St. MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES

ASSESSMENT OF USING SCOPE AND TIME MANAGEMENT TOOLS AND TECHNIQUES IN ETHIOPIAN POWER TRANSMISSION PROJECTS

BY

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ADDIS ABABA/ETHIOPIA

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I, the undersigned, declare that this thesis is my original work. All sources of materials used for this thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher institution for the purpose of earning any degree.

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St. Mary's University College, Addis Ababa. **June 2017**

Confirmation

I confirm that this thesis has been advised by me and submitted for examination with my approval.

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Advisor Signature

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Acronyms and Abbreviations

EEP: Ethiopian Electric Power

GoE: Government of Ethiopia

CPM: Critical Path Method

CCM: Critical Chain Method

EPC: Engineering, Procurement, Construction

IPMA: International project management association

PMI: Project Management Institute

PERT: Program Evaluation and Review Technique

PRINCE: Projects in controlled environment

APM: Association for Project Management

WBS: Work Breakdown Structure

RUI: Relative Use Index

PMTT: Project Management Tools and Techniques

PSM: Project Scope Management

PTM: Project Time Management

PTP: Power Transmission Project

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Abstract

The application of Project Management Tools and Techniques (PMTT) will have potential benefits for increased efficiency, improved project predictability, increased stakeholders confidence, improved communication, and increased probability of project success. Proper management of project scope and time tools and techniques can help project success with standard expectations. However, in most cases the Ethiopian Power Transmissions Projects do not seem making their deadlines. The objective of this paper is to investigate the extent to which project scope and time management tools and techniques are used in power transmission projects in Ethiopia. The study employed descriptive and explanatory research design using primary and secondary data. The data for this study was obtained through questionnaires and interviews. The survey questions were distributed to 60 client, consultant and contractor professionals working on Ethiopian power transmission projects. The respondents were selected using expert and purposive sampling techniques. Interviews were conducted with two project managers to triangulate and supplement the data obtained from the questionnaires. The responses were analyzed and interpreted using SPSS analytical tools. The results of the findings of the study indicated that scope and time management tools and techniques are not effectively utilized for Ethiopian Power Transmission Projects. Based on the findings the conclusion drawn is the constraints for keeping usage of scope and time management tools and techniques to low level are management, organizational, and human. Based on the findings it is recommended companies in power transmission projects address the constraints to make use of customized scope and time management tools and techniques. The results of the study will help companies involved in power transmission projects to improve their level of using project scope and time management tools and techniques and the study lays foundation for further researches. Hence the result of this study will be communicated to companies involved in Power Transmission projects in Ethiopia.

***Key words**: Project scope management, Project time management, Relative Use Index, Tools and techniques of project management.*

CHAPTER ONE: INTRODUCTION

1.1. Background of to the study

When we say construction (Windapo, 2013) what commonly comes in mind is construction of buildings (from small to high rising), construction of roads, bridges, dames etc. essentially such construction works can be categorized as civil works (Construction Industry, 2017) but electromechanical erection is also construction. Electromechanical construction mostly contains erection of electromechanical devices, civil works and structures to support them. But both are constructions. For the electromechanical construction erection is the right terminology. In erection activities the equipment to be installed are manufactured at some other place transported and installed on the civil or mechanical structure prepared to support them. The pure civil construction and erection works have differences and similarities. For cases where they have common similarities researches done on civil works constructions are shared by electromechanical construction projects.

Most of power transmission projects in Ethiopia are constructed by Ethiopian Electric Power/EEP/, a project based organization (PMI, 2000). Private owners construct transmission lines and substations for supplying electric power for their industries and services they deliver. But such projects are few in number. Power transmission projects are mostly financed by foreign banks and Government of Ethiopia (GoE).

To realize power transmission projects, as a phase deliverable, first feasibility study is made (PMI, 2000). The feasibility study contains both technical and financial feasibility etc. Once the feasibility study is completed, searching for the finance required is made. Taking the case of Ethiopia, due to the low industry level, all of the electro mechanical equipment are supplied from abroad making the foreign currency requirement too stringent.

Once the finance required, both foreign and local is sourced out and secured, which could be from GoE or foreign financer be it in the form of soft loan and/or donation, consultant is employed to work as project Engineer.

According to the current prevailing EEP practices mostly a foreign consultant is employed. There are cases where EEP engineering department is assigned to work as consultant. Foreign consultants are employed through International competitive bids (ICB).

Once the consultant is put in place, bids are prepared by the consultant jointly with client mostly EEP. The bids are floated inviting potential contractors to participate. Bids document submitted by interested contractors are evaluated and the contractor found qualified both for the technical and financial/bid with lowest price/requirements is nominated and approved by the respective authorized body (Levine, 2002). This is followed by signing of the contract agreement with the prospective contractor. Signing of the contract agreement with the contractor is one major milestone in power transmission projects life cycle. Once the contract is signed the project starts passing through initiation, planning, implementation, control & monitoring and finally closing phases of the project life cycle.

The contract (FIDIC, 2010) agreement among others contains the cost the contractor is paid and the time period with which the contractor has to complete the power transmission project. Most of the time project performance is lower than what is planned based on the contract agreement. Close investigation of the performance of power transmission projects depicts that majority of the projects are not completed within the time frame agreed, there are time overruns. Some of the projects face cost overrun and some have quality problems.

The construction industry is so diversified and each constituent inherently contains its own specific features that make it different from the other. Even though done in developed countries, many researches addressing low performance, time and cost overruns issues are done on the civil works construction projects.

H.Yiman (2011) quoting Idoko (2008) noted, **"**…many projects in developing countries encounter considerable time and cost overruns, fail to realize their intended benefit or even totally terminated and abandoned before or after their completion …"

Researches made on electromechanical erection projects are not so much compared to civil works construction projects. Researches done on the electromechanical projects in developing countries like Ethiopia are even very few.

Researches made to assess why electromechanical projects suffer time delays, cost overruns and recommendations given to reduce these problems have numerous advantages for all stakeholders involved in the projects. If failure to meet planned performance levels that are seen in Power Transmission Projects in Ethiopia are not given due considerations projects suffer time and cost overruns the country will keep on losing huge amount of resources that might have been used to support other development agendas.

Years of research and development made in project management has produced best practices, standards tools and techniques that are given as body of knowledge areas. According to (PMI,

2013), there are ten knowledge areas given as best practices that assist to enhance project performances. Lack of knowledge and awareness of the importance of customized project scope and time management tools and techniques are still major obstacles toward the efficient utilization of such tools. This thesis is attempting to assess only the application of project scope and time management tools and techniques on power transmission project in Ethiopia particularly in EEP.

Several project management professional organizations have sprouted around the world. In general, these organizations have served to improve the practice of project management by establishing standards, guide lines, and certifications, and have advanced project management from being a simple title or role to a recognized, respected profession. Among the more well-known organizations IPMA (Internationals Project Management Associations), the UK's APM Group (Association for Project Management) and the PMI (Project Management Institute). In 1985, PMI- the largest of these organizations – gathered up all the known, accepted best practices in the profession and later published those in a document called A Guide to the Project Management Body of Knowledge (PMBoK). (Nicholas & Steyn, 2008)

Figure 1.1 Facilities for Power Transmission

Transmision Line.
Source:techportal.eere.energy.gov

Substation.
Source: www.innovative.co,nz

Before reaching the end user, electric power passes through three major processes. Electric Power Generation, Electric power Transmission (Figure 1.1) and Electric Power distribution (Butter, 2001). Electric Power Transmission is the process by which large amounts of electricity from the generating station are transported over long distances for eventual use by consumers. The three major components generation, transmission and distribution are realized through projects that could broadly be classified as construction. Due the specific nature of the industry, the first is

generation the second transmission and the third one distribution. All of these facilities are implemented through projects. In construction of generating stations there are lot of civil works like dam construction, generator and turbine houses, tunnels etc. In addition to the civil works construction of hydropower stations involve the erection of electrical, mechanical and hydro mechanical equipment. Similar to the hydropower power transmission projects involve the civil works and erection of electrical, mechanical equipment.

In most of the cases Electric Power Generating stations are built far away from electric power end users. In the electric power transmission high voltage/HV/ transmission lines are used to transport the bulk electric power from generating stations while the substations are transforming the transmission voltages to medium voltage/MV/ distributions. The medium voltage distributions is further transformed to low voltages/LV/ for supplying electric power to the end users.

Figure 2.3 shows a model for the implementation of power transmission projects. This study is made only on the last box where the project is implemented.

1.2. Statement of the Problem.

Scope and time management in power transmission projects are key factor for project success. In power transmission projects, Figure 2.3 scope definition and estimation of the required time are carried out during the pre-planning phase, which is a period that requires investing a substantial amount of time and resources in activities leading to the final investment decision. Even though this pre-planning phase is an effective way of increasing the chances of project success while significantly decreasing the risks that could arise during project implementation it is observed that power transmission projects in Ethiopia are not completed within stipulated time facing many problems such as extension of time leading to time overruns.

Ineffective utilization of scope and time management tools and techniques like WBS, contemporary scheduling techniques are not the only ones but are among the problems. Low project management capacity, low project maturity level of clients and contractors are possible causes of ineffective application of scope and time management tools and techniques. Extension of time, project time overruns affect both contractors and clients. Due to project time overruns contractors face mainly cost overruns, losing huge amount of money paying for Liquidated Damages (LD), lose credibility and this is negatively affecting contractors' image. Client may penalize the contractor for its failure to deliver the Power Transmission Project timely but there are consequential effects like postponing other development agendas which affect the country at large.

The literature on project management tools and techniques still has gap since it is treated with universal approach that does not consider the specific real situations of the project under study to achieve its goals successfully. Moreover, despite the wide spread utilization of modern Project Scope and Time Management Tools and Techniques in various projects across many countries these Tools and Techniques are not effectively utilized in Ethiopian Power Transmission Projects. This research is made as part of the effort made fill this gap.

Conceptually, integrating theory of stakeholders, theory of complexity, theory of construction management and theory of constraints with project management, project life cycle, project management maturity level and project scope and time management tools and techniques customized to specific condition consequently enhance Power Transmission Project performances.

1.3. Basic Research Questions.

1. To what extent are project scope and time management tools and techniques effectively utilized in power transmission projects in Ethiopia?
2. What are the constraints related to the application of project scope and contemporary time management tools and techniques in Power Transmission Projects in Ethiopia?
3. What structure, policy and procedure can be put in place for the effective use of contemporary scope and time management tools and techniques?

1.4. Objective of the Study.

1.4.1. General objective of the study.

To assess how and to what level contemporary project scope and time management tools and techniques are applied in Power Transmission Projects in Ethiopia. Investigate the issues related to project scope and time management. Explore the current practices of project time and scope management.

1.4.2. Specific objectives of the study:

1. To assess to what level to what level project scope and time management tool and techniques are effectively utilized in power transmission projects.
2. To assess the constraints for the using scope and contemporary time management tools and techniques.

3. To assess the need for government or public institution for supporting the effective implementation of modern project management in Ethiopia.

1.5. Definition of terms.

Project Scope: The work that needs to be accomplished to deliver a product, service, or result with the specified features and functions (PMI, 2013)

Project time management: Refers a component of overall Project Management in which a timeline is analyzed and developed for the completion of a project or deliverable.

Electric Power Transmission: is the bulk power movement of electric energy from a generating site, such as power plant, to an electric substation.

Work breakdown structure (WBS): is a deliverable oriented decomposition of a project into smaller components.

Activity: individual works that constitute the project.

Duration: The numbers of minutes, hours, days, months, or years use to complete an activity in a project.

Stakeholder: According to the Project Management Institute (PMI), the term project stakeholder refers to, 'an individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project' (PMI, 2013, p. 30).

Transmission Line: An overhead power line is a structure used in electric power transmission and distribution to transmit electric energy along a large distances. It consists of one or more conductors (Commonly multiples of three) suspended by towers or poles

Substations: A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions.

Prequalification: Preliminary stage in a bidding process where it is determined if an applicant has the requisite resources and experience to compete the job required.

1.6. Significance of the study

The result of the study will be important to public and private enterprises who are undertaking Power Transmission Projects. The study will create awareness on the importance of the application of project scope, time management tool and techniques to enhance the project performance. Even though the research focuses on Power Transmission Projects, the findings and the outcome could be relevant to practitioners in other industries with particular emphasis at the various stages involved in Project Scope and Time Management.

1.7. Delimitations/Scope of the study.

Due to time limitations, availability of data, and financial constraints the study is limited only to actively running Power Transmission Projects undertaken by Ethiopian Electric Power/EEP/. Power Transmission Projects undertaken by companies other than EEP and projects that are not active in the current fiscal year are not included in the study. The thesis is also limited only to the assessment of Project Scope and Time Management Tools and Techniques using data gathered through questionnaires and interviews. The research design is mainly descriptive and other data collection tools and other design methods are not employed. Due to time and data availability constraints and involvement of many variables impact assessment on the implementation of scope and time management tools and techniques is not done.

1.8. Organization of the Research Report.

This research paper is organized in five chapters. The first chapter deals with the introduction, background of the study, statement of the problem, objectives of the study, definition of terms, significance of the study, scope/delimitation of the study and limitations of the study.

The second chapter contains review of related literature. Chapter three focuses on the research methodology, data collection and procedures, sample and sampling techniques; whereas the fourth chapter presents interpretation of data, summary analysis and discussion. The fifth chapter presents Conclusions and recommendations.

CHAPTER TWO: LITERATURE REVIEW

This section of the study reviewed literatures that provided the application of project scope and time management in general and include details of effective utilization of Project scope and time management tools and techniques in particular to enhance Power Transmission Project performances.

2.1. Project.

> "A project is a temporary endeavor undertaken to create a unique product, service, or result. Project has a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists." (PMI, 2013, p. 2)
>
> "A project is a one-time, multitask job with a definite starting point, definite ending point, a clearly defined scope of work, a budget, and usually a temporary team." (Lewis, 2004, p. 5).

Kohli & Chikatra (2012) Quoting ISO 10006 which defines project as a unique process, consists of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources.

2.2. Project management.

> "Project management deals with *tools*, *people*, and *systems*. The tools are work breakdown structures, PERT scheduling, earned value analysis, risk analysis, and scheduling software (to name a few). And tools are the primary focus of most organizations that want to implement project management. However, the tools are a necessary but not sufficient condition for success in managing projects. So, what is project management? I define it as facilitation of the planning, scheduling, and controlling of all activities that must be done to meet project objectives." (Lewis, 2004, p. 11)

Kohli (2012) says, the British Standard BS 6079:2000, defines project management as "the planning, monitoring and controlling of all aspects of a project and the motivation of all those involved in it to achieve the projective objectives on time and to the specified cost, quality and performance". Project management, according to ISO 10006:1997(E), includes "the planning, organizing, monitoring and controlling of all aspects of the project in a continuous process to achieve its objectives". The project management Institute of USA, describes project management

as the application of knowledge, skills, tools and technology to project activities to meet project requirements" (Kohli & Chikatra, 2012, p. 13).

In context, project management is the art and science of managing all aspects of the project to achieve the project mission objectives, within the specified time, budgeted cost and pre-defined quality specifications; working efficiently, effectively and ethically in the changing project environment.

Wysocki (2012) argues, to me the answer to our management difficulty is obvious. Project managers must open their minds to the basic principles on which management is based so as to accommodate change, avoid wasted dollars, avoid wasted time, and protect market positions.

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of 47 logically grouped project management processes (PMI, 2013). The 47 project management processes identified in the *PMBOK Guide* (PMI, 2013) are further grouped into ten separate Knowledge Areas and five process groups of project management life cycle. The ten Knowledge Areas of PMI are Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management and Project Stakeholder Management.

All the ten project management body of knowledge areas are applicable and assist a lot to enhance the performance and complete Power Transmission Projects within time, cost and required quality. Project management is the discipline of planning, organizing, securing, managing, leading, and controlling resources to achieve specific goals. A project is a temporary endeavor with a defined beginning and end undertaken to meet unique goals and objectives, typically to bring about beneficial change or add value. The primary challenge of project management is to achieve all of the project goals and objectives respecting primarily scope, time, quality and budget constraints.

2.3. Project Life cycle.

Before any project is actually realized it has to pass through various planning phases. There tends to be a natural sequence in the way projects are planned and carried out and the different phases through which this project passes constitutes what is often called "the project life cycle" (Bogale

& Nigussei, 2014, p. 34). There are various models that deal with the project life cycle. These project cycle models differ in their perspective, emphasis and level of detail. The basic models are: The Baum's (World Bank procedures), The UNIDO and European commission's project cycle (Bogale & Nigussei, 2014). The three project cycles contain the following processes.

1. The Baum cycle (World Bank Procedures).

a. Identification b. Preparation c. Appraisal and Selection d. Implementation e. Evaluation

2. UNIDO Project cycle.

a. The pre-investment b. The investment c. The operational phases

3. European commission Project Cycle

a. Programming b. Identification c. Project formulation and appraisal d. Financing

e. Implementation f. Evaluation and Audit

Wysocki (2012) in his book entitled, Effective Project Management, Traditional, Agile, Extreme indicates one-size-fits-all approach to project management does not work and has never worked saying it is far more effective to group projects based on their similarities and use a project management approach designed specifically for each project type. There is no single ideal project life cycle that will apply to all projects (PMI, 2013). Most of the literatures including that of PMI group project life cycle into five phases i.e., Initiation, planning, execution, monitoring and control, and closing phases. According to (PMI, 2013) project phases are used when the nature of the work to be performed is unique to a portion of the project ending in the completion of one or more deliverables. It is important to have project life cycle that best fit power transmission projects.

2.3.1. Project Life Cycle Methods.

According to (WLC, 2008), during the 80s and early 90s, the waterfall model was the de-facto in project delivery. With the rapid pace in software development and popular use of the internet, many companies started shifting to more flexible life cycles such as the iterative, incremental, spiral, and agile. These new life cycle methods provide more flexibility and support fast-paced development, giving companies the edge in delivering "the first" in the industry. To date, there are dozens of life cycle methods available to choose from, each having its own advantages and disadvantages. Here are some of the more popular project life cycles methods.

2.3.1.1. Waterfall.

Waterfall is traditional project life cycle method has been around for decades and has proven its ability to deliver. Waterfall is defined as a sequential development model with clearly defined

deliverables for every phase (WLC, 2008). Many industry practitioners are strict in performing audit reviews to ensure that the project has satisfied the input criteria before continuing to the next phase.

2.3.1.2. Iterative, Incremental.

According to (WLC, 2008): The main objective of iterative development is to build the system incrementally, starting from basic partial system features and gradually adding more features until the entire system is completed. Compared to waterfall, iterative development allows flexibility in accommodating new requirements or changes thereof. It also provides room for improvement in succeeding iterations based on lessons learned from previous iterations.

2.3.1.3. Agile.

Agile methodologies arose from the need to develop software applications that could accommodate the fast-paced evolution of the Internet (WLC, 2008). Agile is, in some way, a variant of iterative life cycle where deliverables are submitted in stages. The main difference is that agile cuts delivery time from months to weeks. Companies practicing agile are delivering software products and enhancements in weeks rather than in months. Moreover, the agile manifesto covered development concepts aside from the delivery life cycle, such as collaboration, documentation, and others.

