ST. MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

CONSTRUCTION PROJECTS SCHEDULE MANAGEMENT PRACTICE IN ETHIOPIAN AIRLINES

BY

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ADDIS ABABA, ETHIOPIA

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Declaration

I, the undersigned, declare that 'construction projects schedule management practice in Ethiopian Airlines' is my original work and 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 earning any degree.

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Confirmation

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

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St. Mary's University College, Addis Ababa. **June 2019**

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Thank you

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Acronyms

AFRAA	African Airlines Association
CCPM	Critical Chain Project Management
CPM	Critical Path Method
EAA	Ethiopian Aviation Academy
EAE	Ethiopian Airport Enterprise
EAL	Ethiopian Airlines
ERP	Enterprise Resource Planning
ET	Ethiopian
EVA	Earned Value Analysis
GBC	Gantt bar Chart
GDP	Gross Domestic Product
HR	Human Resource
IATA	International Aviation Transport Authority
LFA	Logical Framework Approach
LOB	Line of Balance
MDPT	Milestone Date Programming Techniques
MRO	Maintenance Repair and Overhaul
PDM	Precedence Diagraming Method
PERT	Program Evaluation and Review Technique
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PND	Precedence Network Diagram
P3	Primavera Project Planner
PS	Project System
PSMTT	Project Schedule Management Tools and Techniques
PTM	Project Time Management
RUI	Relative Use Index
SAP	Systems Applications and Products
SPI	Schedule performance Index

SPSS	Statistical Packages for Social Science
STT	Scheduling Tools and Techniques
SV	Schedule variance
UI	Use Index
WBS	Work Breakdown Structure

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Abstract

Construction projects schedule management will have potential benefits for increased efficiency, improved project predictability, increased stakeholder's confidence, improved communication, and increased probability of project success. Proper management of project schedule tools and techniques can help project success with standard expectations. However, in most cases the Ethiopian Airlines construction Projects do not seem meeting their deadlines. The objective of this paper is to identify the scheduling tools and techniques used, to identify the schedule performance and analyze determinants contributed for the delay of Ethiopian Airlines construction projects. The study employed descriptive research design using primary and secondary data. The data for this study was obtained through questionnaires, interviews and the project's document. The survey questions were distributed to 74 Client, Contractor and Consultant professionals working on Ethiopian Airlines construction projects. The respondents were selected using purposive sampling techniques. Interviews were conducted with the Manager of Group Infrastructure Planning and Development section and the Director of the section to triangulate and supplement the data obtained from the questionnaires and Ethiopian Airlines project's document. The responses were analyzed and interpreted using SPSS analytical tools. The results of the study indicated that schedule management tools and techniques are not effectively utilized for Ethiopian Airlines construction projects. The conclusion drawn is the usage of schedule management tools and techniques is low level. Based on the findings it is recommended that construction projects contractors address the constraints to make use of customized schedule management tools and techniques. The results of the study will help Ethiopian Airlines construction projects to improve their level of using Project schedule management tools and techniques and the study lays foundation for further researches.

***Key words**: Ethiopia, Ethiopian Airlines, Project schedule management, Schedule management tools and techniques, SPSS analytical tools*

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Construction industry contains large number of parties as clients, contractors and consultants. This make the industry complex and the success of construction project depends on its performance, and measured based on timely completion, within the budget, required quality standards and customer's satisfaction (Omran 2012). The aim of project control is to ensure the projects finish on time, within budget and achieving other project's objectives. It is a complex task undertaken by project managers in practice, which involves constantly measuring progress; evaluating plans; and taking corrective actions when required Kerzner (2009). The industry is among those industries that face the trend of project failures in terms of project delivery, and has been argued that the diverse kinds of construction projects including their multifaceted nature make planning, forecasting, managing and controlling of projects more difficult. Therefore, decisions that are taken at the initial stages of the management aspect of the project process become critical to the success of the project (Miller *et al.*, 2000).

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. Ethiopia as a country has presented a remarkable growth over the past ten years with average annual growth GDP of 10.9% (UNDP, 2014). Recently, the contribution of the industry sector (which is 21.2%) and particularly that of the construction sector to the national economy is given high importance and is mainly driven by the active performance of the construction sub-sector (ECIDP,2014). Despite the construction sector has high standing, several defects are being noted in the sector that require immediate action (Nega, 2008). One substantial problem is significant delay of infrastructure and construction projects that impair planned economic development (ECIDP, 2014; Li-Yin *et al*, 2006). Abadir (2011) found out that among the knowledge areas of project in Ethiopia, project time management is considered the critical one with only 24% projects managed well.

Project activities and management efforts in any of the project phases could affect the success of a given project. This makes the management process more complex and challenging task, requiring a more comprehensive view in the projects. During the last few decades, numerous project control methods, such as Gantt Bar Chart (GBC), Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM), have been developed (Lester, 2014).
According to PMI (2013), Project management software for scheduling provides the ability to track planned dates versus actual dates to report variances to and progress made against the schedule baseline, and to forecast the effects of changes to the project schedule mode. Delay will affect all parties involved in the project and the profits that would be obtained if the project can be completed on the schedule. However, 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 schedule management is very important and crucial to achieve successful completion of construction projects.

Ethiopian Airlines simply "Ethiopian" hereafter EAL, is Ethiopian's flag carrier and is owned by the Government of the Federal Democratic Republic of Ethiopia. EAL was founded on 21 Dec 1945 and commenced its first flight took place to Cairo via Asmara on April 8, 1946. EAL has been a member of the International Aviation Transport Authority (IATA) since 1959 and of the African Airlines Association (AFRAA) since 1968 and Ethiopian is joined the largest alliance of Airlines (Star Alliance) on December 2011. By originating from its main hub at Bole International Airport, EAL serves a network of 100 international and 21 domestic destinations as well as 41 freighter destinations as of April 2019 (Ethiopian Airlines, 2019).

EAL has been playing a pivotal role in advancing economic development of the country for the last 73 years (1946-2019). EAL made a positive net economic value contribution to the national economy by facilitating trade, investment and tourism in line with its vision (Kirubel 2015). EAL aimed to be fast growing airline by providing excellent air transport services and will be the most competitive and leading aviation group in Africa by providing safe, market driven and customer focused passenger and Cargo Transport, Aviation Training, Flight Catering, Maintenance Repair and Overhaul (MRO), Ground Services, Domestic and regional services by 2025. Ethiopian has more than 16,000 employees as of April 2019. To accommodate the increasing demand of the

organization, constructing, modifying and maintaining a number of facilities became necessary from time to time, for the last 9 years EAL handled more than 42 large and medium construction projects.

Ethiopian Airlines had shown its potential growth and development to the Airline industry. In line with the rapid growth of the organization, the infrastructure requirements became challenging to the management, besides many operating and management problems. According to the researcher observation and the organization reports among the construction projects constraints, delay in project completion time is the one that need improvement to support the growth of the Airline. The aim of this study is to assess the construction projects schedule management practice in terms of the usage of scheduling tools and techniques and identify delay indicators from Client (Ethiopian Airlines), Consultants and Contractors. The researcher believes the study will show the effectiveness level of construction projects scheduling tools and techniques used and find the determinants of delay in the construction projects by indicating the level of applicability of project management knowledge, make recommendations that will improve project scheduling in the organization in particular, and contribute to the research environment in general.

1.2 Statement of the problem

The construction industry is one of the industries that has significant contribution to the economy of developing countries. Despite the critical role the construction industry plays in these countries' development, the performance of the industry remains generally poor. Idoko (2008) noted many projects in developing countries encounter considerable delay to realize their intended benefit or even totally terminated and abandoned before or after their completion. Due to the challenges in different areas, there is a need for a better understanding of the constraints to follow structured approach in identifying and modeling constraints. Project delay is one of the problems of construction project performance in selection, planning, execution or control phase of the project. According to Richard, (2012) one of the main reasons of project failure in developing countries is time overrun, only rare projects completed on the estimated time, a

number of major projects fail in meeting the schedule deadline. Construction project schedule is considered as a measurable indicator of performance criteria for successful project completion. According to Haseeb (2011), the most important and highly ranked delay causes in construction industry of Pakistan is inaccurate time estimation. In another study, Majid (2006), a construction project is commonly considered as successful when it is completed on time, within budget, in accordance with specifications. According to Haseeb (2011), inaccurate time estimation, weak economy, lack of managerial skills, bad labor productivity, bad planning, and slow decision-making by owners, unrealistic imposed contract duration, and contractor subcontracting, increasing prices of materials, environment and others are main factors delay in construction projects.

