

ADDIS ABABA UNIVERSITY COLLEGE OF BUSINESS AND ECONOMICS SCHOOL OF COMMERCE DEPARTMENT OF PROJECT MANAGEMENT

EXAMINING THE PRACTICE OF ETHIOPIAN AIRLINE IN PLANNING AND SCHEDULING OF AIRCRAFT HEAVY MAINTENANCE PROJECTS

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APPROVAL BOARD COMMITTEE

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DECLARATION

I, NEBIYAT BELAY hereby declare that this thesis entitled “Examining the practice of Ethiopian airline in planning and scheduling of aircraft heavy maintenance projects” is my own paper work and that it has not been submitted before anywhere for any award.

_____ _____

Nebiyat Belay Date:

Letter of Certification

This is to certify that Nebiyat Belay carried out this research entitled ―Examining the practice of Ethiopian airline in planning and scheduling of aircraft heavy maintenance projects. This work is original and suitable for submission to the award of Master of Arts Degree in Project Management.

_____ _____

Wubishet Bekalu (PHD) Date:

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List of Abbreviations and Acronyms

AEP	Aircraft Engineering & Planning
AMP	Approved Maintenance program
AMO	Approved Maintenance Organization
ECAA	Ethiopian Civil Aviation Agency
EASA	European Aviation Saftey Agency
ET-MRO	Ethiopian Mainteanance and Over haul
FAA	Federal Aviation Administration
GSE	Ground Service & Equipment
JIC	Job Instruction Card
MCM	Maintennce Control Manual
MD	Managing Director
MOE	MRO Organization Exposition
MP	Maintenance Program
MPD	Maintenance Planning Document
MRO	Maintenance and Overall Repair
PERT	Program Evaluation and Review Technique
PMBOk	Project Management Book of Knowlege
PMI	Project Management Institute
SLA	Service Letter Agreement
TPM	Technical Procedural Manual
TAT	Turnaround Time
WBS	Work Breakdown Structure

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Abstract

Planning and scheduling process is a major phase of project life cyle. And when the process is embedded in an operation which is costy and time sensitive, like in aircraft heavy maintenance projects, the criticality of the process intensifies. This study examines the practice of Ethiopian Airline which is a giant and the only industry in Ethiopia as Approved Maintenance Organization. The focal of the study is on ET-MRO (Ethiopian Mainteanance and Over haul) specifically on the organizational units that are responsible and are in direct engagement with maintenance planning and scheduling processes.The conceptual frame work used in guiding the study is formulated by contemplating the factors that affect planning and scheduling of maintenance program. And it is presented at the end of the literature review.The study is purely qualitative in its methods & design and the ontological perspective of the study has been clearly stated in the methodology chapter.In-depth interview, focus group discussion and document review are the methods for source of data. Subsequently methodological triangulation is implemented in testing the validity and reliability of the data. The imposition of the flight operator on the planning and scheduling process due to downtime of aircrfts during maintenance, the lack of benchmarks for work processes, lack of clear work description among organization units, low involvement of the project manager in the planning and scheduling process are the issues identified in the study.

***Key words**: Planning and scheduling, MRO(Maintenance and Overall repair), Aircraft, maintenance*

CHAPTER I

INTRODUCTION

This study is entitled to explain the practice of Ethiopian airline in planning and scheduling of Aircraft Heavy Maintenance Projects. It is focused on the planning process specifically the scheduling Aircraft Heavy Maintenance Project management process such as initiating, planning, implementing, Evaluation and monitoring and close out of the project process.

This chapter gives an overview and the summary of the whole research thesis. It briefly state the background of the study, background of the organization, statement of the problem, objectives of the study, research questions, significance, scope and limitation of the study.

1.1 Background of the Study

Planning and scheduling of a project is the major task in the life cycle of a project. Project planning is the heart of good project management because it provides the central communication that coordinates the work of all parties (Oberlender, 2000).

Maintenance of a large fleet of aircraft poses significant challenges for a business in terms of achieving the multiple, and in some ways conflicting, goals relating to maintenance and operation costs and desired service levels, including safety (Knotts, 1991)

The perception of flight operators about aircraft heavy maintenance is down time for revenue incurrence and high cost incurred area. This notion makes planning and scheduling a challenging task. Aircraft heavy maintenance planning and scheduling is one of the areas where efficiency is a mandate in order to make cost effective, and time efficient maintenance.

In essence, the vast majority of research in the area of heavy maintenance has focused on the service-scheduling problem whereas the attention to detailed planning and scheduling of materials, resources and operations at the activity or task level has been limited (Samaranayake & Kiridena, 2012).