2.3.2. Choice of Project Life Cycle method.

One of the biggest factors that dictate the choice of a life cycle method is the clarity and stability of the project requirements. Frequent changes in requirements after the project has started can derail project progress against the plan. In such cases, choose agile or iterative approach because each provides an opportunity for you to accommodate new requirements even after the project has started (WLC, 2008). On the other hand, if you are engaged in a more traditional project development where there is a stiff rule on ensuring complete set of requirements before going on to the next phase, waterfall would be your choice. However, such traditional projects are becoming less and less common as companies realize the benefits of using a more agile method of managing projects.

Which life cycle and life cycle method will work best for a power transmission project? Thinking about delayed deliveries, unhappy clients and stakeholders, project time and cost overruns it is a strategic question to choice the right project life cycle and method. Other than the traditional practices depicted in Figure 2.3 the researcher has not come across any study made to identify the

type of project life cycle and project life cycle method customized to best fit power transmissions projects.

2.4. Project Scope Management.

Plan scope management is a process that is taking place throughout the project life cycle. According to (PMI, 2013) Project Scope Management contains plan scope management, collect requirements, define scope, create work breakdown structure, validate scope and control scope processes.

2.4.1. Plan Scope Management.

Plan Scope Management is the process of creating a scope management plan that documents how the project scope will be defined, validated, and controlled (PMI, 2013). The key benefit of this process is that it provides guidance and direction on how scope will be managed throughout the project. Managing the scope of a project is the most important function of a project manager.

Construction projects in specific bring different degrees of changes on the surrounding environment and people that may trigger redefining project definition boundaries subjected to differing expectations and interpretation by different stakeholders. Project scope definition practices can benefit from stakeholders' management procedural justice and participation theories to bring together the two domains (Fageha & Aibinu, 2013).

2.4.2. Work Breakdown Structure

The project management institute defines the WBS as "Representing the sum total decomposition of all work that the project encompasses, from beginning to end" (PMI, 2013). Creating WBS is the process of subdividing project deliverables and project work into smaller, more manageable components. Once a project is accepted and approved by the competent authority, an important initial step in its implementation process is to prepare a work-break down structure for the project (Goel, 2002).

Work Breakdown Structure is essential as part of project's lifecycle and timeline. As important part of project planning, the WBS begins with a hierarchy of tasks and levels that help to identify how the project will flow within a designed timeline set for the project.

The sub-division of a project into smaller and smaller components facilitates planning and management of the project is referred to as Work Breakdown Structure (Woldemichael, 2013). It is the hierarchical breakdown of the total work contents of the project for use in planning and

controlling the project. It gives a full picture of the entire work and the relationships between the parts.

Woldemichael (2013) Quoting (Wysocki and McGary(2003, P:85) give six criteria to test the completeness of WBS for a project:

- The completion of an activity must be proven in measureable value. The status of an activity at any one point in time should be expressed quantitatively.
- There ought to be defined start and finish times of the work contents or events for each activity means work on the activity begins and the finish point indicates work on the activity is closed and for the activity some kind of output is produced.
- At the completion of an activity there is a concrete output called deliverable.
- Time and cost for the activity must be concretely and reliably estimated.
- There may have to be an acceptable level of activity duration without necessarily ruling out exception.
- Each activity ought to be performed independently and with no interruption.

The WBS of every project requires that all activities meet these testing criteria for the effective management of the project (Woldemichael, 2013).

Norman, Brotherton, & T. Fried (2008) Quoting (Halli 1993) says today, Project Managers are more frequently finding high value in the creation of Work Breakdown Structures as they begin the process of project management. Project success may be attributed specifically to use of a WBS.

Norman et al., (2008) Argue, in spite of the fact that WBS ensures clear definition and communication of project scope, while at the same time it performs a critical role as a monitoring and controlling tool, little is written about WBS.

According to Norman et al., (2008, p. 2)"…*The WBS is a foundational project management component, and as such is a critical input to other project management processes and deliverables such as activity definitions, project schedule network diagrams, project and program schedules, performance reports, risk analysis and response, control tools or project organization.*"

2.4.2.1. Scope Baseline

The scope baseline is the approved version of a scope statement, work breakdown structure (WBS), and its associated WBS dictionary, that can be changed only through formal change control procedures and is used as a basis for comparison. It is a component of the project management plan (PMI, 2013):

2.4.2.2. WBS dictionary.

The WBS dictionary is a document that provides detailed deliverable, activity, and scheduling information about each component in the WBS (PMI, 2013). Information in the WBS dictionary may include, but is not limited to, code of account identifier, description of work, assumptions and constraints, responsible organization, schedule milestones, associated schedule activities, resources required, cost estimates, quality requirements, acceptance criteria, technical references, and agreement information.

2.4.3. Validate Scope.

Validate Scope is the process of formalizing acceptance of the completed project deliverables. The key benefit of this process is that it brings objectivity to the acceptance process and increases the chance of final product, service, or result acceptance by validating each deliverable (PMI, 2013). The verified deliverables obtained from the Control Quality process are reviewed with the customer or sponsor to ensure that they are completed satisfactorily and have received formal acceptance of the deliverables by the customer or sponsor. (PMI, 2013).

Management Knowledge Area, such as the requirements documentation or the scope baseline, as well as the work performance data obtained from the Execution processes in other Knowledge Areas, are the basis for performing the validation and for final acceptance.

The Validate Scope process differs from the Control Quality process in that the former is primarily concerned with acceptance of the deliverables, while quality control is primarily concerned with correctness of the deliverables and meeting the quality requirements specified for the deliverables. Control Quality is generally performed before Validate Scope, although the two processes may be performed in parallel (PMI, 2013).

2.4.3.1. Inspection

Inspection includes activities such as measuring, examining, and validating to determine whether work and deliverables meet requirements and product acceptance criteria. Inspections are sometimes called reviews, product reviews, audits, and walkthroughs. (Mishra & Soota, 2005).

2.4.3.2. Accepted Deliverables

Deliverables that meet the acceptance criteria are formally signed off and approved by the customer or sponsor. Formal documentation received from the customer or sponsor acknowledging formal stakeholder acceptance of the project's deliverables is forwarded to the Close Project or Phase process (Mishra & Soota, 2005).

2.4.3.3. Change Requests

The completed deliverables that have not been formally accepted are documented, along with the reasons for non-acceptance of those deliverables. Those deliverables may require a change request for defect repair. The change requests are processed for review and disposition through the Perform Integrated Change Control process (Mishra & Soota, 2005).

2.5. Project Time Management.

Time is the most precious asset available to man which cannot be stored, recovered or transferred. Every human activities uses time, but time is limited in supply i.e. we have only 24 hour in a day, 7 days a week etc. So the supply of time is perfectly inelastic, and due to this nature of time, need for optimal utilization of time is imperative (Nepal, 2014).

Delay or time overrun will affect all parties involved in the project. It will affect the profits which would be obtained if the project can be completed on the schedule. But due to the time overrun, contractors had to spend more money on labor, plant and may lose the opportunity to get the next project. Hence, effective time management is very important and crucial to achieve successful completion of construction projects (Aftab Hameed Memon, 2014).

There are many scheduling techniques available as well as many tools for reducing project duration which are being practiced since long time. But still data shows there are significant number of projects that exceeds the planned schedule. So it can be concluded that implementation of these tools and techniques alone, in isolation is not sufficient for gaining the benefits, it should be customized and well supported by good management practices, competent personnel, good organizational culture, supporting management and committed owner (Nepal, 2014).

Time is one of most critical resource in projects. It is also one of vital success criteria for every kind of projects. Time management in projects involves processes required to accomplish timely completion of projects (PMI, 2013).

Project Time Management includes the processes required to manage the timely completion of the project. Project time management contains plan schedule management, define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule and control schedule processes (PMI, 2013).

Different tools, techniques and frameworks had been developed to carry out these processes efficiently and effectively. From the range of tools and techniques one have to choose the tools that best fits for the organization and type of projects (Nepal, 2014).

This thesis will discuss some of these important tools and techniques and basic principles behind them.

2.5.1. Plan Schedule Management.

According to (PMI, 2013): The Plan Schedule Management process may involve choosing strategic options to estimate and schedule the project such as: scheduling methodology, scheduling tools and techniques, estimating approaches, formats, and project management software. The schedule management plan may also detail ways to fast track or crash the project schedule such as undertaking work in parallel. These decisions, like other schedule decisions affecting the project, may affect project risks.

Organizational policies and procedures may influence which scheduling techniques are employed in these decisions. Techniques may include, but are not limited to, rolling wave planning, leads and lags, alternatives analysis, and methods for reviewing schedule performance (PMI, 2013).

2.5.2. Define Activities.

The process of identifying and documenting the specific actions to be performed to produce the project deliverables. The key benefit of this process is to break down work packages into activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work (PMI, 2013).

Decomposition is a technique used for dividing and subdividing the project scope and project deliverables into smaller, more manageable parts. Activities represent the effort needed to complete a work package. The Define Activities process defines the final outputs as activities rather than deliverables, as done in the Create WBS process. The activity list, WBS, and WBS dictionary can be developed either sequentially or concurrently, with the WBS and WBS dictionary as the basis for development of the final activity list (PMI, 2000).

2.5.2.1. Activity List

The activity list is a comprehensive list that includes all schedule activities required on the project. The activity list also includes the activity identifier and a scope of work description for each activity in sufficient detail to ensure that project team members understand what work is required to be completed. Each activity should have a unique title that describes its place in the schedule, even if that activity title is displayed outside the context of the project schedule (PMI, 2013).

2.5.2.2. Activity Attributes

Activities, distinct from milestones, have durations, during which the work of that activity is performed, and may have resources and costs associated with that work. Activity attributes extend the description of the activity by identifying the multiple components associated with each activity. The components for each activity evolve over time. During the initial stages of the project, they include the activity identifier (ID), WBS ID, and activity label or name, and when completed, may include activity codes, activity description, predecessor activities, successor activities, logical relationships, leads and lags resource requirements, imposed dates, constraints, and assumptions. Activity attributes can be used to identify the person responsible for executing the work, geographic area, or place where the work has to be performed, the project calendar the activity is assigned to, and activity type such as level of effort (often abbreviated as LOE), discrete effort, and apportioned effort. Activity attributes are used for schedule development and for selecting, ordering, and sorting the planned schedule activities in various ways within reports (PMI, 2013).

2.5.2.3. Milestone List

A milestone is a significant point or event in a project. A milestone list is a list identifying all project milestones and indicates whether the milestone is mandatory, such as those required by contract, or optional, such as those based upon historical information. Milestones are similar to regular schedule activities, with the same structure and attributes, but they have zero duration because milestones represent a moment in time (PMI, 2013).

2.5.3. Sequence Activities.

Sequence Activities is the process of identifying and documenting relationships among the project activities. The key benefit of this process is that it defines the logical sequence of work to obtain the greatest efficiency given all project constraints (PMI, 2013).

Every activity and milestone except the first and last should be connected to at least one predecessor with a finish-to-start or start-to-start logical relationship and at least one successor with a finish-to-start or finish-to-finish logical relationship. Logical relationships should be designed to create a realistic project schedule. It may be necessary to use lead or lag time between activities to support a realistic and achievable project schedule. Sequencing can be performed by using project management software or by using manual or automated techniques (PMI, 2013).

According to (PMI, 2013):The precedence diagramming method (PDM) is a technique used for constructing a schedule model in which activities are represented by nodes and are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed. Activity-on-node (AON) is one method of representing a precedence diagram. This is the method used by most project management software packages. PDM includes four types of dependencies or logical relationships. A predecessor activity is an activity that logically comes before a dependent activity in a schedule. A successor activity is a dependent activity that logically comes after another activity in a schedule. These relationships are defined below.

- **Finish-to-start (FS).** A logical relationship in which a successor activity cannot start until a predecessor activity has finished. Example: The awards ceremony (successor) cannot start until the race (predecessor) has finished.
- **Finish-to-finish (FF).** A logical relationship in which a successor activity cannot finish until a predecessor activity has finished. Example: Writing a document (predecessor) is required to finish before editing the document (successor) can finish.
- **Start-to-start (SS).** A logical relationship in which a successor activity cannot start until a predecessor activity has started. Example: Level concrete (successor) cannot begin until pour foundation (predecessor) begins.
- **Start-to-finish (SF).** A logical relationship in which a successor activity cannot finish until a predecessor activity has started. Example: The first security guard shift (successor) cannot finish until the second security guard shift (predecessor) starts.

In PDM, finish-to-start is the most commonly used type of precedence relationship. The start-to-finish relationship is very rarely used but is included to present a complete list of the PDM relationship types (PMI, 2000).

2.5.3.1. Dependency Determination

According to (PMI, 2013): Dependencies may be characterized by the following attributes: mandatory or discretionary, internal or external, as described below. Dependency has four attributes, but two can be applicable at the same time in following ways: mandatory external dependencies, mandatory internal dependencies, discretionary external dependencies, or discretionary internal dependencies.

2.5.3.2. Leads and Lags

A lead is the amount of time whereby a successor activity can be advanced with respect to a predecessor activity. A lag is the amount of time whereby a successor activity will be delayed with respect to a predecessor activity. The project management team determines the dependencies that may require a lead or a lag to accurately define the logical relationship (PMI, 2013).

2.5.3.3. Project Schedule Network Diagrams

A project schedule network diagram is a graphical representation of the logical relationships, also referred to as dependencies, among the project schedule activities. A project schedule network diagram is produced manually or by using project management software. It can include full project details, or have one or more summary activities (PMI, 2013).

2.5.3.4. Precedence Diagramming Method (AON)

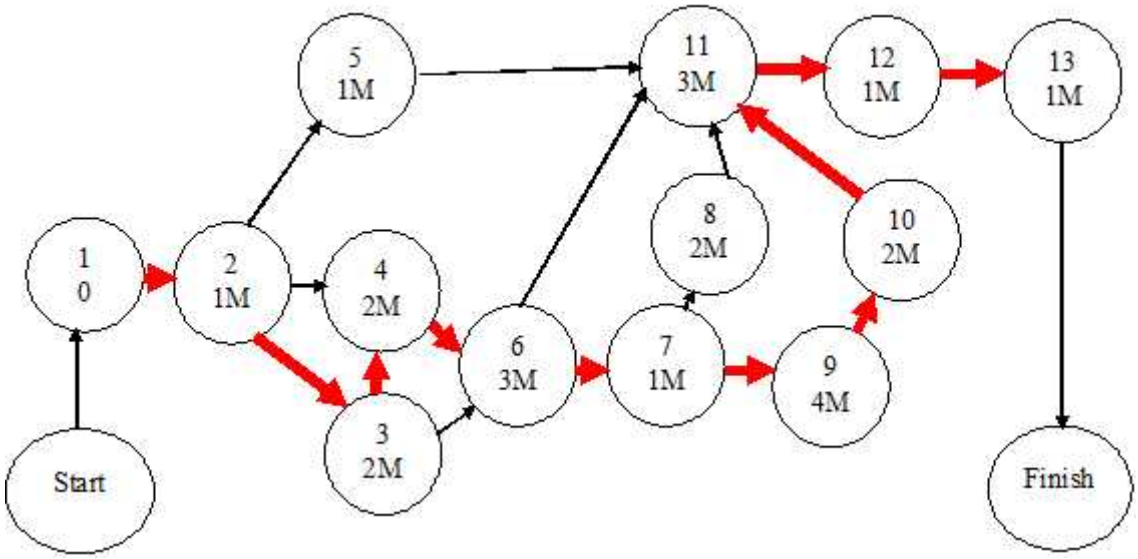
Precedence Diagramming Method (PDM) also called as Activity on Node (AON) is a method of constructing a project schedule network diagram that uses boxes or rectangles, referred to as nodes, to represent activities and connects them with arrows that show the logical relationship that exist between them (Tzu, 2007). Arrows only represent precedence relationships and events are not shown in this representation of network. This method is used by most of the project management software packages. Figure 2.1 shows a simplified representation of AON network for a typical PTP in Ethiopia.

Table 2.1 Activity and Activity Duration for a Typical PTP in Ethiopia

Activity No	Activity Name	Duration /Month/
	Start	
1	Contract Signature	0
2	Receipt of Advance payment	1
3	Electrical design	2
4	Civil design	2
5	Mobilization	1
6	Design review and approval	3
7	Purchase order/ prepare and issue/	1
8	Procure shelf items	2
9	Manufacturing	4
10	Procure manufactured items	2
11	Civil works	3
12	Electromechanical works	1
13	Test and commissioning and energization	1
	Finish	

Source: Own Survey 2017.

Figure 2.1 Simplified PTP Activity on Node Precedence Diagram (PDM)



Source: Own Survey 2017.

2.5.3.5. Precedence Diagramming Method (AOA)

Another method of schedule activities sequencing is Arrow Diagramming Method (ADM) also called as Activities on Arrows method (AOA) (PMI, 2000). In this method activities are mapped on arcs and nodes represents events. Arrows are used to represent activities and connects them at nodes to show their relationship. As compared to PDM it is less prevalent.

2.5.4. Estimate Activity Resources.

Estimate Activity Resources is the process of estimating the type and quantities of material, human resources, equipment, or supplies required to perform each activity. The key benefit of this process is that it identifies the type, quantity, and characteristics of resources required to complete the activity which allows more accurate cost and duration estimates (PMI, 2013).

Expert judgment is often required to assess the resource-related inputs to this process. Any group or person with specialized knowledge in resource planning and estimating can provide such expertise.

Bottom-up estimating is a method of estimating project duration or cost by aggregating the estimates of the lower-level components of the WBS. Project management software, such as a scheduling software tool, has the capability to help plan, organize, and manage resource pools and develop resource estimates. Depending on the sophistication of the software, resource breakdown structures,

resource availability, resource rates, and various resource calendars can be defined to assist in optimizing resource utilization (PMI, 2000).

2.5.5. Estimate Activity Durations.

Estimate Activity Durations is the process of estimating the number of work periods needed to complete individual activities with estimated resources. Estimating activity durations uses information on activity scope of work, required resource types, estimated resource quantities, and resource calendars. The inputs of the estimates of activity duration originate from the person or group on the project team who is most familiar with the nature of the work in the specific activity (PMI, 2013).

Expert judgment, guided by historical information, can provide duration estimate information or recommended maximum activity durations from prior similar projects. Expert judgment can also be used to determine whether to combine methods of estimating and how to reconcile differences between them.

Analogous estimating is a technique for estimating the duration or cost of an activity or a project using historical data from a similar activity or project. Analogous estimating uses parameters from a previous, similar project, such as duration, budget, size, weight, and complexity, as the basis for estimating the same parameter or measure for a future project. Analogous estimating is generally less costly and less time consuming than other techniques, but it is also less accurate (PMI, 2000).

