JIMMA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

JIMMA INSTITUTE OF TECHNOLOGY

CIVIL ENGINEERING DEPARTMENT

CONSTRUCTION ENGINEERING AND MANAGEMENT STREAM

ASSESMENT ON PLANNING AND SCHEDULING IN LOW VOLUME ROAD PROJECT: A CASE OF JIMMA ZONE DISTRICT

A Thesis Submitted to the School of Graduate Studies of Jimma University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Civil Engineering

By

ABRAHAM KEBEDE TEFERA

June, 2017

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Assessment on the Planning and Scheduling in Low Volume Road Project: A Case Study of Jimma Zone District

By

Abraham Kebede Tefera

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DECLARATION

I, the under signed, declare that this thesis entitled "**Assessment on planning and scheduling in low volume road project: A case of Jimma Zone district**" is my original work and has not been presented for any academic award in any other university, and all sources of material used for these have been dually acknowledged.

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As Masters research Advisors, we hereby certify that we have read and evaluate this MSc research prepared under our guidance, by Abraham Kebede entitled: **Assessment on planning and scheduling in low volume road project: A case of Jimma Zone district.** We recommended that it can be submitted as fulfilling the MSc thesis requirements.

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ABSTRACT

This thesis assesses on planning and scheduling of low volume road projects found in Jimma zone district with the focus on the practice and impacts of planning and scheduling in road projects and give recommendations based on findings. In the construction of low volume road projects many activities have to be done to change the design drawing into physical practice. Therefore to achieve this product proper and acceptable planning and scheduling of low volume road projects enables the contracting firms to optimize the quality, time and resource to the best possible way. In this regard project planning and scheduling has very critical impact on project's performance. Well organized project management team recognizes the importance and applies the basics to achieve the project objectives.

The objectives of the study were firstly to analyze current trends and problems in planning and scheduling low volume road projects; secondly to rank the causes of schedule delay and lastly to analyze the impacts of schedule and how controlling is done in planning and scheduling low volume road project. A desk study, interview and questionnaire survey were carried out to achieve the study objective and to seek recommendation based on findings. The collected data were analyzed via statistical RII formula and Microsoft excel software package. Among the 27 low volume road projects identified during the study time, five completed projects with extension of time approved were selected for case study by using non-probability purposive sampling. Interviews were made with selected experienced professionals in the sector for the expert opinion. Interview questions are structured and extracted through a comprehensive study of literature review, resulted in identification of 39 causes of schedule delay were mapped in frequency table and 25 interview response of professionals from Jimma zone roads authority district bureau, consulting firms and contractors in the sector have been analyzed.

According to the study findings there is no standard procedure to plan and schedule low volume road projects hence risk factor associated with schedule delay is prevalent. For this matter there is a need to improve plans and schedules in the construction projects. To improve the performance of the project in connection with plan and schedule operation constructability review methods and its follow up mechanism has to be implemented. Accordingly, the constructability review teams have to be formed independently from designers, project managers and other professionals. Proper planning and scheduling in low volume road project ultimately improves wisely utilization of construction resources, good project performance and time management; in turn, brings increased profit, timely completion and better quality.

Key Words: *plan, schedule, delay, low volume road, Jimma zone district*

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ACRONYMS

AACRA …………………………………….…....Addis Ababa City Roads Authority

CPM ……………………………….……….....Critical Path Method

DC……………………………………….......Domestic Contractor

EOT……………………………………….....Extension of Time

ERA...…………….…………………...….......… Ethiopian Roads Authority

ETB …………………………….……..........…Ethiopian Birr

GC ….……………………….……...............Gregorian Calendar

GTP…..Growth and Transformation Plan

GWC…………………………...…....…..Gravel Wearing Course

IC……………………………….….........…....International Contractor

Km...Kilo Meters

LVR …………………………….….…...…...Low Volume Roads

MOFED……………………………………Ministry of Finance and Economic Development

ORA ………………………………….......Oromia Roads Authority

PERT…………………………….….…....…Project Evaluation and Review Techniques

PMBOK……………………………………Project Management Body of Knowledge

PMI………………………………….…...…Project Management Institute

SN……………………………..……..…..Sign Number

WBS…………………………..….…..…......Work Break Down Structure

VO………………………...…….…….….…Variation Order

CHAPTER ONE
INTRODUCTION

1.1Background of the Study

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). Jimma 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).

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 organizations 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).

Assefa (2008) 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 (Assefa, 2008).

1.2 Statement of the Problem

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. 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 of road users due to increased travel time, benefits foregone and health issues.

Projects are needed to be completed within the time frame, budgeted cost and required quality. However, unfortunately many projects take longer time to complete, cost more than necessary and some projects are cancelled because of various factors directly and/or indirectly related with it. Project failures have significant effect from economic as well as political points of view**.** If the project takes longer time it requires additional resources, and budgets and this increases labor, material, machinery and equipment cost. This affects the budget of other projects and in general, it affects the economy of the country (Mohaamed, 2014).

Similarly, due to delay in project implementation the people and the economy have to wait for the provision of public and services facility longer than necessary. Thus failure of project limits the growth of the economy because the output provided by infrastructure, construction, manufacturing, information technology projects serve as input for many other sectors of the economy.

In this regard, different researchers show the effects of project planning on project performance. The studies by Wang and Gibson (2008), shows that time spent on project planning activities will reduce risk and increase project success. Other researchers on the project planning activity such as Morris (1998) and Thomas et al. (2008) shows inadequate analysis and planning will lead to a failed project but the more planning there is in a project, the more successful the project will be. Therefore according to this evidence even if all the resources are available poor project planning will result to project failure.

The proper and acceptable planning and scheduling has to be within the standard and modern procedures in order to be more workable and easy for appraisals. Therefore, it is the duty of the planner to check the above criteria on the planning and scheduling issues (Chotchai, 2002).

According to Mohammed (2014) the following major points have been raised by stakeholders in project progress document.

The executors did not submit their revised monthly plans and schedules on due time to the consultants and clients. Due to late schedule updating (rescheduling) the projects follow up and control are affected so that delay was imminent. Contractors raise claim that consultants are delayed on making comments and work measurements to the works executed.

Major tools for planning and scheduling are not updated as to the current technological and managerial advancements. The evaluation of the work progress is not made based on the merits of the physical work progress; rather it is conducted in financial status basis.

The researcher believed that meaningful low volume rural road project success in Jimma zone district requires careful study of the projects planning and scheduling before the project is 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 corrective action and prevent project failure**.** Hence in order to solve the above major problems the following research aim and objectives are developed.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of this study is to make assessment on the practice and impacts of the planning and scheduling of low volume road projects constructed in Jimma zone district.

1.3.2 Specific Objectives

The specific objectives of this study are:

- ✓ To identify the trends in the current practice and major problems in planning and scheduling of low volume road construction projects.
- ✓ To rank the major cause of schedule delay in the construction of low volume road project activities in Jimma zone district.
- ✓ To analyze the impacts of scheduling and how controlling is done in planning and scheduling activities of low volume road construction projects specific to Jimma district.

1.4 Research questions

From the above objectives the following research questions are raised to answer the objective of the research

1. What are the common practice and problems in plan and schedule preparations of low volume road projects?
2. What are the major causes of planning and scheduling which makes project late completion beyond the time granted in low volume road projects activities?
3. What are the common impacts in planning and scheduling of low volume rural road projects?
4. How are the plans and schedules evaluated and reviewed in low volume road projects?

1.5 Significance of the Study

As a research, the primary merits of the study goes to the university academics. Since this study is the first, it will give a comprehensive starting point for more studies in project management. Second public and governmental organization participating in any types of project will get important concepts on the study of planning and scheduling processes on low volume road project outcome, this will create /develop/ awareness.

Therefore, the significance of this study is to recommend a knowledge driven road construction planning and scheduling trends which it will helps to avoid risk factors that are associated with non excusable delays that finally will assist 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.

Further the significance of this study is at the verge of studying on the planning and scheduling of low volume rural road construction projects in Jima zone district considerations in planning and scheduling by which high volume roads are not considered.

Furthermore, the significance of this research work is an attempt to assess the current project time estimating practices in low volume road construction projects in Jima zone district. Likewise for other low volume road Construction Companies in Ethiopia, this may serve as wake-up call about the methods that could improve the overall time estimating accuracy and management of risk factors to extremely delay in regional low volume road construction industry.

1.6 Scope and delimitation of the study

This study will be conducted in some selected areas of LVR construction projects found in Jimma zone district that they are 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 LVR are feeder roads, collector roads and main access roads (Ethiopia Roads Authority, 2011).

This study mainly focuses on the assessment of planning and scheduling of low volume rural road projects, and most of the information is applicable to all types of roads, although high volume standard roads are not the emphasis of this study.

The scope of the study is, therefore, limited to study of planning and scheduling trends, impacts of scheduling and risk factors of project delays in low volume rural road projects in Jima zone district. Due to time limitation and financial constraint, this research will be concerned with low volume rural road construction projects found in Jimma zone districts only and did not take into account the other district companies /organizations/ in Orormia region.

The research will be focused on planning and scheduling of low volume road construction without including advanced mechanism of planning and scheduling that is not deserve right at this moment.

CHAPTER TWO

LITERATURE REVIEW: Project Planning and Scheduling

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 (also housing project).

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 (Kemp, 2006).

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 (Saleh, 2005).

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 (Saleh, 2005).

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 non linear (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).

2.1.2 Construction Project

Construction is one among many types of project-based production systems (Ballard and Howell, 2003). According to Chitkara's (1998) 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, 1998).

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"(Lemma, 2014).

2.1.4 Project management process

According to Lemma (2014) the 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, 1996). 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.

Figure 1: Project management process

1. **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.
2. **Planning Processes** include devising and maintaining the workable scheme to ensure that the project addresses the organizations 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 relates to the project at that point.

3. **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.
4. **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.
5. **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.

2.2 Project Planning

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

Table 1: Defining Planning

References	**Definitions of planning**
(Pierce, 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, 1998)	"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

	environment. The project's requirements set the major milestones"

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).

Many authors and references have defined project planning in different ways emphasizing its different aspects. Summarizing those definitions given, this research defines project planning as:

The extent to which timetables, milestones, workforces, equipments, and budget are specified or estimating the effort, time, cost and staff resources needed to execute the project (Chatzoglou and Macaulay, 1996). It is the systematic arrangement of project resources in the best way to achieve project objective (Faniran et al., 2000). It is described by Naoum et al. (2004) "as one of the key tools that stakeholders use to ensure that projects are successful."

Faniran et al. (1998) describe it as the process of determining the appropriate strategies for the achievement of predefined project objectives. It can also be described as the process of defining project objectives, determining the framework, methods, strategies, tactics, targets and deadlines to achieve the objectives and communicating them to project stakeholders.

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

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 to the organization.

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).

2.2.3 Project Planning Techniques

One of the most important phases of project management is the "Planning phase", in which all work to be done is determined and defined. Planning is the most time consuming set of activities but valuable if done properly. Planning is the most time consuming set of activities but valuable if done properly. In this phase, many different techniques are used, such as tables, work breakdown structure (WBS), charts and networks. Tables are used to present the project activities and relevant information such as the duration, dependency, and cost, starting, ending, and required resources. It is used during the planning and controlling phase and can be used for implementation and monitoring.

WBS (Work Breakdown Structure) is an organizational chart that breaks the project into subsystem, components and tasks that can be readily accomplished. It is used for scheduling, pricing and resource planning. It simplifies summarizing and reporting progress and costs. Organization Breakdown Structure (OBS) is a model that organizes resources into groups for better management. It can be used to keep track of resources allocation and specific work assignments. There is a strong interdependency between OBS and WBS (Badiru and Pulat, 1995).

The gantt chart is one of the oldest and most useful techniques of planning. It is clear, simple and easy to use and understand. The interdependency between activities is not easily represented, especially in large projects, hence networks are used. Networks are a graphical display of the project activities showing their interdependency. Several network techniques have been introduced and used over the years. Mainly two types of networks can be used, depending on the type of project under consideration: deterministic and probabilistic methods. For representation, either activity–on-arrow (AOA) or activity-on-node (AON) are used to model the project. The probabilistic method is known as the program evaluation and review technique (PERT), while the deterministic method is called either the precedence diagramming method (PDM), which uses the AON method for representation, or the arrow diagramming method which uses AOA method. All of the methods use what is known the critical path method for determining the project duration, critical path(s), floats and other relevant data.

2.2.4 Mistakes in planning

During planning process mistakes might be done if they are not identified. It is helpful to sort out common mistakes done during planning. Ibrahim believed there are five common mistakes that people made in planning (Mohammad, 2014).

2.2.4.1 Unilateral planning

This mistake is made when the project manager plans a project for the group and turns it over to the group members to execute. The major reason that this is a mistake is no one individual can possibly think of everything in a project. Even a one person project can benefit from the thinking of other individuals (Hassan, 2011).

Mohammed (2014) dictates that no project can succeed when the team members are not committed to the plan, so the first rule of project planning is that the people who must do the work should help plan that part of the project. Not only will it is gained their commitment to the plan, but they will most likely coverall of the important issues that single person may have forgotten.

2.2.4.2 The Ready –Fire- Aim Mistake

When project is to be executed with need of urgency and funds are available, most of the executors are eagerly anticipated to get the job done. The reason that project plan is not done by the executor is that they are convinced project is completed by the time they could do the plan. Proper planning helps to deliver the project with the best possible duration (Mohammad, 2014).

2.2.4.3 Planning in Too Little Detail

One major cause of project failures is that approximate estimates become targets. If the ball is hit over the wall, it is out of the approximate. If it does not go over the wall, then it is in the approximate. So we use the term approximate estimate to mean one that is nearly correct. It is within acceptable boundaries or limits (Ibrahim, 2011).

2.2.4.4 Planning in Too Much Detail

Unfortunately, the reverse of too little detail also causes problems. Some people get carried away and micro plan. The basic principle is that you should never plan in more detail than you can actually control (Mohammad, 2014).

2.2.4.5 Failing to plan for risk

Risk planning is one of the fundamental considerations in planning and scheduling stages due to reasons that life is full of surprises so we surely got what we did not expect and life is again full of surprises which engage us with unforeseen events again and again. Risks and opportunities are common in construction sector that needs to be considering (Hassan, 2011).

2.2.5 Project Planning Methodologies

According to Marco (2011) there are two different planning methodologies in general: beginning-to-end planning and top down planning. Beginning-to-end planning breaks the job into steps or activities, starting with mobilization of the project and proceeds step by step through the project to completion. This method presumes some level of detail from the beginning or starts with limited detail and adds detail as planning proceeds.

Top-down planning, sometimes referred to as work breakdown structure, starts with the overall project, breaking it into its major pieces, and then breaking the major pieces into their component pieces. This process continues until the pieces are of sufficient detail to satisfy the complexity of the project. Both methods arrive at the same result: job activities that can be used to form a graphical logic diagram. It utilizes the following common types of WBS, namely, the Project WBS, Standard WBS and Contract WBS (Marco, 2011).

Due to the complex behaviors and high cost of execution, road construction should follow top down planning method because it precisely estimates resources needed and works to be done. The project WBS is an operational tool usually prepared by contractors to monitor and control the work. A contract WBS is agreed between owner and contractor. This is a decomposition of the scope of work into the main elements that will be used for progress measurement, control and payment of the contract price. It may include less detail than a project WBS.

2.2.6 Project Planning Steps

The following steps may be used as a guideline, or checklist to develop a project plan:

1. Define the scope of work, method statement, and sequence of work.
2. Generate the work breakdown structure (WBS) to produce a complete list of activities.
3. Develop the organization breakdown structure (OBS) and link it with work breakdown structure to identify responsibilities.
4. Determine the relationship between activities.
5. Estimate activities time duration, cost expenditure, and resource requirement.
6. Develop the project network.

2.2.7 Developing the work breakdown structure

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

PMI (2008) summarizes WBS is a deliverable-oriented decomposition of the project scope until a sufficient level of granularity enables easy definition of all information required to execute and manage detailed tasks.

The WBS identifies the tasks and activities that must be performed, but does not provide the order in which they must occur (Oberlender, 2000). In addition, once tasks have been identified, the time and resource requirements must be determined. A major problem in project planning is determining how long tasks will take and what it will cost to do them. Inaccurate estimates are leading causes of project failures, and missed cost targets are common causes of stress and recrimination in project management (Lewi, 2001). Accordingly, the most useful tool for accomplishing all of these tasks is the Work Breakdown Structure (WBS).

WBS is important to create before the schedule. A WBS does not contain the sequence of the work packages and this is done later on in the scheduling process. WBS shows the scope of the project in a graphic form allowing resource allocation as well as time and cost estimates. It is misleading to develop a schedule before all work packages have been identified and agreed on by the project team (Lewi, 2001).

Saleh (2005) states that prior to beginning the process of project scheduling it is mandatory to establish what is known as work break down structure (WBS) of the specific project. It is very strong tool to establish sound scheduling to the best working projects. The following are fundamental characteristics of WBS:

1. It identifies all work to be done in the project graphically, so that it can be reviewed by all stakeholders to ensure that nothing has been forgotten.
2. It provides a graphical representation of the scope (or magnitude) of the job. This is important because people are sometimes surprised at the cost estimates you give them, and this helps them see why the job is going to cost as much as you have said it would.
3. The WBS provides the basis on which resource assignments are made.
4. It allows you to estimate working times for each task.
5. Knowing the working times then allows us to calculate labor costs for all work, so that a labor budget for the project could be developed. The times also provide the basis for developing a schedule.
6. You can also identify material, capital equipment, and other costs associated with each activity (such as insurance costs) (Saleh, 2005).

2.2.8 Project Activities

The Building block (the smallest unit) of a WBS is the activity, which is a unique unit of the project that has a specified duration. An activity is defined as any function or decision in the project that: consumes time, resources, and cost (Elbeltagi et al., 2012). In the activity definition process the WBS work package deliverables are further broken down into smaller schedule activities that can be scheduled and monitored during the project duration. According to PMI (2004) in large multiyear projects with thousands of people working on the initial planning the top – level activities are usually created by a core group. Other team members until then further develop these levels and break them into lower – level activities.

The short – duration activities have a definite start and finish time, have costs assigned and spend resources (Pinto, 2007). A single person or a discipline within the organization is responsible for the work described in the activity. These activities are not a part of the actual

WBS structure but the structure offers a framework for defining these activities for the project (Haugan, 2002).