Most construction projects in Ethiopia suffer from delay (Nega, 2008). Regardless of the fact that efforts of the organization are visible, construction delay remains the main problem and there are various factors, which affect the accomplishment of projects as planned in this case in terms of time requirement.

Low projects management capacity, low project maturity level of clients and contractors are possible causes of ineffective schedule 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, lose credibility and this is negatively affecting contractors' image. Client may penalize the contractor for its failure to deliver the construction projects timely but there are consequential effects like postponing other development agendas of the organization, which affect the country at large.

The usage level of construction projects scheduling tools and techniques and the extent of projects delay not known. The high demand and requirement for construction facility in size and complexity increased, due to the rapid growth of Ethiopian Airlines making construction project more difficult to meet schedule objective. Thus, this study aims to bridge the knowledge gap by assessing project schedule related problems, specifically, the usage level of scheduling tools and techniques and the extent of completing projects with in schedule.

1.3 Research Questions

In light of the problems discussed above the study is going to be guided by the following research questions:

1. What are the tools and techniques used for the construction project in EAL?
2. What is the extent of completing projects with in planned schedule in the context of EAL?

1.4 Objective of the Study

1.4.1 General Objective

The overall aim of this study is to assess and analyze the construction projects schedule management practice in Ethiopian Airlines.

1.4.2 Specific Objective

Specifically, the study tries to address the following key research objectives:

- To identify construction project scheduling techniques and tools used for EAL.
- To identify to what extent the construction projects in EAL meet their schedule.

1.5 Significance of the Study

This study will contribute to the construction projects schedule management of EAL, as it could guide the client, consultants and contractors in addressing the use of project management tools and techniques. The study serve as a policy or strategy input for the improvement of overall construction projects performance in EAL and enhance the delivery of project within the set period. Construction projects schedule management capacity of EAL increases and hence the understanding of implementing a good project scheduling and control tools and techniques increases. This study serves as a guideline for further studies that pertains to the management of construction projects and for future development to lessen the risk of delays.

1.6 Scope and limitation of the Study

1.6.1 Scope of the study

The study covers a limited number of construction projects constructed in Addis Ababa by Ethiopian Airlines. Various projects at international and domestic stations of the organization are excluded due to their geographical location.

Although Ethiopian Airlines has long years of experience, more than 73 years the study addresses only those construction projects carried during the past 10 years. Construction projects completed before 2011 are excluded from this study due to their time.

Currently Ethiopian Airport Enterprise (EAE) is merged with Ethiopian Airlines. However, the study excluded those constructions projects handled by EAE. Other construction projects, which are not listed in the population, are excluded.

1.6.2 Limitation of the study

The study is limited to descriptive research design and other design methods are not employed. Due to time constraint and involvement of many variables, impact assessment on the implementation of schedule management tools and techniques is not done.

The study is limited to assessing the project time aspect and the usage of construction projects schedule management tools and techniques in relation to project management body of knowledge areas. As clearly defined in the problem statement, the study is an assessment on the existing practices only.

To gate project information from contractors and consultants who have completed or terminated from the construction projects of Ethiopian Airlines and has no contact currently was difficult.

1.7 Ethical Considerations

The purpose of the study was explained to the participants of the study to make them more comfortable to reply. The researcher has declared that all participants will be voluntary participate in the data collection and the respondents will be free of any harm and more importantly their views were very confidential and anonymous. Additionally, the questionnaire

does not have any connection with the respondents since it is for education purpose. According to Rajesh Kumar (2012) ethical consideration in research work are the following:

Right to choose: everyone has the right to determine whether or not to participate in the research project.

Right to be informed: Research participants have the right to be informed of all aspects of a research task. Knowing what is involved, how long it will take, and what will be done with the data, etc.

Right to Privacy: All stakeholders have right to Privacy.

1.8 Organization of the Research Report

The thesis contains five chapters as described below; Chapter One is an introductory part containing discussions on study background, research problems, Research question, objective of the research, and significance of the research, scope of the research and organization or layout of the research. Chapter Two on the other hand presents literature review with general descriptions by different researchers in the area of project schedule management. Chapter Three discusses about the research design and methodology. Chapter Four presents results and discussions and Chapter Five contains summary, conclusions and recommendations based on what is discussed in the previous chapters.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Theoretical Review

2.1.1 Project management Approach

According to the PMI (2013), project management method is fundamentally designed to apply tools and techniques as well as the needed knowledge and skills to the activities of a project so as to meet the projects requirement. The importance of project management techniques and tools in achieving project expectations and objectives has been reported in the literature Murphy and Ledwith, (2007). For instance, the use of project management principles has been regarded very effective in managing and controlling project activities Murphy and Ledwith, (2007). There are techniques that can be used to solve many problems confronting projects such as those relating to project planning, human resources management, cost management, time management among others. However, the application of project management principles to drive project success is still at its early stage in the Kingdom of Saudi Arabia (CIOB, 2008).

2.1.2 Project Time Management

Time is the most precious asset available that cannot be stored, recovered or transferred. Every human activity uses time, but time is limited in supply i.e. we have only 24 hours 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 commanding (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 is the efficient use of time by means of good organization, efficient productivity, and proper planning. Project managers, who are tasked with overseeing projects from start to finish, utilize these time management skills to complete their work in the most efficient, cost-effective ways possible. It is necessary because a team needs to be organized to

meet deadlines and to streamline collaboration. The knowledge area of time management typically refers to the skills, tools, and techniques used to manage time when accomplishing specific tasks, projects and goals Kerzner, (2013). Scheduling and sequencing of activities will usually use to manage the time to be used in the appropriate utilization of the project schedule time.

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).

There are many scheduling techniques available as well as many tools for reducing project duration, which are being practiced since long time. 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).

Delay or time overrun will affect all parties involved in the project. It will affect the profits that would be obtained if the project can be completed on the schedule. However, 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).

2.1.3 Project Schedule

Scheduling is the process used to determine the overall project duration and when activities and events are planned to happen. This includes identification of activities and their logical dependencies, and estimation of activity durations, taking into account requirements and availability of resources. There are different types and formats of schedules. Examples of schedule formats are milestone charts, bar charts and project schedule network diagrams. These formats are briefly described as follows (PMI, 2013). A Schedule is a critical component of every project that makes commitments, lets participants see their roles in meeting those

commitments and allows for tracking of the project. According to Christine (2010) while it may seem like an oversimplification, without a schedule, there is no project. This is because a project by definition is finite, and whether or not the schedule is formal, there is always an expected end. A well-managed project has a formal schedule. Although they may be considered a type of schedule, the network diagrams, their objective is to identify dependencies and the critical path.

2.1.4 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).

2.1.5 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. 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.

2.1.6 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, 2013).

2.1.7 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). PMI, (2013) uses three estimates to define an approximate range for an activity's duration of PERT. These are:

- 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.

2.1.8 Schedule Development

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 starts 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.

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).

Gantt Charts

Gantt Charts are useful tools for planning and scheduling projects, how long a project should take and determine the resources needed. Gantt charts are the most commonly used method of scheduling and controlling in construction industry Arditi, Sikangwan and Tokdemir (2002). Moreover, Gantt charts help in managing the dependencies between tasks and determining the resources required for each activity.

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. 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 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).

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 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.

Critical Chain Method

According to (PMI, 2013), critical chain method (CCM) is a scheduling method that allows the project team to place buffers on any project schedule path to account for limited resources and project uncertainties. Critical chain method 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).

Program Evaluation and Review Technique (PERT) is a network model that allows for randomness in activity completion times. PERT was originated by the U.S. Navy in 1958 as a tool for scheduling the development of a complete weapon system Cottrell (1999). The primary use of PERT is for the projects that have not been done before. It provides a basis from which time and cost performance can be estimated and an assessment of the probability of reaching certain milestones by specified dates or of achieving overall project completion within a specified time period (Callahan, 1992).

Precedence Network Diagram is quite similar with CPM, and it 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.

Primavera Project Planner (P3) can manage all kind of project whether large or short duration event critical project because it was designed to handle large-scale, intricate and multifaceted projects. This program is capable of organizing the resources (such as labor, material and equipment) needed by the company for managing complex and integrated projects. The main benefits of P3 include that it can handle the smaller to medium size of the project, produces various reports needed to document the project progress, and it can give real time comparison on where the project is compared to the objectives in the business plan.

Microsoft project is designed to assist the project manager in developing a plan, assigning resources to ask tracking progress, managing the budget and analyzing workloads. This program has many different versions where it allows the user to understand and control project schedules and finances, to communicate and present project information, and to organize work and people to make sure that projects are completed on schedule. It also provides functionality for the user to create reports that communicate the status and progress of the project.

