments from another senior engineer from a public construction firm who asserted: CPM and Gantt charts have posed some problems to project managers. . . Usually most of these methods are formulated on linear programming and this caused problems when changes happened on minor activities that are not in line with critical path activities [Senior project engineer].

Problems of interface (or the interrelationship) between critical path activities and non-critical path activities, including minor tasks, should be properly identified and managed in the development of project schedules. In this regard, an operation manager from a facility management firm recommended:

Minor activities also have to be taken into account in the preparation of the project schedule. [Operation manager].

Buffer management may be one tool to use in controlling the execution of project schedules, especially multitasking schedules (Leach, 2011).

In addition, project stakeholders and practitioners should also consider other important factors, such as the coordination of delivery and supply systems for required materials when developing the schedule, correlation of the project schedule to the risk management plan, and consideration of weather history and geopolitical issues in project planning and scheduling. In this study, some of these aspects were identified as important factors by a senior project engineer from a facility management firm who asserted.

During preparation of schedule it is advisable to review site weather history. . . It is advisable to correlate schedule with the project risk matrix . . . To involve contractor, subcontractors, suppliers and end user during preparation and updating the schedule . . . To consider the geopolitical issues that affects the progress of the project . . . To consider financial status of contractors, sub-contractors and suppliers. . .. During preparation of schedules it will be nice to use 20/80 Pareto to place buffers/contingency on all project activities Between 10–25%. [Senior project engineer]

This view was shared by another senior engineer from a facility maintenance unit who suggested:

Any project should be planned in deep coordination with maintenance-related aspects of all materials and equipment for the life time of the project [senior project engineer).

Respondents also revealed that there is a need to improve the efficiency of decision-making for the entire scheduling process. In this respect, a project engineer from a public construction firm commented:

From my point of view using proper planning means/leads to better decision-making and efforts saving . . . If there is no good planning lots of problems will be faced related to project delays and additional costs [Project engineer).

As discussed, the improvement of decision-making related to scheduling processes relies on understanding by project management teams involved in planning and scheduling of the key characteristics and underlying theories of different planning approaches.

Enhancing Knowledge or Awareness about planning and Scheduling Most of the suggestions or comments provided by respondents regarding knowledge-based planning and scheduling

Concepts emphasize the need for a professional and skilled team, including planners, and for in-house or on-site training. For example, a project engineer from a construction Firm commented:

Planning systems must be prepared by very experienced planners, who know the entire practical difficulties of the scheduling process, [Project engineer].

Competencies of project leadership in controlling schedules have been classified among the principle features of successful projects (Iyer&Jha, 2006; Mulholland & Christian, 1999). As discussed earlier, improvement of practitioner knowledge should occur using training programs on the use of new methods and computerized approaches. A project manager from a construction management firm commented:

Traditional methods have limited features. Therefore, assign specialized planners who can use Advanced computer programs. [Project manager].

Acquisition of knowledge on project management specific tools appears to be a key factor in improving efficiency of the construction process. For instance, a recent study conducted on risk analysis of schedules using a simulation model-based PERT concept by Hwang and Ng (2013) revealed that planning and scheduling are one of the most important areas requiring particular knowledge and experience. Specifically, Hwang and Ng identified contribution to decision-making, and team delegation and problem-solving as most important for project managers. In the context of the author's research study, respondent's revealed that improvements in current knowledge have to include every-one involved in planning and scheduling by providing education and training on new methods and techniques. For instance, project manager from a private construction firm stated that: all people who are executing the work schedule at site must be trained in new techniques. Another project engineer from a consultancy construction firm supported this claim as follows:

There is no problem with new methods and techniques only people are not trained well, so efficiency of scheduling becomes less [Project engineer).

The findings revealed that adoption of new techniques and methods would work if education and training were implement-ted for project staff. For instance, it was argued that development of knowledge-based scheduling models can enable project managers and planners to undertake a more efficient evaluation of the scheduling system (Mikulakova et al., 2010). Such models could be used as a support tool by those who have sufficient knowledge of planning and scheduling.