Activity lists from similar projects in the past or a standard list can be used as template for new projects. The template can also include further information on resource skills and the requisite hours of effort, reference to risks and possible other characteristic information needed in activity definition (PMI, 2004). Activities are classified to three types (Elbeltagi et al., 2012).

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

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

Management activity: activity that are related to management decisions such as approvals, vacation and others.

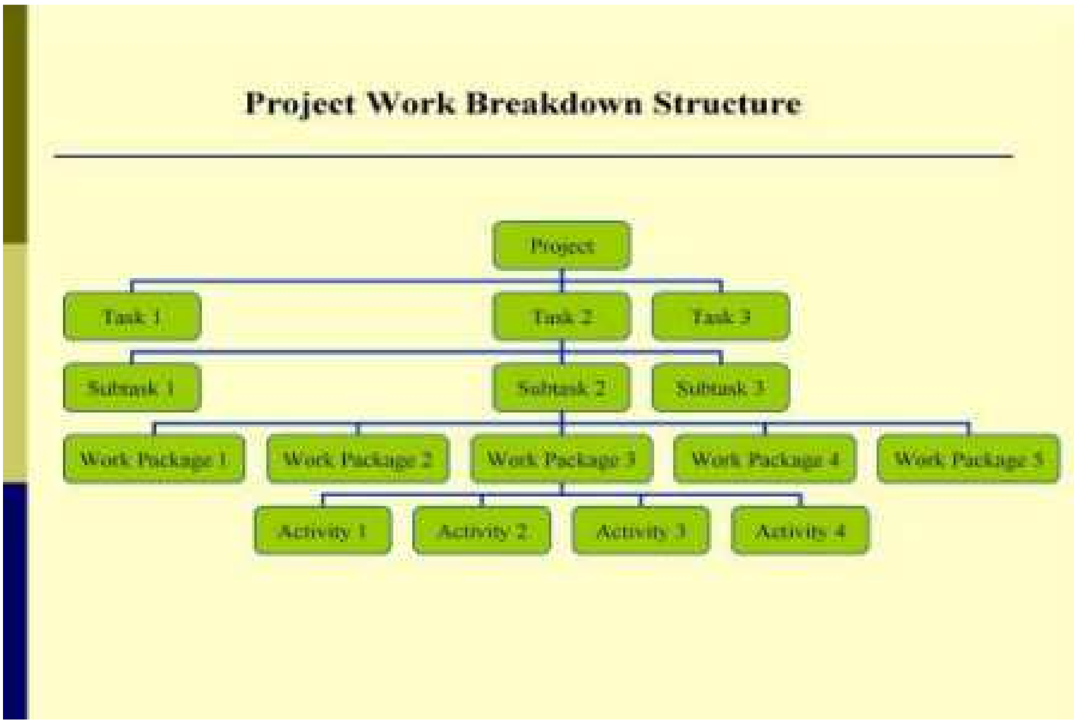

Figure 2: Typical Work Breakdown Structure

2.2.9 Activity Duration Estimation

The scheduling process starts with estimating how long each activity will take to complete and respond to the question "When will it be accomplished?" Activity duration signify the total elapsed time which means the time for the work plus any additional waiting time. Activity duration estimates are based on the assumption that they will be completed with normal working methods, during normal working hours and normal business days (Gido and Clements, 2003).

The ideal situation would be to have the person performing the job estimating the duration. This creates commitments to the work and avoids bias. However, in large multi year projects in particular involving hundreds of people, this would not be possible. Here each organization or subcontractor designates a responsible person to make the duration estimations for all the activities the organization or subcontractor is responsible for (Koivisto, 2010).

The activity duration estimate is always directly linked to the available resources in the project and estimation must always be based on the resources that will be expected to be used on the performance of the activity. This should be as realistic as possible, not too pessimistic or positive. People sometimes perform to expectation, hence if the duration estimation is too pessimistic and set to 10 days, the activity may take the whole 10 days even if it could have been done in a shorter time. The activity estimation should not include a lot of extra time for things that could go wrong (Gido and Clements, 2003).

Gido and Clements (2003) further states duration estimation is always somewhat uncertain. Past work and experience can be used as a guide and history to estimation. What worked in the past might not work right now due to for example different external factors. Duration estimations for some tasks will be spot on, some will be delayed for one reason or another and some activities are performed faster than expected. Over the duration of the whole project these delays and accelerations sometimes tend to cancel each other out. For example, one activity can take two weeks longer to complete but two activities preceding it took each one week less to complete than expected and this way cancelling each other out.

The entire project also requires a start and completion time. These times can also be dates, usually the completion times is a date that is stated in the contract. Creating the project schedule can begin from the completion date when the project is due to end and worked from there until the start date can be defined. Alternatively the project schedule creation can begin from the start date and be built from there until the completion date is defined. Often in practice both the completion date and the start date are defined in the contract and the project schedule is created either form the beginning or the end but is restrained by both the start and completion dates (Gido and Clements, 2003).

2.2.10 Activity Resource Estimation

Activity resource estimation is to define the appropriate resources whether it is material, equipment, facilities or personnel to perform the activities in a work package. The budget of the project often dictates how much resources are at disposal. Resource estimation is closely knitted with cost estimation and budgeting process (PMI, 2004).

Available resources for the use of a project are often limited. Several different activities may require the use of same resources at the same time span and therefore are competing for the use of these resources. If there are not enough resources for all the activities some of them may have to be rescheduled until the necessary resources are available (Gido and Clements, 2004).

2.2.11 Time Contingency

The main goals of any successful construction project management system(s) are to complete the project on time, within the planned budget, and with the required quality limits. The three goals are inter-related where each of them is affecting, and being affected by, the others. In order to meet the time deadline of a project, an accurate scheduling should be sought. Due to the unique nature of construction projects, time contingency and project uncertainty are essential for accurate scheduling, which should be flexible enough to accommodate changes without negatively affecting the overall duration of the project. It is essential to allocate a contingency value to both cost and time (Touran, 2003). Yet, there are situations where there could be delays in activities that result in a delay in the overall project duration. These delays will consequently have a negative impact on the quality and budget of the project (Dalia et al., 2009).

After the proper time estimation of projects is successfully completed it is very essential to consider some unexpected risk factors that affect normal working environment. Therefore, estimating time contingency is seen as a major factor for achieving a successful construction project time. Although several industrial sectors developed and used software for estimating time, and cost contingencies in order to minimize delays and over budget, yet limited efforts are reported in the literature in the area of predicting time contingency in the construction sector (Dalia et al., 2009).

It is an amount of money or time (or other resources) added to the base estimated amount to achieve a specific confidence level or allow for changes where experience shows obligation. It can also be defined as the budget that is set aside to cope with uncertainties during construction

Or the amount of money or time needed above the estimate to reduce the risk of overruns of project objectives to an acceptable level to the organization (PMI, 2000). Department of Treasury (United States 1993) identified two major categories of contingency for construction projects: (Dalia et al., 2009).

i. Design Contingency – it addresses the changes during the design process for factors, such as incomplete scope definition and inaccuracy of estimating methods and data (Clark & Lorenzo,1996).

ii. Construction Contingency– it addresses the changes during the construction process. Under a traditional procurement arrangement, the contract typically contains a variation clause(s) to allow for changes and provide a mechanism for determining and valuing variations (Staugas, 1995).

Most engineers, planners and agencies depend on their experience to estimate cost and time contingency. The contractor's contingency was represented as a fixed percentage of the contract value or as a percentage of total project cost or duration. Smith and Bohn (1999) estimated the contingency as 5-10% of the contract value. On the other hand Park and Pena-Mora (2004) estimated time contingency as 20% of the project duration (Dalia et al., 2009).

Documents from various contractors and consultants engaged in low volume rural road constructions engineer's used 5-10% of time and cost contingency to road constructions.

2.3 Project 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 (2010) explains that schedules are the result of asking "when" during planning. Scheduling is part of the Project Time Management process (Project Management Institute, Inc., 2013). The table 2 below shows four different definitions of scheduling.

Table 2: Defining scheduling

References	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 projects is determined as the result of the resources assigned to activities.”

The purpose of scheduling is to provide a “roadmap” that represents the delivery of the project scope over time as defined the project team (Project Management Institute, Inc., 2013). Kerzner (2013) 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).

2.3.1 Developing Schedule

According to Moneke (2012) without scheduling, managers cannot be certain that they are actually processing towards their goals. It could be said that scheduling put the plan on calendar basis. Therefore, a time schedule outlines the project work program; hence, it is a time table of work planned. Development of accurate work schedules is a challenge to managers due incompetence into consideration the factors that affect work scheduling. Construction project with effective work schedule is a recipe for progress monitoring and control as it depicts the activities to be executed on a time scale.

Based on the practice standard developed by the Project Management Institute (2007) in the process of developing schedule 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 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).

There are different tools to help scheduling process in construction; According to PMI the followings are the most common used in construction industry

1. Mathematical analysis method: it involves calculating theoretical early and late start finish dates for project activities without regarding any resources pool limitations.

❖ Critical Path Method (CPM): calculates a single deterministic early and late start and finish date for each activity based on a single duration estimate.

- ❖ Program Evaluation and Review Technique (PERT): uses a weighted average duration estimate to calculate the activity durations.
- ❖ Graphical Evaluation and Review Technique (GERT): allows the probabilistic treatment of both network logic and activity duration estimates (Saleh, 2005).

2. Duration compression is a special case of mathematical analysis that looks for ways to shorten the project schedule without changing the project scope.

- ❖ Crashing: in which cost and schedule tradeoffs are analyzed to determine how, if at all, to obtain the greatest amount of compression for least incremental cost.
- ❖ Fast tracking: doing activities in parallel that would normally be done in sequence.

1. Simulations: it involves multiple project durations with different sets of activity assumptions. Monte Carlo simulation analysis method is the common one.

Simulation methods are usually built to forecast uncertain outcomes and then to select the most attractive of feasible outcome scenarios from those calculated to inform decision making. Monte Carlo simulations are applied to project networks (CPM and PERT) to output results from large number of trials. The output is then analyzed statistically to predict the most likely durations and completion date for any project activity the probability of specific targets being achieved (Saleh, 2005).

Therefore in order to use simulations to the purpose of the duration estimating of activities it is mandatory to answer the following risk associated crucial questions

- ❖ What are the risks associated with achieving specific cost and time targets?
- ❖ What impact do changes in time of an activity have on the whole project?
- ❖ When can the project as whole be completed?
- ❖ Can it be delivered on time?

The general scheme of Monte Carlo simulation is as follows

- Generate random values for each of activity duration with in critical path of the project.
- Add each series of random values to arrive the total project durations.
- The expected duration of this project will be the average of these values.

The random value for each selected activity = Rand (0.1) * (period1-2) (1)

Determining the number of iterations

The Monte Carlo method provides an estimate of the expected value of a random variable and also predicts the estimation error.

The total error ὲ is given by:

$$ὲ=3ð/ (N) \quad \text{(Equation 2)}$$

Where, ð is standard deviation of the random variable, N is the number of iteration.

The probability of the iteration's error should be as minimum s possible to 0.2%.

Most road construction projects follow common theories to achieve workable plan and schedule. At the beginning of the project execution project management team develops WBS. After achieving the first step network diagram will be prepared. This will help to achieve the project critical path. Then the resource allocation to the critical path will be done based on the above project analysis. Finally by converting the above findings to bar charts the project management team will develop spending and earned value baselines to project resource flow forecasting. The figure below illustrates the above work flows of projects (David, 2001).

2.3.2 Resource Allocations and Management

In planning and scheduling of a construction projects the major factors that affect are resource allocation and management. These should carefully analyze in order to achieve successful delivery of the project goals. The word resource is used in many ways. In construction management the term is used to indicate three categories: human, materials and equipment (Saleh, 2005).

According to Saleh (2005) human resource can be further classified into two as direct and indirect. Direct human resources are hired to execute a specific task or activity (carpentry, mason, iron workers electricians and foremen). Indirect human resources are hired and tied to the projects but not connected to the specific tasks or activities (superintendents, engineers, project managers and secretaries).

Materials resources are direct inputs to the productions of the project deliverables which are standardized in the contracts. Its management is defined as the planning and controlling of all necessary efforts to ensure that the correct quality and quantity of materials and equipment are appropriately specified in a timely manner, are obtained at a reasonable cost, and available when needed (Lewis, 2011).

There three important objectives of materials management are as follows (Saleh, 2005).

1. Ensure that materials meet the specifications and are on hand when and where required.
2. Obtain the best value for purchased materials.
3. Provide efficient, low cost transport, security and storage of materials at constructions sites.

Equipment resources: are tools that are used continuously in production process of the project deliverables. Equipment resources are divided into two.

1. Movable construction equipments: these type of equipments are used for the construction process but is not permanently installed. Example bulldozers, backhoes, cranes, forklifts and some other.
2. Immovable equipments: this type of equipment and materials stays permanently in the projects after completion. Examples of installed equipment are heat pumps, emergency generators, equipment installed in kitchens and any other

Hence, based on the resource need to works to be executed, the planning and scheduling should be done properly with a very precise skill. That means resource assignment plays the most significant role in the scheduling of works, keeping in mind well thought is well done. In general resource allocation is the major consideration to planning and scheduling of road constructions (Saleh, 2005).

2.4 Planning Versus Scheduling

Mohammad (2014) declares that understanding the distinction between planning and scheduling can best be approached by first defining management and briefly reviewing the functions of management, which includes planning - paramount of the functions. Most authorities define management as the establishment and maintenance of an internal environment in which people working together in groups can perform effectively and efficiently to attain group objectives. In addition to operational functions such as marketing, manufacturing, finance, engineering, construction, or some other endeavor, managers perform several functions which are common to all managers. These managerial functions are planning, organizing, staffing, directing, and controlling. These functions frequently overlap. For example, as group members plan to attain their objectives, they must often consider the adequacy of the organizational structure, staffing availability, or some other function of management (Saleh, 2005).

Planning establishes what, how, where and in what order work will be performed, while scheduling sets forth who and when. Construction planning is the development of a feasible operational design for completing the work. The process involves the selection of work sequence and methods, and provides information for the scheduling process. 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).

2.4.1 Planned Schedules and its Impacts

According to Abbas (2006), late completion of works as compared to the planned schedule or contract schedule is what is known as delay. Delay occurs when the progress of a contract falls behind its scheduled program. It may be caused by any party to the contract and may be a direct result of one or more circumstances. A contract delay has adverse effects on both the owner and contractor (either in the form of lost revenues or extra expenses) and it often raises the contentious issue of delay responsibility, which may result in conflicts that frequently reach the courts. A cost overrun occurs when the final cost of the project exceeds the original estimates (Constructability, 2002).

There is a relationship between schedule, the scope of work and project conditions. Changes to any one or more of the three can affect the cost of the project and time of completion. It has been argued that it is necessary to create awareness of causes of project schedule delays, their frequency, and the extent, to which they adversely affect project delivery (Constructability, 2002).

Planning and scheduling have direct relationships with delays which eventually cause cost and time overruns of the project. Therefore the remedial to possible cost and time overruns should be thought while one is preparing plan and schedule to a project (Constructability, 2002).

Furthermore Assaf et al. (1995) in a review of the literature, extracted and reported that a survey data consisting of 39 top root causes of schedule impacts for schedule delay have been sorted out as a major civil works construction worldwide and in his slightly modified version classified as: materials, manpower, equipment, financing, environment, changes, government action, contractual relationships and scheduling and controlling techniques. Accordingly, table 3 ranked top 39 root causes of schedule impacts as per Assaf et al. (1995) determination the relevant causes of delay grouped under this heading was listed more appropriately as follows.

Table 3: Ranked top 39 root causes of schedule impacts as per (Assaf et al., 1995).

Rank	Major causes for schedule delay
1	Underestimation of cost of projects
2	Delay in honoring payment certificates
3	Underestimation of complexity of projects

4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor
5	Difficulty in accessing Bank credit
6	Poor supervision
7	Poor Professional Management
8	Fluctuation of prices
9	Underestimation of time for completion by contractors
10	Lack of effective managing and controlling subcontractor
11	Extreme quantity changes to meet field condition
12	Construction methods
13	Delay in instructions from consultants
14	Shortage of unskilled labor
15	Poor management of the project changes
16	Late deliveries of materials
17	Poor management of project site
18	Lack of Program of Works
19	Delay by sub-contractors
20	Poor design
21	Breakdown of construction equipments
22	Client initiated variations
23	Obtaining permit from municipality
24	Insufficient communication between parties
25	Public holidays
26	Shortage of skilled labor
27	Accidents during construction
28	Risk response planning prepared
29	Unskilled equipment operators
30	Discrepancy between design specification and standards
31	Dispute among contracting parties
32	Conflict in work schedule of contractor
33	The project completed on the original (planned) schedule

34	The project completed with the planned budget
35	Unfavorable Site conditions
36	Foundation conditions encountered on site
37	Bad weather conditions
38	Mistakes with soil investigations
39	Delay in claim approval

Schedule impacts are incidents happened in projects that eventually causes counter effects to the base line schedule (Frank et al., 2007).

- Types of Schedule Impacts
  - ✓ Delays

A delay is an event that prevents the contractors from completing the work within the contractually specified performance period Wickwire et al. (2003) a slowing down of the work without stopping it entirely, triggered by something other than a formal directive from the owner to stop work (Frank et al., 2007).

- ✓ Classifying Schedule Delays

Once recognized that an event has occurred in the as-built completion of a project that differs from the established schedule of record, which potentially has an impact on the schedule and is attributable to a party, the next step is to classify the delay, so that a schedule impact technique can be applied. Delays are classified into one of the following three categories: excusable, non-excusable and concurrent (Mohammad, 2014).

- ✓ Disruptions

A disruption can be defined as an impact that alters the contractor's planned work sequence or flow of work expected at the time of bidding, which results in increased difficulty, cost, and/or time (Bramble et al., 1990). As opposed to delays, damages associated with disruption are likely to be increased labor costs due to inefficiency, the activation/deactivation of increased manpower, and additional equipment costs (Mohammad, 2014)

- ✓ Change

Another major type of potential schedule impact involves changes. When a contractor takes on any type of work that deviates from the original contract, or from the scope of work or plan of action reasonably anticipated under the contract that results in an increase in performance time, the contractor may seek an adjustment (Frank et al., 2007).

- ✓ Suspensions

A suspension of work is a written directive by the owner to stop all work on the project, either because the contractor has failed to perform in accordance with contract documents, or at the owner's convenience. Work will not continue until the owner has raised the suspension of work. A cost and time adjustment shall be made for any suspension of work ordered by the owner, as long as the contractor was not responsible for the suspension of work. As opposed to a pure delay, when an owner issues a suspension of work, the contractor is also entitled to equitable adjustment for profit (Mohammad, 2004).