Microsoft Excel is one of the programs provided by Microsoft and the document is called a Workbook. Worksheets are the grid where one can store and calculate data. Besides that, Microsoft Excel is a useful tool for scientific and statistical analysis with large data sets.

SAP is software stands for System Application Product, which has different modules for different professions. **SAP Project System (PS)** is one of the key modules of SAP to perform project and portfolio management. It helps to manage the project life cycle starting from structuring to planning, execution, until the project completion. SAP Project systems (PS) helps to manage and support all the SAP projects in a company. Project System is a source to organization for planning, scheduling, collecting, and generating revenue and expenditure over a project period.

2.1.9 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 resource leveling and resource smoothing.

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 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).

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. Resource smoothing may not be able to optimize all resources (PMI, 2013). In resource smoothing, as opposed to resource leveling, the project's critical path is not changed and the completion date may not be delayed, activities may only be delayed within their free and total float.

2.1.10 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 crashing and fast tacking.

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).

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).

2.1.11 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, take corrective and preventive actions, and thus minimize risk (PMI, 2013). Performance reviews and trend analysis are commonly used construction project schedule control systems.

Performance Reviews

According to Levine, (2002) Performance reviews measure, compare, and analyzes schedule performance such as actual start and finish dates, percent complete, and remaining duration for work in progress.

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, 2002).

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 could be performed to determine the cause and degree of variance relative to the schedule baseline and any corrective or preventative actions needed.

2.1.12 Scheduling Tools and Techniques 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 and 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 (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), another project management tool closely follows definition of the individual activities in the form of the WBS 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 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 based on similarities, standards, professional opinions or simulation.

According to Trietsch and Baker (2011), the Program Evaluation and Review Technique (PERT) represent a more sophisticated method of planning the time demands of individual activities. 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.

A potential tool that can be used for optimization of the project time plans is the Critical Chain Method (Kostalova & Tetrevova 2014). 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 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.

2.1.13 Difference between Planning and Scheduling

Planning and Scheduling, most often are used concurrently and as a joint term. However, the

two tasks are different. Fischer (2002) pointed out the apparent differences between a construction plan and construction schedule. He contends that a plan shows the logical relationships of construction project activities. However, on a plan that start and end dates are missing because activities do not communicate that. Whereas a schedule shows the start and end dates that helps in the definition of project duration.

Planning, according to Hancher (2003), includes the consideration of the existing constraints and available resources that impact on project execution. Planning is essential in the following support functions: project, materials storage, office space, temporary utilities, etc. Planning involves;

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

Development of a construction plan is critical to the success of projects Heesom and Mahdjoubi (2004), however, it is by far the most difficult task (Hancher 2003). Here, the project is built on paper. Scheduling, although distinct, is commonly acknowledged as part of the construction planning process. According to Heesom and Mahdjoubi (2004), in scheduling, planners, project managers and site mangers altogether simulate various construction processes required to build the project. This stage of the construction process requires the adoption of computer-based tools. Scheduling involves the determination of the timing of each work item, activity, in a project within the overall project duration (Hancher 2003).

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

2.2 Empirical literature review

This research will try to summarize existing literature on the area, most of which are result of Master's thesis done at different countries. The most common reasons of change order encountered during the construction projects in Ethiopia are categorized into the following major causes of change orders: Design Errors and Omissions, Change of Scope, Unforeseen

Conditions, Value Engineering, Force Major and Others (Mekonnen, 2015). Among the nine PMBOK areas, poor scope management is the main reasons of change according to this study. Poor definition of project scope will result in work variations, delays, cost overrun and improper relationship between the stake holders.

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.

Shanmuganathan, (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.

Rómel (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. Solís, et al., 2015).

Aftab, 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 Airlines construction projects, CPM is among the tools used to the minimum level while Microsoft project software application has better usage level compared to CPM.

Delays in construction projects are known to be among the common problem facing the industry as it causes a number of negative impact on both the project itself and the parties involved. Thus, it is very important to pinpoint the main causes of these delays to reduce and do away with them as well as their corresponding outlays. According to Rahel, (2016) construction projects continue to face the challenge of delays even in this current phase of knowledge in technology as well as organization management. Rahel, (2016) stated that, delay in setting of construction refers to a project happening later than the anticipated time specified in terms and conditions of the contract or exceeding the date set by parties involved.

According to Alex (2016), when project is delayed, they are both giving time extension or the project activities augmented and thus causing extra cost. Even though parties involved in the project would agree up on the additional cost and time that are related with the delay, in most cases problems exist between the contractors and the clients as regards whether a contractor has the right to claim for extra cost (Rahel 2016). Abdullah et al. (2011), stated that, countries are assessed as underdeveloped, developed, and developing on the basis of quality and quantity of accomplished construction projects inside their territory. Long et al. (2008), established that, many researchers have carried out a number of studies concerning the construction projects schedule management, among the most common and most widely used techniques for project schedule management, include network analysis.

Summary of Empirical literature review

From the above researchers we understood that construction projects schedule management practices are affected due to different reasons.

- Mostly construction projects in Ethiopia suffer from delays, have poor scope management, run out of budget and face serious quality defects.
- Lack of knowledge and awareness of the importance of projects schedule management tools and techniques found to be the major obstacles towards the efficient utilization of such tools.
- Identified the effective time management technique and software package used based on their specific study.
- Construction projects continue to face the challenge of delays even in this current phase of knowledge. Therefore, this study addresses construction projects schedule management practice of Ethiopian Airlines and which will be the benchmark for future improvement.

2.3 Conceptual Framework of study

Different researchers in different countries investigated project schedule management and success criteria from different industries perspectives. In this sub section, the methodology used and findings identified on studies conducted on project schedule management, the tools and techniques used for scheduling and delay indicators. There are number of studies on success factors in the construction industry. According to Jha and Lyer (2008) adopted the success factors identified by Ashley et al (1989). It can be seen that critical success factors have been predominantly contributing towards enhancing the performance level and success of projects. Due to its comprehensive, detailed descriptions, and because much of the other research was based upon it in some way Jha and Lyer (2008), the on most significant success factors in determining project success identified by Ashley et al. (1987) time have been chosen for this study to be dependent variable.

The studies conducted by Ashley et al. (1987) and Chua et al (1999) are one step closer to the study conducted by the researcher from the above summarized studies. All this studies are conducted on critical success factors for construction projects schedule management as described in figure 2.1 conceptual framework of the study below.

Nguyen et al (2004) studied project success factors in large construction projects in Vietnam. Nguyen started his investigation with 20 success factors and identified five of critical success factors by the completion of the study. Among the 20 success factors, he started his study with, competent project manager, adequate funding until project completion, competent project team, commitment to project, and availability of resources are found to be the critical ones. Nguyen's study also grouped the success factors into one of four components that are comfort, competence, commitment and communication. His findings found to be supportive to that of Ashley's study.
Chua et al (1999) identified critical success for construction projects based on the accumulated knowledge and judgment of 20 experts in the industry. Sixty-seven success- related factors were considered and grouped under four main project aspects, project characteristic, contractual arrangements, project participants, and interactive process. The results of the study revealed that experts agree that there are different sets of construction projects success factors for different objectives. They determined that the probability of project success could increase if the inherent characteristics of the projects are thoroughly understood, appropriate contractual arrangements are adopted, a competent management team is assigned, and a sound monitoring and control system is established.

Milosevic (2004) argue regardless of how important the use of Project Schedule Management Tools and Techniques (PSMTT) impact project success, the literature on PSMTT still has gaps since the literature on project management typically treats the use of PSMTT with universal approach not dependent with particular projects like Ethiopian Airlines specific conditions.
The conceptual framework that supports this study is shown in Figure 2.1 below. This conceptual framework is the base for the literature review contained in this chapter. The study dedicated itself in assessing construction projects schedule management practice in Ethiopian Airlines.