The accuracy of single-point activity duration estimates may be improved by considering estimation uncertainty and risk. This concept originated with the program evaluation and review technique (PERT). PERT (PMI, 2013) uses three estimates to define an approximate range for an activity's duration:

- **Most likely** (*tM*). This estimate is based on the duration of the activity, given the resources likely to be assigned, their productivity, realistic expectations of availability for the activity, dependencies on other participants, and interruptions.
- **Optimistic** (*tO*). The activity duration based on analysis of the best-case scenario for the activity.
- **Pessimistic** (*tP*). The activity duration based on analysis of the worst-case scenario for the activity.

2.5.6. Develop Schedule.

Develop Schedule is the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model. The key benefit of this process is that by entering schedule activities, durations, resources, resource availabilities, and logical relationships into the scheduling tool, it generates a schedule model with planned dates for completing project activities (PMI, 2013).

Developing an acceptable project schedule is often an iterative process. The schedule model is used to determine the planned start and finish dates for project activities and milestones based on the accuracy of the inputs. Schedule development can require the review and revision of duration estimates and resource estimates to create the project schedule model to establish an approved project schedule that can serve as a baseline to track progress.

Once the activity start and finish dates have been determined, it is common to have project staff assigned to the activities review their assigned activities and confirm that the start and finish dates present no conflict with resource calendars or assigned activities in other projects or tasks and thus are still valid. As work progresses, revising and maintaining the project schedule model to sustain a realistic schedule continues throughout the duration of the project.

2.5.6.1. Bar Charts or Gantt Chart.

These charts, also known as Gantt charts, represent schedule information where activities are listed on the vertical axis, dates are shown on the horizontal axis, and activity durations are shown as horizontal bars placed according to start and finish dates. Bar charts are relatively easy to read, and are frequently used in management presentations. For control and management communications, the broader, more comprehensive summary activity, sometimes referred to as a hammock activity, is used between milestones or across multiple interdependent work packages, and is displayed in bar chart reports. (Levine, Practical Project Management Tips, Tactics, and Tools, 2002) Gantt bar chart or Gantt charts are one of the basic scheduling techniques. (Nepal, 2014) Quoting (What is Gantt chart? (2012) says Gantt chart is one of common and popular way of showing activities/ tasks/ events against time. It is named after an American engineer Henry Gantt, who modified the chart which was first devised by a Polish engineer Karol Adamiecki during mid-1890s. Gantt charts were primarily used as production planning tool used to plan and manage batch production in manufacturing industries and became popular in project management much later. (Wilson, 2003) Gantt charts establish a time-phased network, which links project

activities to a project schedule. Activities list are placed along the vertical axis while the horizontal axis shows the time and duration. Each activity is represented by a horizontal bar and the position and length of the bar indicates the start date, duration and end date of the activity. This allows to see different information at a glance, like, various activities, starting date and end date of each activities, duration of activities, where activities overlap with other activities and by how much and the start and end date of whole project.

2.5.6.2. Milestone Charts.

These charts are similar to bar charts, but only identify the scheduled start or completion of major deliverables and key external interfaces (Mishra & Soota, 2005).

2.5.6.3. Project Schedule Network Diagrams.

According to (Mishra & Soota, 2005): These diagrams are commonly presented in the activity-on-node diagram format showing activities and relationships without a time scale, sometimes referred to as a pure logic diagram. These diagrams, with activity date information, usually show both the project network logic and the project's critical path schedule activities. Another presentation of the project schedule network diagram is a time-scaled logic diagram. These diagrams include a time scale and bars that represent the duration of activities with the logical relationships. It is optimized to show the relationships between activities where any number of activities may appear on the same line of the diagram in sequence.

One A schedule presentations could be in the forms of (1) a milestone schedule as a milestone chart, (2) a summary schedule as a bar chart, and (3) a detailed schedule as a project schedule network diagram (Levine, 2002).

Schedule network analysis is a technique that generates the project schedule model. It employs various analytical techniques, such as critical path method, critical chain method, what-if analysis, and resource optimization techniques to calculate the early and late start and finish dates for the uncompleted portions of project activities (Mishra & Soota, 2005).

Some network paths may have points of path convergence or path divergence that can be identified and used in schedule compression analysis or other analyses.

2.5.6.4. Critical Path Method

The critical path method, is a method used to estimate the minimum project duration and longest path to determine the amount of scheduling flexibility on the logical network paths within the

schedule model. This schedule network analysis technique calculates the early start, early finish, late start, and late finish dates for all activities without regard for any resource limitations by performing a forward and backward pass analysis through the schedule network (Levine, 2002). The resulting early and late start and finish dates are not necessarily the project schedule, rather they indicate the time periods within which the activity could be executed, using the parameters entered in the schedule model for activity durations, logical relationships, leads, lags, and other known constraints. The critical path method is used to calculate the amount of scheduling flexibility on the logical network paths within the schedule model (PMI, 2013).

On any network path, the schedule flexibility is measured by the amount of time that a schedule activity can be delayed or extended from its early start date without delaying the project finish date or violating a schedule constraint, and is termed "total float." A CPM critical path is normally characterized by zero total float on the critical path. As implemented with PDM sequencing, critical paths may have positive, zero, or negative total float depending on constraints applied. Any activity on the critical path is called a critical path activity. Positive total float is caused when the backward pass is calculated from a schedule constraint that is later than the early finish date that has been calculated during forward pass calculation. Negative total float is caused when a constraint on the late dates is violated by duration and logic. Schedule networks may have multiple near-critical paths. Many software packages allow the user to define the parameters used to determine the critical path(s) (PMI, 2013).

Adjustments to activity durations (if more resources or less scope can be arranged), logical relationships (if the relationships were discretionary to begin with), leads and lags, or other schedule constraints may be necessary to produce network paths with a zero or positive total float. Once the total float for a network path has been calculated, then the free float the amount of time that a schedule activity can be delayed without delaying the early start date of any successor or violating a schedule constraint can also be determined.

2.5.6.5. Critical Chain Method

According to (PMI, 2013): The critical chain method (CCM) is a schedule method that allows the project team to place buffers on any project schedule path to account for limited resources and project uncertainties. It is developed from the critical path method approach and considers the effects of resource allocation, resource optimization, resource leveling, and activity duration uncertainty on the critical path determined using the critical path method. To do so, the critical

chain method introduces the concept of buffers and buffer management. The critical chain method uses activities with durations that do not include safety margins, logical relationships, and resource availability with statistically determined buffers composed of the aggregated safety margins of activities at specified points on the project schedule path to account for limited resources and project uncertainties. The resource-constrained critical path is known as the critical chain. The critical chain method adds duration buffers that are non-work schedule activities to manage uncertainty.

One buffer, placed at the end of the critical chain, is known as the project buffer and protects the target finish date from slippage along the critical chain. Additional buffers, known as feeding buffers, are placed at each point where a chain of dependent activities that are not on the critical chain feeds into the critical chain. Feeding buffers thus protect the critical chain from slippage along the feeding chains. The size of each buffer should account for the uncertainty in the duration of the chain of dependent activities leading up to that buffer. Once the buffer schedule activities are determined, the planned activities are scheduled to their latest possible planned start and finish dates. Consequently, instead of managing the total float of network paths, the critical chain method focuses on managing the remaining buffer durations against the remaining durations of chains of activities (Levine, 2002).

2.5.6.6. Resource Optimization Techniques

Examples of resource optimization techniques that can be used to adjust the schedule model due to demand and supply of resources include, but are not limited to:

2.5.6.6.1. Resource Leveling.

A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing demand for resources with the available supply. Resource leveling can be used when shared or critically required resources are only available at certain times, or in limited quantities, or over-allocated, such as when a resource has been assigned to two or more activities during the same time period, or to keep resource usage at a constant level. Resource leveling can often cause the original critical path to change, usually to increase (Levine, 2002).

2.5.6.6.2. Resource Smoothing.

A technique that adjusts the activities of a schedule model such that the requirements for resources on the project do not exceed certain predefined resource limits. In resource smoothing, as opposed to resource leveling, the project's critical path is not changed and the completion date may not be

delayed. In other words, activities may only be delayed within their free and total float. Thus resource smoothing may not be able to optimize all resources (PMI, 2013).

2.5.6.7. Schedule Compression

Schedule compression techniques are used to shorten the schedule duration without reducing the project scope, in order to meet schedule constraints, imposed dates, or other schedule objectives. Schedule compression techniques include, but are not limited to:

2.5.6.7.1. Crashing.

A technique used to shorten the schedule duration for the least incremental cost by adding resources. Examples of crashing include approving overtime, bringing in additional resources, or paying to expedite delivery to activities on the critical path. Crashing works only for activities on the critical path where additional resources will shorten the activity's duration. Crashing does not always produce a viable alternative and may result in increased risk and/or cost (Mishra & Soota, 2005).

2.5.6.7.2. Fast Tracking.

A schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration. An example is constructing the foundation for a building before completing all of the architectural drawings. Fast tracking may result in rework and increased risk. Fast tracking only works if activities can be overlapped to shorten the project duration (PMI, 2013).

2.5.6.8. Schedule Baseline

A schedule baseline is the approved version of a schedule model that can be changed only through formal change control procedures and is used as a basis for comparison to actual results. It is accepted and approved by the appropriate stakeholders as the schedule baseline with baseline start dates and baseline finish dates. During monitoring and controlling, the approved baseline dates are compared to the actual start and finish dates to determine whether variances have occurred. The schedule baseline is a component of the project management plan (PMI, 2013).

2.5.7. Control Schedule.

Control Schedule is the process of monitoring the status of project activities to update project progress and manage changes to the schedule baseline to achieve the plan. The key benefit of this

process is that it provides the means to recognize deviation from the plan and take corrective and preventive actions and thus minimize risk (PMI, 2013).

2.5.7.1. Performance Reviews

According to (Levine, 2002): Performance reviews measure, compare, and analyze schedule performance such as actual start and finish dates, percent complete, and remaining duration for work in progress. Various techniques may be used, among them:

2.5.7.1.1. Trend Analysis.

Trend analysis examines project performance over time to determine whether performance is improving or deteriorating. Graphical analysis techniques are valuable for understanding performance to date and for comparison to future performance goals in the form of completion dates (Levine, Practical Project Management Tips, Tactics, and Tools, 2002).

2.5.7.1.2. Critical Path Method.

Comparing the progress along the critical path can help determine schedule status. The variance on the critical path will have a direct impact on the project end date. Evaluating the progress of activities on near critical paths can identify schedule risk (Mishra & Soota, 2005).

2.5.7.1.3. Critical Chain Method.

Comparing the amount of buffer remaining to the amount of buffer needed to protect the delivery date can help determine schedule status. The difference between the buffer needed and the buffer remaining can determine whether corrective action is appropriate (Levine, Practical Project Management Tips, Tactics, and Tools, 2002).

2.5.7.1.4. Earned Value Management.

According to (PMI, 2013): Schedule performance measurements such as schedule variance (SV) and schedule performance index (SPI), are used to assess the magnitude of variation to the original schedule baseline. The total float and early finish variances are also essential planning components to evaluate project time performance. Important aspects of schedule control include determining the cause and degree of variance relative to the schedule baseline, estimating the implications of those variances for future work to completion, and deciding whether corrective or preventive action is required. A major delay on any activity not on the critical path may have little effect on the overall project schedule, while a much shorter delay on a critical or near-critical activity may require immediate action. For projects not using earned value management, similar variance

analysis can be performed by comparing planned activity start or finish dates against actual start or finish dates to identify variances between the schedule baseline and actual project performance. Further analysis can be performed to determine the cause and degree of variance relative to the schedule baseline and any corrective or preventative actions needed.

2.6. Organizational Project Management Maturity Level.

The operational structure and culture of sponsoring organization, the priorities and expectations of the customer, the environment, and physical realities of the project site all shape the project. However, the amount of effort the project manager and team must expend to create an environment for project success is affected by the project management maturity of the organizational environment. A more mature project management environment in the organization sponsoring the project allows the team to focus on project results and reduces wasted effort in efficiency across the project (S.Cooke & Tate, 2005).

To improve an organization's project management maturity, people need a model that demonstrates how project management can and should apply, as well as what elements need to be in place for it to work effectively. Working through the project management institute (PMI), volunteers collaborated to create models & standards for managing projects, as well as for identifying an organization's project management maturity. They created:

- A professional referred publication for best practices, the project management journal.
- A standard guide to the project management body of knowledge needed by project management professionals, documented in PMBoK Guide.
- A knowledge foundation for determining an organization's project management maturity model, or OPM3.
- A model for competence in the profession.

2.7. Tools and Techniques of Project Management and its Impact on Project Success

The efforts to increase the probability of a project completion, to implement a project within the shortest possible period, in the top quality and with the lowest costs together with elimination of any other possible risks have led to development of a number of project management tools.

According to (Kostalova & Tetrevova, 2014): The project management tools have been developed one by one, and they are subject matters of interest of both the theory and practice of project management, where they are fine-tuned and modified, and new tools are created. In view of the

continuous process of changes, it is not possible to provide an exhaustive list of project management tools, but it is possible to mention the best-known and most widespread ones.

The project management tool used before starting a project is the Pre-Project Study with Formalized Structure, consisting of a feasibility study. (Norwegian Development Cooperation, 1999) Indicates: project management tool used at the beginning of project implementation is the Logical Framework Approach (LFA). LFA is an analytic tool for objectives-oriented project planning and management, it helps clarify the purpose, and the justification for a project, identify information requirements, clearly define the key elements of a project, analyze the project's setting at an early stage, facilitate communication between all parties involved and identify how the success or failure of the project should be measured.

The project management tool used in the phase of detailed project planning is the Work Breakdown Structure (WBS) (Kostalova & Tetrevova, 2014). The WBS makes it possible to break the project hierarchically down into individual activities in such a detail to make it possible to assign each activity with responsibilities, labor-intensity and time demands.

As per (Kostalova & Tetrevova, 2014): Defining of the individual activities in the form of the WBS is closely followed by another project management tool: the Time Planning Using Schedules and Critical Paths, e.g. in the form of Gantt charts. This part of planning includes defining of the time demands of individual activities, their mutual succession and dependence, also in view of availability and performance of individual resources and available technological procedures. To achieve a quality estimate of the time demands of individual activities, it is possible to use estimates on the basis of similarities, standards, professional opinions, or on the basis of simulation (e.g. using the Monte Carlo technique)

Trietsch and Baker (2011) say: A more sophisticated method of planning the time demands of individual activities is represented by the Program Evaluation and Review Technique (PERT), which does not look for only one project implementation timeline, but it determines optimistic, realistic and pessimistic alternatives of the time demands with different probability of implementation for each activity.

Kostalova & Tetrevova (2014) Quoting (Goldratt 1997): A potential tool that can be used for optimization of the project time plans is the Critical Chain Method. The Critical Chain Method works, among others, with the time buffers, which make it possible to adapt the project plan to

potential changes better. This tool is also used in connection with the Theory of Constraints – the method that presumes that each activity has its weak points and limits that slow down the continuous course of activities. This tool helps to search for and identify just these weak points and, at the same time, it helps to seek solutions enabling changes in the problem areas.

Once the activities are planned and their time demands and suitable successions are determined, there comes the step where the individual activities are assigned with responsible persons. The project management method of the Responsibility Assignment Matrix (RACI Matrix) or the Linear Responsibility Chart is the method used for assigning and displaying different types of responsibilities for implementation of the appropriate activities to the respective persons in the project. For planning in the area of human resources, it is not only necessary to determine responsibilities, but also to specify the rules of communication within the project. The tool that must be prepared at the very beginning of the project implementation is the Formalized Project Communication Plan.

In the project implementation phase the method enabling the project progress monitoring from the points of view of its scope, time schedule and expended costs is the Earned Value Management. This method compares the work done with the planned value (Kostalova & Tetrevova, 2014).

According to (Kostalova & Tetrevova, 2014): Before its commencement and for the whole course of the project implementation, it is necessary to have an overview of any potential risks related to the project. A Formalized Risk Analysis is an integral part of the proper project management. It includes identification of all such risks, assessment of their possible impacts and probability of their occurrence, and a plan of their elimination.

Beck K, et al., (2003) argues: The method of Agile Project Management belongs to the newer project management methods, defined initially in 2001 for the area of software development projects and subsequently extended to projects generally. It is an alternative approach to project management placing a greater emphasis on an individual than on processes, prefers creation of project outcomes to work on documentation, and is open to a higher rate of changes during the project implementation.

When the project is finishing, it is possible to apply another project management tool for which it is necessary to collect data for the whole period of the project implementation called the Lessons

Learned (also called the Project or Post-Implementation Evaluation) (Kostalova & Tetrevova, 2014).

Since projects are temporary in nature, the success of the project should be measured in terms of completing the project within the constraints of scope, time, cost, quality, resources, and risk as approved between the contractor and owner/client/.

Ali (2010) Referring to Schlichter (1999) project management has led a number of organizations to be more effective and efficient in delivery of their products and services, to have more accurate budgeting and scheduling and improved productivity. The growth and acceptance of project management is continuing to increase as resources become scarce in less developed countries (Ali, 2010).

2.8. Current Practices of Using Tools and Techniques of Project Management on Power Transmission Projects in Ethiopia.

2.8.1. The Status of Stakeholders Integrated Practice in Power Transmission Project in Ethiopia

In Power Transmission Projects there are lot of stakeholders but the client/owner, the engineer/consultant and the contractor are involved fully and directly in the project. Government, financing institutions, employees and the general public are affected directly or indirectly by the output of Power Transmission Projects are the stakeholders. In Ethiopia most of the Power Transmission Projects are owned by the government delegated by EEP. The consultant, and the contractor are appointed and put in place through competitive bidding. The client and contractor sign contract, as part of the project document the project scope defined and cost will be included in the document. The owner and consultant are in charge of plan scope management, validate and control project scope. In project scope management it is the contractor who is mainly responsible for the creation of work breakdown structure.

Project management principles are project structure, definition, clear goals, transparency, risk recognition, management of project disturbance, smooth communication among the stakeholders, responsibility of project manager and project success. Successful definition must involve the entire team at every step to facilitate acceptance and commitment to the project. These goals should always be defined using the SMART paradigm (Rangan, 2012).

At this phase it should be accurate because it defines nearly all of the costs of the project. On the other hand it doesn't cost anything to adjust something in this phase. Researchers revealed a connection between the definition phase of a project and the success. The longer the definition phase of a project lasts the shorter is its processing time. Be transparent about the project status and be able to give a short overview about the costs, the timeline, and the achieved milestones. Every project is confronted with a lot of risks, is a unique endeavor with strict goals concerning costs, appointments and performance. The sooner these risks are identified the sooner negative developments are stopped.

The Project Manager develops the Project Plan with the team and manages the team's performance of project tasks. It is also the responsibility of the Project Manager to secure acceptance and approval of deliverables from the Project Sponsor and Stakeholders. The Project Manager is responsible for communication, including status reporting, risk management, escalation of issues that cannot be resolved in the team, and, in general, making sure the project is delivered in budget, on schedule, and within scope. The project managers of all projects must possess the following attributes along with the other project related responsibilities: knowledge of technology in relation to project products. Understanding of the concepts of Management Interpersonal skills to get things done · Ability to see the project as an open system and understand the external-internal interactions.