- ✓ Termination

Termination is a permanent stoppage of work of all or a portion of the contract and the contract is terminated. For a party to possess the right for termination, a termination clause must be specifically included in the contract. Most contracts allow the owner the right to terminate the contract, while some contracts grant the contractor this right (Mohammad, 2004).

2.5 Risk Management Plan and Identification

2.5.1 Definitions and classifications of Risks

Webster's dictionary defines risks as "the possibility of loss, injury, disadvantages, or destruction". Jaafari (2006) defined risks as the exposure to loss / gain, or the probability of occurrence of loss / gain multiplied by its respective magnitude. He further elucidate that events are said to be certain if the probability of their occurrences is 100% or totally uncertain if the probability of occurrence is 0%. In between these extremes the uncertainty varies quite widely.

The Association of Project Management (2004) argues that risks arise when uncertainty has the potential to affect objectives, and defined the term as "Any uncertain event or set of circumstances that, should it occur, would like an effect on one or more objectives". There are uncertainties that can not affect objectives, and which are therefore not risks. It is this relationship between risk, uncertainty and objectives that makes risk management such an important contributor to both project success and business benefits (Hillson, 2006). Oxford dictionary define 'Uncertainty' as the state of being uncertain and, a thing that is uncertain or causes one to be uncertain.

The definition of a risk given by Hillson (2006) as "an uncertainty which if it occurs would affect one or more objectives" also allows inclusion of opportunities as well as threats within the risk process, since an opportunity is simply an uncertainty with a positive effect on an objective. Thus, uncertainty is always present, even when information is perceived as complete (Smallman, 2000).

Risk can also be defined as the product of the probability and the eventual impact of a hazard (Smallman, 2000). Hazards can be defined as threats to people and the things that they value. In other words, risks are the product of the probability or likelihood of an undesired event and the consequences of that event. In the context of conventional risk management, uncertain events are usually considered as hazards, with the potential to have negative effects. However, uncertain events can also give attractive opportunities with positive effects. Including these positive opportunities is a rather modern extension of the common understanding of risk and risk management (Staveren, 2006).

Risk classification is a significant step in the risk management process, as it attempts to structure the diverse risks affecting a construction project. According to Smith et al. (2006) all project risks can be divided into three main categories: known risks, known unknowns and unknown unknowns. The difference between the categories is the decreasing ability to predict or foresee the risks. A known is an item or situation containing no uncertainty. Unknowns are things we know but we do not know how they will affect us. A known – unknown is an identifiable uncertainty. An unknown – unknown is simply an item or situation whose existence has yet to be encountered or imaged. Taking into account the probability of the occurrence and the consequence for project objectives, those events that have high probability and high impact are subject to risks management.

The PMI (2000) classify risks as internal or external. Internal risks are those that arise within the scope and control of the project team. Most internal risks can be referenced to a specific project document such as a cost estimate or a schedule. Internal risks usually refer to items that are inherently variable external risks are items that are generally imposed on the project from establishments beyond the limits of the project. Interactions with regulators are typical external risks. Funding constraints and restrictions are other common external risks. External risks tend to refer to items that are inherently unpredictable but generally foreseeable (Caltrans, 2007).

The risks for infrastructure projects, according to Yoyjie (2001) have a wide range of sources and can be classified into the following broad categories:

a. Technical, quality or performance risks such as employment of inexperienced designers, changes to the technology used or to industry standards during the project.
b. Organizational risks such as cost, time and scope objectives that are internationally inconsistent, lack of prioritization of projects, inadequacy or interruption of funding, and resource conflicts with other projects in the organization.
c. External risks such as shifting legal or regulatory environment including institutional changes, poor geological conditions and weather, force majeure risks such as earthquake and floods.
d. Project management risks such as poor allocation of time and resources, inadequate quality of the project plan, poor use of project management disciplines.

In addition to the above, Caltrans (2007) includes design, construction, environment, and right of way risks in its classifications. Hassan (2005) also includes planning and selection, financial, contractual, site, resource, technology, communications risks in its generic checklist for transportation projects.

2.5.2 Risk management planning

Possibly risks that are involved in construction environment include external risks such as weather risks, and internal risks such as construction design risk. The typical losses of these risks are generally relevant to project delay, project cost overrun, and poor quality of work (papageorge, 1988). Thus, there is a considerable need to incorporate the risk management concepts into infrastructure construction practice in order to mitigate or eliminate risk consequence and enhance the performance of projects (Tsegaye, 2009). Risk management is recognized as an essential tool to tackle the inevitable uncertainty associated with projects at all levels. Moreover, significant improvement to construction project management performance may be achieved by adopting the process of risk management (Hillson, 2006).

Shehu and Sommerville (2006) defined risk management as a process of controlling the level of risk and to mitigate its effects. Nummedal et al. (1996) define risk management as a systematic approach for identifying, evaluating and responding to risks encountered in a project. Kerzner (2003) defines same as the act or practice of identifying, analyzing, and evaluating risk. Angelo and Day (2001) see risk management as an important part of any project that limits delays, budget overruns, and claims between parties.

The overall objective of the risk management process is to maximize the opportunities and minimize the consequences of a risk event (Shehu and Sommerville, 2006). Dealing with risk involves planning for risk, assessing risk issues, developing risk handling strategies, and monitoring risks to determine how they have changed. PMI (2000) proposed six major processes for risk management these are risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control. According to PMI (2004) the typical risk management process has the following steps, which are undertaken iteratively throughout the project life cycle.

2.5.3 Risk management planning

In this phase, the scope and objectives of the risk process are defined, the techniques and tools to be used, the thresholds of acceptable risk to various stakeholders are stated, roles and responsibilities are detailed. The planning process should be completed early during project planning phase is a risk management plan, which identifies and establishes the activities of risk management for the project.

Each risk plan should be documented, but the level of detail will vary with the unique attributes of each project. Large projects or projects with high levels of uncertainty will benefit from detailed and formal management plans that record all aspects of risks identification, risk analysis, risk response planning, and risk monitoring and control. Projects that are smaller or contain minimal uncertainties may require only the documentation of a red flag item list that can be updated at critical milestones throughout the project development and construction.

2.5.4 Risk identification

Risk identification is the process of systematically and continuously identifying, categorizing, and assessing the initial significance of risks associated with a construction project (Al-Bahar and Crandall, 1990). Risk identification involves identifying, categorizing and recording potential risks, together with information on their cause(s) and possible effect(s), which might affect the project objectives (Shehu and Sommerville, 2006). It is the first step of the risk management process. It is aimed at determining that means those that may affect the project.

Ward and Chapman (1995) suggest that it is often said that the real risks in any project are the ones that the project team fails to identify. Jenkins (1998) explains that risk identification at the operational level is very effective and can help with on-the-spot improvements and day-to-day management. Tasmania (2002) also suggests that before risks can be properly managed, they need to be identified. One useful way of doing this is defining categories under which risks might be identified: for example, in terms of risks external to the project and those that are internal.

Risk identification is ideally carried out during the appraisal of the project, although it can be carried out at any stage of the project (Smith, 1999). It should also be performed on a regular basis throughout the project (Duncan, 1996). The inputs of risk identification process include the project objective, risk management scope and plan and historical related the project. The project related document, project participants and events occurring in the scope of project are some sources of information used to identify risk (Aleshin, 2001). It is desirable to identify risk based on the determined objectives, which are generally related to time, cost and quality aspects.

The identification process will vary, depending on the nature of the project and the risk management skills of the team members, but most identification processes begin with an examination of issues and concerns created by the project development team. These issues and concerns can be derived from an examination of the project description, work breakdown structure, cost estimate, design and construction schedule, procurement plan, or general risk checklist. This is practical way of addressing the large and diverse numbers of potential risks that often occur on highway design and construction projects. Risks are those events that team members determine would adversely affect the project (Caltrans, 2007).

After the risks are identified, they should be categorized into groups of like risks. There are several approaches to categorizing projects risks and risk source (Jaafari, 2001). In general, the sources of risk in construction projects may be divided into three groups:

a) Internal or controllable risks. For instance, design, construction, management and relationships)

b) External or uncontrollable risks. For example, finance, economic, political, legal and environmental.
c) Force majeure risks.

2.5.5 Risk in Construction Projects

According to Turner (1992) a project is an endeavor in which human, material and financial resources are organized in a novel way; to undertake a unique scope of woke of given specification, within constraints of costs and time, so as to achieve unitary, beneficial change, through the delivery of quantified and qualitative objectives. The definition suggests three key targets of the project that means time, costs and quality, which are to be in focus when undertaking the project. It also highlights the importance of efficient organization of available resources in order to achieve a good final result.

Flanagan and Norman (1993) emphasize two aspects of any construction project: the process that means project phases, and the organization, that means project actors. From the process perspective, any construction project comprises a number of sequential phases. Different authors suggest a different number of project phases (Chapman and Ward 2003, Flanagan and Norman 1993, Harris et al. 2006, PMI 2000, Smith et al. 2006). The simplest approach identifies two main phases – project development and project implementation. These two can be further detailed and developed into a larger number of phases that means feasibility, design, procurement, construction, commissioning, and operation.

Another important aspect of the construction process is project organization. Different participants are usually involved in a construction project. These are clients or owners, consultants, contractors, sub-contractors, manufacturers and suppliers, local authorities, funding organizations and others. The more participants that are involved, the more complex the task of project management becomes. In this research three main groups of construction industry actors are in focus; clients, contractors and consultants.

According to PBL (1987), a client is a party that carries out or assigns others to carry out construction. There are two main groups of construction clients: public and private. Privately owned companies undertake the projects to make a profit. The public sector includes the central government and local authorities and undertakes the projects to provide a public service and/or benefit to the citizens. A contractor is an organization that provides a service for the client, that means executes the construction works. The contractor organizations have different complexities and provide different ranges of services. The role of consultants is to assist clients and contractors and provide engineering services.

The environment within which decision-making takes place can be divided into three parts: certainty, risk and uncertainty (Flanagan and Norman, 1993). According to Flanagan and Norman, certainty exists only when one can specify exactly what will happen during the period of time covered by the decision. This, they concluded, of course does not happen very often in the construction industry. Uncertainty, in contrast to risk, might be defined as a situation in which there are no historic data or previous history relating to the situation being considered by the decision-maker; in other words, where the situation is ‘one of a kind’. Bennett and Ormerod (1984) argue that uncertainty is endemic in construction and needs to be explicitly recognized by construction managers.

Due to their dynamic nature, projects change continuously. Thus a great amount of risk and uncertainty is involved in construction activities (Chapman and Ward, 2004). This uncertainty may have a significant impact on the project objectives and, therefore, has to be properly managed by the project actors during the whole project life cycle. Many time and cost overruns, according to Perry and Hayes (1985) are attributable to either unforeseen or foreseen events for which uncertainty was not appropriately accommodated. Thompson (1992) also identified an effect of risk on construction projects as failure to achieve the required quality and operational requirements. This is in addition to cost and time overruns which other authors also identified.

Perry and Hayes (1985) have identified risk sources in construction at the pre-contract stage to include design risk, competitive tendering risk, tender evaluation risk and estimating risk among others. In addition, they also identified risk factors at the post-contract stage to include physical risk, site condition, inclement weather, legal risk, environmental risk, logistic risk, political risk, financial risk and contractual risk among others.

Hassun’s (2005) and Caltrans’ (2007) categorization of the sources of risks include planning and selection risks such as inadequate project planning and inefficient project delivery system; financial risks such as funding risks; design risks; construction risks; external risks such as price escalation; environmental risks such as incomplete environmental analysis; contractual risks such as ambiguities in contract formation process; project management risks such as lack of coordination/ communication; and force majeure risks such as severe weather.

Abdou (1996) classified construction risks into three groups that means that construction finance, construction time and construction design, and addressed these risks in detail in light of the different contractual relationships existing among the functional entities involved in the design, development and construction of a project. Nevertheless one major area where significant improvements could be made is in the elimination and reduction of risk at the design stage (Waldron, 2005).

2.5.6 Risk classification

Risk classification is a significant step in the risk management process, as it attempts to structure the diverse risks affecting a construction project. In order to manage risks effectively, many approaches have been suggested in the literature for classifying risks. Perry and Hayes (1985) presented a list of factors extracted from several sources which were divided in terms of risks retainable by contractors, consultants and clients. Combining the holistic approach of general systems theory with the discipline of a work breakdown structure as a framework, Chapman (2001) grouped risks into four subsets: environment, industry, client and project. Of the 58 identified risks associated with Sino-Foreign construction joint ventures, Shen (2001) categorized them into six groups in accordance with the nature of the risks, that means financial, legal, management, market, policy and political, as well as technical risks (Tsegaye, 2009).

2.6 Constructability

According to Russell et al. (1993) highway construction projects are characterized by among others changes of design, cost overruns, and time delays. Constructability is seen as one of the best solutions to these problems where it has demonstrated the potential to minimize the number and magnitude of change, disputes, cost overruns, and delays during construction (Hassun, 2005). For transportation facilities and other engineered structures, constructability involves the incorporation of knowledge is demonstrated in the facility's design. The need for an early start in incorporating construction knowledge is demonstrated by the fact that opportunities to influence cost and quality diminish with the passage of time during the life of the project (Construction Industry Institute, 1986).

Folk (2005) characterized constructability problems as a project risk affecting the expectation interests of the contracting parties. On the other hand, when constructability problems are rooted in some aspect of the project's design, and those problems are not discovered until after construction commences, then costs and delays can be expected to occur. When the contracting party's expectations are frustrated, the groundwork has been laid for future claims and disputes with the design team.

Further, Folk (2005) emphasized that constructability problems arise from faulty drawings, incomplete specifications, and adversarial relationships between owners, designers and contractors. These problems result in poor quality, or even litigation. Poor quality in design or construction can require rework. Rework "the unnecessary effort of redoing a process or activity that was incorrectly implemented the first time" typically accounts for 3-23% of contract values (Love et al., 2004). This is a significant cost and no one wants to assume the cost or the responsibility often leading a project into litigation. Strategies can be implemented to avoid these problems. One of the most effective strategies used by design and construction firms is the implementation of constructability programs. Constructability practices not only ease the construction, but they can shorten the schedule and reduce the budget as well (Kriag, 2006). A sound constructability program helps the designer and contactor work together in each stage of a project to avoid confusion or misunderstanding (Folk, 2005).

2.6.1 Definition of constructability

It is the proponent in the United Kingdom who originated the concept of "buildability" and defined it as "the extent to which the design of a building facilitates ease of construction, subject to the overall requirements for the completed building" (CIRIA, 1983). Ferguson (1989) defines buildability as "The ability to construct a building efficiently, economically and to agreed quality levels from its constituents materials, components and sub-assemblies".

"Buildability" stresses on integration of design and construction to achieve the project goal by enriching the knowledge of designers in construction operations and involving construction expertise in the design process (Hassun, 2005). The Construction Industry Institute (CII) in the United States proposed a similar concept to "buildability" and labeled it as "constructability". Constructability is defined as "the optimum use of construction knowledge and experience in planning, design, procurement and field operations to achieve overall project objectives" (CII, 1987). Constructability is also defined as a measure of the ease or experience with which a facility can be constructed (Hugo et al., 1990).

Constructability is often portrayed as integrating construction knowledge, resources, technology and experience into the engineering and design of a project (Anderson et al., 1995). Eldin (1988) states that "Constructability is the integration of construction knowledge into all project phases as an effective means for reducing the project costs and the time required for its completion". Further, constructability may be described as "the ability of project conditions to enable the optimal utilization of construction resources" (O'Connor et al., 1986). Fisher (1997) defined constructability as the extent to which the design facilities ease of construction, subjected to the requirements of construction methods.

Although all definitions are quite similar, the definition given by the Construction Industry Institute (CII, 1987) which says "The optimum use of construction knowledge and experience in planning, design, procurement and field operations to achieve overall project objectives" (CII, 1987) is adopted in this studies.

2.6.2 Historical Background

Experienced construction personnel have provided input into construction to enhance constructability for many years (Edward, 1994). Legend has it that Hamid, one of the superintendents building the Great Pyramid, complained to the pharaoh that the blocks coming in were designed so large that installation into their final positions was too difficult, required too many men, led to unsafe work practices, and took too long. He also complained about the cutting of the blocks at the quarry. The blocks were not always true shapes, the surfaces were too rough, and required much rework at the site to make them fit. The blocks also arrived at the site too late. The pharaoh, as a result of these complaints, insisted on an aggressive constructability program. He brought in Hamid to sit down with the designers and the block supplier. The designers were forced to consider rigging and manpower constraints, and accordingly reduced the size of the blocks. The quarry had to improve their quality control and deliver on time. Further, the ensuring pyramids were installed 13.50% faster at an overall savings of 23.80%. These improvements lasted until the lessons learned were lost and design and construction went back to their old ways (ASCE, 1991).

Constructability was recognized in the mid seventies when it first appeared in "Building and Technology Bulletin", and "Constructability-It Works" (Proctor and Gamble, 1976). Then about two years later, an NSF-ASCE (National Science Foundation – American Society of Civil Engineers) study identified constructability, among other topics, as a specific research need for structural engineering (ASCE, 1979). In 1983, the Business Roundtable published a series of studies, collectively called the Construction Industry Cost Effectiveness project (CICE), to promote quality, efficiency, productivity, and cost effectiveness in the construction industry. This group of construction users intended the studies to motivate the construction industry to improve its work methods and costs effectiveness. In its summary report, "More Construction for the Money" the Business Roundtable defined a problem and proposed actions to address it (Business Roundtable, 1983). The problem defined was that there is a lack of knowledge by owners with respect to opportunities for costs reductions and shortened schedules by integrating advanced construction methods and material into the planning, design, and engineering phases of the project.

The actions proposed were:

- Owners, individually, need to write contracts that give contractors an incentive to mesh engineering and construction expertise with the process called "Constructability", which can often save 10-20 times the costs it adds to a project.
- Owners, jointly, need to make concerted effort to help overcome the shortage of experts in "constructability" by helping to develop training materials and encouraging universities and colleges to add facets of construction management to their undergraduate curricula.
- The academia need to add "constructability" skills to undergraduate curricula in construction management.