In summary, it can be argued that to improve the efficiency and effectiveness of planning and scheduling, it is necessary to consider other supportive management strategies and tools. This should involve a number of new management measures including: education and training related to specific topics at particular stages in projects; ability to adopt knowledge-based models to enable the use of more modern tools and methods; ability to manage effective communication and to take proactive action when implementing schedules; and consideration of external or

In general, the suggestions provided by respondents can be used to determine whether or not the low volume road project contractors and practitioners have adequate awareness of knowledge-based planning and scheduling concepts. Respondents were asked how to overcome current shortcomings in planning and scheduling for future improvements with regard to: (1) management strategies needed to improve effectiveness of planning and scheduling and (2) knowledge requirements for successful planning and scheduling. Efficiency of Planning and Scheduling Theory and Methods Some respondents suggested measures to improve planning and scheduling efficiency. In a broader sense, respondents highlighted the need to design more proactive planning for efficient system of scheduling. For example, a project manager from a private construction firm asserted. The study results also revealed that practitioner adoption of a routine follow-up or application of controls seems to be given a higher priority than other conformance measures for schedule outcome. In summary, the overall findings of the study imply that there is a need to change current organizational behaviors in construction project schedules, by adopting a more effort system that should be strongly embedded into the whole low volume road construction project process, as well as through all management and Operational levels of the project. The contractors and Practitioners knowledge and awareness of planning and scheduling in low volume road construction project process are important. So this is the importance of this study.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

Based on the research objectives this chapter presents the findings obtained and benefited from the analyzed and interpreted data results that are collected through further desk study, case study and interviews made with selected professionals so as to draw conclusion and recommendation on the planning and scheduling trends and its impacts on low volume rural road project performance. Accordingly, based on the above findings the following research objectives conclusions and recommendations were presented here under so as to successfully complete the study objectives and to answer the stated problems.

5.1 Conclusion

The first specific objective of this research was to assess the major problems in planning and scheduling of low volume road construction projects. Accordingly, major findings observed during the study time were concluded as follows. The questionnaire response confirmed that Planning and Scheduling are crucial to the success of low volume road construction projects and but Traditional techniques and by Extension Network planning techniques, which are to be known as poor techniques, were the most used for the planning and scheduling of low volume road. All data collection methods: interview, questionnaire and survey confirm that most of the construction of low volume road project execute delay. And this delay also related to the improper planning and scheduling techniques. The conclusion of the study was made bellow by summarizing each of the specific objectives.

- Planning and Scheduling are crucial to the success of low volume road construction projects, and the success somewhat depends on the tools and techniques available to the planners and managers.
- It was seen that Traditional techniques and by extension Network planning techniques are the most used planning. The reason may be ascribed to the sophisticated nature of the tools given the level of computer knowledge in the low volume road Construction project.

- Several Challenge`s outbreak the smooth usage of planning and scheduling techniques and tools. Bridging the gap requires the identification of these challenges. The challenges largely centered on technology.
- In summary, planning and scheduling in the low volume road construction project at Bench Majizone is still in the preliminary stages with almost contractor and stakeholders relying heavily on simple ‘tools and techniques of planning and scheduling.
- Improving project performance requires the adoption of planning and scheduling tools that exposes inherent problems, otherwise could not be detected by the simple planning and scheduling tools.

5.2 Recommendations

It is known that construction works, especially road construction, require abundant care. This shows any mistakes in road project may scarify with elapse of time and a lot of money. One of the point that needs decisive care is while planning and scheduling Low Volume Road projects. The purpose of this study was to find out the problems in planning and scheduling of Low Volume Road, to assess the delay causes due to the improper planning and scheduling and to recommend the best planning and scheduling techniques.

Hence, as planning and scheduling are the faces construction, both must be carefully done by using proper tools and techniques. Factors of planning and scheduling delay must be considered before planning. One must use good practices in planning and scheduling Low Volume Road.

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27.

APPENDIX -1

QUESTIONNAIRE

Jimma University

School Of Graduate Studies

Jimma Institute Of Technology Faculty Of Civil And Environmental Engineering Construction Engineering And Management Stream

Dear Respondents,

These questionnaires are prepared for the successful completion of "MSc in Construction Engineering and Management" under the thesis title "**Assessment on planning and scheduling of Low Volume Road projects construction: in Case of Bench- maji zone**".

The purpose of this study is to analyze the assessment on planning and scheduling in the Low Volume Road project constructions and identify the problems in it, then finally to provide possible solutions to the problems raised with respect to the practical approaches of the constructors in the project. Therefore, your honest response to these questionnaires will be greatly help to identify the current planning and scheduling practices of road constructing projects and to conclude and give recommendations following the research findings and the results are intended to serve for academic purposes only.

Finally, you are asked for your kind cooperation and willingness in answering the questions as truthfully as possible until the questionnaire is successfully completed and your response will be highly confidential.

Sincerely Yours,

Thanks for your cooperation!