Integrated operation of all stakeholders in Power Transmission Projects is vital criteria upon which the relative success or failure of the project may be judged

2.8.2. Project Scope Management in Power Transmission Projects

A well-defined project scope enables successful completion of a project within the planned time, budget, and quality parameters. Scope management practices in Power Transmission Projects are broadly divided in two parts. The first part is where scope definition is carried out during the pre-planning phase (feasibility stage), which is a period that requires investing a substantial amount of time and resources in activities leading to the final investment decision. This effort is proven to be an effective way of increasing the chances of project success while significantly decreasing the risks that could arise during project implementation. The time required for the overall duration of the project is forecasted in the pre-planning stage. This can also assist in managing delivery time expectations and thus, in some sense, even positively influence project success. This first part essentially contains collecting requirements and defining scope processes of the PMI. The second

part contains plan scope management, create WBS, validate and control scope. These processes of the scope management are exercised in the implementation phase of Power Transmission Projects. It is mainly the duty of the Power Transmission Project contractor to plan the scope management create the WBS. The client and consultant mainly concentrate on controlling and validation of the project scope.

2.8.3. Project Time Management in Power Transmission Projects

The project time for Power Transmission Projects is estimated at the feasibility stage. Normally this time ranges from 18 to 24 months. This time is so long mainly due to the equipment manufactured and supplied from abroad. Among the Power Transmission Equipment, the power transformer is taking the longest manufacturing time, manufacturers in the average take eight to one year time. Power Transformer is very heavy equipment and its transportation and delivery to site is an activity that is consuming its own time. Considering all these factors it is the client who eventually decides the project time.

Following the contract signature and fixing the effective date for launching a Power transmission Project, the contractor has to submit Master Schedule. Simple bar charts using Excel or software like Microsoft Project are used to preparing master schedules. In most of the cases Contractors use expert and historic records for activity listing and estimation of activity durations. The maser schedule is used as basis for monitoring the time performance of the project.

Once the schedule has been created and baselined, the client and consultant control it by monitoring the status of the project in order to update its progress and handle any changes that are needed to the schedule baseline.

2.9. Principles and Practices of Project Management

2.9.1. Major challenges of Power Transmission Projects

Power transmission projects are basically projects. But the question is what type of project. There are lot of alternatives for classifying projects. Project classification may be based on size complexity, etc. Project can be classified in various ways: Based on Scope and Significance, Size and Scale, Ownership and Control, Degree of Change, Technology Involved, Speed, Beneficiary and Purpose (Mishra & Soota, 2005).

Wysocki, (2012) has defined two rules for classifying projects. The first is based on the characteristics of the project, and the second is based on the type of project. In classification based on project characteristics risk, business value, length, complexity, technology used, number of departments affected and cost are taken as parameters for classification.

Project characteristics can be used to build four classification rules with classes as follows (Wysocki, 2012).

Table 2.2 Types of Projects

Class	Duration	Risk	Complexity	Technology	Likelihood of problems
Type A	>18 months	High	High	Breakthrough	Certain
Type B	9-18 months	Medium	Medium	Current	Likely
Type C	3-9 months	Low	Low	Best of breed	Some
Type D	< 3 months	Very low	Very los	Practical	Few

Source: Effective Project management, Traditional, Agile, Extreme (Wysocki, 2012).

Electric power transmission projects normally demand durations greater than 18 months. As per (Wysocki, 2012) classification, these projects are of Type A having high risk, high complexity, demand breakthrough technology and certain in occurrence of likelihood of problems.

Moreover, next to generating stations power transmission projects are consuming huge amount of money. Substantial amount of this money is foreign currency. In Power Transmission Projects high voltage transmission lines and substations are constructed as unique products and they are built within defined period and have definite beginning and end. After construction of these facilities are completed they are brought into operations and they are expected to serve for years.

The role of different project management techniques to implement projects successfully has been widely established in areas such as the planning and control of time, cost and quality. In spite of this the distinction between the project and project management is less than precise. Success of project management has often been associated with the final outcome of the project. Overtime it has been shown that project management and project success are not necessarily directly related. The objectives of both project management and the project are different and control of time, cost and progress, which are often the project management objectives, should not be confused with measuring project success (Munnis & Bjeirmi, 1996).

The significance of Munnis & Bjeirmi argument is evident when coming to Power Transmission Projects. Power transmission project management success is the completion of the project within

agreed time cost and quality. In relation to this project management success, the major challenge of Power Transmission Projects in Ethiopia is time over run. Project success as Munnis & Bjeirmi argued has to see into the service delivered by the project when brought into operation following project management success. Due to time and resources the assessment of this paper is limited only to Power Transmission Project Management success.

2.9.2. The Experience of Some Developed Countries in Project Management Tools and Techniques

2.9.2.1. The Experience of United States of America

According to (PM, n.d) 1950 marked the beginning of modern project management. In the United States, prior to the 1950 projects were managed using mostly Gantt Charts and informal techniques. Around this time, the mathematical methods, Critical Path Method (CPM) was developed as joint venture of Dupont Corporation and Remigton Rand Corporation for managing plant maintenance projects and Program Evaluation and Review Technique (PERT) was developed by United States Navy in conjunction with the Lockheed Corporation and Booz Allen Hamilton as part of Polaris missile submarine program. In 1956, the American Association of Cost Engineering was formed and this association latter developed process portfolio, program and project management, total cost management framework.

In 1969, the Project Management Institute (PMI) was found in USA. PMI published A Guide to the Project Management Body of Knowledge (PMBoK Guide) and offers Certifications. In 1989 Earned Value Management (EVM) elevated under Secretary of Defense for Acquisition and came to prominence as project management technique in late 1980s and early 1990s. In 1997 Critical Chain Project Management (CCPM) developed by Eliyahun M. Goldratt based on methods and algorithms drawn from his Theory of Constraints (TOC). In 1998 PMBOK is accepted as a standard by the American National Standards Institute (ANSI) and later by Institute of Electrical and Electronic Engineers (IEEE). In 2001, the Agile Manifesto is written (PM, n.d).

2.9.2.2. The Experience of United Kingdom

According to (Haughey, 2014), by the year 1979, the UK Government's Central Computing and Telecommunications Agency (CCTA) adopted the PRINCE method for all information systems projects. This evolved into one of the most acclaimed project management methodology known as PRINCE (projects in controlled environments). However, the PRINCE method developed a reputation only for large projects and this led to a revision in 1996. Most companies who adopt a PRINCE approach to project management adapted the method to their commercial environment

and use those parts of PRINCE that work for them. Originally developed for IS and IT projects to cut cost and time overruns; the second revision was made more generic an applicable to any project type.

In 2002 and 2005 PRINCE2 was updated in consultation with the international user community. In the revision the method is made simpler and more easily customizable. PRINCE2 contains 7 basic principles i.e., Continued Business Justification, Learn from Experience, Define Roles and Responsibilities, Manage by Stages, Manage by Exception, Focus on Products, Tailor to the Environment; seven themes(considered as knowledge areas) i.e., Business Case, Organization, Quality, Plans, Risk, Change, Progress, and seven processes i.e., Starting Up a Project (SU), Initiating a Project (IP), Directing a Project (DP), Controlling a Stage (CS), Managing Product Delivery (MP), Managing Stage Boundaries (SB) that contribute to project success. Overall the updated method is aimed to give project managers a better set of tools to deliver projects on time, within budget and with the right quality.

Apart from the numerous variants evolved on need based customizations, the two major parent methodologies in practice these days are PMI-PMP & PRINCE2.

According to its news article (APM, 2013), Association for Project Management (APM) is founded in 1972 and it is a registered charity in the UK. AMP has individual and corporate members. APM's mission is: "To develop and promote the professional disciplines of project and program management for the public benefit." The APM is dedicated to the development of professional project, program and portfolio management across all sectors of industry and beyond. APM has branches throughout the UK and in Hong Kong. APM, London UK, has announced that it has issued 6th edition APM Body of Knowledge. APM is the UK national representative in the International Project Management Association (IPMA).

2.9.2.3. The Experience of Japan

According to (Ohara, 2005) Orthodox-type project management (PM) has been developed for engineering methodology of building an artificial system. PM has been widely spread and applied in the engineering arena in Japan. It is deemed an essential skill to ensure steady achievement of project goals under rigid constraints and unique conditions. However, faced with the matured society, business demands are increasing beyond the sole engineering system.

According to (Siddiqui, 2009) : Japan has experienced a severe economic recession since the early 1990s. According to (Siang & Yin, 2012) : To survive in the economic recession, Japanese organizations looked for alternatives in project management methods as a mean. Developed in 2001 P2M/project program management/ is the Japanese version of project and program management, and is the first standard guide for education and certification. P2M is intended not only to benefit Japanese organizations but to profitably apply to any organizations globally, who seek a comprehensive guide to program and project management (Ohara, 2005). P2M is widely used as a standard guide, and with its respect for other standards and innovative approach of project and program management for value creation in enterprises, it provides a sound foundation for further development and improvement of the project management.

Although P2M is still being put into practical use both internationally and in Japan
(Siang & Yin, 2012), quoting (Kinoshita, 2005), an improved paradigm called *Kaikaku* Project Management (KPM) has been introduced (Ohara and Asada, 2009). Kaikaku signifies the comprehensive contexts of the breakthrough implemented by innovation, development and improvement. KPM is defined as encompassing the 3 K's of Kakusin (innovation), Kaihatsu (development) and Kaizen (improvement), or more specifically, the synergetic unity to be challenged and linked to corporate-level strategy.

KPM is the developed version of P2M. P2M/KPM manages projects and programs based on the mission-driven approach and are proposed to foster development of project management through value creation in a complex and changing environment. It is a project management approach that is comprehensive and adaptable to flexible environment. It has been proven that flexibility, adaptability, and reformation are essential to survive during an economic crisis. The strategies and methodologies of P2M/KPM have proven to be effective and successful in providing learning opportunities in companies, enhancing participation, and motivating the consensus and awareness of core leaders.

2.9.2.4. The Experience of Germany.

According to (Wagner, n.d) Germany was influential in developing project management and moving the profession forward. Germany has worked in collaboration with France and UK into the formation of IPMA in the year 1965. Germany Project Management Association/GPM/ was established in 1979.

GPM is organized in more than 35 regions in Germany, practicing an intensive exchange of experience in that region and developing know-how through Special Interest Groups (SIGs), ranging from Automotive Project Management to Project Management in the Wind Sector. The IPMA 4-Level-Certification System is well established in Germany.

A well-elaborated system for education and training is practiced. Starting with the renowned initiative “PM macht Schule” GPM supports adolescents at secondary school level, continues training activities during vocational schools and universities.

Research activities, publications (e.g. books and the periodical PMAktuell) and the GPM Blog are part of an attractive offering of GPM at national level. GPM has established close relationships with Project Management Austria (PMA), the Swiss Project Management Association (SPM) as well as many other association around the world (Wagner, 2017).

2.9.2.5. International Project Management Association/IPMA/

The International Project Management Association (IPMA) was found in Europe in 1967, as a federation of several project management associations. IPMA now includes member associations on every continent. IPMA offers a Certification program based on the IPMA Competence Baseline (PM, n.d).

It is in developed countries that modern project management is born and flourishing. Developed countries have adequate administrative, financial, institutional capacity and trained personnel that can deal with the dynamics of change to implement projects and programs effectively. Ineffective project planning and preparation, faulty appraisal and selection process, defective design, problems in start-ups are minimal in developed countries. However, if not managed properly projects may fail in developed countries (PM, n.d).

2.10. Trends of Project management in Ethiopian Power Transmission Project.

Lemma (2014) Says: Ethiopia seeks to provide more electricity, more roads and expansion of sanitation facilities, telecommunication networks, as well as large scale investment to expand its infrastructure. These projects have a major role to play in the economic development of a country. (H.Yimam, 2011) Quoting (Jekale, 2004) says: the Construction industry in many developing countries is characterized by “too fragmented and compartmentalized; Public sector dominated market; considerable government interventions; considerable foreign finance (dependency for

public construction), and low development of indigenous technology". According to (H.Yimam, 2011): Similar to the case with other developing countries, the Ethiopian construction industry shares many of the problems and challenges the industry is facing in other developing countries, perhaps with greater severity.

Due to low level of development, low level of manufacturing capacity all the equipment required for power transmission projects are imported from abroad. Considering this fact what (H.Yimam, 2011) says is true and even worse for Power Transmission Projects in Ethiopia.
According to (Getahun, 2016): for project management training in the country, there was no formal and sufficient training except the introductory course given in some business and management departments. Now there is a good start in few of the universities in the Country to give the discipline in post graduate level.

According to (H.Yimam, 2011):The need for the improvement and development initiative has already been acknowledged by the government of Ethiopian, and University Capacity Building Program (UCBP) has been initiated with the assistance of the German government to support the capacity of local contractors by providing managerial and entrepreneurial training and coaching that prepare contractors for ISO 9001certification. Contractors under the program were given training in areas such as modern contract and project management, modern financial and construction equipment management systems, general management and leadership, marketing, project and quality management.

For power transmission projects in Ethiopia, collect requirements and define scope are done at the feasibility stage while plan scope management, create work breakdown structure, validate and control scope are done in the implementation stage of the model indicated in Figure 2.3. The scope of power transmission project in our country is defined in pre-planning stage and yet these projects commonly face time overruns.

Table 2.3 EEP's Power Transmission Project Performances for three consecutive years

No.	Projects	2013/2014(2006EC)			2014/2015(2007EC)			2016/2016(2008EC)		
		Planned	Performed	% performance	Planned	Performed	% performance	Planned	Performed	% performance
1	Hidase-Dedesa-Holeta 500kv high voltage transmission line	29.86	23.85	79.9			53.37	12.65	12.65	100
2	Ethio-Kenya 500kv regional interconnection	7.8	2.18	27.9	9.42	4.85	51	9.47	6.33	68.63

No.	Projects	2013/2014(2006EC)			2014/2015(2007EC)			2016/2016(2008EC)		
		Planned	Performed	% performance	Planned	Performed	% performance	Planned	Performed	% performance
3	Wolaita –Sodo-Addis Ababa 400 KV Power transmission project	6.73	6.23	92	0.51	0.48	99.98	0.16	0.16	100
4	Gibe II – Wolaita Soddo 400kv Power transmission	30.78	21.45	75	10.98	4.56	42	4.47	4.18	93.5
5	Awash-Melka Sedi 230kv transmission lien project	30.45	23.9	78.48	41.17	4.9	18.73	21.68	8.02	36.9
6	Alamata-Muehuoni-Mekele 230KV power Transmission Project	23.99	14.66	90.67		9.33	99.56	0.44	0.44	100
7	Koka-Hurso-Dire Dawa 230kv Transmission line project	27.55	19.5	91.95		8.05	99.34	0.65	0.65	100
8	Alaba-Hossana-Wokite-GilgelGibe Jimma-Agaro-Bedele 230 Kv Power Transmission project	26.99	17.62	90.63		6.71	97.43		1.74	99.08
9	Metu – Gambela 230kv PTP	30.08	24.42	91.65		8.38	98.72		1.3	66.9
10	Ethio-Djibouti railway transmission line project							100	80.42	80.42
11	Asosa-Bamza 132kv transmission line project	46	25.245	54.88	28.81	1.42	26.47	17.05	5.97	35
12	Wolkait Sugar factory power transmission project TL	46.55	24.96	53.62		23.09	51.07		26.96	55.11
13	Beles 132kv power transmission line project TL	69.1	22.64	32.76		15.43	31.32		29.68	43.2
14	Suluta-Gebreguracha power transmission project	21.31	21.6	68	38.42	27.85	72.5	33.5	3.46	99.6
15	Transmission and substation networks reinforcement project	20.69	10.45	50.5	24.49	9.9		11.37	4.39	
16	Transmission and substation rehabilitation and upgrading project				37	1.38		24.73	16.96	
17	Genale Dawa III-Yirgalem-Wolayita Sodo 400kv PTP	22.95	14.25	42	9.09	2.21	15.12	31.54	25.3	80.2
	Average annual performance (%)			68.00			61.19			77.24
	Average performance for the three years (%)	68.81								

/ Source: EEP's Annual bulletins/

Performance records of 17 power transmission projects were taken from EEP annual bulletins and indicated in Table 2.3. As shown in the table, the average annual performance of 2013/2014(2006EC) is 68.00%, that of 2014/2015(2007EC) is 61.19% and that of 2015/2016(2008EC) is 77.24%. Average of the three year is 68.81%. 2015/2016(2008EC) performance appears to be better than the previous years which shows that there is improvement. However, this improvement is not sustainable since the performance of 2014/2015(2007EC) is lower than that of 2013/2014(2006EC).Generally power transmission projects in EEP have an average delay close to 30%.This figure is not small amount, this is a big gap. There could be so

many reasons behind this big gap. Application of project scope and time management tools and techniques might contribute their share to narrow this big performance gap.

2.11. Effects of Implementing Project Scope and Time Management Tools and Techniques on Performance of Ethiopian Power Transmission Projects.

Researchers have recognized the importance of scope management in construction projects as a key factor for project success. Effective scope management of a project ensures the successful management of other key project management areas, including time, cost, and quality (Khan, 2006).

It is believed that projects that have a well-defined scope during pre-planning are less likely to encounter surprises such as scope creep, schedule slippages, cost overruns, and poor quality of deliverables (Morris, 2005). The existing research on scope and change management focuses on the identification of facts which influence the success of change processes, and studies best practice in the implementation of change management (Motawa, Anumba, & El-Hawalawi, 2006).

Time management is important in any construction project. Without proper time management, many problems will occur such as extension of time or time overrun. Time overrun occur when the actual progress of a construction project is slower than the planned schedule. Challenge of completing construction projects within estimated time frame is biggest concern amongst the practitioners. Several approaches and tools have been introduced over the past years to enhance the management of the construction project (Aftab Hameed Memon, 2014). Effective time management is very important in determining a success of any project. Thus, without proper controlling of time will cause project delay and consequently budget overrun. Time management is an important criterion to ensure the successful completion of projects. Construction industry is experiencing poor time management practices which have resulted in significant amounts of time overrun. These overruns in time have become a global phenomenon (Ismail, Rahman, Memon, & Karim, August 2013).

2.12. Empirical Literature Discussion

N.E. Sawalhi (n.d)conducted a study under the title" Application of time management tools and techniques to the construction industry in the Gaza Strip" .The objective of the study was to investigate the level of applying the project time management tools and techniques by public owners and construction contractors in Gaza Strip. The study has been conducted by means of

survey questionnaire. The target group that are made to participate in the survey were construction contractors and public owners. Congruent to the findings of this study, the survey result indicated that project time management tools and techniques are not widely used among local contractors and owners. Lack of knowledge and awareness of the importance of project time management tools and techniques are found to be major obstacles towards the efficient utilization of such tools. The study recommended for an urgent need to establish a professional industry body such as an Institute of Building to review and evaluate existing local project management practices.