The Construction Industry Institute (CII) grew out of Business round table's effort. Based at the University of Texas, CII also includes many owner and construction companies as well as public and academic institutions. For many years, CII led the way in constructability research and guidelines for implementing constructability. In addition, local and regional groups of construction users have been formed, resulting in increased awareness of the benefits to be gained through improved constructability programs (Pocock et al., 2006). By 1991 this body of work had grown to the point that the construction management committee of the ASCE authored its “constructability and constructability programs: white paper”. This paper recognized the value of constructability and summarized the best practices for implementing constructability programs as “The integration of experienced construction personnel into the earliest stages of project planning as full-fledged members of the project team will greatly improve the chances of achieving a better quality project, completed in safe manner, on schedule, for the least cost” (ASCE, 1991). This endorsement by ASCE provided further emphasis and credibility to constructability, as demonstrated by the concerned industry effort and academic research since then.

2.6.3 Constructability Concepts in Highway Projects

Hassun (2005) argue that construction problems encountered in the field can be costly and many construction problems can be avoided with attention and consideration of the constriction process during the design phase. He further elaborates that changes orders, budget overruns, scope growth, and even litigation, in some instances, can be avoid by incorporating construction knowledge in the design process. Constructability requires a systematic process to create construction-oriented designs meeting the owners’ project objectives in the areas of safety, cost, schedule, and maintainability. The goal of constructability is not to cheapen the design, change the project objectives, or improve upon or take over designer’s responsibilities. The goal of constructability is to obtain broader knowledge earlier into the decision processes used in design.

Concept is a significant, distinct and executable objective for enhancing constructability (Nima, 2001). Concepts are not specific or unique with respect to project type or organization. It presents a desperate need and requirement to improve the construction project constructability (O’Connor et al., 1987). The term and concept of constructability has its origin with a series of studies conducted by the Construction Industry Institute (CII) in Austin, Texas. These studies examined numerous projects around the country and found that the design decision process lacked the necessary construction knowledge and experience to realize the full potential of constructability benefits without sacrificing the integrity of other design considerations.

According to Gibson et al. (1996) the constructability concepts was born out of the realization that designers and contractors see the same project from different perspectives, and that optimizing the project requires that the knowledge and experience of both parties be applied to the project planning and design processes. They suggest that construction expertise would ensure the following;

i. Reduce cost
ii. Shorter Schedules
iii. Improved quality
iv. Enhances Safety
v. Better control of risk
vi. Fewer changes orders and
vii. Fewer claims

2.7 Rescheduling and Scheduling Updating

Rescheduling is common in project management, especially in the manufacturing industry (Mohammad, 2014). Generally unexpected events adversely affect projects when necessary treatments are not adopted. Therefore, the dominant issues in rescheduling are how to adapt to a changing environment and reschedule incomplete work and resources.

A rescheduling problem consists of general scheduling problems that develop after a schedule is updated. Project information modifications and schedule updating may generate additional constraints due to the altered environment. Based on schedule updating results, rescheduling must rearrange incomplete work and resources while generating a practical schedule that meets the project goal. Compared to the manufacturing industry, construction projects have more unpredictable factors, such as environmental and productivity issues, that make maintaining schedules difficult.

Although construction schedules are regularly updated and controlled during construction, few studies have investigated the effects of rescheduling issues on the rescheduling process. Therefore, applying manufacturing rescheduling concepts to the construction field is worthy of investigation.

- ✓ Construction rescheduling

It classifies rescheduling problems and can be used as a reference for construction rescheduling problems. For classification details, refer to Vieira et al. The terms used in this study are quoted from Vieira et al. as follows.

Rescheduling is the process of updating an existing production schedule in response to disruptions or other changes. This includes arrival of new jobs, machine failures, and machine repairs.

- o Rescheduling environment identifies the set of jobs that the schedule should include.

- A rescheduling strategy describes whether or not production schedules are generated.
- A rescheduling policy specifies when and how rescheduling is done. The policy specifies the events that trigger rescheduling.
- Rescheduling methods generate and update production schedules.
- Complete regeneration reschedules the entire set of operations (jobs) not processed before the rescheduling point, including those not affected by the disruption.
- Partial rescheduling reschedules only the operations affected directly or indirectly by the disruption.

✓ Construction Schedule updating

Identifying project changes due to actual progress is the first task in schedule updating. Environmental changes may require information modifications, which are represented as parameter revisions. Additional constraints may be required. A schedule can be updated for the following four activity types.

i. Finished activity Scheduling updating removes finished activities from the rescheduling activity list and retains information regarding actual progress and expenses to determine the impact of project changes on the initial schedule. The information for finished activities must be corrected. If any inconsistency is discovered, the causes, which may be due to environmental factors or an incorrect productivity assessment, must be investigated.

ii. In-progress activity in-progress activity may be the primary reason for requiring rescheduling. Generally, in-progress activities can be schedule updated by splitting activities. Splitting activity means when a single task activity is changed into various activities in order to create convenience to the whole work schedule. Non splitting activities are when tasks in activity are partially actualized then changing into various activities would be inconvenient.

iii. Changed orders and other risks can add new activities to a construction project. Although such additions sometimes significantly influence the initial schedule, these new activities reflect real situations and resource requirements. Parameters also define information about these new activities.

2.8 Ethiopian Context Planning and Scheduling

2.8.1 Ethiopia, general information and brief history of roads

Ethiopia is situated in the Horn of Africa, bordered by Eritrea to the North, Sudan to the West, Kenya to the South, Somalia to the East and Djibouti to the Northeast. With archaeological finds dating back more than 3 million years, it is a place of ancient culture and currently known to be Land of Origin. Among its important sites are Lalibela with its rock-cut Christian churches from the 12^{th} - 13^{th} centuries. Aksum is the ruins of an ancient city with obelisks, tombs, castles and Our Lady Mary of Zion church. It covers an area of about 1,104,300 square km and the topography of the country is rugged ranging with an altitude from 125m below sea level to 4,620m above sea level. According to United Nations latest estimates (2017) the population of Ethiopia in year 2017 was reached 104,213,827. The capital city, Addis Ababa, had a population of 3.60 million and other urban centers include Dire Dawa, Mekele, Awasa, Bahir Dar, Desse, Harer, Jimma, Nazreth and Gondar (Ethiopia Population (2017)).

Figure 3: Map of Ethiopia

2.8.2 Overview of road sector policies in Ethiopia

There is a vision to transform Ethiopia from a least developed country into a middle-income country by 2028, by sustaining the two digits economic growth registered in the recent years (2003–2010/11). Achieving this Government vision requires sustainable growth of the Ethiopian economy, which in turn depends on the development of infrastructure in general and expansion and improvement of the road network of the country in particular (MOFED, 2006).

The Ethiopian economy is highly dependent on agriculture, which accounts for around 50 percent of the gross domestic product (GDP). An estimated 85 percent of the population is directly or indirectly depending on the agricultural sector. More than 90 percent of export earning is generated from the agricultural sector. Second to the agricultural sector, services account for more than one-third of economic activity. The composition of service earnings has shifted only slowly in response to economic liberalization, with recent slight growth in the construction, transport, and tourism sectors. Contribution of the construction industry to GDP at constant factor cost is about 6 percent for 2006/07 (Central Statistical Authority, 2008). On the other hand, industry accounts for almost 12 percent of economic activity where most of the manufacturing firms are concentrated in Addis Ababa. However, these days it is also common to see manufacturing industries being established in some other cities and towns. Industrialization of towns outside of Addis Ababa obviously requires more road infrastructure and efficient transportation operation (Tefera, 2013).

The road network of the country over the past five decades, compared to the year 1951, the total road network has increased with factor seven to reach the level in 2009. In 1951 the total stock of road network was only 6400 km; in 2009 that is 46,812 km (ERA, 2009). The rise in the length of road is due to the emphasis given to the sector. In particular, the current government the Federal Democratic Republic of Ethiopia, has placed increased emphasis on improving the quality and size of the road infrastructure. To address the constraints in the road sector related to restricted road network coverage and low standards the Government originally formulated a 10-year Road Sector Development Program in 1997 (RSDP 1997-2007).

The first phase of the RSDP (1997-2002) focused on the restoration of the road network to an acceptable condition. Specifically, the program focused on (1) rehabilitation of main roads; (2) upgrading of main roads; (3) construction of new roads; and (4) regular maintenance on the network. Side by side, the program also considered major policy and institutional reforms.

The program was launched with a very significant donor support to create adequate capacity in the road sector and to facilitate the economic recovery process through the restoration of essential road network. The first five year of the program (RSDP I), 1997-2002, was officially launched in September 1997, and has been completed in June 2002. Accomplishment under RSDP II is rather encouraging. The total disbursement rate of investment on federal and regional roads for the 5 years of RSDP II is about 125% and 73%, respectively, whilst the corresponding physical accomplishment is 134% and 145% of the planned. Within the ten years period of the program, the total disbursement of projects planned for the execution amount 25.4 billion Birr. This would enhance the integration of domestic markets and the potential growth of exports in terms of volume and international competitiveness (ERA, 2008).

Base on the firm's possession in general, two types of construction sectors exists in Ethiopia: Private and Public. Most of the construction works in the public sectors are foreign fund initiated. Funding for a high percentage of construction projects come from multilateral development agencies (MDA) like the World Bank or Africa Development Bank, Chinese EXIM Bank, European Union and International Development Association.

The World Bank, African Development Bank (2010) and others provided assistance for new road construction and maintenance. Expansion of the rural road network accounted for much of the roads constructed thereafter until the change of government in 1991 and the network was further reduced with Eritrea as a new state. In 1993 the Ethiopia Roads Authority (ERA) was reestablished with a legal autonomy and being responsible for overall planning, construction, maintenance and management of the country's trunk and major link roads.

Mohammed (2014) also further confirms that ERA has now three technical departments – each headed by deputy general manager: Regulatory and Engineering service, Human Resource and Financial and the Operations Departments. In 1991, in addition to the 13,000 kilometers of all weather roads, of which about 4,000 were asphalted and 8,900 were all-weather gravel roads, there were 4,900 kilometers of rural dirt roads, making a total of nearly 18,000 kilometers of all types of roads.

2.8.3 Overview of the Road Network in Ethiopia

In 1951 the total stock of road network was only 6400 km of which 3400 km was asphalt and the remaining 3000 km was gravel road. This entire network was found only in urban areas. When the Imperial regime lost power, the network has reached to 9160 km in 1973. On average, the network has been growing at a rate of 2.05 percent per annum over the period 1951-1973. During the Derg regime, 1974-1991, the stock road increased to 19,017 km with a growth rate of 6.2

percent per annum. With the current regime, the road network has reached 46,812 km in 2009 with an average annual growth rate of 9.35 percent. Over the period 1991 to 2009, 28,731 km of new road network was constructed which is still lower compared to the middle income countries performance on road network development (Addisu, 2013).

Addisu (2013) further suggests that as it can clearly be seen from the trends, the development of road network is yet to go far. A large space in the country is networked with only a few roads. Though the development is yet needs hard to work, more construction is important for connecting the remote areas. Especially, the rural part of Ethiopia where large agricultural product of the nation is available and less networked with roads.

According to World Bank (2010), only 10 percent of the rural population lives within two kilometers of all weather roads. Thus, the remaining 90 percent of rural people live at a distance of more than two km from all weather roads. The underdevelopment of the road network has its implication for the development of the agricultural sector which is the mainstay of the rural people and the country in general.

2.8.4 The Growth Transformation Plan and Road constructions

According to Mohammed (2014) further confirms that developing and improving the country's road network and building the capacity of road authority so as to manage and administer the road network were the main objective of road sector development plan. Generally during the five year GTP it was planned to rehabilitate 728 km of trunk roads, upgrading 5023km of trunk and link roads, construction of 4,331 km of new trunk and link roads, periodic maintenance of 4,700 km of asphalt and gravel roads and routine maintenance of 84,649 km of road network as well as construction of 71,522 Km of new all weather that connect all rural districts. The regional roads authorities also have a plan to construct 11,212 km of rural roads in the five years period. The national level road length (federal and regional total road length) has increased from 48,793 km in 2009/10 to 52,042km in 2010/11.

Hassan (2011) suggests that there were no all weather district roads in 2009/10, but in 2010/11 a total of 854 km of district road was constructed. As a result of the increased road construction and maintenance in the country, road density measured by km per 1000 square km of area increased from 44.5 to 48.1 and the proportion of kebeles connected by all weather roads increased from 39 percent in 2009/10 to 42 percent in 2010/11 fiscal year. Moreover, roads in acceptable condition (good + fair conditions) increased from 79.7 percent in 2009/10 to 82 percent in 2010/11 indicating improvement in the quality of roads. Owing to increase in roads density and improvement in the quality of roads, the average vehicle coverage per day (measured by km of travel per day) has increased from 9.6 million km to 12.1 million km. As a result of all these accomplishments in the road sector, the average travel time to all weather roads declined to 3.5 hours in 2010/11 from the 3.7 hours in 2009/10 (Mohammed, 2014).

2.8.5 Planning and scheduling in road construction projects.

Wubishet (2004) suggests the application of time performance evaluation as critically important criteria in bidding process in Ethiopia construction industry because the government of Ethiopia waived the use of completion time and allowed low evaluated cost award system for tender evaluation in 1993. According to Wubishet (2004) confirmation, the consultant shall estimate a reasonable time for the completion and announce the same on invitation to bid and the estimated time for completion should satisfy the interest and schedule of the client.

According to Mohammed (2006) during the year under review, several new road constructions, maintenance of roads, rehabilitation and upgrading works have been carried out by the Federal, Regional and District level governments of the country and other development partner. In addition design, feasibility study, environmental impact assessment (EIA), civil service reform and capacity building activities were accomplished. During 2010/11 the physical accomplishment of federal roads was above the level planned for the fiscal year except the construction of new roads.

There is an increasing need for prediction of construction time at planning and bid preparation stages for including realistic project duration in the bid package. It represents a problem of continual concern and interest to both researchers and contractors. It is also important for the studies related to estimating, scheduling and management of construction works taught both at the graduate and undergraduate levels in the schools of science (Mohammed, 2006).

The growth of constructing road projects will make the planning and scheduling works to be given more and strict emphasis due the following reason (Mohammed, 2006).

1. The government has planned to build many projects within short period of time. Therefore in order to achieve it, there should be well planned and scheduled projects and strict control with updated scientific appraisal methods.

2. The routine from various discussion with the project managers and engineers it is learnt that project completion on due time has not been achieved in most of the projects. Hence planning and scheduling should be executed in great emphasis.

In the traditional practice of road construction in Ethiopia, determining the period to complete the road construction is primarily set by the client's need of occupancy; do the engineers give proper emphasis and attention towards planning of the road construction process ahead of the commencement? It is discussed below with reference to the time cost models set to estimate construction times and desk study findings from stakeholder's documents on federal road construction (Mohammed, 2006).

2.8.6 Time Estimation Comparisons

Based on the time a cost relation analysis developed by Assefa (2008) the duration to complete projects have been estimated and compared to the period client has approved to the respective projects. Accordingly projects which started years ago have showed some exaggeration of time estimation by the client. In other case for projects whose commencement is in recent time, the client estimation to project completions is lesser than the time cost model. It is because the period where time cost model developed is not recently and needs to be updated in order to be adaptive to the current projects. Projects from 3-5, which had been commenced five years ago had shown that client has assigned exaggerated time by 30-50% from the total duration of the projects necessary according to the time cost model of Assefa (2008). This implies that the time set by the need of clients has not coincided with developed model estimations. Hence there was a difference in time estimation to project delivery in the selected projects.

2.8.7 Major Planning and Scheduling Problems in Low Volume Roads construction

According to the report from Jimma Zone roads Authority bureau finds one of the great problems during desk study observed phenomena was planning and scheduling problems in the sector of low volume road projects. According to the stake holder's documents, the following are risk factors to impacts of scheduling in the low volume road projects.

- Gross negligence on contractual duties and responsibilities of the parties
- Due to right of way problem contractor have interrupted the work as a result of late claim approval by the project owner.

- From the report it is also evaluated that work plan have not been attached to the contract document and there is no estimated or valid work program to work with.
- Unclear line of responsibility with respects to poor supervision on site management and organization
- Late commencement of contractors to the project site hence delay in mobilizing construction resources materials, equipments and staff members to the project site.
- Delay in design review and approval from the consultant side for crossing structures working drawing and details.
- Extreme bureaucracy of project owners on the issuance of monthly statements to the contractors hence payments could not effected on due time.
- Due to insufficient communication between the contracting parties which resulted gross negligence on duties and responsibilities caused thereto contractors could not use machineries on some item of works. For instance, to improve the bearing capacity of sub grade which contributes to structural strength of wearing course compacting roller could not been used and during placing materials to improve optimum density or compaction shower truck could not been used which was the joint result of poor professional management.
- It is also evaluated that proper work plan have not been attached to the contract document and there is no estimated or valid work program to work with.
- Late design and design reviews which should have been made prior to the project, design has been delayed due to recklessness. Readiness of design on due time is very essential to complete the projects deliveries on the intended duration.
- According to stake holders experience and desk study of selected projects being late in designs and design reviews is common experience in low volume road projects.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with methodologies to be followed and presents tools and techniques to be adopted to successfully complete and enhance the objectivity of the study findings. There is also description of the sources and types of data, sample and sampling procedure and the procedures of data collection. The research relied on both primary and secondary data sources. The research methodology employed in this thesis outlines the steps used to answer research questions as described using desk study, discussion, interview and questionnaire.

3.2 Study Area

Jimma town is the capital of the zone that is 346 km away from Addis Ababa. Jimma zone is one of the nineteen zones of the Oromia Regional States which geometrically lies at the south-western part of Ethiopia. Jimma zone is found at an altitude of 1,744 meters (5,722 feet) and the latitude and longitude of $7^{o}40'$ (7.67^{o}) North and 37^{o} East respectively. Jimma zone is bordered on the south by the Southern Nations, Nationalities and Peoples Region, the northwest by Illubabor, on the north by East Wolega and on the northeast by West Shewa; part of the boundary with East Shewa is defined by the Gibe River (Central Statistical Agency, 2007).

Based on the 2007 census conducted by the central statistical agency, Jimma zone has a total population of 2,486,155 and an increase of 26.76% over the 1994 census, of whom 1,250,527 are men and 1,235,628 women; with an area of 15,568.58 square kilometers. The three ethnic groups reported in Jimma zone were the Oromo (87.60%), the Amhara (4.05%) and the Yem (3.12%); all other ethnic groups made up 5.23% of the population. The majority of the inhabitants were Muslims, with 85.65% of the population having reported they practiced that belief, while 11.18% of the population practiced Ethiopian Orthodox Christian and 2.97% professed Protestantism. World Bank (2004) memorandum signifies 9% of the inhabitants of Jimma zone have access to electricity; this zone has road density of 77.0 kilometers per 1000 square kilometers (compared to the national average of 30 kilometers).