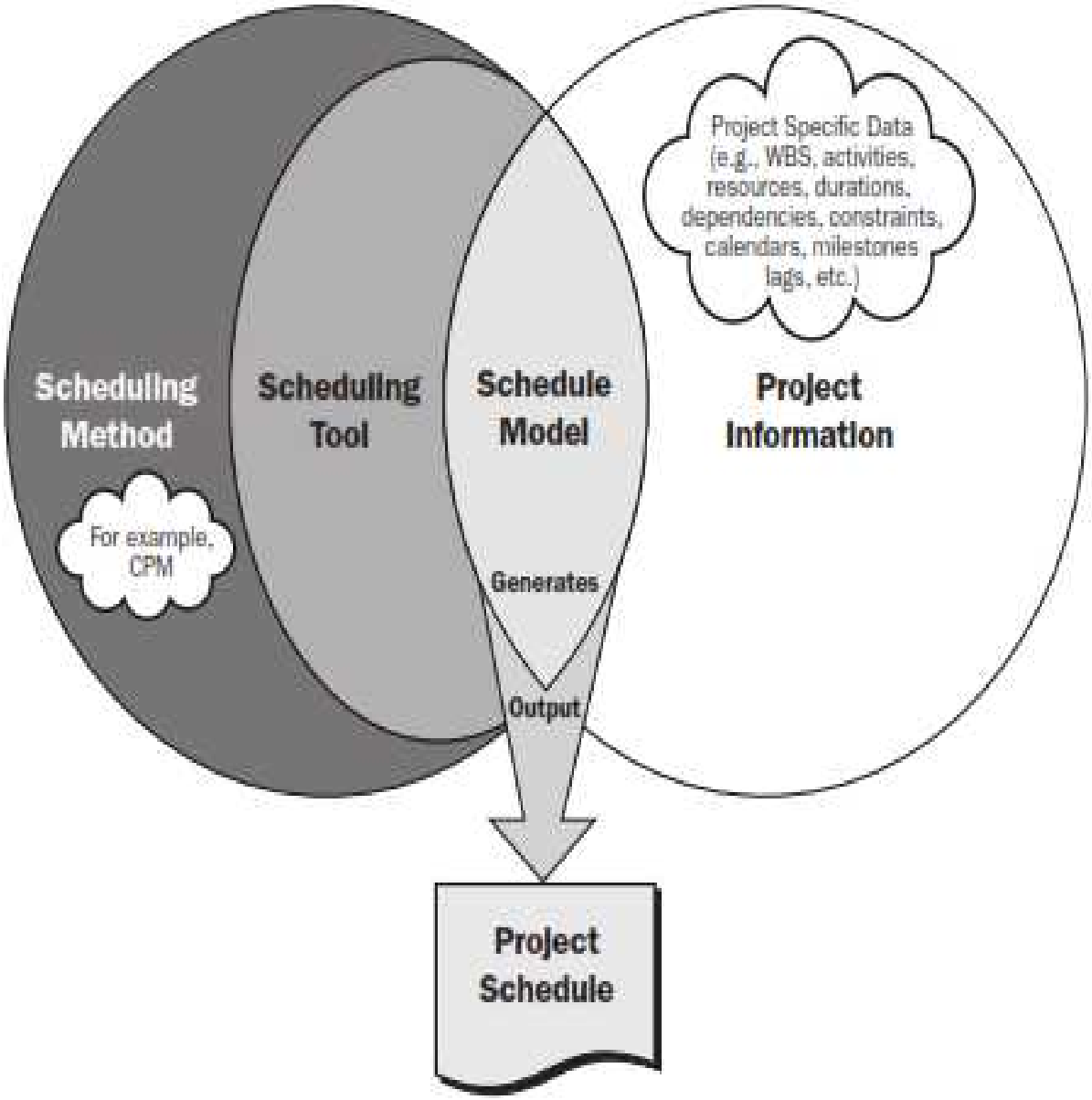

Figure 2.1 Conceptual framework of the study: Project Schedule Management

Source: Adapted from Project Management Institute (2013)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter attends to the detailed discussion of the research methodology engaged in the study. Important subjects upsetting the philosophical stance of the researcher including the strategies adopted for this research was discussed explicitly. Likewise, a brief discussion of the strategy used in the questionnaire design, the target respondents, the sample size required and the questionnaire administration. The method of analysis for this study is using SPSS. The benefit of using SPSS is easy to determine frequency distribution during questionnaire analysis. Frequencies statistic were used to obtain frequencies of a set of selection. The highest frequency of a selection means it is a favorite selection by respondents. Furthermore, according to Morgan et al (2007), frequency analysis is a tally or count of the number of times each score on a single variable occurs. The frequency result can be chosen either in percentage of respondents (%) or number of respondents. For better and easy understanding, the result data transform into bar charts and the mode of data presentation in addition to the statistical tools used for the critical analysis of the data gathered is discussed.

3.2 Description of the study Organization

The focus of this research is construction projects schedule management practice in EAL. Ethiopian Airlines is growing in very rapid rate and currently it has eight major administrative groups. These areas are:

- Operations
- Ethiopian Cargo and Logistic Service
- Ethiopian Aviation Academy
- Ethiopian Customer Service
- Ethiopian Corporate
- Ethiopian Commercial
- Ethiopian Airport Enterprise
- Ethiopian Skylight Hotel

Except Ethiopian Airport Enterprise which are merged a year before with Ethiopian Airlines, 30 selected construction projects constructed by local and foreign contractors and completed during the last ten years from 2011 to 2009 in the other seven groups of the Airline were the target for this study.

3.3 Research Design and Approach

In light of the objectives, this study preferred and employed descriptive research method using a combination of qualitative and quantitative data. According to Mark (2009), as cited in Aida (2015) mixing qualitative and quantitative approaches gives the potential to cover each method's weaknesses with strengthens from the other method. The method enables an instrument to tabulate, analyze and describe the context. While describing the collected data use the visual aids such as graphs and charts are used to make the reader understand the data easily.

3.5 Sampling size and sampling design

As discussed in chapter one, scope of the study section, construction projects completed during the past ten years, based on the report from the Group Infrastructure Planning and Development section and Engineering and Construction works section were the unit of analysis. Interview was conducted with the Manager and the Director of the section. Questioner was distributed to concerned participants of the projects. These participants include employees from the client, which are management staff of the Airline who have direct relation with those projects, the project managers, project engineers, project supervisor, and project monitoring team, various technical teams of the construction projects of Ethiopian Airlines, different Consultants, and Contractors performed construction project for EAL.

3.5.1 Sample size determination

According to Kothari (2004), a sample is part of the target population that has been procedurally selected to represent the study. In principle, accurate information about given population could be obtained only from census study. However, due to time constraint, in many cases, a complete coverage of population is not possible; thus, sampling is one of the methods, which allow the

researcher to study relatively small number of units representing the whole population (Sartnakos, 1998).

The study adopted simple random probability sampling method, randomly pick individuals from the population to include in the sample. In this case all individuals have an equal chance of being selected and as sample size increases, sample becomes more and more representative of population. This study applied simplified formula provided by Yamane, (1967) to determine the required sample size at 95% confidence level.

$$n = \frac{N}{1 + N(e)^2}$$ ---------- (Eq. 1)

n= 90/1+90 $(0.05)^2$ = 74

Where:

n = Desired sample size

N =Total population size

e = Accepted error limit (0.05) on the basis of 95 percent degrees of confidences put into decimal form.

3.5.2 Sampling selection procedure

A list of all sampling units those are eligible and available for selections at the stage of sampling process identified and sampling frame prepared. To select the respondents for the questionnaire a purposive sampling technique was employed. This sampling method is chosen for it allow the researcher to focus on a limited number of informants that were selected randomly 30 projects to get the required information to carry out the study in order to get optimal insight. In this study, projects are taken as unit of analysis. The respondents were selected from contractors, consultants and EAL staffs due to their participation in construction projects, information and area of work they have about project implementation and management challenges in their respective area in the organization in relation to construction projects schedule management.

Table 3.1 Population and sample size

Item	Organization type	Description of the respondents	Number	Total population	Sample size
1	Consultants	External Consultants	9	9	7
2	Contractors	Large scale contractors	9	32	27
		Pre-qualified Contractors	17		
		Small Scale contractors	6		
3	Client (Ethiopian Airlines)	Infrastructure planning and development department employees	10	49	40
		Management staffs who has direct relation with the construction projects	13		
		Employees participated in the construction projects	19		
		Engineering and Construction works Maintenance Department Employees	5		
			Total	**90**	**74**

Source: Developed for this study

The majority of the respondents were working for Ethiopian Airlines, which represent 54 % of the respondents followed by contractors and consultants with percentage of 36.5 and 9.5 respectively.

3.5.3 Data collection methods and tools

The research was conducted mainly using primary data. Structured questionnaire survey and key informant interview guideline are used to collect data from EAL Group Infrastructure and Development section. The questionnaire contains three parts. The first part addresses the

academic background and work experience of respondents and second part about the company background. The third part contains questionnaires on a 3- point Likert scale aimed to collect respondent's opinion on the extent to which project schedule management tools and techniques are used and a 5- point Likert scale to collect data related to delay indicators with respect to the construction parts. 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 use as perceived by the respondents was done with Relative Use Index (RUI), which was computed using the following equation.

$$RUI = \Sigma W / (A*N) \quad \text{---------- (Eq. 2)}$$

Where:

W=weighting given to each factor by respondents
A=highest weight
N=total number of respondents

Relative Use Index (RUI) assessment methodology is adopted from the research done in Mexico Rómel (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. The data collected 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 is presented in chapter four of this study.