Shanmuganathan N and Dr. G.Baskar (2015) conducted a study under the title." Effective Cost and Time Management Techniques in Construction Industry" in India. This research was conducted to identify the most successful cost and time management techniques and software's used to control the projects in the construction industry .The data for the study were collected through questionnaire survey from engineers, contractors and clients who worked in the various construction industry. The collected data were analyzed using relative importance index (RII) and ranking the factors based on percentage of relative importance. This research identified important techniques to control the cost and time performance in a project and also most successful time management software's used by the construction industry. For the time management techniques part , that is also part of this study, top most three successful techniques and soft wares were identified to be critical path method(CPM), Programme Evaluations and Review Technique(PERT), Gantt chart, Primavera, Microsoft project, and Microsoft excel respectively. In fact, the purpose of the study is not to assess to what extent time management techniques are used but the study found that application of these techniques assist the successful completion of projects in construction industry.

Aftab H.M. et al., (2014) conducted a study in Malaysia under the title," Time Management Practices in Large Construction Projects". Data was gathered through survey technique amongst the practitioners involved in handling large construction projects. Relative Importance Index (RII) calculation was employed to assess the level of effectiveness for time management techniques and software packages adopted in the construction project. The results highlighted that most common and effective time management technique and software Package are CPM and Microsoft Project respectively. In the Ethiopian Power Transmission Projects CPM is among the tools used to the minimum level while Microsoft project software application has better usage level compared to CPM.

Rómel G. Solís-Carcaño, et al., (September 2015) conducted a study under a research title," The Use of Project Time Management Processes and the Schedule Performance of Construction Projects in Mexico". The study included the assessment of fourteen school construction projects executed by different construction firms. A Use Index (UI) depicting the extent to which a PTM process was used was then computed as the ratio of the number of tasks marked by the respondent and the total of tasks associated with that process. The results of study reported in this paper indicated a significant effect of the use of processes related to Project Time Management on project performance, especially for completing the construction phase within the original schedule. The mean value obtained for the Use Index of these projects evidenced a poor application of project management, or at least of Project Time Management which is congruent to the findings of this study. The RUI used in this study is customized from Romel G. Solís-Carcaño, et al., (September 2015).

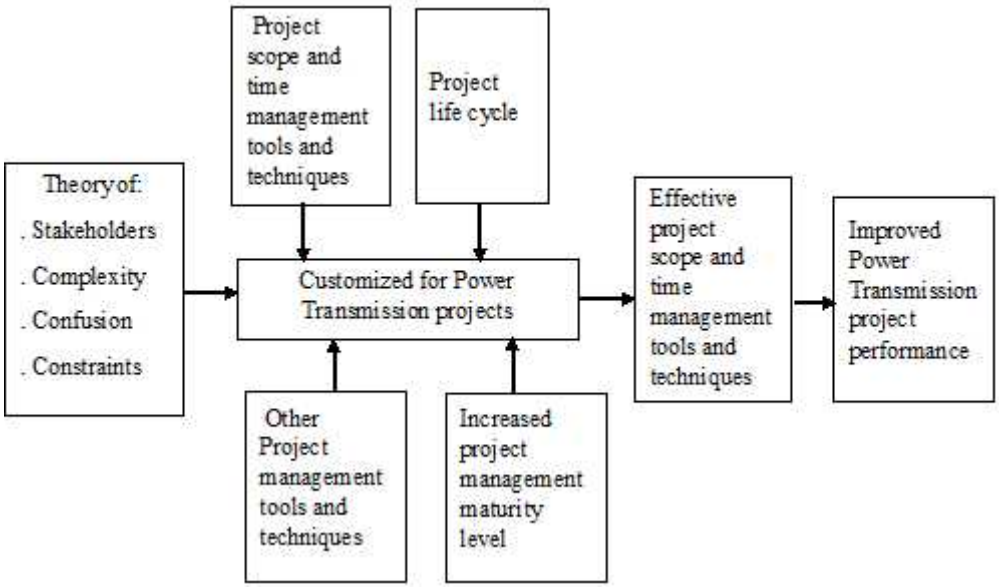
2.13. Conceptual Frame Work and Model for Power Transmission Projects in Ethiopia Developed for the Study

2.13.1. Conceptual Frame Fork

Z.Milosevic & Iewwongcharoen (2004) argue regardless of how important the use of Project Management Tools and Techniques/PMTT/ impact project success, the literature on PMTT still has gaps since the literature on project management typically treats the use of PMTT with universal approach not contingent with particular projects like Power Transmission Project specific conditions.

The conceptual framework that underpins this study is depicted in Figure 2.2 below. This conceptual framework is the base for the literature review contained in this chapter.

Figure 2.2 Conceptual Framework of this Thesis



/Source: developed for this study/

As depicted in the Figure 2.2 theory of stakeholders, theory of complexity, theory of construction management and theory of constraints fit together with project management, project life cycle, and project management maturity level customized to produce effective project scope and time management tools and techniques that consequently enhance power transmission project performance.

In line with this conceptual framework project management tools and techniques, principles and practices of project management, project life cycle, project management maturity level, project scope and time management are discussed.

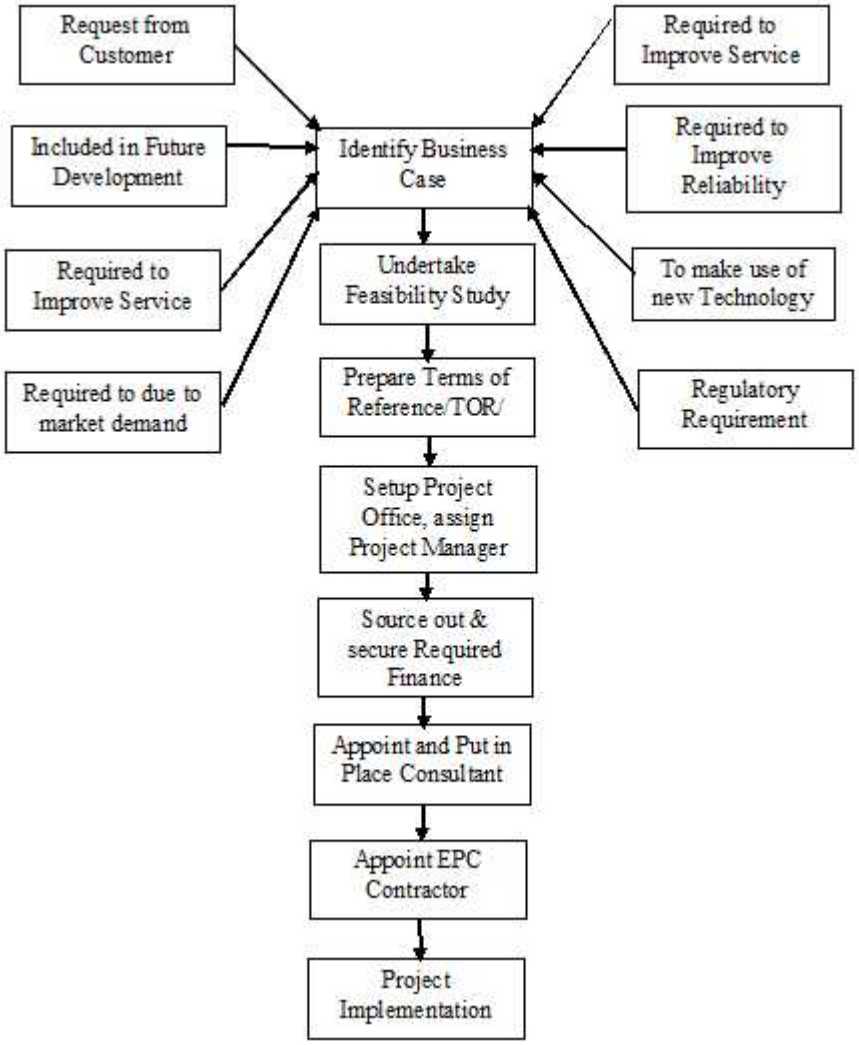
2.13.2. Project Management Life Cycle Model for Power Transmission projects in Ethiopia.

A project life cycle is the series of phases that a project passes through from its initiation to its closure. The phases are generally sequential, and their names and numbers are determined by the management and control needs of the organization or organizations involved in the project, the nature of the project itself, and its area of application. The life cycle provides the basic framework for managing the project, regardless of the specific work involved.

The project life cycle can be determined or shaped by the unique aspects of the organization, industry, or technology employed. While every project has a definite start and a definite end, the specific deliverables and activities that take place in between will vary widely with the project.

Initiation, planning, implementation, control and monitoring and closing are the various distinct phases of Power Transmission Projects life cycle.

Figure 2.3: Phase through which Electric Power Transmission Project passes before project implementation.



/Source: Model Developed by the researcher for the purpose of this study. /

S. Seth (2012) explains: Project Life Span has four Phases:

1. Concept - for developing project parameters 2. Development - of the plan, design and facility 3. Execution of the plan, and 4. Transfer of the completed facility over to operations. The concept and development parts fit to the foregoing model developed for PTP in Ethiopia.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1. Research Design

This study applied explanatory and descriptive research method. Descriptive research is aimed simply at describing phenomena and is not particularly concerned with understanding why behavior is the way it is. This study is focused on project scope and time management tools and techniques as applied to Power Transmission Projects in Ethiopia particularly in EEP. The study is descriptive that assessed the applications of project scope and time management tools and techniques using primary and secondary data. This study employed both quantitative and qualitative approaches

3.2. Population and Sampling Techniques

The number of power transmission projects currently running in EEP is six. The six projects are used for the study. The study population included categories of electro-mechanical and civil work engineers, project team members, clients/EEP/, consultants and contractors. All of the professionals are selected based on their experience and special care was taken for their educational qualification. All the respondents who participated in this survey, their minimum educational qualification is diploma, most of the respondent have completed fist degree education and few respondent have MSc or MA degrees. The sample compromised about 60 key resource persons that were directly involved in power transmission projects.

For the study population, power transmission projects in Ethiopia that are active in 2016/2017 fiscal year were taken. As project management is relatively new discipline, engineers and graduates working with client, consultant and contractor organizations are considered to constitute the population.

Selection of consultants and contractors staff was made from currently active projects while the key informants that constituted the study population were selected using expert, purposive and availability sampling techniques. The questionnaires were distributed to those key informants who were available and were willing to respond.

Number of professionals working for projects vary depending on type of duties to be performed and activities at the sites. The number of population size indicated in the Table 3.1 is the peak time man power working on the projects.

Table 3.1 Table used to show population size.

No	Project Name	Project owner	Client/Owner staff			No of Consulting staff	No of Contractor staff
			Ele. Eng.	Civ. Eng.	Other (Grad.)		
1	Ethio-Kenya 500kv regional interconnection	EEP	4	5	3	6	9
2	Ethio-Djibouti railway transmission line project	EEP	3	4	3	5	8
3	Suluta-Gebreguracha power transmission project	EEP	3	4	3	5	7
4	Transmission and substation rehabilitation and upgrading project	EEP	3	4	3	4	7
5	Akaki-Dukem-Debrezeit-Modjo-Ginchi power transmission project	EEP	4	4	3	4	7
6	Jijiga-Degehabur 132kv PTP	EEP	3	4	2	4	6
	Total		20	25	17	28	44
			62				

Source: Own Survey 2017.

3.3. Source of Data and Data Collection Tools Used

Primary data was collected using structured questionnaires on a 3 and 5- point Likert scales, interviews are also conducted as well as three years performance review is made on seventeen power transmission projects.

The questionnaires and interviews contained a set of simple and straight forward questions whose purpose was to collect particular data and information. (Sauders, Lewis, & Thornhill, 2009) Quoting (deVaus 2002) explain questionnaire is a general term to include all techniques of data collection in which each person was asked to respond to the same set of questions in a predetermined order.

3.4. Procedure of Data Collection

Questionnaires were prepared in hard copies and were distributed to the respondents directly. The data were collected from professionals, who provided answers to the questions based on their personal understanding and experience. This has likely differed from person to person. The responses collected from the respondents provided the basis to assess the extent to which project scope, and time management tools and techniques are applied to power transmission projects. The procedure for the data collection is made as follows.

1. Prepared survey questions, face to face interviews.
   The survey questions were distributed to 60 power transmission professionals constituting about 40% of those working in currently running Power Transmission Projects. 2(about 40%) project managers were interviewed,
2. Responses collected and analysis made.

2.5. Data Analysis Methods used.

The study included the assessment of six power transmission projects executed by EEP. The practices, tools, and techniques that the PMI recommends were considered in order to assess the extent to which the project scope management/PSM/ and project time management/PTM/ processes were used in the execution of the power transmission project in Ethiopia.
A small-scale pilot test was made to advance opportunity for the researcher to check the data collection questionnaires had minimum errors that could arise due to improper design, such as question wordings or sequences.

For the study primary and secondary sources of data are collected using structured questionnaires and interviews. The questionnaires and interviews contain a set of simple and straight forward questions whose purpose was to collect primary data used for the research. The questionnaire contains three parts, i.e. part I contains demography of the respondents, part II contains questionnaires on a 3- point Likert scale aimed to collect respondents opinion on the extent to which scope and time management tools and techniques are used. The scores assigned to each factor by the respondents were entered and consequently the responses given are subjected to statistical analysis for further insight. The contribution of each of the factors to overall use was examined and the ranking of the factors in terms of their effective use as perceived by the

respondents was done with Relative Use Index (RUI) which was computed using the following equation.

$$R = \frac{\sum_{i=0}^{i=3} W}{A.}$$

Where:
w = weighting given to each factor by respondents and it ranges from 0 to 3
x = frequency of i^{th} response given for each cause
A = highest weight (i.e. 3 in this case)
N = total number of respondents

Relative Use Index (RUI) assessment methodology is adopted from the research done in Mexico (Rómel G. Solís-Carcaño, September 2015) titled, the use of project time management processes and schedule performance of construction projects in Mexico, is customized to draw conclusions for this research.

For part III of the questionnaire a 5-point Likert scale was used to draw respondent's opinion on the constraints of the application of project scope and time management tools and practices. Data collected in part II, III and IV are analyzed using frequency analysis presented using frequency and percentage charts. Statistic Package for Social Science/SPSS/ software is used for the analysis. The analysis of parts I, II, III are presented in chapter four of this study.

2.6. Validity and Reliability Measures

Structured interviews are conducted with two project managers undertaking power transmission projects. The responses given for the interviews are grouped, summarized and used for triangulation of responses given for the questionnaires.

2.7. Ethical considerations.

Owing to the nature of proposed research questions and unique situation, the major ethical issue is the confidentiality of the informants. This ethical issue can be satisfactorily dealt with because the research focuses on project scope and time management practices and it did not require any sensitive financial data or target area disclosure (Mui, 2002).

While distributing the questionnaire and undertaking interviews, the consent of respondents were obtained and the objectives, methods to be used and the purpose of the study were explained. Respondents provided their response voluntarily and were assured that the privacy of their response is maintained. In addition, the integrity of data collection, analysis and reporting of results were maintained.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.1. Introduction.

This chapter deals with presentation of data obtained through questionnaires administered with various professionals and interviews made with two project managers. The questionnaire contains three parts, the demography of respondents, usage of project scope management (PSM) and project time management (PTM) tools and techniques, and constraints of PSM and PTM tools and techniques. The data obtained through interviews administered with two project managers is integrated into the data analysis made using the questionnaire. This chapter contains discussion, analysis and major findings the study.

4.2. Results/Findings of the study

4.2.1. Respondents' Demographics

Table 4.1 Respondents' Demography.

Var.Name	Category	Frequency	Percent (%)
Sex	**Gender**		
	Male	48	88.9
	Female	6	11.1
Age	**Age**		
	20-30 Years	3	5.6
	31-40 Years	21	38.9
	41-50 Years	17	31.5
	51-60 Years	10	18.5
	Over 60 Years	3	5.6
PI3	**Field of study**		
	Electrical Engineer	21	38.9
	Civil Engineer	22	40.7
	Mechanical Engineer	2	3.7
	Communication Engineer	5	9.3
	Computer or ICT	4	7.4
	Project Management	0	0
	Other	0	0

Var.Name	Category	Frequency	Percent (%)
PI4	**Level of Education**		
	PhD	0	0
	MA/MSC	8	14.8
	BA/BSC	46	85.2
	College Diploma	0	0
	Other	0	0
PI5	**Training in project management**		
	Yes	54	100
	No	0	0
PI6	**Training taken**		
	Sufficient	11	20.4
	Insufficient	43	79.6
PI7	**Name of company**		
	Name of respondent's company	0	0
PI8	**Category of respondent's Company**		
	Client/Owner	39	72.2
	Consultant	6	11.1
	Contractor	9	16.7
	Other (Specify…….)	0	0
PI9	**Company's years of experience in projects**		
	Less than one year		
	1-5 years	3	5.6
	6-10 years	4	7.4
	11-15 years	12	22.2
	Over 15 years	35	64.8
PI10	**Respondent's Position/Role**		
	Project Manager or Deputy PM	6	11.1
	Civil Works Supervisor	22	40.7
	Electrical Works Supervisor	16	29.6
	Mechanical Works Supervisor	2	3.7

Var.Name	Category	Frequency	Percent (%)
	Communication Works Supervisor	1	1.9
	Commissioning Engineer	0	0
	Automation and SCADA works supervisor	3	5.6
	Design review and approval Engineer	4	7.4
	Other	0	0
PI11	**Respondent's experience in project works**		
	Less than one year	0	0
	1-5 years	42	77.8
	6-10 years	6	11.1
	11-15 years	3	5.6
	Over 15 years	3	5.6
PI12	**Respondent's Over all Experience**		
	Less than one year	0	0
	1-5 years	0	0
	6-10 years	9	16.7
	11-15 Years	21	38.9
	Over 15 years	24	44.4

Source: Own Survey 2017.

According to Table 4.1, male respondents constitute 88.9% while 11.1 % are female respondents. The number of male respondents is much higher than that of female. This is attributed to the fact that the number of male workers in power transmission projects is higher than female workers.

About 70% of the respondents fall within 31 to 50 years age group. This is a working age where people more are strong, healthier and provide quick responses to questionnaires. Of the respondents 38.9% are electrical engineers, 40.7 % are civil engineers, 3.7% mechanical engineers, 9.3% are communication engineers and 7.4% are computer or IT engineers. As shown in the table professional with diversified field of study in engineering are made to participate in the survey. This signifies the various professionals (man-power) input power transmission projects are demanding. As shown in the table there are no professional with project management field of study.

According to Table 4.1, 14.8 % are MSC graduates while 85.2% are BSc holders. The participants of the survey are all university graduates. The fact that the respondents are all graduate professionals has assisted to get responses for the questions. Project management is a discipline whose concepts are not yet widely understood by all project workers with lower level of education.

Even though no one reported having formal education in project management, as per table 4.1 100% of the respondents have taken training in project management. This has contributed to receiving responses to all the questions. However, 20.4% reported the training they took is sufficient and 79.6% insufficient for their duties in project management. The interpretation of this is that short term trainings, though important, are insufficient for effectively using project management tools and techniques.

As per Table 4.1, 72.2% of the respondents are from client/owner, 11.1% are from consultant, and 16.7% are from contractor organizations. This shows respondents from the main stakeholders and players in power transmission project have participated in the survey.