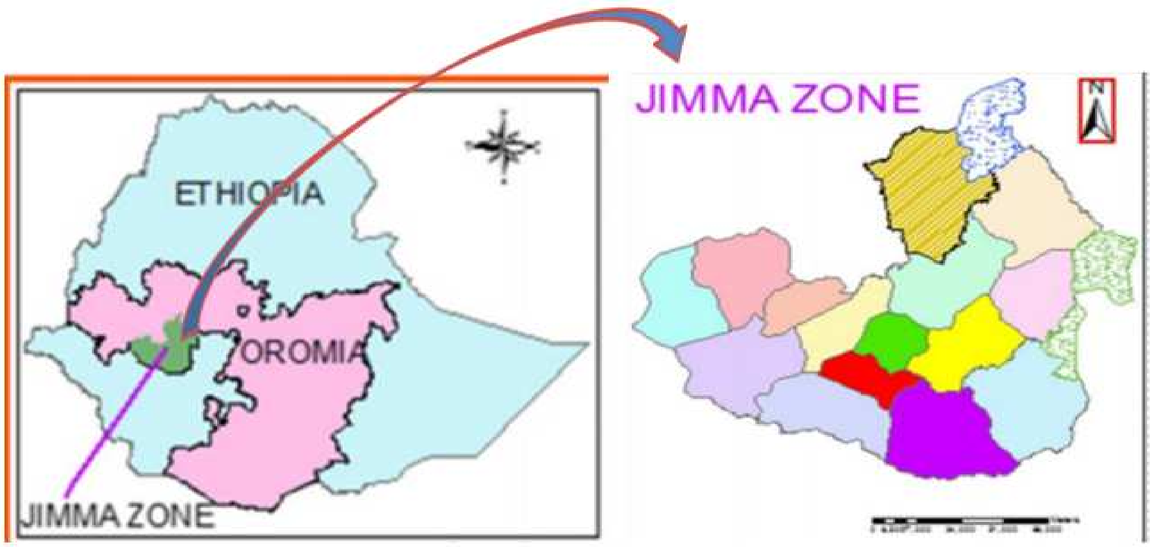

Figure 4: Map of Jimma zone

3.3 Study Design

The strategy to be followed in this study is first started with the identification of relevant information regarding research topics the trends in practice and major problems in planning and scheduling of low volume road construction projects with the relationships to schedule impacts which makes late completion of projects beyond time agreed in contract, desk study on relevant documents related to research topic, practical views of the stakeholders on the subject through interviews and case study to selected projects.

- The first approach to successfully accomplish the objective of the thesis is to conduct existing complete literature survey / review / and analysis undertaken with regards to research topic
- The second approach is to identify planning and scheduling impact related delay causing factors of various road contracting firms, common problems in planning and scheduling procedures and other very important research related concepts, how they have concluded based on the results.
- The third approach is to collect schedule data, cost data, factors of schedule delay causes in LVR projects by reviewing extracted concepts from project progress reports such as monthly, quarterly and annual reports, site diary, unstructured interview and payment certificates on different status date so that the analysis can be done and conclusion can be made in terms of physical accomplishment, financial accomplishment and major failures noticed due to if any.

- The fourth approach is developing and distributing questionnaire to different road contracting stake holders to rank the major responsible root causes of schedule delay and to draw other related impacts caused thereof LVR projects. A questionnaire was developed to assess the perceptions of the clients, contractors and consultants via importance indices (RII) of impact of schedule delay causing factors and in relation to theoretical proposition in selected Jimma zone districts low volume road projects execution. The format used for questionnaire was organizational information, nominal scale "yes" or "no" and in terms of degree of agreement priority ranking (5-Strongly agree; 4-Agree; 3-Neutral (neither agree nor disagree); 2-Disagree; 1-Strongly disagree).The target groups in this research are owners, consultants and contractors as possible. 38 questionnaires were distributed as follows: 13 to owners, 10 to consultants and 15 to contractors. 25 questionnaires (66%) were received as follows: 7 (54%) from owners, 6 (60%) from consultants and 12 (80%) from contractors as respondents.
- The fifth approach is to perform the analysis for questionnaire after inputting the key informant's response through questionnaires ratings. The analysis was done by RII formula by using Microsoft Office Excel and in relation to theoretical proposition.
- The final approach is to make suitable conclusions based on the schedule and research findings obtained after analysis is undertaken.

3.4 Study Population and Sample Size

Due to the nature of data collected through desk study and the expected participants for the survey study, a non probability sampling was preferred to be used. A purposive sampling method was used to select the target population under study.

Therefore, the target group considered to successfully complete the objective of this study were low volume rural road projects executed in Jimma zone district from beginning of September, 2007 up to the end of October, 2009 of which the physical and financial accomplishment of the project is reached beyond 85% during the study which is administered under the regional government of Oromia Roads Authority, Jimma zone rural district.

For the successful assessment on current low volume road project planning and scheduling trends and major problems, standard procedure and schedule impacts specific to Jimma zone district as well as to distinguish the gap that causes delay in project completion beyond the time granted in the contract desk study, discussion with selected professionals in the sectors without making the feeling that they are interviewed, concepts extracted from feasibility study documents and progress reports (taken from Jimma Zone Roads Authority Bureau) during the study identified a target population of twenty seven (27) low volume rural road projects executed in Jimma zone district during aforementioned time frame (see Appendix E).

From aforesaid target population five (5) projects are successfully completed beyond the time agreed in contract with extension of time as well as provisional acceptance approved and the rest are on progress beyond 85% physical accomplishment. A brief overview of the projects is given and a more detailed description of each and every project is provided in the Appendix E.

Questionnaire was distributed for a total of thirty eight selected professionals in the sectors with contingency factor accounts for incompleteness, non responsiveness and willingness to answer. The total number of questionnaire distributed to contractors was 15 questionnaires. The total number returned was 12 questionnaires. The total number of questionnaire distributed for consultants were 10 questionnaires. The total number returned was 6 questionnaires. Since the client or project owner is Jimma Zone Roads Authority contract administration bureau and district rural road offices, 13 questionnaires is planned to be distributed and 7 is returned, the rest is rejected due to incompleteness.

Statistical scholars suggested that if the study population is less than thirty there is no need to calculate the sample size by which the estimated sample size 38 is planned to be distributed to aforementioned stakeholders and 25 is returned on due time. From the entire on returned questionnaires, 6 are rejected due to incompleteness and 7 are due to non responsiveness and willingness to answer. In terms of percentage from 38 planed to be distributed questionnaire 66% is returned on time.

3.5 Sampling

It is well known that the sampling method adopted for the case study part is non probability sampling technique as the samples taken direct from target population are assumed to be information reach case and readily available so as to make detail investigation and analysis to answer research questions.

On the other hand, the sampling method adopted for questionnaire part is purposive sampling technique as the samples are selected to have great importance to the particular study because it is assumed to be representative of total population and produces a well matched group.

Accordingly, the primary relevance of this research is to make study on planning and scheduling in low volume road projects specific to Jimma zone district with project schedule delay in which delay is inherent as impact. Therefore, from projects constructed during aforementioned time frame projects successfully completed beyond the time granted in contract with extension time as well as provisional acceptance approved have been analyzed for case study. Data also collected from aforesaid stake holders through questionnaire.

3.6 Study Variables

3.6.1 Dependent Variables

The dependent variable which is to be observed to determine the effect of the independent variables is listed as planning and scheduling low volume road.

3.6.2 Independent Variables

The independent variables which are to be evaluated to determine its relationship to observed phenomena are selected and listed as time, scope, cost, quality and risk.

3.7 Data Collection

In order to successfully answer the primary problem of this study, data was collected through desk study and survey (interview and questionnaire).

3.7.1 Desk Study Technique

In order to optimize the significance of the research on the stated problem, useful data was extracted from payment certificate, Progress report (monthly, quarterly and annual), site diary and site book and from feasibility study documents so as to gain a better understanding between theoretical and actual real world on site practice of low volume road construction specific to Jimma zone district under the administration of the regional government of ORA Jimma zone district bureau contract supervision and monitoring. The data collected through desk study indicates the worthiness and significance of the research topic under current study.

3.7.2 Survey

3.7.2.1 Interviews

Interview is a means to create conversation with professionals found in concerned sectors without creating the feeling that they are being interviewed. Important data for the study which would not probably be accessible through observation and questionnaire will be collected through face-to-face dialog with the interviewee asking question. This technique significantly helps to understand the way how to successfully answer the research question and enhance the objective of the study. Thus, semi structured interview was held with senior professionals in the sectors, contract administration and design review team, project planners and monitor teams, and senior project managers to gather information on the planning and scheduling of low volume road projects to identify current planning trends and major problems in scheduling and its impacts in which delay is inherent as impact as well as to seek for recommendation if any to minimize and / or optimize its impacts.

3.7.2.2 Questionnaire

The questionnaire is a principal powerful data collection tool to successfully solve the stated problem raised with respect to research particular objectives. Thus, it is a time saving technique to collect data effectively and efficiently from a large number of respondents. The questionnaire was designed to collect data from randomly selected professionals in the sector of low volume rural road projects executed in Jimma zone district. Thus, questions are formulated from identified variables to identify the current practice in planning and scheduling through participants in the sector.

Questionnaire is designed and extracted from literature review parts that help as a checklist to assess current planning trends so does major problems and schedule impacts in which delay is inherent as impact as well as to look for recommendation if any to minimize and / or optimize its impacts.

Even though the nature of questionnaire is closed ended, at the end of some section other variables from respondent’s technical experience are allowed to add (see appendix A). The questionnaire was structured in five parts as follows.

Question # I: The category of organization in which respondents serve, his/her role in the organization and respondents working experience. Normally there were five question in this section were detailed for respondents.

Question # II: This part deals with basics of planning and scheduling in relation with the experience of respondents with regards to plan and schedule and the common trend as well as the standard procedure in the preparation of low volume road planning and scheduling.

Consequently, problem in planning and scheduling which brings schedule delays in low volume rural road are under these parts.

Question # III: To obtain responses from the respondents on the top root causes of schedule delay in the low volume road project execution specific to Jimma district. The ranking of the response was by using Likert's scale of five ordinal measures in ascending order from 1 to 5. Accordingly, a total of thirty nine root causes of schedule delay were identified and extracted from different sources required to answer the research question to enhance the objective of this finding.

Question # IV: This part assesses the common impacts of planning and scheduling, risk management strategy and risk associated with delay in LVR construction projects justified as per respondent's perception. Six questions were asked under this part to successfully collect respondent's opinion.

Question # V: This part deals with how controlling is done in planning and scheduling of LVR projects and schedule impacts happened in the sector also asked and finally followed by the respondent's comments on this research were asked and participants were interested with study and recommended for further future study to be undertaken. Accordingly, a total of 38 respondents were required to answer the question to enhance the objective of this finding.

3.8 Method of Data Analysis

The case and desk study as well as interview were analyzed in relation to the theoretical propositions. The questionnaire data were analyzed by the ranking of the response was by using Likert's scale of five ordinal measures in ascending order from 1 to 5 arranged in ascending order according to their degree of contribution to each causing factor.

The principal approach applied to analyze the data was by the use of Relative Importance Index (RII) systems. The response was analyzed using Microsoft excel software package. The analysis includes ranking of factors in terms of its degree effects.

To compute the result the following formula was used (Abushaban, et al., 2009):

$$\text{RII} = {\sum W}/_{A * N} \text{ ....equation 3.1}$$

Where;

- RII indicates Relative Importance Index
- W indicates the weight given to each causing factor by the respondents. It ranges from 1 to 5.

- A indicates the highest weight which is 5
- N indicates the total number of respondents

The Spearman (Rho) rank correlation coefficient is used for measuring the differences in ranking between two groups of respondents scoring for various factors that mean, clients versus consultants, clients versus contractors, and consultants versus contractors (Singh, 2006).

The Spearman (Rho) rank correlation coefficient for any two groups of ranking is given by the following formula (Singh, 2006):

$$\text{Rho } (\rho_{cal}) = 1 - \frac{6 * \sum {d_i}^2}{N * (N^2 - 1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{equation 3.2}$$

Where;

Rho (ρ_{cal}): Spearman's rank correlation coefficient

d_i: the difference in ranking between each pair of factors and

N: number of factors (variables).

The value of the Spearman (Rho) rank correlation coefficient varies between -1 and +1. A correlation coefficient of +1 implies perfect positive correlation, 0 implies no correlation and -1 implies perfect negative correlation.

3.9 Description of projects under case study

The data for case study were selected and gathered from Jimma Zone Roads Authority Bureau of various contract agreements. Relevant project data, problems encountered during construction period and the relation of evaluated problem with plan and schedule which leads significant schedule delay impacts, finally possible measures undertaken to overcome such problems have been extracted from the contract document were discussed in detail to enhance this research objectives.

4.0 Plan for dissemination of findings

The results and plan for such dissemination should be adapted to the level of understanding and interests of the different audiences in the industry. Moreover, the result of this study will be disseminated to Jimma University, contractor and consultants engaged in low volume rural road construction, Jimma Institute of Technology, especially to the Civil Engineering Department, while a copy of it will be set aside in the library of Jimma University for future reference.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Introduction

This chapter presents, interprets and analyze in detail the data collected through questionnaire, desk study and interview held with professionals in the sectors as well as data extracted through case study from the stamped, signed and a legally binding documents. While the collected data through questionnaire was analyzed according to ranking on their relative importance index (RII) it is reasonable enough to address and verify the stated problem of this study, case study on selected road projects and interview from selected professionals in the sectors is presented to enhance the objective of this study in great depth. Therefore, the objective of this chapter is to analyze and discuss the highest ranked schedule delay causing factor in low volume rural road project executions with respects to the current trend and standard procedure for planning and scheduling impacts and to find correlation with findings from the interview and desk study.

4.2 Analysis of Data from the Case Study

During the study time, reports from contract administration bureau confirm that on average twenty seven (27) low volume rural road constructed in the district have been reached beyond 85% contract completion which were a contractual duration since February, 2007 up to October, 2009. From aforesaid target population five (5) projects are successfully completed beyond the time agreed in contract with extension time as well as provisional acceptance approved and the rest are on progress beyond 85% physical accomplishment.

The data for case study were selected and gathered from Jimma Zone Roads Authority Bureau of various contract agreements. Relevant project data, problems encountered during construction period and the relation of evaluated problem with plan and schedule which leads significant schedule delay impacts, finally possible measures undertaken to overcome such problems have been extracted from the contract document were discussed in detail to enhance this research objectives.

The selected road projects for case study are given below:

1. Project A: Tele – Masa which is a project length of 17.50 km with a terrain pattern of rolling mountainous and surfacing type gravel wearing course.
2. Project B: Shabe – Do'o which is a project length of 19.80 km with a terrain pattern of mountainous escarpments and surfacing type gravel wearing course.
3. Project C: Toli – Gasera which is a project length of 8.10 km with a topography flat terrain and surfacing type gravel wearing course.
4. Project D. Anga – Masa which is a project length of 9.80 km with a topography rolling terrain and surfacing type gravel wearing course.
5. Project E: Angech – Bore which is a project length of 12 km with a topography mountainous terrain and surfacing type gravel wearing course.

The evaluations of the above road project have been undertaken here under with in depth information regarding the stated problems and all data are gathered from respective contract administration bureau.

Table 4: List of selected case study low volume rural road projects

S.N	Projects	Total length (Km)	Surfacing type	Contract amount (million Birr)		% VO	Physical Prog. (Km)		% age	Contract time (days)	EOT granted (days)	% over	Remark
				Plan	Exec.		Plan	Exec.					
1	Project A	17.20	GWC	8.05	13.49	68	17.20	17.20	100	288	210	42	Completed
2	Project B	19.80	GWC	5.75	16.09	179	19.80	19.80	100	310	242	44	Completed
3	Project C	8.10	GWC	2.05	2.05	Nil	8.10	8.10	100	240	215	47	Completed
4	Project D	9.80	GWC	4.41	4.41	Nil	9.80	9.80	100	265	205	44	Completed
5	Project E	12.00	GWC	3.65	3.65	Nil	12.00	12.00	100	288	235	45	completed

4.2.1 Project A

The tender sum of project A was 8,050,000.00 ETB and the original planed work duration was 288 calendar days. Due to poor design, under estimation of complexity of projects and discrepancy between design and specification the project cost was under estimated which was resulted in extreme quantity changes to meet this field condition. The project nature and prevailing topography was difficult to work with hence dense forest with heavy tree removing was cumbersome and land sliding during earth work was challenging situation hence contractor was requested for this change. On the other hand, since insufficient communication between contracting parties consultants are delayed the amended instruction to work with under current situation and the interim payments are delayed for more than 120 days due to client cash flow problem.

The other problem was lack of effectively managing and controlling subcontractors during construction of subcontracted minor drainage cross structure vent fords and pipe works which resulted due to inappropriate construction procedure the cross structure was extremely defected which brings significant socio political impacts which falls under poor supervision and poor management of project changes.

During the execution of work, it was observed that items for land slide like retaining structure, removal of heavy trees and massive volume of excavation depending on soil strata and road furniture and traffic signage were missing from contract document. Due to these changes a variation amount of 7,252,723.94 ETB was justified.

Due to aforesaid scenarios, the contractor could not able to finish on schedule and extension of time 210 days was granted which was schedule overrun 42% over the schedule of works. Among 17.20 km project length planned to be executed 17.20 km were executed which signifies 100% physical accomplishment.

Summary of the Cases:

Accordingly, from the reports of the consultant it is learnt that the type or bases of contract was unit rate and it was observed that the there was no proper work plan attached to the main contract document which signifies poor plan and schedule procedure. The identified report summarized is as follows;

- Gross negligence on contractual duties and responsibilities of the parties
- Due to right of way problem contractor have interrupted the work as a result of late claim approval by the project owner.
- From the report it is also evaluated that work plan have not been attached to the contract document and there is no estimated or valid work program to work with.
- Unclear line of responsibility with respects to poor supervision on site management and organization
- Late commencement of contractors to the project site hence delay in mobilizing construction resources materials, equipments and staff members to the project site.
- Delay in design review and approval from the consultant side for crossing structures working drawing and details.
- Extreme bureaucracy of project owners on the issuance of monthly statements to the contractors hence payments could not effected on due time.
- Due to insufficient communication between the contracting parties which resulted gross negligence on duties and responsibilities caused thereto contractors could not use machineries on some item of works. For instance, to improve the bearing capacity of sub grade which contributes to structural strength of wearing course compacting roller could not been used and during placing materials to improve optimum density or compaction shower truck could not been used which was the joint result of poor professional management.
- From the report it is also evaluated that work plan have not been attached to the contract document and there is no estimated or valid work program to work with.