1.2 Background of the Organization

Ethiopian Airlines was founded in 8th April, 1946. Its main service of operation is air transport. In addition, the company provides services related to the aviation business. It has been in operation seventy plus years. It has been the country's symbolic company. During its existence, it has become one of the continent's leading carriers.

Operating at the forefront of technology, the airline has also become one of Ethiopia's major industries and a veritable institution in Africa. It commands a lion's share of the pan African network including the daily and double daily east-west flight across the continent. Ethiopian currently serves 100 international and 21 domestic destinations operating the newest and youngest fleet. It has a total of 89 fleets of Boeing, Airbus, and Bombardier.

Ethiopian Airlines' functional areas of operation in its overall organizational activities are the Ethiopian aviation academy, and the maintenance and overall repair (MRO) areas of operations, the passenger flight operation, cargo and freight transport &airline catering services.

In 1957, Ethiopian MRO established at Addis Ababa to reduce the need for maintenance overseas. In the following years, the MRO expanded into a well-equipped center for maintenance, overhaul and modification work on aircraft, engine and avionics. The service has been given not only to its own aircrafts, but also for other airlines in the region.

The MRO base is fully operational for Airframe maintenance up to D-Checks, Engine, Overhaul, Components repair & overhaul, Light Aircraft maintenance and technical, and management assistance for other airlines. The maintenance base is certified by the US- Federal Aviation Administration (FAA).

Ethiopian MRO is an Approved Maintenance Organization (AMO) with approvals from ECAA, the FAA and EASA. Ethiopian MRO is a division of Ethiopian Airlines (MCM, 2016).

Ethiopian Airlines, as an OPERATOR, works very closely with Ethiopian MRO Services on continued airworthiness management and maintenance tasks. The following maintenance tasks are contracted to Ethiopian MRO Services. However, the responsibility for their proper performance shall remain with Ethiopian Airlines (MCM, 2016).

1.3 Statement of the Problem

Aircraft Maintenance projects are vital in the life of Aircraft's operational time. Aircraft Maintenance ensures the reliability and safety of the aircraft in its operation. Given the increasing technical sophistication of the asset and the intricacies introduced by different types of aircraft that make up a typical fleet, planning and scheduling of aircraft maintenance can be demanding (Samaranayake & Kiridena, 2012).

Scheduling a number of aircraft for maintenance at various levels is a huge task for the airline industry because much of this maintenance involves planning, control, and execution of large number of components such as materials (spare parts), operations (both assembly and disassembly), resources and suppliers (Samaranayake, 2006). The research paper subsequently has identified planning and scheduling as one of problem areas of aircraft maintenance. Its categorization for major aircraft problem areas are heavy maintenance, line maintenance, engine maintenance, component maintenance and configuration management. And then, of all categories above, Samaranayake, (2006) has emphasized heavy maintenance is considered to be the most complex problem due to involvement of planning and scheduling of large structures and many components.

Airlines demand their aircrafts to be back to operation after every maintenance activities as soon as possible because it is when the aircraft is on air that the airline can gain revenue in the business. During heavy maintenance, an aircraft is temporarily taken out of revenue service, and the elapsed time is treated as downtime (Samaranayake & Kiridena, 2012). In spite of the above assumptions, it is inevitable to recoil from the maintenance procedure as it is mandatory. Hence effective planning and scheduling should be the mandate to effectively manage the Aircraft Heavy Maintenance

projects. Hence, this paper identifies the issues of planning and scheduling for aircraft Heavy Maintenance projects.

1.4 Objective of the Study

1.4.1 General Objectives

The study is generally aimed at examining the practice of Ethiopian MRO in planning and scheduling of aircraft heavy maintenance projects.

1.4.2 Specific Objectives

The specific Objectives of the study are the following:

- Identify the steps where by Ethiopian MRO follows to plan and schedule for Heavy Maintenance Projects
- Identify the stakeholders and their impact on the overall planning and scheduling process of Aircraft Heavy Maintenance Projects
- Examine the tools and techniques that are used in the planning and scheduling process of Heavy Maintenance Projects
- Explore the issues which reside in the planning and scheduling process of Aircraft Heavy Maintenance Projects.

1.5 Research Questions

1.5.1 General Research Question

What is the practice of Ethiopian MRO in planning and scheduling of aircraft heavy maintenance projects?