By: CHERNET BENTI

Mobile: _____

Email: _____

Principal Advisor: _____

Co-Advisor: _____

Please use the thick mark (√) and You can write the desired answer for close-ended questions

Ser. No	Service Years	Educational Status	Sex		Age	Total
			Male	Female		
1	0-5	1st degree				
		2nd degree				
2	6-10	1st degree				
		2nd degree				
		PhD and above				
3	11-20	1st degree				
		2nd degree				
		PhD and above				
4	Above 21	1st degree				
		2nd degree				
		PhD and above				
5	Total 1-4	Educational status total				
		1st degree				
		2nd degree				
		PhD and above				
		Total				

Please rate your option on a 5 point Likert scale on the Values and Rankings for Knowledge-Based Planning and Scheduling Concepts

Statement **Planning and Scheduling Roles and Concepts in low volume project.**	Rating Scale				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Q1. Planning and scheduling is a critical area where construction interacts with operation in the LVRP					
Q2. Planning reflects all inputs and Needs					
Q3. Both construction and operation managers are responsible for the selection of the appropriate method					
Q4. All inputs and deliverables are correctly identified in the pre-tender stage of the schedule					
Q5. Planning methods are updated in terms of latest developments					
Q6. Managers and planners should have adequate understanding of planning and scheduling software					
Q7. Pull schedules are preferred to push Schedules					
Q8. Motivation of the planning and scheduling team is of high importance					
Q9. Low productivity in terms of resources are treated as waste					
Q10. Clients have understood the scope of planning and scheduling					
Q11. All constraints are properly identified in the risk plan in advance of the execution of the schedules					
Q12. A disciplined system of control is implemented top-down					
Q13. The organization is satisfied with its planning knowledge					

Please rate your option on a 5 point Likert scale on the usage of the following construction Planning and scheduling techniques in low road construction projects

Statement of Techniques	**Rating Scale**				
	Strongly	**Disagree**	**Neutra**	**Agre**	**Strongly**
Q1 Tradition planning Techniques					
Q2.Gantt Chart					
Q3.Cyclogram					
Q4. Network Planning Techniques					
Q5.Sufficiencyof existing methods In meeting scheduling needs in					
Q6. Scheduling deadlines are met using existing methods in low volume road project					
Q7. Accurate estimates Of schedule Uncertainty using existing methods For low volume road project					
Q8. Skilled team used to implement existing methods at					
Q9.Existingmethods considered suitable for continued use					

Please rate your option on a 5 point Likert scale on the expressive Challenges facing Planning and Scheduling in low volume Road Construction Project

Challenges of statements	Rating Scale				
	Strongly Disagree (1)	**Disagreed (2)**	**Neutral (3)**	**Agreed (4)**	**Strongly Agreed (5)**
Q1.High Computer Illiteracy Rate					
Q2. Complexity of Tools					
Q3.Unable to take into account spatial planning					
Q4. Traditional tools forces minds visualizations					
Q5. Cost of Modern planning and scheduling tools (Cost of Software)					
Q6. Technological Challenges					
Q7. Fragmented nature of the Ethiopian Construction Project					
Q8.inadequatecommunication between contractors, engineers and with others					

The Major Causes for Schedule Delay

Major causes for schedule delay	RII of Client	Rank
Lack of effective managing and controlling system		1
Poor supervision		2
Poor Professional Management		3
Poor communication between parties		4
Lack of Working on Program		5
Fluctuation of prices		6
Obtaining permit from municipality		7
Poor management of the project changes		8
Late deliveries of materials		9
Unfavorable Site conditions		10
Bad weather conditions		11
Negligence the contractors on completion time		12
Poor design		13
Risk response planning prepared		14
Foundation conditions encountered on site		15
Mistakes with soil investigations		16
Shortage of skilled labor		17
Accidents during construction		18

APPENDIX -II

INTERVIEWING QUESTIONS

1. How awareness of knowledge-based planning and scheduling concepts are important in low volume road construction project?
2. How to overcome the current shortcomings in planning and scheduling for future improvements with regard to low volume road project constructions?
3. Can we improve planning and scheduling efficiency on low volume road construction? And How?
4. How higher priority than other conformance measures for monitoring schedule outcomes on low volume road construction project?
5. How a need to change current organizational behaviors in monitoring project schedules on low volume road project construction?
6. Practitioner knowledge and awareness of planning and scheduling of key elements of the construction process are important how?