4.2.2 Project B

Project B was awarded with a tender sum of 5,750,000.00 ETB and the original planned duration was 310 days. As a result of poor design and poor management of the project changes, contractors could not completed the project on due time hence late instruction from the consultant to work within prevailing topography. The problems encountered during executing months are the domain of project A. Due to poor planning and weak investigation of the project nature the contractor could not satisfied with the work which resulted in huge volume of earth work and massive land slide have been anticipated within the route corridor hence a variation amount of 10,344,767.14 ETB was granted to meet extra quantity changes and items missing from the contract.

As a result of aforementioned reasons the contractor could not completed the agreed contract on due date and extension of time 242 days have been granted which means time overrun 44 % over the schedule of works. Among 19.80 km project length planned to be executed 19.80 km were executed which signifies 100% physical accomplishment.

4.2.3 Project C

The amount of signed contract agreement between the parties in contract to complete the planned works of project C was 2,051,236.28 ETB and the original planned duration was 240 days. As a result of extreme bureaucracy and late approval of contractor's interim payments the project schedule was further delayed beyond the completion time by which extension of time 215 days was approved which means schedule overrun 47% over the schedule of work.

According to the report from the consultant it is anticipated that the original project time planning and prediction of actual on site works it is not compromising to give such an extended time. Accordingly, among 8.10 km project length planned to be executed 8.10 km were executed which signifies 100% physical accomplishment.

Summary of the Cases:

According to extracted reports it is anticipated that:

- The very great problem reported from joint office consultant and contractor is that extreme bureaucracy of the project owner on issuance of monthly statements to the contractors and client related cash flow problem have been delayed further beyond expected time which can have great impact on contractors scheduled activities.
- Due to insufficient communication between the contracting parties which resulted gross negligence on duties and responsibilities caused thereto contractors could not use machineries on some item of works. For instance, to improve the bearing capacity of sub grade which contributes to structural strength of wearing course compacting roller could not been used and during placing materials to improve optimum density or compaction

shower truck could not been used which was the joint result of poor professional management.

- According to the report contractor's interim payments could not been paid on due time.
- From the report it is also evaluated that work plan have not been attached to the contract document and there is no estimated or valid work program to work with.
- Due to the interrupted weather condition contractor could not mobilized to the project work on early time.
- Contractors of referenced road project could not pay enough attention to commence the project on early hence delay in mobilization.
- Due to right of way problem contractor have interrupted the work as a result of late claim approval by the project owner.

4.2.4 Project D

This referenced project was awarded to the tender sum of 4,419,082.43 ETB and the original planned duration was 265 days to complete the project as agreed in contract. The problems encountered during the executing months of this project was the domain of project C by which extension time of 205 days was granted to complete the delayed scheduled works. Among 9.80 km project length planned to be executed 9.80 km were executed which signifies 100% physical accomplishment.

4.2.5 Project E

The amount of signed contract agreement between the parties in contract for construction of project E was 3,652,996.14 ETB and the original planned duration was 288 days to complete the work as agreed in the contract. Due to aforementioned reason under project C extension time of 235 days was granted to complete the delayed scheduled works. Among 12.00 km project length planned to be executed 12.00 km were executed which signifies 100% physical accomplishment.

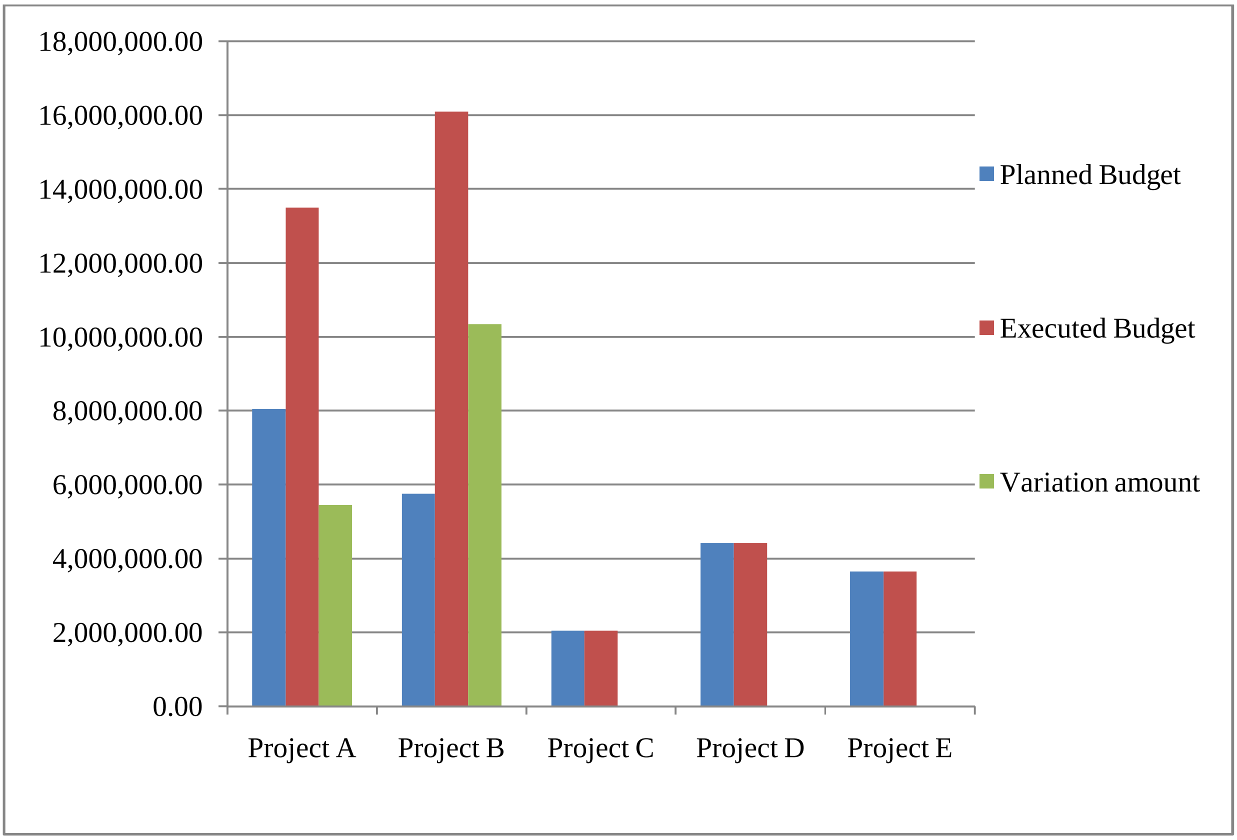

Figure 5: Graphical overview of selected projects in terms of financial accomplishment

The financial accomplishment of projects selected for case study as depicted on above figure 5 are elaborated appropriately as follows; the blue color for project A shows planed project budget but due to aforementioned reasons the project requires variation amount of green color which is a variation order of 68% and the project is completed with red color that shows executed budget. On the other hand, under project B the blue color signifies planed project budget due to aforesaid scenarios of poor plans and schedule the project requires variation amount designated under green color which is a variation order of 64% was justified and the project is completed with a total of red color executed budget. Even though project C, D and E are delayed due to poor practice aforementioned, these projects are completed with planed budget with no further variation amount granted.

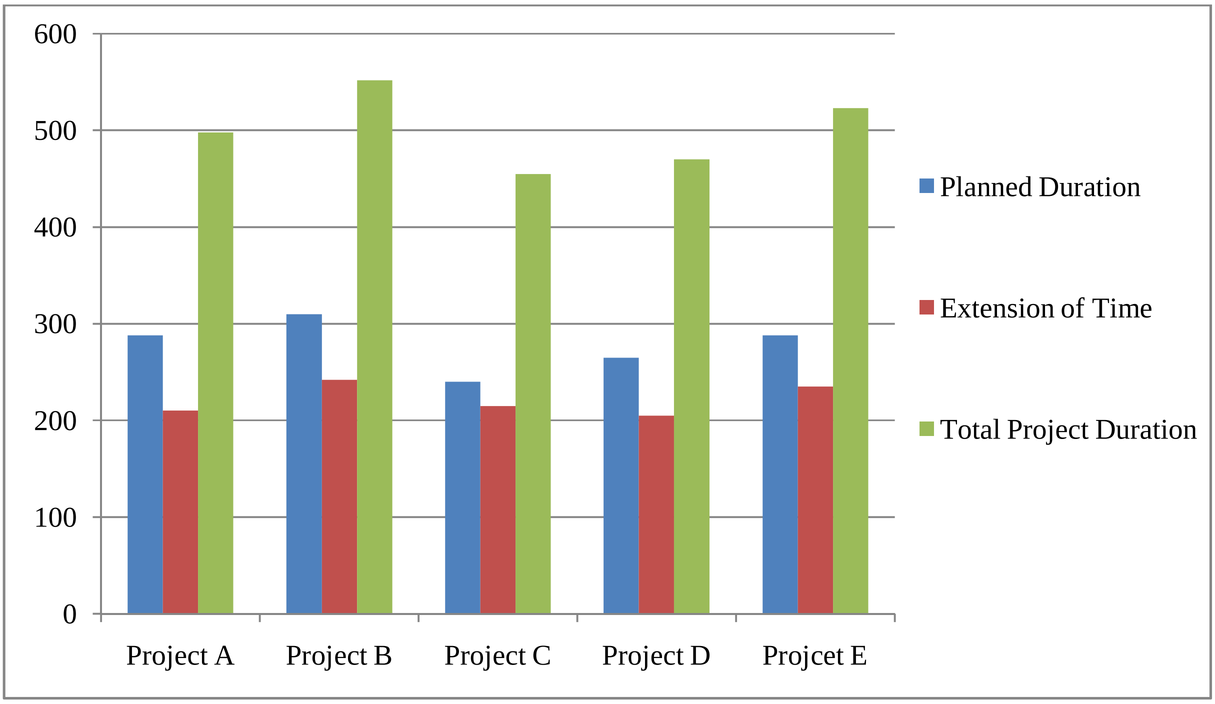

Figure 6: Graphical overview of selected projects contract duration

A comparative project completion time as to planned, extension of time and total project duration for selected case study project is elaborated as appropriately in figure 6 above; the blue color under project A signifies that planned duration by which project can not completed on time hence require an extension of time 42% over scheduled duration that is red color and total project completion is green color. On the other hand, project B needs extension of time 44% over scheduled duration which is red color and takes to complete total duration marked under green color. Similarly project C, D and E marked respectively red color signifies extension of time 47%, 44% and 45% over scheduled duration hence due to poor planning and scheduling these project takes longer time to complete.

Table 5: Total summary of the case study

No	Major causes for schedule delay	Selected Project for case study				
		A	B	C	D	E
1	Underestimation of cost of projects	✓	✓	✓		
2	Delay in honoring payment certificates	✓	✓	✓	✓	✓
3	Underestimation of complexity of projects	✓	✓	✓		
4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	✓	✓			
5	Difficulty in accessing Bank credit					
6	Poor supervision	✓	✓	✓	✓	✓
7	Poor Professional Management	✓	✓	✓	✓	✓
8	Fluctuation of prices					
9	Underestimation of time for completion by contractors	✓	✓	✓	✓	✓
10	Lack of effective managing and controlling subcontractor					
11	Extreme quantity changes to meet field condition					
12	Construction methods	✓	✓			
13	Delay in instructions from consultants		✓	✓		
14	Shortage of unskilled labor					
15	Poor management of the project changes	✓	✓			
16	Late deliveries of materials					
17	Poor management of project site	✓	✓	✓	✓	✓
18	Lack of Program of Works					
19	Delay by sub-contractors					
20	Poor design	✓	✓	✓	✓	✓

21	Breakdown of construction equipments					
22	Client initiated variations					
23	Obtaining permit from municipality					
24	Insufficient communication between parties	✓	✓			
25	Public holidays					
26	Shortage of skilled labor	✓	✓	✓	✓	✓
27	Accidents during construction					
28	Risk response planning prepared					
29	Unskilled equipment operators					
30	Discrepancy between design specification and standards	✓	✓			
31	Dispute among contracting parties					
32	Conflict in work schedule of contractor					
33	The project completed on the original (planned) schedule					
34	The project completed with the planned budget			✓	✓	✓
35	Unfavorable Site conditions					
36	Foundation conditions encountered on site					
37	Bad weather conditions					
38	Mistakes with soil investigations					
39	Delay in claim approval	✓	✓			

4.3 Interviews

4.3.1 Analysis of Data from the Interview

An interview was made between selected low volume rural road construction practitioner with an emphasis on the low volume road project planning and scheduling trends and its impacts on the overall performance of projects with regards to constructability issue and how controlling is done. The interviewees are senior project manager; division manager and team leader's representative from the consultant group, client group and contractor group were asked and discussed about the above issue without making the feeling that they are interviewed as shown in table 6 below.

Table 6: Interview held with the selected senior professionals

questions	client	consultant	Contractor
What are the common trends and major problems in planning and scheduling LVR projects?	✓ No standard project performance database ✓ Plans included on bidders document did not accommodate all things ✓ Time contingency is not considered in estimation of project duration	✓ No standard duration estimation hence it is difficult to evaluate the estimate ✓ Schedule is prepared based on the various production and work methodology available	✓Durations are estimated based on clients financial available and product objectives to meet ✓ Discrepancy between design and specification standards at the tender stage

Did you confirm factors of schedule delay in LVR projects with regards to plan and schedule?	✓ Poor design from inability of the parities ✓ Incomplete contract document ✓ Poor management of project site ✓ Delays in contractors monthly interim payments	✓ Delays in honoring contractors monthly interim payments ✓ Lack effectively controlling subcontractors ✓ Underestimation of cost and complexity of projects	✓ Underestimation of cost and complexity of projects ✓ Discrepancy between design and specification standards ✓ Delay in honoring monthly statements
How did you confirm constructability review issue with regards to schedule impacts in LVR projects?	✓ There is no other team made other than team involved in design and execution of works ✓ Unavailability of sufficient professionals and managers	✓ There is no other team made other than team involved in design and execution of works	✓ No independent team other than design consultants and work executors
How controlling is done in planning and scheduling in LVR construction?	✓ Plan of the project is evaluated at the bidding / tender stage ✓ Content of work methodology is also evaluated at bidding stage	✓ Progress report is made based on the merits of financial progress than physical	✓ The experience of updating schedule in relation to practical execution is very week

In your own opinion what did you recommend to address the above problems?	✓ Team independent from project design should be established ✓ Project performance database throughout project duration should be established	✓ In the scheduling of LVR projects time contingency should be established	✓ Standard procedure for planning and schedule LVR project have to be made

4.4 Analysis of Data from the Questionnaire

4.4.1 Rate of Response

For the successful accomplishment of this study representative respondents from the contracting firms are categorized into three namely client, consultant and contractors. Table 7 below depicts an average response rate in terms planned distributed and collected return from the representative respondents. From 38 planed responses, only 25 (66%) were successfully completed in answering and returned the questionnaire. Twenty five questionnaires from 12 contractors, 6 from the consultants and 7 from the client were received.

Table 7: Questionnaire return rate from the responders

Group	Planned Number of questionnaire distributed	Returned Number of questionnaire	Response Rate (%)
Client	13	7	54
Consultant	10	6	60
Contractors	15	12	80
Total	38	25	66

4.4.2 Respondent's Background

Among the seven responders representative from the client, six (86%) were senior civil engineer construction supervisor and one (14%) were from the contract administration bureau representative.

Among the six responses received from the consultant it is learnt that two (33%) were resident engineer and four (67%) were material engineer and quantity surveyor from contract administration. And from the contractor twelve responses were received, four (33%) were executive engineers, two (17%) were material engineer, three (25%) were quantity surveyor and three (25%) were office engineers. Figure 7 below depicts that respondents profile in the respective organization.

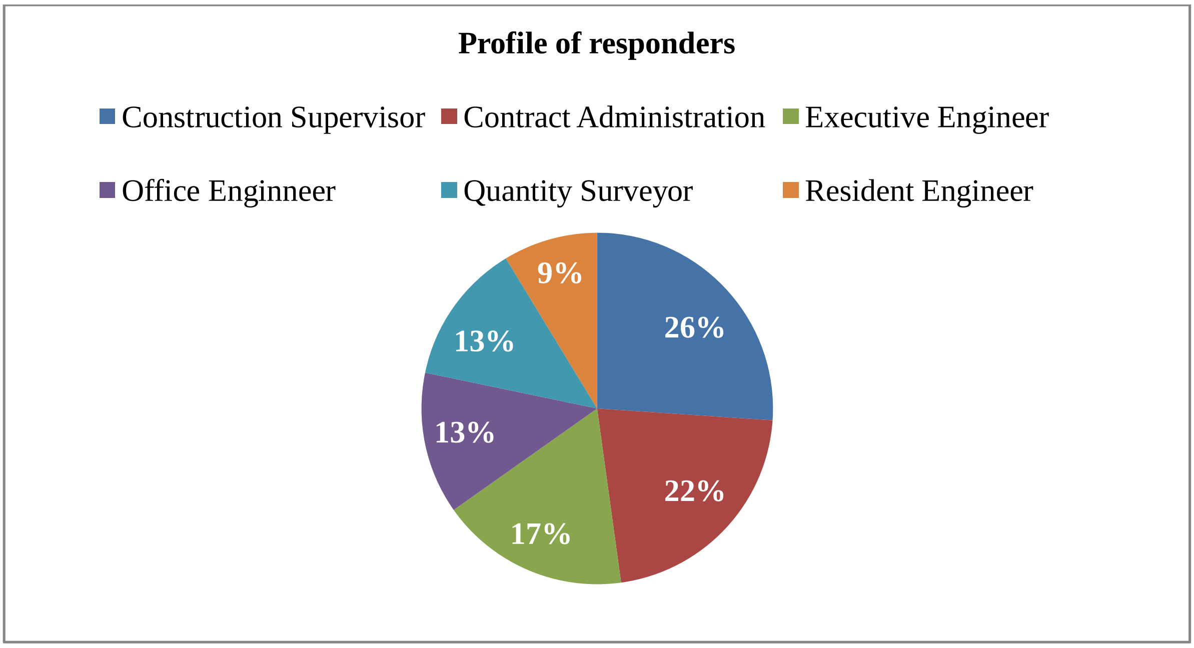

Figure 7: Position of respondents profile within respective sector

4.5 Current trends and major problems in planning and scheduling of low volume road projects

For the successful accomplishment of the objective of this study case study on selected project, interview with selected professionals and desk study on preliminary concepts have been carried out.