As per Table 4.1, 11.1% of the respondents worked as project managers, 40.7% as civil work supervisors, 29.6% as electrical work supervisors, 3.7% as mechanical work supervisors, 1.9% as communication works supervisors, 5.6% as automation works supervisors, 7.4% as design engineers. Even though to varying degree, all PTP professionals except commissioning engineers have participated in the survey.

As per Table 4.1, 77.8% of the respondents have 1-5 years, 11.1% 6-10 years, 5.6% have 11-15 years and 5.6% over 15 years in project works. This shows respondents have sufficient project work exposure and the responses given to the questions reflect the reality and, recommendations made and conclusions drawn thereof may support to improve the application of project management tools and techniques.

As per Table 4.1, 16.7% of the respondents have 6-10 years, 38.9%, 11-15 years, and 44.4% over 15 years of overall experience. This shows the respondents have over 5 years of experience and have worked in non-project activities. This could be taken as an additional benefit supporting the respondents in responding to the questionnaires.

4.2.2. Usage of Scope and Time Management Tools and Techniques

The primary data rated on 0 to 3 Likert Scale (i.e. 0=Not at all, 1= Occasionally, 2=Usually, 3= Always) collected through questionnaires on the use of scope and time management tools and techniques has been further analyzed, compounding variables into groups using frequency analysis. Those respondents who do not know the specific tool or technique (99) are not include in the evaluation. Relative Use Index (RUI) is calculated using the formula given in chapter 3. The calculated RUI values are ranked in order of increasing to show which tool and technique is more used compared to others. The results of the survey are depicted through tables, and bar charts followed by discussions on the findings.

Table 4.2 Scope Definition

Var. Name	**Tools and Techniques**	RUI	Rank
PII1	In PTP, scope definition is made in Business Case Development and/or feasibility Study stage.	0.74	5

Source: Own Survey 2017.

Scope definition made in Business Case Development and/or feasibility Study stage has RUI=0.74(Rank 5) as shown in Table 4.2. 74 % of the respondents agree that, scope definition is made in Business Case Development and/or Feasibility Study stage. The advantages of defining project scope in feasibility study stage is explained in the previous chapters. The project managers interviewed have indicated that for most of PTP projects scope definitions are made during the feasibility study that is line with the findings from the questionnaire. According to the interviewees it is this scope that is latter made to be included in the contract agreement made between the client/owner and the contractor for the implementation of the Power Transmission Project.

Table 4.3 Stakeholders involvement

Var. Name	**Tools and Techniques**	RUI	Rank
PII2	In PTP scope definition, interest of all stakeholders/Government, owner, contractor, consultant, Financing Bank, local community, etc., / is optimally addressed.	0.67	8

Var. Name	**Tools and Techniques**	RUI	Rank
PII3	In PTP scope definition project deliverables are made clear to all stakeholders/ Government, owner, contractor, consultant, Financing Bank, local community, etc.,	0.67	8
PII4	Compensation issues/ for substation plot area, tower location, and right-off-way for transmission lines/ are effectively taken care during the scope definition stage of PTP.	0.07	19

Source: Own Survey 2017.

Interest of all stakeholders/Government, Owner, Contractor, Consultant, Financing Bank, Local Community, etc., / is optimally addressed has RUI =0.67(Rank 8). Project deliverables are made clear to all stakeholders/ Government, Owner, Contractor, Consultant, Financing Bank, Local Community, etc. has RUI =0.67(Rank 8). Compensation issues/ for substation plot area, tower location, and right-off-way for transmission lines/ are effectively taken care during the scope definition stage has RUI=0.07(Rank 19).

As shown in Table 4.3, responses on average shows 67% of the respondents agree that scope definition, interest of all stakeholders/ Government, Owner, Contractor, Consultant, Financing Bank, Local Community, etc., / is optimally addressed. 67 % responded that project deliverables are made clear to all stakeholders/ Government, Owner, Contractor, Consultant, Financing Bank, Local Community, etc., in scope definition.

Only 7 % the respondents agree that compensation issues/ for substation plot area, tower location, and right-off-way for transmission lines/ are effectively taken care during the scope definition stage of PTP. Latter in the part III of the analysis this issue is indicated to be as one of the major constraints in project scope and time management.

Table 4.4 Work Breakdown Structure

Var. Name	**Tools and Techniques**	RUI	Rank
PII5	Work Break Down Structure/WBS/ is prepared in sufficient details for PTP.	0.52	11
PII6	Work Break Down Dictionary is prepared in sufficient details for PTP.	0.00	22
PII7	Project Scope Base Line is prepared and regularly updated in due course for PTP.	0.52	11

Source: Own Survey 2017.

Application of Work Break Down Structure/WBS/ in sufficient details has RUI=0.52 while Work breakdown dictionary has RUI=0.00.Project Scope Base Line preparation, usage and regular update has RUI=52. 52 % of the sample population (Table 4.4) said WBS and project base line preparation and regular updated are made for PTP. But 100% of the respondents accept Work Breakdown Dictionaries not used at all. The very low (nil) usage of WBS dictionary for PTP may be attributed to the unawareness of its importance and lack of knowledge about its application.

Table 4.5 Project schedules

Var. Name	**Tools and Techniques**	RUI	Rank
PII8	For PTP Master schedule is prepared within predefined time after contract signature.	0.96	1
PII9	PTP master schedules contain resource plan/material, labor and equipment/	0.35	14
PII10	Project master schedule is revised and updated regularly by producing baseline schedules depending on the progress of the PTP.	0.72	6

Source: Own Survey 2017.

The survey results on assessing the usage level of Project schedules are as shown in Table 4.5. For PTP master schedule is developed by the contractor and submitted for employer/engineer approval in a defined time after contract signature and has RUI=0.96. Master schedules contain resource plan/material, labor and equipment/ has RUI=0.35. Also of interest was the fact that nearly three-quarters of the study population (72%) responded PTP master schedules are updated 'occasionally'. However, 65% the study population agree that PTP master schedules do not contain resource plan. Computer in project scheduling makes schedule updating an easy task but only 72% of the master schedules are updated occasionally.

Table 4.6 Project scheduling tools and techniques

Var. Name	**Tools and Techniques**	RUI	Rank
PII11	Gantt chart or Bar Chart(plain)/ is used in PTP for scheduling	0.96	1
PII12	Linked Gantt chart or Bar Chart is used in PTP for scheduling	0.65	9

Var. Name	**Tools and Techniques**	RUI	Rank
P1113	Precedence diagram method (PDM) employing Activity On Arrow (AOA) diagrams is used for PTP scheduling.	0.13	15
PII14	Precedence diagram method (PDM) employing Activity On Node (AON) diagrams is used for PTP scheduling.	0.07	19
PII15	Program Evaluation and Review Technique/PERT/ is used for estimation of activity durations for PTP.	0.07	19
PII16	Expert judgment is used for estimating activity durations while preparing PTP schedule	0.69	7
PII17	Historic records are used for estimating activity durations while preparing PTP schedule.	0.63	10
PII18	Combination of both Expert Judgment and Historic Records are used for estimating activity durations for PTP.	0.78	4

Source: Own Survey 2017.

The survey results on assessing the usage level of Project Scheduling Tools and Techniques are as shown in Table 4.6. Gantt chart/Bar Chart/ has RUI=0.96. Interconnected Gantt chart/Bar Chart/ has RUI=0.65. Precedence diagram method (PDM) employing activity on Arrow diagrams has RUI=0.13, Precedence diagram method (PDM) employing activity on node diagrams has RUI=0.07, Program Evaluation and Review Technique/PERT/ has RUI=0.07. Expert judgment used for estimating activity durations has RUI=0.69, Historic records for estimating activity durations has RUI=0.63 while combination of both Expert Judgment and Historic Records for estimating activity durations has RUI=0.78.

When asked about activity scheduling techniques the respondents indicated that bar charts are used “almost always” (96%). Linked bar charts, Expert Judgment, Historic Records and combination of the two have better usage rate. Precedence Network Diagram is quite similar with CPM, and it is also widely used in the construction industry. Precedence diagrams are also easier to draw and modify; additional activities can be inserted without changing node reference numbers. There is less risk of making logical errors with precedence diagrams, since each activity is connected to others by a relationship. However, only 18% of the respondents say Networks on Arrow (AoA) is used while 7% of respondents say AoN is used. 7 % of the respondents said Program Evaluation and Review Technique/PERT/ is “occasionally” used for estimation of activity durations for PTP.

In addition to skill and knowledge constraints, there is no tendency from clients/owners or consultants to request PERT and network schedules. The contract documents also contain no provisions enforcing the use of these tools.

Table 4.7 Schedule Tracking tools and techniques

Var. Name	**Tools and Techniques**	RUI	Rank
PII19	Critical Path Method (CPM) is used for PTP.	0.08	18
PII20	Critical Chain method (CCM) is used for PTP.	0.04	21
PII21	Project Performance review and trend analysis is sustainably made at regular interval for PTP.	0.88	2
PII22	Schedule performance measurement is made using schedule variance/SV/ and schedule performance index(SPI) for PTP	0.10	16
PII23	Earned value/EV/ analysis is made for PTP.	0.05	20

Source: Own Survey 2017.

As per Table 4.7, Critical Path Method (CPM) has RUI=0.08, Critical Chain method (CCM) has RUI=0.04.Project Performance Review and Trend Analysis has RUI=0.88, Schedule performance measurement using Schedule Variance/SV/ and Schedule Performance Index (SPI) has RUI=0.10 and Earned Value/EV/ analysis has RUI=0.05.

Critical path technique is important time management tool to identify the longest path in projects like PTP that are made of a number of individual activities. As per the survey made 8% of the respondents say CPM is used whereas the Critical Chain method (CCM) is used only 4%. 88% of the respondents say Project Performance Review and Trend Analysis is made for PTP, 10%, schedule variance/SV/ and schedule performance index (SPI) and Earned Value/EV/ analysis 5%. CPM, CCM, SV, SPI, and EV have very low level (practically nil) usage in PTPs. Skill and knowledge constraints and absence of enforcing contract provisions may be the major causes.

Table 4.8 Resource optimization tools and techniques

Var. Name	**Tools and Techniques**	RUI	Rank
PII24	Resource leveling technique is used for PTP.	0.07	19

Var. Name	**Tools and Techniques**	RUI	Rank
PII25	Resource smoothing technique is used for PTP.	0.09	17

Source: Own Survey 2017.

Table 4.8 shows, Resource Leveling Technique has RUI=0.07. Resource Smoothing Technique has RUI=0.09. Approximately ten percent of the respondents say resource levelling and resource smoothing technique are used. Similar to most of the foregoing tools and techniques these have also very low level of usage. Resource allocation and optimization may consume considerable efforts and may need a wide range of data during the planning stage that is not dealt with seriously by PTP contractors and the usage level is so low.

Table 4.9 Schedule compression tools and techniques

Var. Name	**Tools and Techniques**	RUI	Rank
PII26	Crashing technique for compressing scheduled time is used for PTP.	0.10	16
PII27	Fast tracking technique for compressing scheduled time is used for PTP.	0.08	18

Source: Own Survey 2017.

The survey results on assessing the usage level of Project Schedule Compression Techniques are as shown in Table 4.9. Crashing technique for compressing schedules has RUI=0.1(Rank 16). Fast tracking technique has RUI=0.08(Rank 18). Only 10% of the study population is crashing time schedule and 8% of the study population responded fast tracking technique for PTP. This shows about 90% of PTPs are not benefiting the advantages of using schedule compression tools and techniques.

Table 4.10 Scheduling software

Var. Name	**Tools and Techniques**	RUI	Rank
PII28	Microsoft project is used in PTP	0.47	11
PII29	Microsoft Excel is used in PTP	0.45	12
PII30	Primavera project planner is used in PTP	0.41	13

Source: Own Survey 2017.

The survey results on assessing the usage level of scheduling software are as shown in Table 4.10. Microsoft project has RUI=0.47(Rank 11), Microsoft Excel has RUI=0.45(Rank 12) and Primavera project planner has RUI= 0.41(Rank 13). Microsoft Project (47%) is the most used tool for project time planning. User friendliness may be the reason for selecting the specific tool. This three software were popularly used in construction industry, but Microsoft excel is now oldest one while comparing these three tools.

4.2.2.1 Summary on Scope & Time management tools and techniques.

Table 4.11 Ranking of PSM & PTM tools and techniques

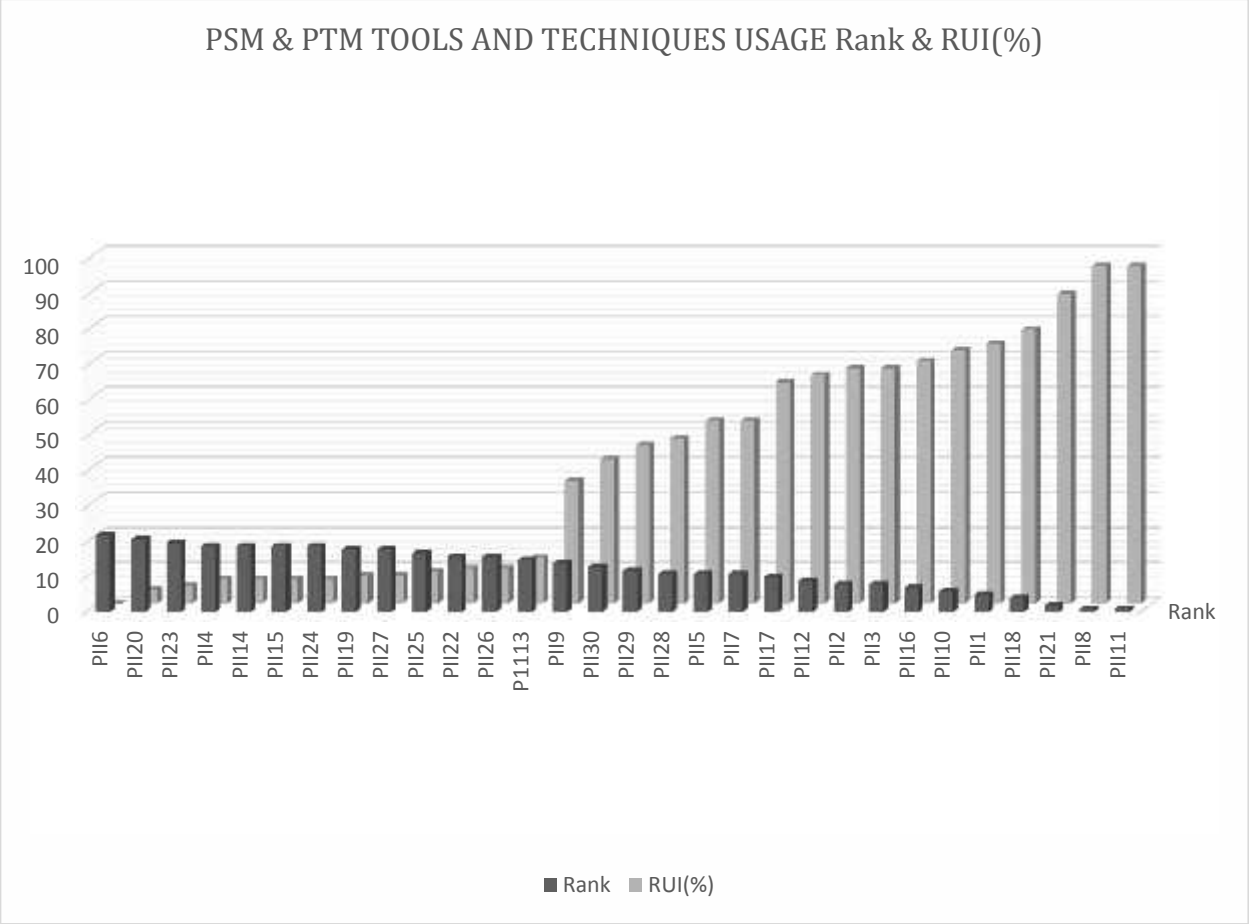
Variable Name	Variable	RUI (%)	Rank	Variable Name	Variable	RUI (%)	Rank
PII6	WBD	0	22	PII29	Ms. Excel	45	12
PII20	CCM	4	21	PII28	MS Project	47	11
PII23	EVA	5	20	PII5	WBS	52	11
PII4	Compensation taken care	7	19	PII7	Scope base line	52	11
PII14	PDM-AON	7	19	PII17	Historic records	63	10
PII15	PETRT is used	7	19	PII12	Interconn. Gantt	65	9
PII24	Resource levelling	7	19	PII2	Stakeholders Inter.	67	8
PII19	CPM is used	8	18	PII3	Deliverable clear	67	8
PII27	Fast tracking	8	18	PII16	Expert Judgement	69	7
PII25	Resource smoothing is made	9	17	PII10	M.s. updated	72	6
PII22	SV & SPI	10	16	PII1	Scope defin. Duri. Business case	74	5
PII26	Crashing is made	10	16	PII18	Expert + Historic	78	4
PII13	PDM-AoA	13	15	PII21	Performance review	88	2
PII9	Master sch. contain resou. plan	35	14	PII8	Master schedule is prepared	96	1
PII30	Primavera	41	13	PII11	Gantt chart	96	1

Source: Own Survey 2017.

Summary of the results of the findings of using project scope and time management tools and techniques are shown in Table 4.11.Gantt charts are almost always used, WBS dictionary are not used. For most of the tools, the usage level is very low (occasionally) and very few (usually) that is not satisfactory. This finding is congruent with the one obtained while interviewing the project

managers. The interviewees have admitted project scope and time management tools and techniques are not effectively used for PTP.

Figure 4.1 PSM & PTM Tools & Techniques Usage Rank & RUI (%)



Source: Own Survey 2017.

Figure 4.1 depicts the RUI (in %) and the rank of the PSM and PTM tools and techniques included in this study. As per the survey result, the figure shows most of these tools and techniques are not effectively used,

4.2.3. Constraints in using the PSM and PTM tools and techniques

The primary data rated on 1 to 5 Likert Scale (i.e. 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4= Agree, 5=Strongly Agree) collected through questionnaires on the constraints of using of scope and time management tools and techniques has been further analyzed, compounding variables into groups using descriptive analysis calculating the Means. The primary data is collected from 54

respondents. The results of the survey are depicted through tables, and bar charts followed by discussions on the findings.

Table 4.12 Constraints on education, training, knowledge & skill

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV1	Effective training in project management tools and techniques is not given for PTP staffs.	41 13	0	0	0	75.9	24.1	4.2407
PIV2	Project managers of PTP are lacking sufficient knowledge & skill in modern project management for effective implementation of scope and time management tools and techniques.	24 20 10	0	44.4	0	37.0	18.5	3.2963

Source: Own Survey 2017.