3.4 Data type and source

The research was conducted using both Primary and secondary data types, that helps to answer the research questions and achieve research objectives. Both quantitative and qualitative data was used to collect from different primary and secondary sources**.**

3.4.1 Primary Data

The primary data were collected from EAL Employees who has direct relationship with the construction projects constructed with in the last ten years, Consultants of these construction projects and Contractors using survey questionnaire to assess the tools and techniques used for construction project schedule management and to what extent the projects met their schedule. The employees of contractors involved in the construction of those projects and EAL employees who have direct relation with those completed projects are chosen to fill the questionnaire and this was help to receive unbiased and more accurate response.

3.4.2 Secondary Data

To strengthen the reliability of research data and supplement the information missing in the questioner survey, secondary data was also be used. Documents review and analysis of secondary data from various sources was used as useful information for the study. Books, research articles, journals and other written documents on the relevant issues were used. In addition, available organizational documents such as schedule and accessible project documents including agreement project profile, plans and reports were reviewed.

3.5.4 Validity and Reliability Measures

Structured interviews are conducted with the Manager of Group Infrastructure Planning and Development and the Director of the section. The interview responses and the projects documents are summarized and used for triangulation of responses given for the questionnaires.

CHAPTER FOUR

RESULTS AND DISCUSSOIN

4.1 Introduction

This chapter deals with the results of data obtained through questionnaires administered with contractors, consultants and Ethiopian Airline staffs who have direct relation with the construction projects of EAL and interviews made with the Manager Group Infrastructure planning and Development and the section Director. Project documents are also used to support the study.

The questionnaire contains three parts, the academic background and work experience of respondents with construction industry, about the company background, the utilization of construction projects schedule management tools and techniques. The data obtained through interviews were integrated into the data analysis made using the questionnaire. This chapter contains results of data presentation and discussion on major findings of the study.

Table 4.1 Demographic characteristics of the respondents

Demographic Characteristics	**Category**	**Frequency**	**Percent (%)**
Education Qualification	Certificate	2	2.7
	Diploma	8	10.8
	First Degree	51	68.9
	Masters	13	17.6
Work Experience	Less than 5	13	17.6
	Between 5 and 10	4	5.4
	Between 11 and 15	24	32.4
	Greater than 15	33	44.6

Source: Survey of the study 2019

Most of the respondents involved in the survey were holding bachelor degree in term of education qualification with the highest percentage 68.9% compare to others. Survey statistics showed that 44.8% of the respondents have experience above 15 years, followed by 32.4% of respondents with 11 to 15 years' experience, 17.6% with less than 5 years of experience and only 5.4% of respondents with 10 to 15years'of experience. As shown in table 4.1 above the demographic characteristic of the respondents of the questioners have enough educational level and work experience on the construction projects.

4.2 Results and Discussions

4.2.1 Construction projects schedule management tools and techniques usage in EAL

The primary data rated on 0 to 3 Likert Scale (i.e. 0=Never, 1= Occasionally, 2=Usually, 3= Always) collected through questionnaires on the use of Schedule management tools and techniques has been further analyzed, compounding variables into groups using frequency analysis. The option "I don't know" presented in the questioner for those respondents who do not know the specific tool or technique are used, not include in the evaluation.

Figure 4.1 below indicates the practice of using scheduling tools and techniques in EAL based on the respondents of the questionnaires. Relative Use Index (RUI) is calculated using the formula given in chapter 3. The calculated RUI values are ranked in order of decreasing to show which tool and technique is more used compared to others. The results of the survey are depicted through Tables 4.2 and 4.3 below.

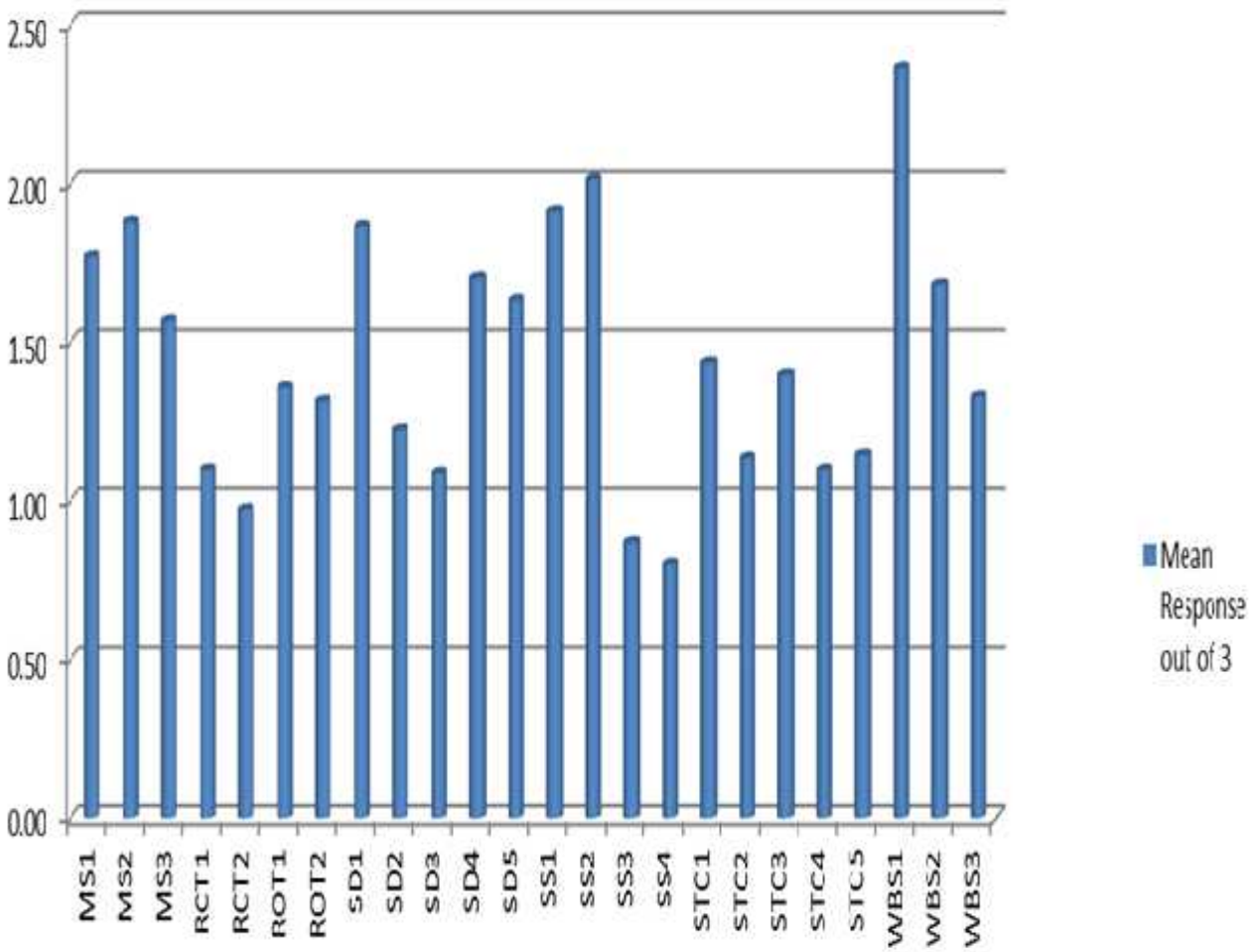

Figure 4.1 Scheduling tools and techniques usage

Source: Survey for the study

The survey results on assessing the usage level for top ten project scheduling tools and techniques are as shown in Table 4.2. Mostly used construction projects scheduling tools and techniques are Work Breakdown Structure with RUI=0.79, Microsoft Excel RUI=0.67, Microsoft Project for scheduling RUI=0.64, Master Schedule for resource plan RUI= 0.63, and Gantt chart for Schedule Development RUI= 0.62. Master Schedule Preparation with RUI= 0.59, Expert Judgment for Schedule Development RUI=0.57, Work Breakdown Structure Dictionary RUI=0.56, Historic Record for Schedule Development RUI=0.54 and Master Schedule updating RUI=0.52 are used relatively at moderate usage level in descending order.

Table 4.2 Rank of top ten construction projects schedule management tools and techniques relative usage level in Ethiopian Airlines.