Accordingly, a summarized response from all respondents to the first specific objective was drawn based on the interview question undertaken for which 75% of the informants responded that there is no standard procedure to plan and schedule low volume rural road projects specific to Jimma zone district. Hence, from the desk studies it is possible to emphasis that the project duration was predetermined by the clients based on the period to which projects financial resources are available for particular projects in question. Prior to the award of contract the bidder's are notified the duration of projects at the bidding stage to comply with based on the said scenarios after which parties bound with the terms and conditions set out in the contract.

The respondents to the interview question could also confirm that the common trends to plan and schedule in low volume rural road project specific to Jimma zone district were master duration of project completion time was included in bidding document based on the owners estimated period of financial flow availabilities. On the other hand, the project duration was estimated based on the relevance of production the output product to meets the intended objectives.

The respondents could also confirm that it is not able to evaluate and estimate project duration hence the standard duration estimation were not available. Therefore, the schedule to the project is prepared based on the work methodology and various production standards available.

Finally, respondents as per interview question suggested that the major problem with respect to estimating the duration of activities for scheduling low volume rural roads project activities the project data base was not available to determine the time estimate. To accommodate loss due to different factors and unforeseeable circumstances in the time estimation a time contingency factor was not considered.

4.6 The top root causes of schedule delay in Jimma zone district low volume road project.

The respondents are asked to rate on the degree of contribution of the variables extracted from the literature in the structured part of the questionnaire. The structured part of questionnaire data collection approach was considered to study the causes of schedule impacts in which delay is inherent as impact and to rank those causes due to the influence of plan and schedule in the construction of low volume road project management specific to Jimma zone district.

The results are analyzed via Microsoft excel software. All the root causes of schedule delay were used as extracted from the literature to indicate the impact of plan and schedule on the current low volume road project management. In order to successfully understand those top root causes, the analysis was categorized into three groups these from the clients point of view, the consultant point of view and the contractors point of view and over all response of the group was also carefully under taken. A ranking system using the Relative Importance Index (RII) method was calculated to find the most significant factor for each section. The value of RII ranges from 0.2 to 1.The value 0.2 represents the lowest strength and the value 1 representing the maximum strength.

Accordingly, here under tables 8, 9 and 10 depicts the top root causes of schedule delay in the construction of low volume road projects with respect to responder's perception were ranked in the order of their relative indices. The frequency of the causes of schedule delay were identified by using a 5 point Likert scale, namely Strongly Disagree = 1; Disagree = 2; Neutral (neither Agree nor Disagree) = 3, Agree = 4; and Strongly Agree = 5.

1. Client Group

By comparing the relative importance indices (RII) the top root causes of schedule delay was ranked as depicted in the following table 8. As per clients perception, Poor management of project site and Delay in honoring payment certificates were the most ranked top root causes of schedule delay with respective RII value of 0.971and 0.914 followed by Poor supervision, Underestimation of time for completion by contractors, Delay in instructions from consultants, Poor design, Shortage of skilled labor and Discrepancy between design specification and standards with equal value (RII=0.886). And the least ranked cause as per client perception signifies that low volume road project cannot complete with planned budget and schedule duration with respective value of RII 0.371 and 0.343.

Table 8: Ranking of causes of schedule delay from client group response

Major causes for schedule delay	RII of Client	Rank
Poor management of project site	0.971	1
Delay in honoring payment certificates	0.914	2
Poor supervision	0.886	3
Underestimation of time for completion by contractors	0.886	3
Delay in instructions from consultants	0.886	3
Poor design	0.886	3
Shortage of skilled labor	0.886	3

Discrepancy between design specification and standards	0.886	3
Poor Professional Management	0.857	4
Poor management of the project changes	0.857	4
Insufficient communication between parties	0.857	4
Underestimation of complexity of projects	0.829	5
Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0.800	6
Extreme quantity changes to meet field condition	0.800	6
Lack of Program of Works	0.800	6
Dispute among contracting parties	0.800	6
Conflict in work schedule of contractor	0.800	6
Underestimation of cost of projects	0.771	7
Mistakes with soil investigations	0.771	7
Construction methods	0.714	8
Late deliveries of materials	0.714	8
Delay in claim approval	0.714	8
Difficulty in accessing Bank credit	0.686	9
Lack of effective managing and controlling subcontractor	0.657	10
Delay by sub-contractors	0.657	10
Fluctuation of prices	0.629	11
Unfavorable Site conditions	0.629	11
Shortage of unskilled labor	0.600	12
Unskilled equipment operators	0.571	13
Breakdown of construction equipments	0.571	13
Public holidays	0.571	13
Bad weather conditions	0.543	14
Client initiated variations	0.514	15
Obtaining permit from municipality	0.514	15
Accidents during construction	0.514	15

Foundation conditions encountered on site	0.514	15
Risk response planning prepared	0.486	16
The project completed with the planned budget	0.371	17
The project completed on the original (planned) schedule	0.343	18

2. Consultant Group

By comparing the relative importance indices (RII) the top root causes of schedule delay was ranked as depicted in the following table 9. As per consultants perception Discrepancy between design specification and standards and Poor design were the most ranked top root causes of schedule delay with equal RII value 1.00 followed by Poor supervision, Delay in honoring payment certificates, Poor Professional Management, Extreme quantity changes to meet field condition and Underestimation of cost of projects with respective RII value of 0.967, 0.933, 0.933, 0.933 and 0.900. And the least ranked cause as per client perception signifies that low volume road project cannot complete with planned budget and schedule duration with respective RII equal value of RII = 0.200 are were the least cause for schedule delay in the sector of low volume rural roads construction projects.

Table 9: Ranking of causes of schedule delay from consultant group

Major causes for schedule delay	RII of Consultant	Rank
Discrepancy between design specification and standards	1.000	1
Poor design	1.000	1
Poor supervision	0.967	2
Delay in honoring payment certificates	0.933	3
Poor Professional Management	0.933	3
Extreme quantity changes to meet field condition	0.933	3
Underestimation of cost of projects	0.900	4

Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0.900	4
Underestimation of complexity of projects	0.867	5
Underestimation of time for completion by contractors	0.867	5
Insufficient communication between parties	0.867	5
Breakdown of construction equipments	0.867	5
Poor management of project site	0.833	6
Lack of effective managing and controlling subcontractor	0.800	7
Delay in claim approval	0.800	7
Delay by sub-contractors	0.767	8
Poor management of the project changes	0.733	9
Dispute among contracting parties	0.700	10
Conflict in work schedule of contractor	0.700	10
Construction methods	0.667	11
Delay in instructions from consultants	0.667	11
Unfavorable Site conditions	0.633	12
Lack of Program of Works	0.600	13
Shortage of skilled labor	0.600	13
Mistakes with soil investigations	0.600	13
Foundation conditions encountered on site	0.567	14
Difficulty in accessing Bank credit	0.533	15
Bad weather conditions	0.500	16
Fluctuation of prices	0.433	17
Late deliveries of materials	0.367	18
Risk response planning prepared	0.367	18
Client initiated variations	0.300	19
Accidents during construction	0.300	19

Unskilled equipment operators	0.267	20
Public holidays	0.267	20
Shortage of unskilled labor	0.200	21
Obtaining permit from municipality	0.200	21
The project completed on the original (planned) schedule	0.200	21
The project completed with the planned budget	0.200	21

3. Contractor Group

By comparing the relative importance indices (RII) the top root causes of schedule delay was ranked as depicted in the following table 10. As per contractors perception, Delay in honoring payment certificates, Underestimation of cost of projects and Poor design were the most ranked top root causes of schedule delay with respective RII value of 0.967, 0.917 and 0.917 followed by Underestimation of complexity of projects, Poor Professional Management, Poor supervision, lack of applying contractual tools and Discrepancy between design specification and standards with respective RII value of 0.867, 0.867, 0.850, 0.817 and 0.817. And the least ranked cause as per contractor's perception signifies that low volume road project cannot complete with planned budget and schedule duration with respective value of RII 0.300 and 0.250.

Table 10: Ranking of causes of schedule delay from contractor group

Major causes for schedule delay	RII of Contractor	Rank
Delay in honoring payment certificates	0.967	1
Underestimation of cost of projects	0.917	2
Poor design	0.917	2
Underestimation of complexity of projects	0.867	3
Poor Professional Management	0.867	3
Poor supervision	0.850	4
Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0.817	5
Discrepancy between design specification and standards	0.817	5

Extreme quantity changes to meet field condition	0.800	6
Delay in instructions from consultants	0.800	6
Delay in claim approval	0.767	7
Delay by sub-contractors	0.750	8
Poor management of the project changes	0.733	9
Lack of effective managing and controlling subcontractor	0.700	10
Construction methods	0.683	11
Insufficient communication between parties	0.683	11
Shortage of skilled labor	0.683	11
Underestimation of time for completion by contractors	0.667	12
Poor management of project site	0.667	12
Lack of Program of Works	0.650	13
Mistakes with soil investigations	0.633	14
Bad weather conditions	0.617	15
Dispute among contracting parties	0.600	16
Unfavorable Site conditions	0.600	16
Conflict in work schedule of contractor	0.583	17
Fluctuation of prices	0.567	18
Breakdown of construction equipments	0.550	19
Foundation conditions encountered on site	0.550	19
Difficulty in accessing Bank credit	0.517	12
Late deliveries of materials	0.483	21
Shortage of unskilled labor	0.467	22
Unskilled equipment operators	0.417	23
Public holidays	0.400	24
Accidents during construction	0.383	25
Risk response planning prepared	0.383	25
Client initiated variations	0.333	26

The project completed with the planned budget	0.300	27
Obtaining permit from municipality	0.283	28
The project completed on the original (planned) schedule	0.250	29

As per equation 3.2 in chapter three, the Spearman's correlation coefficient is calculated and tabulated as shown below in table 11 and the summarized Spearman's correlation coefficient indicates that there is a strong correlation between all the three groups. It is possible to confirm that most of the respondents have the same perception about the top root causes of schedule delay in low volume road construction projects in Jimma zone district.

Table 11: Summary of the correlation test on the ranking of causes of schedule delay

Respondents	$\mathbf{Rho}\ (\rho_{cal}) = \mathbf{1} - \frac{\mathbf{6} * \sum \mathbf{d_i}^2}{\mathbf{N} * (\mathbf{N^2} - \mathbf{1})}$	**Relation of respondents**
Consultant Versus Contractor	0.901	Strong
Client versus Consultant	0.874	Strong
Client versus contractor	0.794	Strong

The degree of agreement between different classes of respondents is measured by Spearman's correlation coefficient and Rho ranges from 0.794 to 0.901. Generally the correlation test signifies that the degree of agreement between respondents is a very good and the data is highly reliable and valid.

4. Overall Responses

As depicted in table 12 here under; it was possible to rank the most contributory causes for low volume road project schedule delay factors that occur, specific to Jimma zone district by combining the response of all respondents. The most ranked top root causes for schedule delay by all respondents were Delay in honoring payment certificates, Poor design, Poor Professional Management and Discrepancy between design specification and standards with respective RII value of 0.944, 0.928, 0.880 and 0.880 followed by Underestimation of cost of projects, Underestimation of complexity of projects, Lack of applying contractual tools, Poor supervision and Extreme quantity changes to meet field condition with respective value of RII 0.872, 0.856, 0.832, 0.832 and 0.832. And the least ranked causes as per all responders perception was low volume road project construction specific to Jimma district were cannot completed with planned budget and schedule (duration) hence respective RII value of 0.288 and 0.264 confirmed by all responders.

Table 12: Ranking of causes of schedule delay from overall group

Major causes for schedule delay	Overall RII	Rank
Delay in honoring payment certificates	0.944	1
Poor design	0.928	2
Poor Professional Management	0.880	3
Discrepancy between design specification and standards	0.880	3
Underestimation of cost of projects	0.872	4
Underestimation of complexity of projects	0.856	5
Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0.832	6
Poor supervision	0.832	6
Extreme quantity changes to meet field condition	0.832	6
Poor management of project site	0.816	7
Delay in instructions from consultants	0.792	8
Underestimation of time for completion by contractors	0.776	9
Insufficient communication between parties	0.776	9
Poor management of the project changes	0.768	10
Delay in claim approval	0.768	10
Shortage of skilled labor	0.736	11
Delay by sub-contractors	0.728	12
Lack of effective managing and controlling subcontractor	0.720	13
Construction methods	0.688	14

Lack of Program of Works	0.680	15
Dispute among contracting parties	0.680	15
Conflict in work schedule of contractor	0.672	16
Mistakes with soil investigations	0.664	17
Public holidays	0.632	18
Unfavorable Site conditions	0.616	19
Difficulty in accessing Bank credit	0.592	20
Bad weather conditions	0.568	21
Fluctuation of prices	0.560	22
Foundation conditions encountered on site	0.544	23
Late deliveries of materials	0.520	24
Shortage of unskilled labor	0.440	25
Risk response planning prepared	0.440	25
Breakdown of construction equipment's	0.424	26
Accidents during construction	0.424	26
Unskilled equipment operators	0.416	27
Client initiated variations	0.376	28
Obtaining permit from municipality	0.328	29
The project completed with the planned budget	0.288	30
The project completed on the original (planned) schedule	0.264	31

4.7 The third specific objective was to identify the impact of scheduling and how controlling is done in planning and scheduling of low volume rural road projects

The analysis for the third specific objective was drawn based on the informant's response with respect to constructability review issues and how controlling is done in planning and scheduling of low volume rural road projects so as to minimize / optimize common schedule impacts by which projects are completed with no further time and cost overrun so that owners satisfaction with the finished product was achieved.

Accordingly, all informants to the interview question asked for the existence of team of expertise concerning constructability issues other than participants of design and execution of works were responded no.

All respondents to the interview question were confirmed that there was no plan of risk management strategy available in low volume rural road constructions with respects to plan and schedule particularly. On the other hand, all respondents opinion to the risks associated with delay 100% confirmed that it is reducible and common in the construction of low volume rural road projects specific to Jimma zone district.

It now become evident that all respondents confirmed delay as a common schedule impact in low volume rural road construction projects across Jimma zone district in the project's they have been worked and with exception to disruption and changes the informants could also responded 16% suspension and 12% termination was prevalent in the sector they have been working.

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 identify the trends in the current practice and 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 there is no standard procedure prepared to estimate the duration of the project schedule by the low volume road contracting firms so does the case study and interview revealed. The major problem with respect to estimating the duration of activities for scheduling low volume road project activities the project data base was not available to determine the time estimate which have been used for scheduling. Both data collections: questionnaire and desk study confirms that in the construction of low volume road project the project duration is fixed based on the clients occupancy need and period for which client financial flow available noticed prior to entering the contract.
- ✓ Questionnaire response reveals that the main causes of schedule delay in the construction of low volume rural road projects specific to Jimma zone district, the top root causes which contribute the said impacts are identified as per the informant's response. Therefore, the findings obtained are concluded as follows. As to the client group response received poor management of project site, delay in honoring payment certificate, poor supervision, underestimation of completion time and delay in instruction from the consultant were the top five root causes of schedule delay by scoring RII value of 0.971, 0.914, 0.886, 0.886 and 0.886 respectively across the district. The consultant group could also confirms discrepancy between design specification and standards, poor design, delay in honoring

payment certificates, poor professional management and extreme quantity changes to meet field conditions were the top five root causes of schedule delay by scoring RII value of 1.000, 1.000, 0.967, 0.933 and 0.933 respectively across the district. Also contractors group reveals that delay in honoring payment certificates, under estimation of cost of projects, poor design, under estimation of complexity of projects and poor professional management were the top five root causes of schedule delay by scoring RII value of 0.967, 0.917, 0.917, 0.867 and 0867 respectively across the district. From the overall response received delay in honoring payment certificates, poor design, and poor professional management, discrepancy between design specification and standards and underestimation of cost of projects were the top five root causes of schedule delay by scoring RII value of 0.944, 0.928, 0.880, 0.880 and 0.872 respectively across the district. Whereas, unskilled equipment operator, client initiated variation, obtaining permit from municipality, LVR projects can not completed with planned budget and scheduling were the least five causes of schedule delay by scoring RII values of 0.416, 0.376, 0.328, 0.288 and 0.264 respectively.

- ✓ To identify the impacts of scheduling and how controlling is done in planning and scheduling activities of low volume road construction projects specific to Jimma district the following conclusion is drawn as per the informants response reveal. Accordingly, the very common schedule impacts in low volume road projects confirmed by respondents are concluded as delay, suspension and termination of contract are the commonly prevalent issues in the sector. Whereas, disruption and changes are not the impacts of schedule in the sector. The findings from the respondent's response concluded that there is no organized team other than team involved in the design and execution of works for the project constructability reviews. Hence, there is no basis for constructability review process in the low volume road construction sector with respects to factors of risks associated with schedule delay.
- ✓ In the low volume road construction projects pertaining to how plans and schedules are evaluated and reviewed the following summarized response as per interview results are concluded as during the tender stage project activities working methodology and its content as well as plan of project work are analyzed and evaluated. Progress report of the project is analyzed and evaluated based on financial progress of the project.

Proper planning and scheduling in low volume rural road projects ultimately improves wise utilization of construction project resources so does good performance of projects; in turn, brings advantage like increased profits, less time loss and better quality.

5.2 Recommendations

This is to declare that proper and acceptable planning and scheduling of low volume rural road projects could enables the parties in the contracts to achieve better quality of products, budgeted costs and time frame as to the standard technical specification and contract agreements. Therefore in order to improve technical skills and managerial advancement in the sector. The respective contracting parties in the low volume road construction projects have to make the preparation of standard procedure to the planning and scheduling in the execution of works. Throughout the project performance data base have to prepared so as to give as a checklist for the update of planning and scheduling procedures. In order to improve the project performance and time management good pre tendering works, implementation and planning are essential. To minimize the impacts of schedule in which delay is inherent as impact in the low volume road construction project the schedule delay causing factors when they occur in the projects have to be emphasized so that measures have to be under taken;

As to the client must ensure that funds are available or adequate arrangement for funds are made before the project is started. Extreme bureaucratic processes involved in honoring payments to contractors must be solved. Contractors payments must be effected as and when they due in strict compliance with the provisions of the contract. Clients have to give short and long term training for hired technical engineering staffs like road technicians, office and site engineers with regards to site regulation, payment and design approval, completion time and cost of specific projects.