The survey results on assessing Education, Training, Knowledge & Skill constraints on the application of PSM and PTM tools and techniques are as shown in Table 4.12. 75.9% of the respondents agree and 24.1% strongly agree on PIV1 variable with mean value of 4.2407. 44.4% of the respondents disagree, 37.0% agree and 18.5% strongly agree on PIV2 factor. The mean value of PIV2 is 3.2963. For PIV2 factor, all respondents accept effective training is not given for PTP staffs. However, 44.4% respondents disagree that project managers are lacking sufficient knowledge & skills in modern project management where 37.0% agree and 18.5% strongly agree. This could be interpreted as; about 45% of the project manages have sufficient knowledge and skill in managing PTP. The trainings conducted and experiences gained working in different PTP project may assist the managers to acquire project management knowledge and skill. But still the 55% gap is huge signifying the need for effective training in project management tools and techniques.

Table 4.13 Project staff related issues

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV3	Effort creep, people are just not effective and sometimes the job is more complicated in PTP.	15 32 19	0	27.8	37.0	35.2	0	3.0741
PIV4	In PTP employees are not motivated and this is affecting the effective use of project scope and time management tools and techniques.	12 35 7	0	22.2	0	64.8	13	3.6852
PIV5	Staff turnover and replacement of approved client, consultant, and contactor staffs in PTP is impeding the effective use of project scope and time management tools and techniques.	9 35 10	0	0	16.7	64.8	18.5	4.0185
PIV6	In PTPs misconduct manifested by seeking unnecessary benefits is negatively affecting the use of project scope and time management tools and techniques.	15 39	0	0	27.8	72.2	0	3.7222
PIV7	Hope creep, team members in PTP tend to hide when they are falling behind targeted performance.	15 16 14 9	0	27.8	29.6	25.9	16.7	3.3148

Source: Own Survey 2017.

The survey results on assessing staff related issues are as shown in Table 4.13. 27.8% of the respondents disagree, 37.0% are neutral on PIV3, and project staffs are not effective since PTP are complicated. On PIV4 factor, 22.2%, 64.8% and 13% of the respondents disagree, agree and strongly agree respectively on employee motivation. On staff turnover 16.7% of the respondents

are neutral, 64.8% agree while 18.5% strongly agree. On PIV6 misconduct factor, 27.8% of the respondents are neutral and 72.2% agree that misconduct manifested by seeking unnecessary benefits is negatively affecting the use of scope and time management tools and techniques. Respondents' response on staff tending to hide, PIV7 when falling behind is diversified since 27.8% disagreed, 29.6% neutral, 25.9% accepted and 16.7% strongly agreed. The interpretation of these results could be, there are effort creeps, employees are not motivated to the required level, staff turnover, misconducts and hope creep are constrains in the application of PMTT.

Table 4.14 Project team member's experience

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV8	PTP team members have limited experience and lack sufficient knowledge & skill in using project management tools and techniques.	14 33 7	0	0	25.9	61.1	13	3.8704

Source: Own Survey 2017.

The survey results on team member's experience are as shown in Table 4.14. 25.9% of the respondents are neutral on PIV8. 61.1% of the respondents agree and 13% of the respondents strongly agree that PTP team members have limited experience and lack sufficient knowledge and skill in using project management tools and techniques. This result is congruent with the low level usage of PSM and PTM tools and techniques shown in Part II of this study.

Table 4.15 Company level issues

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV9	Project managers are not given full authoritative delegation to run PTP.	44 10	0	0	0	81.5	18.5	4.1852
PIV10	The organizational structure of companies involved in PTP are vertically integrated	39	0	0	0	72.2		4.2778

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
	making scope and time management tools and techniques difficult.	15					27.8	
PIV11	Sufficient support is not given to PTP from top management.	15 9 27 3	0	27.8	16.7	50	5.6	3.3333
PIV12	Companies involved in PTP effort to maximize profit and minimize cost is impacting the effective use of scope and time management tools and techniques for PTP.	16 27 11	0	29.6	0	50.0	20.14	4.0000
PIV13	Effective implementation of scope and time management tools and techniques depend on the financial strength of the companies involved in PTP.	54	0	0	0	100.0	0	4.0000
PIV14	In PTP, companies cut down their costs to get/win/ bids and make project scope and time management tools and techniques inefficiently latter in the implementation phase.	18 30 6	0	0	33.3	55.6	11.1	3.7778
PIV15	Companies involved in PTP are deploying staffs who do not have sufficient project management tools and techniques knowledge, skills.	50 4	0	0	0	92.6	7.4	4.0741

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV16	Companies involved in PTP have low level of project management maturity level.	33 21	0	0	61.1	38.9	0	3.3889
PIV17	The communication within and among participating parties in PTP is poor.	32 22	0	0	59.3	40.7	0	3.4074

Source: Own Survey 2017.

The survey results on assessing about companies involved in PTP is shown Table 4.15. 81.5% of the respondents agree and 18.5% strongly agree on PIV9, project managers are not given full authoritative delegation to run PTP.72.2% agree, and 27.8% strongly agree that organizational structures are vertically integrated. Even though 27.8% disagree, 16.7% are neutral on the support given by top management 50% agree, and 5.6% strongly agree sufficient support is not given from top management for PTP. 29.6% disagree, 50.0% agree and 20.4% strongly agree companies involved in PTP effort to maximize profit and minimize cost is impacting effective use of PMTT. All the respondents 100% agree effective implementation of PMTT depend on the financial strength of companies working in PTP. 33.3% are neutral, 55.6% agree and 11.1% strongly agree that companies cut down their costs to win bids and insufficiently handle PMTT latter in the implementation phase.92.6% agree and 7.4% strongly agree that companies involved in PTP deploy staff who do not have sufficient project management tools, techniques, knowledge and skills.61.1% are neutral and 38.9% agree that companies involved in PTP have low project maturity level. Pertaining to poor communication within and among participating parties 59.3% of the respondents abstain while 40.7% agree. As per the survey, with slight degree of differences in the results all the factors PIV9- PIV17 are found to be constraints for effective use of PMTT.

Table 4.16 PTP contract agreement related issues

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV18	Disputes and claims are problems in PTP.	20 34	0	0	37. 0	63.0	0	3.6296

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV19	Scope creep (adding project scope without addressing the effects on time, costs and resources), is a problem in PTP.	13 26 15	0	24.1	0	48.1	27.8	3.7963
PIV20	In PTP preliminary soil investigation is not done satisfactorily and precisely and this latter on results scope variation.	6 48	0	11.1	0	88.9	0	3.7778
PIV21	Generally contract times allocated for PTP are squeezed, unrealistic and difficult to attain.	54	0	100	0	0	0	2.0000
PIV22	Generally contract times allocated for PTP are long and relaxed.	28 26	0	51.9	48.1	0	0	2.4815
PIV23	Generally contract times allocated for PTP are fair and possible to achieve.	54	0	0	0	100	0	4.0000
PIV24	In PTP contracts, there are no provisions enforcing effective use of scope and time management tools and techniques.	12 15 27	0	22.2	27.8	50.0	0	3.2778
PIV25	PTP are fixed price contracts and this is making project scope management difficult.	10 44	0	18.5	0	81.5	0	3.6296

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV26	Compensation (made for land acquisition for substation and Right-Off-Way corridor for transmission line both at rural and urban sites) is a problem in PTP for effective implementation of scope and time management tools and techniques.	3 35 16	0	5.6	0	64.8	29.6	4.1852
PIV27	Importation/procurement from abroad/ of different equipment and materials for PTP have made the application of project scope and time management tools and techniques difficult.	9 45	0	16.7	0	83.3	0	3.6667

Source: Own Survey 2017.

The survey results on assessing about PTP Contract Agreements Related Issues is shown Table 4.16. 37.0% of the respondents are neutral to disputes and claims problems in PTP while 63.0% agree the problems exist. 24.1% disagree there are scope creep while 48.1% agree and 27.8% strongly agree there are scope creeps in PTP. For factor PIV20, preliminary soil investigation is not done satisfactorily 11.1% disagreed while 88.9% agreed. For factors PIV21 up to PIV23 dealing with the contract times allocated for PTP, respondents agreed time allocated are fair and neither squeezed nor compressed. For factor PIV24 dealing with enforcing contract provisions 22.2% disagree, 27.8% are neutral and 50.0% agree there are no provisions for enforcing the effective use of PMTT. PTP are fixed price contracts and as per this survey 18.5% of the respondents disagree this is affecting the use of PMTT but 81.5% agree that the factor is affecting the use of PMTT. Right-Off-Way compensation is surveyed, 5.6% of the respondents disagree Right-Off-Way problems are affecting PMTT where as 81.5% accept the problem. Factor PIV27 is about importation/procurement from abroad of equipment and materials for PTP. For this factor 16.7% disagree this has no effect on PMTT but 83.3% agree that PIV27 is affected. As shown in

the survey PIV18-PIV27factors related to PTP contracts are among the constraints for the implementation of PMTT.

Table 4.17 Customization of PMTT

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV28	Universal project scope and time management tools and techniques applied in developed countries should be customized to specific conditions to be effectively used for PTP.	7 21 26	0	0	13.0	38.9	48.1	4.3519

Source: Own Survey 2017.

The survey results on assessing customization of scope and time management tools and techniques is shown in Table 4.17. 13.0% of the respondents are neutral to the need for customization while 38.9% agree and 48.1% strongly agree. Clear majority of the respondents accept that PMTT should be customized for effectively using in PTP. The data obtained through the interviews support the need for customized PMTT for PTP.

Table 4.18 Policies, procedures, institutional setup

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV29	At Federal or regional level there are no enforcing Policies and Procedures for the implementation of project management tools and techniques.	33 21	0	0	61.1	38.9	0	3.3889
PIV30	At Federal or regional level there is no public association who supports, promotes, train, certify the	15	0	0	27.8		0	3.7222

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
	application of project management tools and techniques	39				72.2		
PIV31	The use of project scope and time management tools and techniques effectively in PTP is difficult since Ethiopia is a land locked country.	23 0 31		42.6	 57.4	 0	 0	 2.5741

Source: Own Survey 2017.

The survey results on assessing Procedures, Institutional setup and Geographic location is shown in Table 4.18. 61.1% of the respondents are neutral to the need for enforcing policies while 38.9% agree the need for Government intervention to put in place Policies and Procedures for the effective use of PMTT. Involvement of public associations in support and promotion of trainings and certifications is addressed in factor PIV30. As per the survey result 27.8% of the respondents are neutral while 72.2% agree that there are no public associations and this is impaction the use PMTT. As per the assessment made 42.6% disagree and 57.4% are neutral for factor PIV31 showing being a land locked country does not impede the effective use of PMTT. In this connection, the interview result showed there are no articulated policies and procedures for enforcing the use of project scope and time management tools and techniques, pointing out the need for such policies and procedures to supplement the effort made to effectively use PMTT.

Table 4.19 Foreign currency requirement

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV32	PTP demand huge foreign currency that is making project scope and time management difficult.	13 29 12	0	0	24.1	53.7	 22.2	3.9815

Source: Own Survey 2017.

The survey results on assessing whether the huge foreign currency requirements of PTP are making PMTT application difficult is shown in Table 4.19. 24.1% of the respondents are neutral to factor PIV32 while 53.7% agree and 22.2% strongly agree the huge foreign currency requirement is among the constraints in effective use of PMTT.

Table 4.20 Differed conditions

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV33	PTPs start with differed internal & external environment since the time gap when the feasibility study is completed and project implementation started is high.	54	0	0	0	100.0	0	4.0000

Source: Own Survey 2017.

The survey results on assessing whether the starting of PTP within differed internal and external environment shown in Table 4.20. 100% of the respondents agree that PTP are started with differed conditions since the time gap when the feasibility study is completed and the project started is high. This is one of the constraints for effective use of PMTT which almost all the respondent unanimously accepted.

Table 4.21 Payments to contractors

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV34	There is delay in certifying and releasing payments to contractors.	3 24 10 14 3	5.6	44.4	18.5	25.9	5.6	2.8148

Source: Own Survey 2017.

The survey results on assessing whether delayed payments to contractor are constraints for using PMTT is shown in table 4.21. It is for this PIV34 factor diversified mixed responses are received.

5.6% strongly disagreed, 44.4% disagreed, 18.5% were neutral, 25.9% agreed and 5.6% strongly agreed. This is could be attributed to the fact that the respondents are from client, consultant and contractor categories and the question is specifically refers to contractors.

Table 4.22 Project risk management

Var. Name	Constraints of using PSM &PTM Tools & Techniques	Freq.	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
PIV35	Project risk management is not done for PTP	48 6	0	0	0	88.9	11.4	4.1111

Source: Own Survey 2017.

Table 4.22 indicates that the respondents unanimously agree Project Risk Management is not done for PTP and consequently 88.9% of the respondents agreed and 11.4% strongly agreed.

4.2.3.1. Summary on Mean Values of constraints for using PMTT

Table 4.23 Mean values of constraint variables

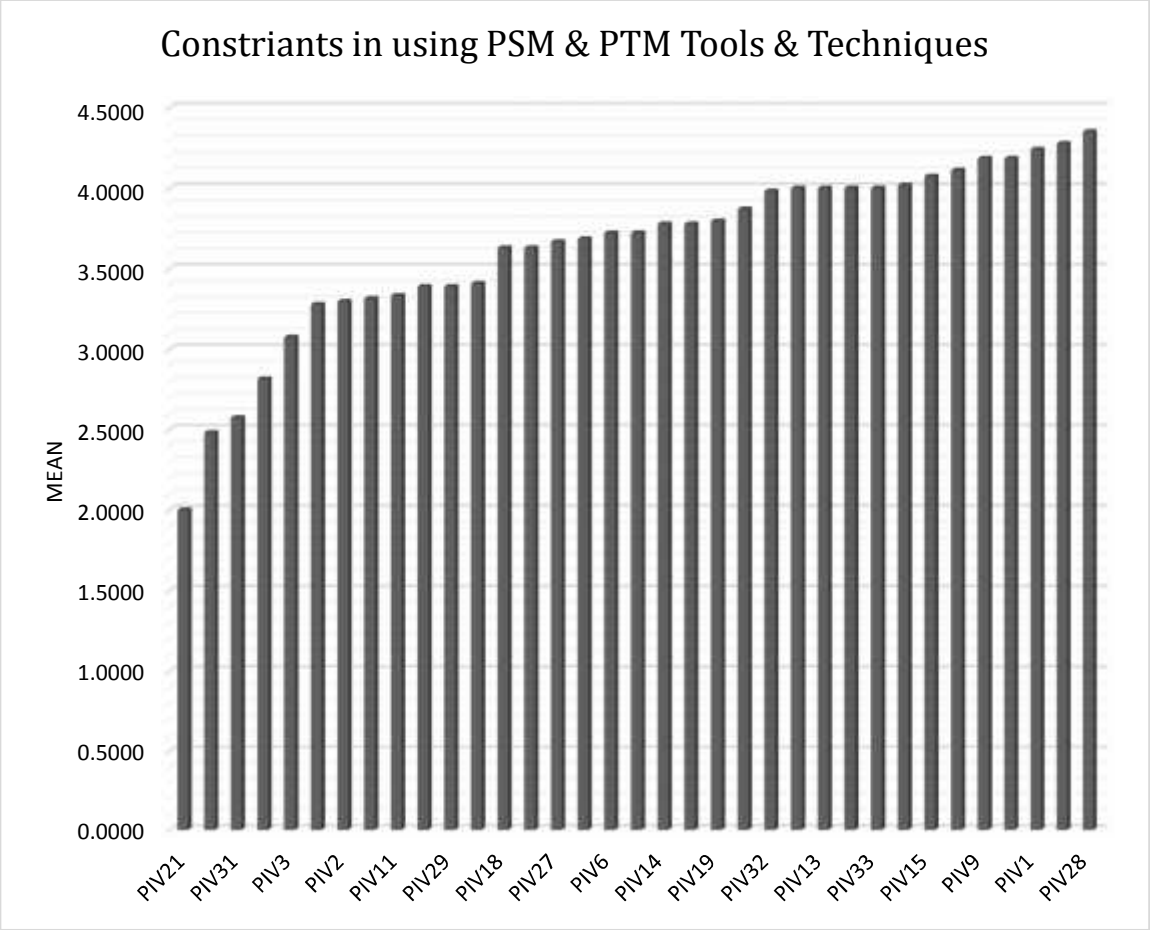
Variable Name	Variable	Mean	Variable Name	Variable	Mean
PIV21	Contract time squeezed	2.0000	PIV14	Cut down to win bids	3.7778
PIV22	Contract time long	2.4815	PIV20	Soil inves. No done eff.	3.7778
PIV31	Ethiopia is land locked	2.5741	PIV19	Scope creep	3.7963
PIV34	Delayed payment	2.8148	PIV8	Team members lack SK	3.8704
PIV3	Effort creep	3.0741	PIV32	Demand huge foreign curr	3.9815
PIV24	No enforcing provision	3.2778	PIV12	Comp.max prof.cut cost	4.0000
PIV2	PM lacks skill & knowl.	3.2963	PIV13	Financial capacity	4.0000
PIV7	Hope creep	3.3148	PIV23	Contract time is fair	4.0000
PIV11	Top manag,support insuf.	3.3333	PIV33	Differed conditions	4.0000
PIV16	Low project maturity levl.	3.3889	PIV5	Staff turnover & replacem	4.0185
PIV29	No enforcing poly & proc	3.3889	PIV15	Employ incompetent staff	4.0741
PIV17	Poor communication	3.4074	PIV35	No risk management exercised	4.1111
PIV18	Disputes & claims	3.6296	PIV9	PM is not given full autho	4.1852
PIV25	Fixed contract price	3.6296	PIV26	Compensation is problem	4.1852
PIV27	Procurement from abroad	3.6667	PIV1	No effective training	4.2407
PIV4	Employee not motivated	3.6852	PIV10	Vertically integrated struc	4.2778
PIV6	Misconduct	3.7222	PIV28	Universal project manage	4.3519
PIV30	No public association	3.7222			

Source: Own Survey 2017.

Table 4.23 shows the mean values of the constraint factors for effective use of PMTT. The mean value of factors PIV21, PIV22, PIV31 and PIV 34 are less than 3 while for the others the mean values are higher than 3 showing the respondents generally agree the factors are constraints for the

effective use of PMTT in Ethiopian Power Transmission Projects. The result of the interviews with the project managers showed that shortage of qualified professionals, lack of sufficient knowledge and skills to be constraints for the effective utilization of PMTT.

Figure 4.2 Constraints in Using PMTT



Source: Own Survey 2017.

As shown in Figure 4.2 above all the Means of the constraints for using PSM and PTM tools and techniques are above 3, as judged by the respondents are constraints except PIV21- contract times are squeezed, PIV22-contract times are long and relaxed, PIV31-the constraint of being land locked, PIV-34 contractors payment are delayed are not constraints for using PSM and PTM tools and techniques.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSION OF THE STUDYAND RECOMMENDATIONS

5.1. Summary of findings

The use of scope and time management tools and techniques in the power transmission projects was studied in this research. It can be stated that there is consensus among respondents that the most used time scheduling tool is Gantt bar charts, while the least used are critical chain method, critical path method, PERT and network scheduling (AoA/AoN). On the other hand, the results confirm that the work breakdown structure and resources allocation and levelling are not satisfactorily used. The findings show that using scope and time management tools and techniques for Ethiopian Power Transmission Project is generally below satisfactory level.