Item No.	Scheduling tools and techniques	RUI	Rank
1	Work Breakdown Structure	0.79	1
2	Microsoft Excel for Scheduling	0.67	2
3	Microsoft Project for Scheduling	0.64	3
4	Master Schedule Contain Resource Plan	0.63	4
5	Gantt Chart for Schedule Development	0.62	5
6	Master Schedule Prepared	0.59	6
7	Expert Judgment for Schedule Development	0.57	7
8	Work Breakdown Structure Dictionary	0.56	8
9	Historic Record for Schedule Development	0.54	9
10	Master Schedule Updated	0.52	10

Source: Survey for the study

Table 4.3 below shows that the least 10 scheduling tools and techniques with resource leveling technique for resource optimization RUI= 0.44, precedence diagram method for schedule development RUI=0.41, critical chain method for schedule tracking and control RUI=0.38. Earned value analysis for schedule tracking and control, schedule performance measurement (SPI and SV) for schedule tracking and control and crashing technique for schedule compression are used with RUI=0.37. Program evaluation and review technique for schedule development with RUI= 0.36, fast tracking technique for schedule compression with RUI=0.32, SAP project system for scheduling with RUI=0.29 and the least from the list is Primavera Project Planner for

scheduling with RUI=0.27. The usage level for these project scheduling tools and techniques are below the expected.

Table 4.3 Rank of ten least used construction projects schedule management tools and techniques in Ethiopian Airlines.

Item No.	Scheduling tools and techniques	RUI	Rank
1	Resource Leveling Technique for Resource Optimization	0.44	14
2	Precedence Diagram Method for Schedule Development	0.41	15
3	Critical Chain Method for Schedule Tracking and Control	0.38	16
4	Earned Value Analysis for Schedule Tracking and Control	0.37	17
5	Schedule Performance Measurement (SPI and SV) for Schedule Tracking and Control	0.37	17
6	Crashing Technique for Schedule Compression	0.37	17
7	Program Evaluation and Review Technique for Schedule Development	0.36	18
8	Fast Tracking Technique for Schedule Compression	0.32	19
9	SAP Project System for Scheduling	0.29	20
10	Primavera Project Planner for Scheduling	0.27	21

Source: Survey for the study

The tools and techniques categorized in Table 4.2 are relatively used in a better usage level than those in Table 4.3. Most of the tools and techniques used in the survey support each other and we need to use them together for a particular construction project. From four project scheduling software popularly used in construction industry and presented in the survey question, only Microsoft excel and Microsoft project are used in a better usage level. These soft wares are not

preferred this day as compared to other soft wares like SAP project systems and primavera project planner that are developed purposely to support the follow up of projects. SAP project systems and primavera are used in a very low usage level in Ethiopian construction projects.

Similarly work breakdown structure is used in a better usage level, However, this tool has to be used together with other tools and techniques like crashing technique for schedule compression and fast trucking for scheduling based the information obtained from the actual project execution, it does not guaranty the on time performance of the project. The usage level of these techniques is very low.

4.2.2 Discussion on construction projects schedule management tools and techniques usage in EAL

The research has tried to assess the construction projects schedule management tools and techniques usage in Ethiopian Airlines. Thus, in this regard this research result has found the following major points.

The construction projects schedule management tools and techniques usage level of the organization is generally found at low level. This indicates that EAL construction projects schedule management needs to strive for better usage of construction projects scheduling tools and techniques to reach organizational standards. These findings are indicative of the low level of project schedule management tools and techniques development in the organization.

Construction projects schedule management tools and techniques like work breakdown structure, master schedule for resource plan, Gantt chart for schedule development have been used in a better usage level. Where as Precedence diagram methods, project evaluation and review techniques, critical path method, project evaluation and monitoring techniques like earned value analysis, schedule variance and schedule performance index usage was unsatisfactory.

From the soft wares Microsoft excel and Microsoft project are used in relatively better usage level, whereas SAP project systems and primavera project planner are used in a very low usage level, this indicate that the follow up capacity of the tools used are mostly are not efficient.

Technology assisted and management supportive software like SAP Project System for scheduling is not used properly, based on the interview response the organization have the software and use it mostly for payment process only. Primavera Project Planner for scheduling is used in a very low level. The projects status and trend not followed up and controlled.

4.2.3 EAL construction projects schedule performance

All of the respondents confirmed that they experience in construction projects delays in which they expressed at different frequency. The survey revealed that from the total respondents, 44.59 % had experienced delays sometimes, 40.54 % had experienced delays usually and 14.86 % had experienced delays always in Ethiopian Airlines construction projects.

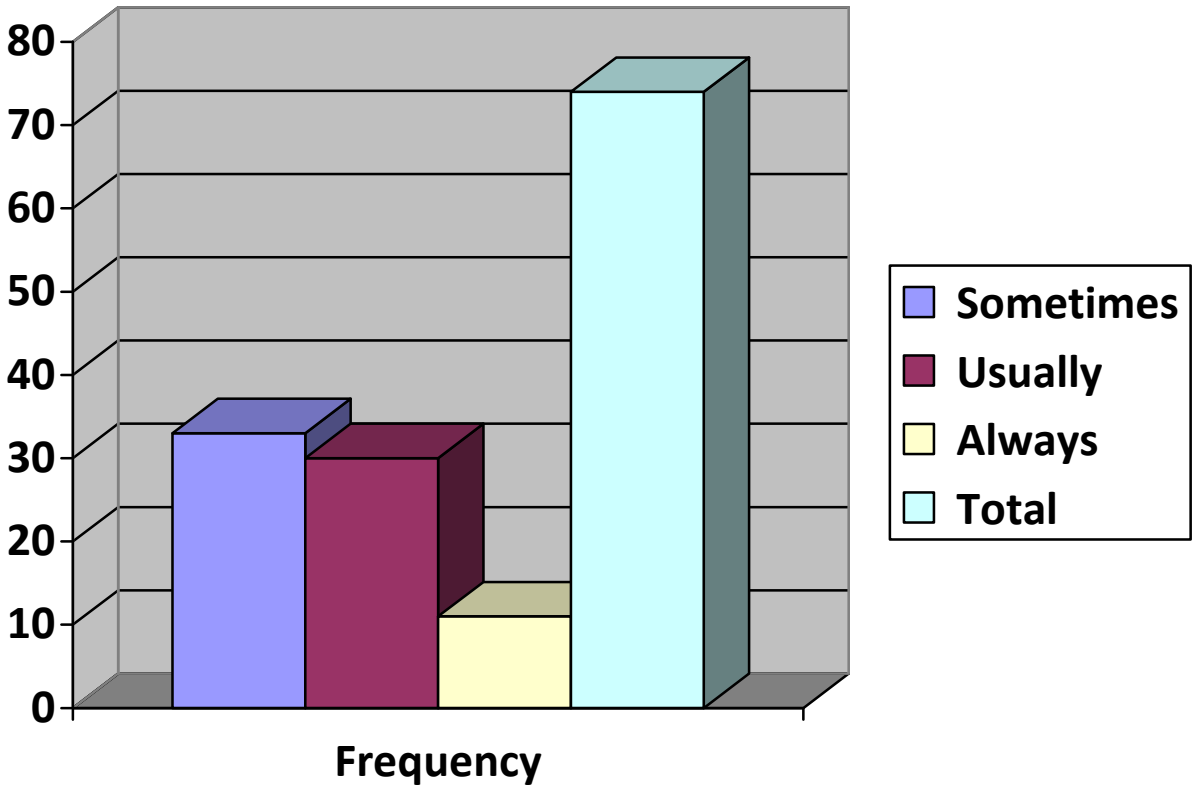

Figure 4.2 Extent of construction projects delay.

Source: Survey for the study

Table 4.4 below refers to construction projects time management practice in Ethiopian Airlines based on the actual project document data obtained from Group Infrastructure planning and Development section. The major projects with actual completion from July 2015 to January 2019 are selected to show the details, out of eight projects only one project is completed on scheduled date. The actual projects document of 13 large projects indicate that on the average projects are delayed for 246 days, in other words the results show that the projects took on average 67% of additional time on the planned project time.

Construction of new Catering Facility delayed by 71 days, Construction of Satellite Cafeteria delayed by 167 days, whereas the project planned time was 91 days, and this implies that the delay for this project is 184% as compared to the project lifetime.