Table 4.7 Values and Rankings for Knowledge-Based Planning and Scheduling Concepts

Statement Planning and Scheduling	Agreement	Frequenc	Percent	Valid Percent	RII Adj	SD	Mean	Rank
Q1. Planning and scheduling is a critical area where construction interacts with operation in the organization	Strongly Disagree	5	14.7	14.7	0.69	4.22	3.44	
	Disagree	3	8.8	8.8				
	Neutral	7	20.6	20.6				
	Agree	10	29.4	29.4				
	Strongly agree	9	26.5	26.5				
	Total	19	100	100				
Q2. Planning reflects all inputs and needs	Strongly Disagree	4	11.8	11.8	0.67	4.08	3.32	
	Disagree	7	20.6	20.6				
	Neutral	5	14.7	14.7				
	Agree	10	29.4	29.4				
	Strongly agree	8	23.5	23.5				
	Total	19	100	100				
Q3. Both construction an operations managers ar	Strongly Disagree	8	23.5	23.5				
	Disagree	9	26.5	26.5				
	Neutral	5	14.7	14.7				

responsible for the selection of the appropriat method for low volume road	Agree	10	29.4	29.4	0.54	5.05	2.68	
	Strongly agree	2	5.9	5.9				
	Total	19	100	100				
Q4. All inputs and deliverables are correctly identified in the pre-tender stage of the schedule	Strongly Disagree	10	29.4	29.4	0.51	5.32	2.73	
	Disagree	11	32.3	32.3				
	Neutral	2	5.9	5.9				
	Agree	7	20.6	20.6				
	Strongly agree	4	11.8	11.8				
	Total	19	100	100				
Q5.Planning methods are updated in terms of latest developments	Strongly Disagree	12	35.3	35.3	0.49	5.47	2.44	
	Disagree	9	26.5	26.5				
	Neutral	3	8.8	8.8				
	Agree	6	17.6	17.6				
	Strongly agree	4	11.8	11.8				
	Total	19	100	100				
Q6.Managers and planners should haveadequate understanding of planning and scheduling software	Strongly Disagree	7	20.6	20.6	0.64	4.63	3.21	
	Disagree	6	17.6	17.6				
	Neutral	2	5.9	5.9				
	Agree	11	32.4	32.4				
	Strongly agree	8	23.5	23.5				
	Total	19	100	100				
Q7.the selection of appropriate techniques or methods for managing a good schedule	Strongly Disagree	5	14.7	14.7	0.62	4.39	3.47	
	Disagree	3	8.8	8.8				
	Neutral	6	17.6	17.6				
	Agree	11	32.4	32.4				
	Strongly agree	9	26.5	26.5				
	Total	19	100	100				
Q8. Motivation of the planning and scheduling team is of high importance.	Strongly Disagree	6	17.6	17.6	0.69	4.54	3.44	
	Disagree	2	5.9	5.9				
	Neutral	6	17.6	17.6				
	Agree	11	32.4	32.4				
	Strongly agree	9	26.5	26.5				
	Total	19	100	100				
Q9. Low productivity in terms	Strongly Disagree	8	23.5	23.5				

of resources are treated as waste	Disagree	11	32.4	32.4	0.53	4.92	2.65	
	Neutral	6	17.6	17.6				
	Agree	3	8.8	8.8				
	Strongly agree	6	17.6	17.6				
	Total	19	100	100				
Q10. Clients have understood the scope of planning and scheduling	Strongly Disagree	6	17.6	17.6	0.67	4.34	3.35	
	Disagree	3	8.8	8.8				
	Neutral	6	17.6	17.6				
	Agree	11	32.4	32.4				
	Strongly agree	8	23.6	23.6				
	Total	19	100	100				
Q11.All constraints are properly identified in the risk plan in advance of the execution of the schedules	Strongly Disagree	6	17.6	17.6	0.60	4.60	2.82	
	Disagree	7	20.6	20.6				
	Neutral	6	17.6	17.6				
	Agree	11	32.4	32.4				
	Strongly agree	4	11.8	11.8				
	Total	19	100	100				
Q12. A disciplined system of control is implemented top-down	Strongly Disagree	7	20.6	20.6	0.67	2.99	3.35	
	Disagree	3	8.8	8.8				
	Neutral	4	11.8	11.8				
	Agree	11	32.4	32.4				
	Strongly agree	9	26.4	26.4				
	Total	19	100	100				
Q13. the exact identification of inputs and deliverables at the pre-tender stage of schedule	Strongly Disagree	5	14.7	14.7	0.62	3.49	4.56	
	Disagree	3	8.7	8.7				
	Neutral	4	11.8	11.8				
	Agree	11	32.4	32.4				
	Strongly agree	11	32.4	32.4				
	Total	19	100	100				