The obstacles that cause non-efficient use of project management practices were investigated. Summary of the obstacles reported by respondents are shown in Figure 4.2. Lack of well trained employees, lack of sufficient knowledge and skills, project staff turnover, unmotivated project staffs, misconduct seeking unnecessary benefits, limited experience of project team members, poor support from top management, vertically integrated project organization structures, involving incompetent, incapable contractors and consultants, poor communication among participating parties, incomplete feasibility study, poor stakeholders involvement, absence of enforcing contract clauses, policies and procedures, absence of government and public institutions working on PMTT, PMTT that are not customized to specific needs of PTP, the differed internal and external conditions that arose due to the big time gap between completion of feasibility study and implementation of PTP, failure to use project risk management as tools for effective use of PMTT are among the constraints.

As per the findings of this study, PSM and PTM tools and techniques should be customized to specific project condition to fully benefit from the use of these tools and techniques. This study has showed that contact times allocated for PTP are fair and achievable.

As the sample population is about 40% of the study population, the findings of this study could be inferred to other power transmission projects.

5.2. Conclusion of the study

As discussed in detail in the literature review part of this study, effective project scope and time management tools and techniques increase the chance of successfully completing projects time, meeting cost and quality constraints. Project scope and time management tools and techniques also help to achieve other project objectives such as customer satisfaction.

The assessment result obtained from questionnaire survey depicted on Figure 4.1 shows that usage of project scope and time management tools and techniques are very low. This is an indication for the need for substantial improvements to increase the use of project scope and time management tools and techniques for Ethiopian Power Transmission Project.

The implementation of project management tools and techniques is not seriously considered in Power Transmission Projects. Therefore, it is crucial for all stakeholders involved in PTP to take practical measures to benefit from the application of the Project Scope and Time Management Tools and Techniques.

5.3. Limitations of the study

Questionnaires were distributed and responses collected mainly from respondents that were available in project offices in Addis Ababa. Due to time and financial limitations few professionals working at the project sites far from Addis Ababa are invited to participate in the survey. One of the limitation of the study was few number of respondents. The researcher believe that the position of some of the respondents in this study has influenced few of the answers in the questions.

5.4. Recommendations:

The gap identified for this research is low level usage of customized project scope and time management tools and techniques in Ethiopian Power Transmission Projects. To fill this gap the following recommendations are made based on the results of the study.

- Improve the extent to which customized project scope management tools like work breakdown structure, work break down dictionary; project time management tools and techniques like network diagraming techniques, project evaluation and review techniques, critical path method, critical chain method, project evaluation and monitoring techniques like earned value analysis, schedule variance and schedule performance index are utilized in power transmission projects,

- Solve the constraints like insufficient training, project staff turnover, project staff misconducts, vertically integrated project organization structures, selection of incompetent contractors and consultants, poor communication among the parties involved in the projects, compensation problems connected with right-off-ways through employee motivation, effective trainings and education, integrated stakeholders involvement.
- Set up government and public institutions that work on the promotion of the utilization of modern project management tools and techniques, incorporating enforcing contract clauses, putting in place policies and procedure at Federal and Regional levels.

5.5. Suggestions for further research.

The practice of project management is in its early ages in Ethiopia. The researcher could not find research conducted on PTP in Ethiopia. Thus, future researches can be conducted in detail and incorporating various project based organizations to compare their project management practice and contribute to its growth in Ethiopia. Further, it is recommended to do the study with respondents having different positions and conduct longitudinal research through a Power Transmission Project full life cycle to investigate the effect of controlled scope and time management tools and techniques on project performance and its cost benefit effectiveness.

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APPENDICES

APPENDIX A. Questionnaire

St. Mary University
School of Graduate Studies

Assessment of using scope and time management tools and techniques on Ethiopian Power Transmission Projects.

Dear respondents,

I am undertaking a research survey on assessment of using project scope and time management tools and techniques on Ethiopian power transmission projects. The research is an individual research project as part of my study for MBA Degree in Project Management at St. Mary's University. The main purpose of the research questionnaire is to collect information on the application of project scope and time management tools and techniques on Power Transmission Projects in Ethiopia.

As a professional who worked on power transmission projects you are invited to participate in this survey. The information you provide in response to the items in the questionnaire will be used as part of the data needed for the study.

All the information you provide will be kept in strict confidentiality and it will be used only for academic research .Please answer each question carefully .There is no right or wrong answer. If you are unsure of an answer, please respond with your best estimate. I value your participation and thank you for the commitment, time, energy and effort. If you have any further question, I can be reached at the address below.

Sincerely,
Tesfaye Delessa
Email: tesfayedelessa629@gmail.com
Cell phone No. 0911240101.

General Instructions.

- Writing name is not required.
- Mark [X] for your appropriate answer.
- In the questionnaire, PTP stands for Power Transmission Project in Ethiopia.

Annex A: Background of Respondents

Part I: Demographic characteristics

Instructions: please put [X] in the relevant box for your response and fill in the blank where appropriate.

1. Gender:

☐ Male ☐ Female

2. Age:

☐ 20-30 Years ☐ 31-40 Yeas ☐ 41-50 Years ☐ 51-60 Years ☐ Over 60 Years

3. What is your field of study and level of Education? /Multiple response is possible/

Your Field of study		Your level of Education.
☐	Electrical Engineering	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other
☐	Civil Engineering	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other
☐	Mechanical Engineering	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other
☐	Communication Engineering	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other
☐	Computer or ICT	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other
☐	Project Management	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other
☐	Other/Please specify……/	☐ PhD ☐ MA/MSc ☐ BA/BSc ☐ College Diploma ☐ Other/Please specify.....

4. What is your level of Education and field of study? /Multiple response is possible/

Your level of Education		Your field of study
☐	PhD	☐ Electrical Engineering ☐ Civil Engineering ☐ Mechanicl Engineering ☐ Computer &IT ☐ Communication Engineering ☐ Project Management ☐ Other
☐	MA/MSc	☐ Electrical Engineering ☐ Civil Engineering ☐ Mechanicl Engineering ☐ Computer &ICT ☐ Communication Engineering ☐ Project Management ☐ Other
☐	BA/BSc	☐ Electrical Engineering ☐ Civil Engineering ☐ Mechanicl Engineering ☐ Computer or IT ☐ Communication Engineering ☐ Project Management ☐ Other
☐	College Diploma	☐ Electrical Engineering ☐ Civil Engineering ☐ Mechanicl Engineering ☐ Computer &IT ☐ Communication Engineering ☐ Project Management ☐ Other
☐	Other (Please specify ……)	☐ Electrical Engineering ☐ Civil Engineering ☐ Mechanicl Engineering ☐ Computer &IT ☐ Communication Engineering ☐ Project Management ☐ Other(Please specify.....)

5. Did you have any training in project management?

☐ Yes ☐ NO

6. If your answer to QNo. 5 is yes, how do rate the training you received?.

☐ Sufficient to implement modern project management principles, tools and techniques.

☐ Insufficient to fully implement modern project management priciples.

7. What is the name of your company (Optional)? .....

8. Category of respondent's company :(Only one answer is possible)

☐ Client/Owner/ company ☐ Consultant/Engineer/ Company ☐ Contractor

☐ Other(Please specify).....

9. Approximately for how long your company been working in project implementation?

☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years

10. What is/was your position/role in a project; and how many years of experience you have? /Multiple response is possible/

Position or Role		Your years of Experience
☐	Project Manager or Deputy PM	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Civil works supervisor	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Electrical works supervisor	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Mechanical works supervisor	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Communication works supervisor	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Commissioning Engineer	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Automation and SCADA works supervisor	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Design and design review Engineer	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years
☐	Other/ Please specify……	☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years

11. Your years of experience in project works and position held?

Your years' of Experience in project works	Your Position/Role
Less than 1 year	☐ Project Manager or DPM ☐ Civil Works Supervisor ☐ Electrical Works Supervisor ☐ Mechanical Works Supervisor ☐ Communication works Supervisor ☐ Commissioning Engineer ☐ Automation SCADA works Supervisor ☐ Design and design review Engineer ☐ Other/ Please specify .....
1-5 years	☐ Project Manager or DPM ☐ Civil Works Supervisor ☐ Electrical Works Supervisor ☐ Mechanical Works Supervisor ☐ Communication works Supervisor ☐ Commissioning Engineer ☐ Automation SCADA works Supervisor ☐ Design and design review Engineer ☐ Other/ Please specify .....
6-10 years	☐ Project Manager or DPM ☐ Civil Works Supervisor ☐ Electrical Works Supervisor ☐ Mechanical Works Supervisor ☐ Communication works Supervisor ☐ Commissioning Engineer ☐ Automation SCADA works Supervisor ☐ Design and design review Engineer ☐ Other/ Please specify .....
11-15 years	☐ Project Manager or DPM ☐ Civil Works Supervisor ☐ Electrical Works Supervisor ☐ Mechanical Works Supervisor ☐ Communication works Supervisor ☐ Commissioning Engineer ☐ Automation SCADA works Supervisor ☐ Design and design review Engineer ☐ Other/ Please specify .....

Your years' of Experience in project works	Your Position/Role
Over 15 years	☐ Project Manager or DPM ☐ Civil Works Supervisor ☐ Electrical Works Supervisor ☐ Mechanical Works Supervisor ☐ Communication works Supervisor ☐ Commissioning Engineer ☐ Automation SCADA works Supervisor ☐ Design and design review Engineer ☐ Other/ Please specify .....

12. How many years of over all work experience (project and non-project) do you have in total?

☐ Less than 1 year ☐ 1-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ Over 15 Years

Part II. Listed below are statements about project scope and time management tools and techniques.

Please rate your level of agreement for each question with the statement so that your answer to these questions will enable the researcher to assess to what extent project scope and time management tools and techniques are used. Please put [X] for your response (only one) on the following scale of 0 to 4 where are: 0= don't know; 1= Not at all; 2 = Occasionally; 3 = Usually; 4 = Always.

No.	**Tools and Techniques**	Do not know (99)	Not at all (1)	Occasionally (2)	Usually (3)	Always (4)
	Project Scope Management					
	Project Scope Definition					
1	In PTP, scope definition is made in Business Case Development and/or Feasibility Study stage.					
	Stakeholders Involvement					
2	In PTP scope definition, interest of all stakeholders/Government, owner, contractor, consultant, Financing Bank, local community, etc., / is optimally addressed.					
3	In PTP scope definition project deliverables are made clear to all stakeholders/ Government, owner, contractor, consultant, Financing Bank, local community, etc.,					
4	Compensation issues/ for substation plot area, tower location, and right-off-way for transmission lines/ are					

No.	Tools and Techniques	Do not know (99)	Not at all (1)	Occasionally (2)	Usually (3)	Always (4)
	effectively taken care during the scope definition stage of PTP.					
	Work Breakdown Structure					
5	Work Break Down Structure/WBS/ is prepared in PTP. (WBS is the process of subdividing project deliverables and project work into smaller, more manageable components.)					
6	Work Break Down Dictionary is prepared in PTP. (The WBS dictionary is a document that provides detailed deliverable, activity, and scheduling information about each component in the WBS**.)**					
7	Project Scope Base Line (a project management schedule that is used as reference through the project life) is prepared and regularly updated in due course in PTP.					
	Project time Management					
	Project Schedule					
8	For PTP Master schedule is prepared within predefined time after contract signature.					
9	PTP master schedules contain resource plan/material resource, labor resource and equipment resource/					

No.	Tools and Techniques	Do not know (99)	Not at all (1)	Occasionally (2)	Usually (3)	Always (4)
10	Project master schedule is revised and updated regularly by producing baseline schedules depending on the progress of the PTP.					
	Tools and Techniques used for schedule development					
11	Gantt chart or Bar Chart(plain)/ is used in PTP for scheduling					
12	Linked Gantt chart or Bar Chart is used in PTP for scheduling					
13	Precedence diagram method (PDM) employing activity on Arrow/AOA/ diagrams is used in PTP scheduling. (The precedence diagram method is a tool for scheduling activities in constructing a project schedule network diagram that uses nodes (boxes) and connect them with arrows that show the dependencies.)					
14	Precedence diagram method (PDM) employing activity on node/AON/ diagrams is used in PTP scheduling.					
15	Program Evaluation and Review Technique/PERT/ is used for estimation of activity durations in PTP. (Project evaluation and review technique is statistical tool used in project management designed to analyze and represent the duration					

No.	Tools and Techniques	Do not know (99)	Not at all (1)	Occasionally (2)	Usually (3)	Always (4)
	of tasks involved in completing a given project.)					
16	Expert judgment is used for estimating activity durations while preparing PTP schedule.					
17	Historic records are used for estimating activity durations while preparing PTP schedule.					
18	Combination of both Expert Judgment and Historic Records are used for estimating activity durations in PTP.					
	Schedule Tracking and control					
19	Critical Path Method (CPM) is used in PTP. (Critical path is the longest path through project schedule that has no slack time)					
20	Critical Chain method (CCM) is used in PTP. (The critical chain is the longest duration path through the project considering both task dependencies and the resource constrains)					
21	Project Performance review and trend analysis is made at regular intervals for PTP.					
22	Schedule performance measurement is made using schedule variance/SV/					

No.	Tools and Techniques	Do not know (99)	Not at all (1)	Occasionally (2)	Usually (3)	Always (4)
	and schedule performance index(SPI) in PTP					
23	Earned value/EV/ analysis is used in PTP.(Earned value analysis is a project management technique of measuring project's progress at any given point in time, forecasting its completion date and final cost, and analyzing variances in schedule and budget as the project proceeds.)					
	Resource Optimization Techniques					
24	Resource leveling technique is used in PTP.(Resource leveling is a technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing demand for resources with the available supply)					
25	Resource smoothing technique is used in PTP. (Resource smoothing is a technique that adjusts the activities of a schedule model such that the requirements for resources on the project do not exceed certain predefined resource limits.)					
	Schedule compression					
26	Crashing technique for compressing scheduled time is used in PTP.					

No.	Tools and Techniques	Do not know (99)	Not at all (1)	Occasionally (2)	Usually (3)	Always (4)
	(Crashing technique used to shorten the schedule duration for the least incremental cost by adding resources.)					
27	Fast tracking technique for compressing scheduled time is used in PTP. (Fast tracking is a schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration.)					
	Scheduling software					
28	Microsoft project is used in PTP					
29	Microsoft Excel is used in PTP					
30	Primavera project planner is used in PTP					

Part III. Listed below are statements about constraints and challenges using project scope and contemporary time management tools and techniques.

Please put [X] for your response (only one) on the following scale of 1 to 5 where: 1= strongly disagree; 2 = disagree; 3 = neither agree nor disagree (Neutral); 4 = agree; 5 = strongly agree.

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
	Education, Training, knowledge & skill					
1	Effective training in project management tools and techniques is not given for PTP staffs.					
2	Project managers of PTP are lacking sufficient knowledge & skill in modern project management for effective implementation of scope and time management tools and techniques.					
	Project Staff Related Issues					
3	Effort creep, people are just not effective and sometimes the job is more complicated in PTP.					
4	In PTP employees are not motivated and this is affecting the effective use of project scope and time management tools and techniques.					

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
5	Staff turnover and replacement of approved client, consultant, and contactor staffs in PTP is impeding the effective use of project scope and time management tools and techniques.					
6	In PTPs misconduct manifested by seeking unnecessary benefits is negatively affecting the use of project scope and time management tools and techniques.					
7	Hope creep, team members in PTP tend to hide when they are falling behind targeted performance.					
	Experience					
8	PTP team members have limited experience and lack sufficient knowledge & skill in using project management tools and techniques.					
	Companies involved in PTP					
9	Project managers are not given full authoritative delegation to run PTP.					
10	The organizational structure of companies involved in PTP are					

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
	vertically integrated making scope and time management tools and techniques difficult.					
11	Sufficient support is not given to PTP from top management.					
12	Companies involved in PTP effort to maximize profit and minimize cost is impacting the effective use of scope and time management tools and techniques for PTP.					
13	Effective implementation of scope and time management tools and techniques depend on the financial strength of the companies involved in PTP.					
14	In PTP, companies cut down their costs to get/win/ bids and make project scope and time management tools and techniques inefficiently latter in the implementation phase.					
15	Companies involved in PTP are deploying staffs who do not have sufficient project management tools and techniques, knowledge, skills.					
16	Companies involved in PTP have low level of project management maturity level.					

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
17	The communication within and among participating parties in PTP is poor.					
	PTP contract agreement related issues					
18	Disputes and claims are problems in PTP.					
19	Scope creep (adding project scope without addressing the effects on time, costs and resources), is a problem in PTP.					
20	In PTP preliminary soil investigation is not done satisfactorily and precisely and this latter on results scope variation.					
21	Generally contract times allocated for PTP are squeezed, unrealistic and difficult to attain.					
22	Generally contract times allocated for PTP are long and relaxed.					
23	Generally contract times allocated for PTP are fair and possible to achieve.					
24	In PTP contracts, there are no provisions enforcing effective use of scope and time management tools and techniques.					

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
25	PTP are fixed price contracts and this is making project scope management difficult.					
26	Compensation (made for land acquisition for substation and Right-Off-Way corridor for transmission line both at rural and urban sites) is a problem in PTP for effective implementation of scope and time management tools and techniques.					
27	Importation/procurement from abroad/ of different equipment and materials for PTP have made the application of project scope and time management tools and techniques difficult.					
	Customization of project scope and time management tools and techniques					
28	Universal project scope and time management tools and techniques applied in developed countries should be customized to specific conditions to be effectively used for PTP.					

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
	Policies, Procedures, Institutional setup & Geographic location					
29	At Federal or regional level there are no enforcing Policies and Procedures for the implementation of project management tools and techniques.					
30	The use of project scope and time management tools and techniques effectively in PTP is difficult since Ethiopia is a land locked country.					
31	At Federal or regional level there is no public association who supports, promotes, train, certify the application of project management tools and techniques					
	PTP foreign currency requirement					
32	PTP demand huge foreign currency that is making project scope and time management difficult.					
	Differed conditions					
33	PTPs start with differed internal & external environment since					

No.	Constraints for using PSM & PTM tools and techniques	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
	the time gap when the feasibility study is completed and project implementation started is high.					
	Payments					
34	There is delay in certifying and releasing payments to contractors.					
	Project risk management					
35	Project risk management is not done for PTP					

APPENDIX B. INTERVIEW QUESTIONS FOR ONE PARTICIPANT

St. Mary University

School of Graduate Studies

Assessment of using scope and time management tools and techniques in Power Transmission Projects on Ethiopian Power Transmission Projects.

This interview questions will be answered by purposively selected respondents. Because project management is a relatively new discipline and it may not easy for any professional to respond to the interview questions satisfactorily.

1. Do you think project scope and time management tools and techniques are effectively utilized for power transmission projects in your organization?
2. What do you think are the constraints to effectively use scope and time management tools and techniques for power transmission projects?
3. Are policies and procedures of using scope and time management available in the company you are working for?
4. Tell us the challenges of the project work for not using scope and time management tools and techniques.
5. What recommendations can you forward for future improvement?