Table 4.4 Major construction projects time in EAL. (Projects with actual completion from July 2015 up to January 2019)

No.	Project Name	Planned Project Finish Date	Actual Project completion Date	Delay in days
1	Construction of B-777, A350 & B737 Max Simulator Building	22-Jul-15	22-Jul-15	0
2	Construction of New Catering Facility	21-Jan-16	1-Apr-16	71
3	Construction of Satellite cafeteria	15-Jan-16	30-Jun-16	167
4	Construction of Hangar No. 6	20-Oct-16	28-Feb-17	131
5	Construction of EFM garage and HR building with car parking	14-Apr-15	4-Oct-17	904
6	Construction of Cargo Terminal no. 2	18-May-17	18-Oct-17	153
7	Construction of ET Housing Project (Phase one Final Stage)	4-Oct-17	7-Jun-18	246
8	Construction of ET 5 Star Hotel	30-Sep-18	27-Jan-19	119

Source: EAL construction projects document

The delay for construction of hangar no. 6 is 131 days and as compared to the project duration it 15%. Construction of EFM garage and HR building with car parking has been extremely delayed for 904 days that is 228% as compared with the planed project duration of 396 days. Construction of Cargo Terminal no. 2 also delayed for 153 days and it is 14% as compared with 1113 days of project time. Phase one final stage construction of ET housing project has been delayed for 246 days, which is 31% 805 days of project time. Construction of ET 5 Star Hotel also delayed for 119 days and that is 10% of 1217 days of project time.

Table 4.5 Small construction projects time in EAL. (Projects with actual completion from February 2018 up to March 2019)

No.	Project name	Planed Project completion date	Actual Project completion date	Delay
1	Water tanker basement for Aviation	2/19/2018	2/16/2018	-3
2	Laundry boiler room renovation work	2/21/2018	3/31/2018	38
3	EFM gate expansion and inspection parking work	9/30/2018	11/16/2018	47
4	Catering pavement construction work	12/5/2018	11/21/2018	-14
5	EAA dormitory renovation	11/25/2018	12/25/2018	30
6	Upgrading of Component shop	1/15/2019	3/18/2019	62

Source: EAL construction projects document

Referring table 4.5 above, there are also small constructions projects of EAL supervised by Engineering and construction works section, Projects with actual completion time from February 2018 up to March 2019 are selected based on the data obtained from this section. Two projects have been completed ahead of the scheduled completion date. Which are construction of water tanker basement for Aviation Academy 3 days before the planed project completion date, 20% ahead of the schedule as compared to the planned project completion 15 days and Catering pavement construction work ahead of the schedule by 14 days with 27.45 % earlier than the planned completion time 51 days.

Construction projects like Laundry boiler room renovation work has been delayed for 38 days, 146% compared to 26 planned Project completion days, EFM gate expansion and inspection parking construction delayed for 47 days 151% as compared to 31planned completion days. EAA dormitory renovation work has been delayed for 30 days 73.13% of 41 days of planed completion days and upgrading of Component shop also delayed for 62 days 84% of 74 days.

On the average from 17 small projects taken for this study, the projects were delayed for 33 days, in other words the results show that the projects took on average 69.74% additional time over the planned project time.

4.2.4 Discussion on the construction projects schedule performance in EAL

The research has tried to assess the construction projects schedule performance of Ethiopian Airlines. Thus, in this regard this research result has found the following major points.

The actual projects document shows that on average construction projects are delayed for 67% of additional time on the planned project time. This is significant delay, that need improvement, based the interview responses the average construction projects delay was about 90 days and questionnaire results also support the existence of substantial delays in the construction projects of Ethiopian Airlines.

Accordingly, other researchers also discussed delays in construction projects are known to be among the common problem facing the industry as it causes a number of negative impact on both the project itself and the parties involved. According to Rahel, (2016) construction projects continue to face the challenge of delays even in this current phase of knowledge in technology as well as organization management style.

According to Alex (2016), when project is delayed, they are both giving time extension or the project activities augmented and thus causing extra cost. Even though parties involved in the project would agree up on the additional cost and time that are related with the delay, in most cases problems exist between the contractors and the clients as regards whether a contractor has the right to claim for extra cost (Rahel, 2016).

According to Idoko (2008) many projects in developing countries encounter considerable delay to realize their intended benefit or even totally terminated and abandoned before or after their completion. Due to the challenges in different areas and there is a need for a better understanding of the constraints to follow structured approach in identifying and modeling constraints to ensure a constraint-free project. Project delay is one of the problems of construction project performance in selection, planning, execution or control phase of the project.

Delay or time overrun will affect all parties involved in the project. It will affect the profits that would be obtained if the project can be completed on the schedule. However, 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, 2014).

Generally, the construction projects schedule management practice in Ethiopian Airlines is found at low level. The organization performs the project management knowledge areas without following structured approach for schedule management, relying solely on the knowledge and experience of the project manager or project team, and on average the contractors are performing only the basic practices under each knowledge area of project management.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of findings

Construction projects schedule management practice of Ethiopian Airlines was studied in this research. Based on the data obtained from the organization construction projects document, interview and data analysis result, construction projects are found delayed. The consensus among respondents of the questioner show that most used scheduling technique is work breakdown structure followed by Microsoft Excel and Microsoft project for scheduling, while the three least used are fast tracking technique for schedule compression, SAP project system and primavera project planner soft wares for scheduling.

5.2 Conclusion of the study

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

Schedule control is a critical task in managing construction projects. However, in practice most contractors do not control and update schedule frequently due to lack of proper controlling method in the real construction world. The bases for most decision are not mathematical methods but on the contractor's assumptions, limitations and management style.

The assessment result obtained from questionnaire survey depicted on Figure 4.1 shows that usage of projects schedule management tools and techniques are very low. This is an indication for the need of substantial improvements to increase the use of current technology with projects schedule management tools and techniques for Ethiopian Airlines. The implementation of projects schedule management tools and techniques are not seriously considered. Therefore, it

is crucial for all stakeholders involved in Ethiopian Airlines construction projects to take practical measures to benefit from the application of the Project Schedule Management.

5.3 Recommendations

The gap identified for this research is delay in Ethiopian Airlines construction projects and low usage level of projects schedule management tools and techniques. To fill this gap, the following recommendations are made based on the results of the study.

- Ethiopian Airlines should initial project management tools and techniques to be used in planning, scheduling and controlling systems before starting construction projects.
- Ethiopian Airlines should put in place policies and procedure to use scheduling tools and techniques, incorporating and enforcing them in the contract clauses.
- Ethiopian Airlines should use technology-assisted project follow up system to know the status and make proper decision on time.
- Contractors should plan their works properly and improve the extent to which customized project schedule management tools and techniques usage like Precedence diagram methods, project evaluation and review techniques, critical path method, project evaluation and monitoring techniques like earned value analysis, schedule variance and schedule performance index.

5.4 Suggestion for further research

Future researches can be conducted in detail and incorporating various project based organizations practices 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 EAL construction projects on other project performance criteria also to investigate the effect of controlled schedule management tools and techniques on construction project performance and its cost benefit effectiveness as well as customer satisfaction.

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APPENDIX

Appendix I: List of projects

Table 1 List of Major Projects Handled by Group Infrastructure Planning & Development

No.	Project Name	Project Start Date	Planned Project Finish Date	Actual Project completion Date	Planned Project time in days	Delay in days	Percentage of delay
1	Construction of EAA dormitory	3-Jun-09	10-Sep-10	5-Aug-11	464	329	71%
2	Construction of simulator Hall & Office Building	8-Jul-11	22-May-12	2-May-13	319	345	108%
3	Construction of Engine Shop	23-Feb-11	17-Apr-12	31-May-13	419	409	98%
4	Construction of Aviation Training Center Second Phase	1-Jul-12	30-Apr-14	30-Jun-14	668	61	9%
5	Construction of Hangar No. 4 & No. 5	29-Jul-13	7-Jun-14	7-Mar-15	313	273	87%
6	Construction of B-777, A350 & B737 Max Simulator Building	24-Nov-14	22-Jul-15	22-Jul-15	240	0	0%
7	Construction of New Catering Facility	21-Jan-15	21-Jan-16	1-Apr-16	365	71	19%
8	Construction of Satellite cafeteria	16-Oct-15	15-Jan-16	30-Jun-16	91	167	184%
9	Construction of Hangar No. 6	16-Jun-14	20-Oct-16	28-Feb-17	857	131	15%
10	Construction of EFM garage with offices and HR building with car parking	14-Mar-14	14-Apr-15	4-Oct-17	396	904	228%
11	Construction of Cargo Terminal no. 2	1-May-14	18-May-17	18-Oct-17	1113	153	14%
12	Construction of ET Housing Project (Phase one Final Stage)	22-Jul-15	4-Oct-17	7-Jun-18	805	246	31%
13	Construction of ET 5 Star Hotel	1-Jun-15	30-Sep-18	27-Jan-19	1217	119	10%

Source: EAL construction projects document

Table 2 List of Small Projects Handled by EFM Construction and Engineering Section