As to the consultant must hire experienced road professionals that have design experience and technical capacity. The consultant give focus on sound design specific to the project and have to use ERA low volume road manual (2011) as guidance. Consultants have to make acceptable cost estimate and completion time. And they have to be properly inspected and supervise the site works in relation to the agreed contract.

As to the contractor effective way must be designed to verify the list of staff produced by contractors in support of their application and to ensure that these key staff positions are continually filled by technically competent individuals.

Constructability review teams have to be established independently from other teams so as to effectively manage the works. Team independent from project design and construction team, should be engaged in various activities such as construction supervision / administration (construction claims and construction delays) schedule estimating.

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APPENDICES

Appendix A: Client's responses for top root causes of schedule delay

No	Major causes for schedule delay	Frequency Analysis (FA)				
		1	2	3	4	5
1	Underestimation of cost of projects	0	1	0	5	1
2	Delay in honoring payment certificates	0	0	0	3	4
3	Underestimation of complexity of projects	0	0	1	4	2
4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0	0	2	3	2
5	Difficulty in accessing Bank credit	0	1	4	0	2
6	Poor supervision	0	1	0	1	5
7	Poor Professional Management	0	0	1	3	3
8	Fluctuation of prices	0	2	2	3	0
9	Underestimation of time for completion by contractors	0	1	0	1	5
10	Lack of effective managing and controlling subcontractor	0	1	2	3	1
11	Extreme quantity changes to meet field condition	0	1	0	4	2
12	Construction methods	0	1	3	1	2
13	Delay in instructions from consultants	0	0	1	2	4
14	Shortage of unskilled labor	3	0	0	2	2
15	Poor management of the project changes	0	0	0	5	2
16	Late deliveries of materials	0	1	2	3	1
17	Poor management of project site	0	0	0	1	6
18	Lack of Program of Works	0	0	3	1	3
19	Delay by sub-contractors	0	1	3	3	0
20	Poor design	0	0	0	4	3
21	Breakdown of construction equipment's	2	1	1	2	1
22	Client initiated variations	1	4	0	1	1

23	Obtaining permit from municipality	3	0	1	3	0
24	Insufficient communication between parties	0	0	0	5	2
25	Public holidays	1	2	1	3	0
26	Shortage of skilled labor	0	0	0	4	3
27	Accidents during construction	1	2	3	1	0
28	Risk response planning prepared	3	0	2	2	0
29	Unskilled equipment operators	1	2	2	1	1
30	Discrepancy between design specification and standards	0	0	0	4	3
31	Dispute among contracting parties	0	0	3	1	3
32	Conflict in work schedule of contractor	0	0	2	3	2
33	The project completed on the original (planned) schedule	5	1	0	0	1
34	The project completed with the planned budget	4	2	0	0	1
35	Unfavorable Site conditions	0	2	2	3	0
36	Foundation conditions encountered on site	1	2	3	1	0
37	Bad weather conditions	2	1	1	3	0
38	Mistakes with soil investigations	0	0	2	4	1
39	Delay in claim approval	0	1	0	6	0

Appendix B: Consultant's responses for top root causes of schedule delay

No	Major causes for schedule delay	Frequency Analysis (FA)				
		1	2	3	4	5
1	Underestimation of cost of projects	0	0	0	3	3
2	Delay in honoring payment certificates	0	0	0	2	4
3	Underestimation of complexity of projects	0	0	0	4	2
4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0	0	1	1	4
5	Difficulty in accessing Bank credit	1	1	3	1	0
6	Poor supervision	0	0	0	1	5
7	Poor Professional Management	0	0	0	2	4
8	Fluctuation of prices	1	3	2	0	0
9	Underestimation of time for completion by contractors	0	0	0	4	2
10	Lack of effective managing and controlling subcontractor	0	0	0	6	0
11	Extreme quantity changes to meet field condition	0	0	0	2	4
12	Construction methods	0	1	3	1	1
13	Delay in instructions from consultants	1	0	1	4	0
14	Shortage of unskilled labor	6	0	0	0	0
15	Poor management of the project changes	0	0	2	4	0
16	Late deliveries of materials	3	1	2	0	0
17	Poor management of project site	0	0	1	3	2
18	Lack of Program of Works	0	1	4	1	0
19	Delay by sub-contractors	0	0	1	5	0
20	Poor design	0	0	0	0	6
21	Breakdown of construction equipment's	4	2	0	0	0
22	Client initiated variations	4	1	1	0	0
23	Obtaining permit from municipality	6	0	0	0	0
24	Insufficient communication between parties	0	0	0	4	2

25	Public holidays	0	0	0	4	2
26	Shortage of skilled labor	0	1	2	3	0
27	Accidents during construction	2	2	2	0	0
28	Risk response planning prepared	2	3	1	0	0
29	Unskilled equipment operators	4	2	0	0	0
30	Discrepancy between design specification and standards	0	0	0	0	6
31	Dispute among contracting parties	0	0	3	3	0
32	Conflict in work schedule of contractor		1	1	4	0
33	The project completed on the original (planned) schedule	6	0	0	0	0
34	The project completed with the planned budget	6	0	0	0	0
35	Unfavorable Site conditions	0	0	5	1	0
36	Foundation conditions encountered on site	1	0	4	1	0
37	Bad weather conditions	1	2	2	1	0
38	Mistakes with soil investigations	0	1	4	1	0
39	Delay in claim approval	0	0	1	4	1

Appendix C: Contractor’s responses for top root causes of schedule delay

No	Major causes for schedule delay	Frequency Analysis (FA)				
		1	2	3	4	5
1	Underestimation of cost of projects	0	0	1	3	8
2	Delay in honoring payment certificates	0	0	0	2	10
3	Underestimation of complexity of projects	0	0	2	4	6
4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0	1	3	2	6
5	Difficulty in accessing Bank credit	1	2	8		1
6	Poor supervision	0	1	2	2	7
7	Poor Professional Management	0	1	1	3	7
8	Fluctuation of prices	1	4	3	3	1
9	Underestimation of time for completion by contractors	2	1	2	5	2
10	Lack of effective managing and controlling subcontractor	0	2	2	8	0
11	Extreme quantity changes to meet field condition	0	1	3	3	5
12	Construction methods	0	1	6	4	1
13	Delay in instructions from consultants	0	0	2	8	2
14	Shortage of unskilled labor	7	0	1	2	2
15	Poor management of the project changes	0	0	5	6	1
16	Late deliveries of materials	5	1	2	4	0
17	Poor management of project site	0	1	5	5	1
18	Lack of Program of Works	0	2	6	3	1
19	Delay by sub-contractors	0	1	3	6	2
20	Poor design	0	0		5	7
21	Breakdown of construction equipment’s	5	2	4	1	0
22	Client initiated variations	5	6	1	0	0
23	Obtaining permit from municipality	7	5	0	0	0

24	Insufficient communication between parties	0	3	2	6	1
25	Public holidays	4	1	2	4	1
26	Shortage of skilled labor	0	3	2	6	1
27	Accidents during construction	5	3	4	0	0
28	Risk response planning prepared	4	5	3	0	0
29	Unskilled equipment operators	5	4	1	2	
30	Discrepancy between design specification and standards	0	2	1	3	6
31	Dispute among contracting parties	0	4	4	4	0
32	Conflict in work schedule of contractor	0	5	3	4	0
33	The project completed on the original (planned) schedule	9	3	0	0	0
34	The project completed with the planned budget	8	3	0	1	0
35	Unfavorable Site conditions	0	2	8	2	0
36	Foundation conditions encountered on site	0	4	7	1	0
37	Bad weather conditions	0	3	5	4	0
38	Mistakes with soil investigations	0	3	5	3	1
39	Delay in claim approval	0	0	4	6	2

Appendix D: Overall responses for top root causes of schedule delay

No	Major causes for schedule delay	Overall Frequency Analysis (FA)				
		1	2	3	4	5
1	Underestimation of cost of projects	0	1	1	11	12
2	Delay in honoring payment certificates	0	0	0	7	18
3	Underestimation of complexity of projects	0	0	3	12	10
4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor	0	1	6	6	12
5	Difficulty in accessing Bank credit	2	4	15	1	3
6	Poor supervision	0	2	6	3	14
7	Poor Professional Management	0	1	2	8	14
8	Fluctuation of prices	2	9	7	6	1
9	Underestimation of time for completion by contractors	2	2	2	10	9
10	Lack of effective managing and controlling subcontractor	1	2	4	17	1
11	Extreme quantity changes to meet field condition	0	2	3	9	11
12	Construction methods	0	3	12	6	4
13	Delay in instructions from consultants	1	0	4	14	6
14	Shortage of unskilled labor	16	0	1	4	4
15	Poor management of the project changes	0	0	7	15	3
16	Late deliveries of materials	8	3	6	7	1
17	Poor management of project site	0	0	7	9	9
18	Lack of Program of Works	0	3	13	5	4
19	Delay by sub-contractors	0	2	7	14	2
20	Poor design	0	0	0	9	16
21	Breakdown of construction equipment's	11	5	5	3	1
22	Client initiated variations	10	11	2	1	1
23	Obtaining permit from municipality	16	5	1	3	0

24	Insufficient communication between parties	0	3	2	15	5
25	Public holidays	5	3	3	11	3
26	Shortage of skilled labor	0	4	4	13	4
27	Accidents during construction	8	7	9	1	0
28	Risk response planning prepared	8	8	6	2	1
29	Unskilled equipment operators	10	8	3	3	1
30	Discrepancy between design specification and standards	0	2	1	7	15
31	Dispute among contracting parties	0	4	10	8	3
32	Conflict in work schedule of contractor	0	6	6	11	2
33	The project completed on the original (planned) schedule	20	4	0	0	1
34	The project completed with the planned budget	18	5	0	2	0
35	Unfavorable Site conditions	0	4	15	6	0
36	Foundation conditions encountered on site	2	6	14	3	0
37	Bad weather conditions	3	6	8	8	0
38	Mistakes with soil investigations	0	4	11	8	2
39	Delay in claim approval	0	1	5	16	3

Appendix E: List of low volume rural road projects for the study

(Taken from Jimma Zone Roads Authority Bureau of Various Contract Agreements (2016))

S.N	Projects	Length (Km)		Design Condition	Consultant	Contractor	Client	Contract amount (Birr)	Executed (Birr)	Remark
		Plan	Executed							
1	Afata – Omo – Cala	6.40	5.57	2	HAD	TEZDA	JZRA	3,671,548	3,157,531.08	
2	Ako – Jato	11	9.70	2	HAD	TEZDA	JZRA	4,520,310	4,023,075.90	
3	Angech – Bore	12	12	2	GIBE	GRDN	JZRA	2,051,375	2,051,375	Case Study
4	Anja – Masa	9.80	9.80	2	GIBE	TWO.H.T.	JZRA	4,410,972	4,410,972	Case Study
5	Asab – Bari	36	30.60	2	HAD	TEZDA	JZRA	34,540,000	29,704,400	
6	Bake – Gudo	20	18.60	2	GIBE	TWO.H.T.	JZRA	14,375,164	13,512,654.16	
7	Balla –Wago – A/Diko	23	20.47	2	BEKTER	YECHALAL	JZRA	12,791,482	11,512,333.80	
8	Bula – Wadiko	8	7.44	2	KIT	WAMA	JZRA	6,921,479	6,436,975.47	
9	D/Qabesa – T/Gubeta	14	11.90	2	G & B	HIYAW	JZRA	8,921,743	7,940,351.27	
10	Dache – Gibe - Bonay	6.30	5.42	2	REIMNA	NABUT	JZRA	3,080,150	2,648,929	
11	Dimtu – Afata	8	7.36	2	BEKTER	TANT	JZRA	3,895,130	3,505,617	
12	Ganbo – Migira	9	7.83	2	GIBE	GRDN	JZRA	5,021,379	4,469,027.91	
13	Girma – Kombolcha	7	6.02	2	HAD	SABSAHARA	JZRA	5,321,795	4,683,179.60	
14	H/Qarsu – Q/Subi	14	12.18	2	HAD	EYOHA	JZRA	8,941,922	7,779,472.14	
15	Hane – Do'o	19.80	19.80	2	GIBE	GRDN	JZRA	5,750,321	16,090,248	Case Study
16	Leku – Migira	11	9.35	2	GIBE	TWO.H.T.	JZRA	5,820,310	5,005,466.10	
17	Marab – Kallacha	9.50	8.17	2	HAD	EYOHA	JZRA	6,751,392	5,941,224.96	
18	Raga – Gabera	16	15.36	2	HAD	TEZDA	JZRA	8,953,410	8,326,671.30	
19	Sarbo – Kallacha	12	11.52	2	KIT	SMES	JZRA	8,342,156	7,925,048.20	
20	Sarbo – Kallacha	12	11.64	2	EDEAB	BIFTUBEHA	JZRA	8,317,297	8,150,951.06	
21	Sarbo – Kusaye - Beru	16	15.04	2	HAD	EYOHA	JZRA	12,475,320	11,726,800.80	
22	Serbo –Busa- Bechane	17.50	16.27	2	HAD	SABSAHARA	JZRA	13,175,952	12,121,875.84	
23	Serbo –Karagora	14	13.85	2	HAD	EYOHA	JZRA	8,795,247	8,619,342.06	
24	Yukkiroo – Q/Qimbibit	10	9.70	2	ABT	JIREN	JZRA	7,941,251	7,623,600.96	
25	Tele – Masa	17.20	17.20	2	GIBE	TWO.H.T.	JZRA	8,051,397	13,492,843	Case Study
26	Toli – Gasera	8.01	8.01	2	GIBE	GRDN	JZRA	3,651,792	3,651,792	Case Study
27	Walla – Kella	16	13.92	2	NABUT	WANKO	JZRA	13,241,792	11,255,523.20	

QUESTIONNAIRE

JIMMA UNIVERSITY

JIMMA INISTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

MASTER OF SEINCE PROGRAM IN CIVIL ENGINEERING

Dear Responders,

This questioner is 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: A Case study Jimma zone district**".

The purpose of this study is to analyze the current trends of planning and scheduling in the Low Volume Road projects and identify the problems in it, then finally to provide possible solutions to the problems raised with respect to the practical approaches of the stakeholders in the sector. Therefore, your honest response to this questioner will greatly help to identify the current planning and scheduling practices of road constructing companies 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.

For further questions pertaining to this research, please contact Jimma University Institute of Technology (JiT), school of Civil and Environmental Engineering.

Very Truly Yours,

Thanks for your successful cooperation!

By: Abraham Kebede

Mobile: 09 12 74 74 73

Email: *abrish211@yahoo.com*

Principal Advisor: Prof. Emer T. Quezon

Co-Advisor: Engr. Alemu Mosisa

PART 1. Basics of planning and scheduling

1. How long do you have experiences in relations to the preparations of road construction planning and scheduling?

a) _______years in client's role

b) _______years in the engineer's role

c) _______ years in the contractor's role

2. Do you have standard procedure to plan and schedule Low Volume Road construction project's activities?

☐Yes ☐No

3. What are the common trends in the preparations of plan and schedule to the project executions? (Low Volume Road projects)

____

____

____

____

4. Do the plan and schedule often executed without delays?

☐yes ☐no

5. Do you assess risks to the Low Volume Road project construction in planning and schedule stage? ☐yes ☐no

If yes elaborate ____

____

____

PART 2. The following top major causes in planning and scheduling delays in low volume road construction project activities from your experience of the sector the following tables are to be filled by you**.** Please also answer all the questions to enhance the objectivity of the research.

Top major causes of schedule delays in low volume road constructions.

No	Major causes for schedule delay	Scale				
		strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**strongly agree (5)**
1	Underestimation of cost of projects					
2	Delay in honoring payment certificates					
3	Underestimation of complexity of projects					
4	Lack of applying contractual tools (liquidated damage or acceleration of work) against subcontractor					
5	Difficulty in accessing Bank credit					
6	Poor supervision					
7	Poor Professional Management					
8	Fluctuation of prices					
9	Underestimation of time for completion by contractors					
10	Lack of effective managing and controlling subcontractor					
11	Extreme quantity changes to meet field condition					
12	Construction methods					
13	Delay in instructions from consultants					
14	Shortage of unskilled labor					
15	Poor management of the project changes					
16	Late deliveries of materials					
17	Poor management of project site					
18	Lack of Program of Works					
19	Delay by sub-contractors					
20	Poor design					

21	Breakdown of construction equipments					
22	Client initiated variations					
23	Obtaining permit from municipality					
24	Insufficient communication between parties					
25	Public holidays					
26	Shortage of skilled labor					
27	Accidents during construction					
28	Risk response planning prepared					
29	Unskilled equipment operators					
30	Discrepancy between design specification and standards					
31	Dispute among contracting parties					
32	Conflict in work schedule of contractor					
33	The project completed on the original (planned) schedule					
34	The project completed with the planned budget					
35	Unfavorable Site conditions					
36	Foundation conditions encountered on site					
37	Bad weather conditions					
38	Mistakes with soil investigations					
39	Delay in claim approval					

PART 3. The impacts of planning and scheduling of Low Volume Road projects

6. What kind of method do you use to represent the LVR project planning and scheduling?

Bar chart method______ Critical Path method________ S-Curve method_____ other's (...)

7. What are the common impacts of planning and scheduling in Low Volume Road projects you have worked?

- Delays_____________________
- Disruptions_________________
- Changes____________________

- Suspensions________________
- Terminations ______________
- If multiple____

8. Is there risk management strategy in low volume road construction project?
   - Yes __________
   - No __________
   - Some times____________

9. What is your opinion in risks associated with delay?
   - Avoidable __________________
   - Reducible and common.________
   - Transferable__________________
   - Combination of____

10. Is there a process of study on team of expertise other than participants of design concerning constructability of projects?_______________________________________

____

____

PART 4. Controlling to the planning and scheduling of the LVR projects

11. Did you confirm the delay of most of low volume road projects executed in Jimma zone district with regards to late completion of projects beyond the time granted in the contract?

Yes___________ No____________ sometimes__________

12. Did the actual cost of projects be more than the estimated cost?

Yes___________ No____________ Sometimes___________

13. Based on the types of the schedule impacts happened in the projects you have been working, who was/were the major reason/s to make schedule updates / rescheduling to happen?

   a. Change orders due to unforeseen circumstances
   b. Delay due to contractors
   c. Delay due to consultants
   d. Delay due to client
   e. Combinations of ____

General comments on the research

____

____

____

____

I sincerely appreciate your timely response and cooperation!