No.	Project name	Planed Project completion date	Actual Project completion date	Planned time in Days	Delay	Percentage of Delay
1	Mezzanine floor construction at Harness wire shop	8/7/16	8/4/16	26	-3	-11.54%
2	Construction of DC Starter Generator building	4/18/16	8/31/16	59	135	228.81 %
3	Receiving mezzanine floor	11/30/16	12/22/16	30	22	73.33%
4	Side walk upgrading work from aviation academy gate to traffic gate	12/25/16	1/10/17	24	16	66.67%
5	Platinum lounge upgrading work	1/25/17	1/18/17	21	-7	-33.33%
6	Test cell upgrading work	2/28/17	4/5/17	85	36	42.35%
7	Sewerage renovation work at main café	2/16/17	4/29/17	52	72	138.46 %
8	Fence work around Motorized equipment shop	5/10/17	5/25/17	30	15	50.00%
9	Security station construction at aviation gate	5/15/17	8/7/17	60	84	140.00 %
10	Gym remaining works	8/24/17	9/15/17	30	22	73.33%
11	Fence construction at cargo	11/27/17	11/29/17	20	2	10.00%
12	Water tanker basement for Aviation	2/19/18	2/16/18	15	-3	-20.00%
13	Laundry boiler room renovation work	2/21/18	3/31/18	26	38	146.15 %
14	EFM gate expansion and inspection parking work	9/30/18	11/16/18	31	47	151.61 %
15	Catering pavement construction work	12/5/18	11/21/18	51	-14	-27.45%
16	EAA dormitory renovation	11/25/18	12/25/18	41	30	73.17%
17	Upgrading of Component shop	01/15/19	03/18/19	74	62	84.00%

Source: EAL construction projects document

Appendix II: Scheduling tools and techniques usage rank

Table 4.1 Scheduling Tools and Techniques Usage Rank

Item No.	Scheduling tools and techniques	RUI	Rank
1	Work Breakdown Structure	0.79	1
2	Microsoft Excel for Scheduling	0.67	2
3	Microsoft Project for Scheduling	0.64	3
4	Master Schedule Contain Resource Plan	0.63	4
5	Gantt Chart for Schedule Development	0.62	5
6	Master Schedule Prepared	0.59	6
7	Expert Judgment for Schedule Development	0.57	7
8	Work Breakdown Structure Dictionary	0.56	8
9	Historic Record for Schedule Development	0.54	9
10	Master Schedule Updated	0.52	10
11	Critical Path Method for Schedule Tracking and Control	0.48	11
12	Project Performance Review and trend Analysis for Schedule Tacking and Control	0.47	12
13	Resource Smoothing Technique for Resource Optimization	0.45	13
14	Project Scope Base Line	0.44	14
15	Resource Leveling Technique for Resource Optimization	0.44	14
16	Precedence Diagram Method for Schedule Development	0.41	15
17	Critical Chain Method for Schedule Tracking and Control	0.38	16
18	Earned Value Analysis for Schedule Tracking and Control	0.37	17
19	Schedule Performance Measurement (SPI and SV) for Schedule Tracking and Control	0.37	17
20	Crashing Technique for Schedule Compression	0.37	17
21	Program Evaluation and Review Technique for Schedule Development	0.36	18
22	Fast Tracking Technique for Schedule Compression	0.32	19
23	SAP Project System for Scheduling	0.29	20
24	Primavera Project Planner for Scheduling	0.27	21

Source: Survey of the study, 2019

Appendix IV: Questionnaire

ST. MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES

MASTER PROGRAM IN PROJECT MANAGEMENT

(QUESTIONNAIRE)

DEAR SIR/MADAM,

The purpose of this questionnaire is to collect data for the study entitled **"Construction projects schedule management practice in Ethiopian Airlines "** for partial fulfillment of M.A in Project Management. The genuine responses you forward will be used as input for the study and have great contribution to the success of the study. Your privacy will be kept anonymously and any information you provide in the questionnaire will be kept confidential and only used for the purpose of the study. Therefore, you are kindly requested to provide your genuine responses to the questions below.

Thank You in advance for your cooperation!

If you have any question concerning this questionnaire, please contact me: Aklil Gebreegziabher; Mobile no.: 0911422704; Office Tel no.: 0115174962; E-mail: aklilge@gmail.com.

General Instruction: Please, tick **"Ě"** in the appropriate columns for your response for closed - ended questions among the provided alternatives but write your response in the space provided for open-ended questions.

Part one: personal data

1.1 Academic background

Certificate ☐ First Degree ☐ PhD ☐

Diploma ☐ Masters ☐ Other ☐ Specify_____

1.2 Work experience in the construction sector (in years)

Less than 5 ☐ Between 11 and 15 ☐

Between 5 and 10 ☐ Greater than 15 ☐

Part two: Company background information

2.1 Organization you are working for i) Ethiopian Airlines ☐

ii) Contractor ☐

iii) Consultant ☐

Part three: Determinants of construction project schedule management

3.1 Listed below are about projects schedule management tools and techniques. Please rate your level of agreement for each question by putting a tick mark "Ě "for your response based on the header given so that your answer to these questions will enable the researcher to identify which of these tools and techniques are used and to what extent it is used.

Table 3.1 Construction projects schedule management tools and techniques.

No.	Tools and Techniques for project schedule management	Don't Know	Never	Occasionally	Usually	Always
A) Work Breakdown Structure						
1	**Work Breakdown Structure (WBS) is used**. It is the process of subdividing process of subdividing project deliverables and projects work into components that are more manageable.					
2	**Work Break Down Dictionary is used**. A document provides detailed deliverable, activity, and scheduling information about each component in the WBS.					
3	**Project Scope Base Line is used.** A project management schedule that is used as a reference through the project life is prepared and regularly updated in due course.					
B) Master scheduling						
1	**Master schedule is prepared within predefined time** after contract signature.					
2	**Master schedule contain resource plan material resource, labor resource and equipment resource**.					
3	**Project master schedule is revised and updated regularly** by producing baseline schedules depending on the progress.					
C) Schedule development						
1	**Gantt chart or Bar Chart is used** for scheduling					
2	**Precedence diagram method (PDM) is used.** depending on the progress a project schedule network diagram which uses nodes and connect them with arrows that show the dependencies					

No.	Tools and Techniques for project schedule management	Don't Know	Never	Occasionally	Usually	Always
3	**Program Evaluation and Review Technique (PERT) is used** for estimation of activity duration. It is statistical tool used in project management design to analyze and represent the duration of tasks involved in completing a given project					
4	**Expert judgment is used** for estimating activity durations while preparing schedule.					
5	**Historic records are used** for estimating activity durations while preparing schedule.					
D) Schedule Tracking and control						
1	**Critical Path Method (CPM) is used.** Critical path is the longest path through project schedule that has no slack time.					
2	**Critical Chain method (CCM) is used.** It is the longest duration path through the project considering both task dependencies and the resource constraints.					
3	**Project Performance review and trend analysis is used.**					
4	Schedule performance measurement is made using schedule variance (SV) and schedule performance index(SPI)					
5	**Earned value analysis (EVA) is used.** It 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					
E) Resource Optimization Techniques						
1	**Resource leveling technique is used**. It 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					
2	**Resource smoothing technique is used.** It is a technique that adjusts the activities of resources on the project does not exceed certain predefined resource limits.					

No.	Tools and Techniques for project schedule management	Don't Know	Never	Occasionally	Usually	Always
F) Schedule compression						
1	**Crashing technique for compressing scheduling time is used.** Crashing technique used to shorten the schedule duration for the least incremental cost by adding resources.					
2	**Fast tracking technique for compressing scheduled time is used.** It a schedule compression technique in which ties or phases normally done in activity sequence are performed in parallel for at least a portion of their duration					
G) Scheduling software						
1	Microsoft project is used					
2	Microsoft Excel is used					
3	SAP Project System					
4	Primavera project planner is used					

3.2 To what extent EAL's construction projects suffer from delay?

Never ☐ Sometimes ☐ Usually ☐ Always ☐

Thank You!

Appendix V: Key informant interview guide

St. Mary University
School of Graduate Studies

Construction projects schedule management practice in Ethiopian Airlines

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

1. How many years have you been working in construction projects?
2. What is your area of responsibilities in EAL construction projects?
3. In how many of EAL construction projects you have been participated.
4. Which of the projects schedule management tools and techniques are adopted for EAL construction projects?
5. Do you think projects schedule management tools and techniques are effectively utilized for EAL's construction projects?
6. What do you think are the constraints to effectively use schedule management tools and techniques for EAL's construction projects?
7. Are policies and procedures of using schedule management for construction projects available in EAL?
8. To what extent do the construction projects of EAL meet their schedule?
9. What are the major reasons for delays of construction projects to in EAL?
10. What recommendations can you forward for future improvement?

THANK YOU!