1.5.2 Specific Research Questions

- What are the steps that Ethiopian MRO follows to plan and schedule for Aircraft Heavy Maintenance Projects?
- Who are the stakeholders and describe their impact on the overall process of the planning and scheduling of the Aircraft Heavy Maintenance projects?
- Are the tools and techniques used for planning and scheduling of Aircraft Heavy Maintenance Projects facilitating the process?
- What are the problemes that reside in the planning and scheduling process of Aircraft Heavy Maintenance Projects?

1.6 Significance of the Study

MRO maintenance is constrained in time. Hence, efficient planning and scheduling is mandatory for the on-time delivery of the aircraft to operation.

The study is significant in explaining the processes in planning and scheduling of the Ethiopian MRO in endeavoring Aircraft Heavy Maintenance Projects. Subsequently, it point out the issues that resides in the phase of the project processes. It will analyze the issues mentioned in the practice by relating it with the theories discussed in the field of project management study. Henceforth, it sees the gaps that have to be filled in the area of operation. Recursively, it will search for any industrial experience that can be an input to the field of project management.

1.7 Scope / Delimitation of the Study

The scope of the study is limited to the extent of comprehending the impact of planning and scheduling on the overall project endeavor, identifying the stakeholders, explain the process, and identify the issues in the planning and scheduling of Aircraft Heavy maintenance projects.

Ethiopian Airline MRO comprises vast area of operation. Its main functionality is to ensure the reliability and safety of the aircraft which are owned by the Ethiopian Airline and also other Customer Airlines. The MRO is complex in its operation to service. And, scoping the study is vital in order to meet the desired objectives. Subsequently, the paper is focused on the study of sections of MRO which are responsible to plan and produce the work package and schedule for the Aircraft Heavy maintenance projects. The planning area on the cost and quality constraints are not thoroughly discussed but the schedule and scope of work. However, there may be related overviews of the cost and quality terms whenever it is applicable to the schedule and work scope of the project or vice versa.

The limitation of the study is the time given to conduct the research. Considering the broadness of the organization in being study, it needs extensive and enough time not only to address the questions raised in the research, but also to isolate the project content of the research from the operational features of most activities in the organization. In addition, regarding the confidentiality of some company documents, it has been a challenge to unveil vital empirical figures that would have bolstered the study more.

1.8 Organization of the Study

This paper is organized in five chapters which follows similar arrangement as most research papers. I.e. chapter one – discusses about the proposal section, chapter two- reviews the literature and related works by other scholars, chapter three- depicts the research design and methodology, chapter four- presents the data result & analysis and in the final chapter which is chapter five – forwards recommendation and reflections on the issues discussed in the data gatherings.

CHAPTER II

LITERATURE REVIEW

2.1 Definition of Terms

2.1.1. Project Definition

Distinguished scholars have forwarded the definition of projects in their own way. Westland (2006) defined project as a unique endeavor to produce a set of deliverables within clearly specified time, cost and quality constraints. Heagney (2012) has stated the parameters for a work to be a project. Accordingly, it can be inferred from the book that project is said to be a project, because it has a definite starting point, target, end date, specific performance requirements, defined scope of work, and a budget. According to PMI (2013) a project is a temporary endeavor undertaken to create a unique product or service. The book has subsequently explained that temporary means every project has a definite beginning and definite end and unique means that the product or service is different in some distinguishing way from all other products or services.

The main reason for the existence of a project is the desire to have a deliverable. Deliverables are measureable, tangible output (kerzner, 2009). The form of a deliverable can be distinguished from different perspective. For one, a deliverable can be a service or product. For other, deliverable can be categorized as hardware, software or interim.

The framework that can be drawn from most definitions given to a project is parameterized in Scope, time, cost and quality. And project output is the function of this four parameters. In some cases customer requirement is taken as a bench mark of a project along the other four parameters.

The key characters that distinguish a project have been explained by Wallace (2014), as the following;

- ✓ A project usually has a single definable purpose or aim.
- ✓ A project usually has a series of individual operational constraints or performance objectives.
- ✓ Each project team tends to be unique in that it is generally multidisciplinary
- ✓ Each project is unique.
- ✓ Projects tend to be unfamiliar.
- ✓ A project generally has a finite lifespan.
- ✓ Projects tend to pass through clear stages of development.
- ✓ Projects are often complex.
- ✓ Projects are characterized by change.
- ✓ Projects are often high risk.
- ✓ Projects tend to be secondary to the main strategic function of the organization.

Projects are very essential in realizing the strategic plan of organizations and are the means by which strategy is implemented as manifested in (PMI, 2013).

2.1.2 Project Management

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements (PMI, 2013). Westland (2006) has explained it in similar terms of

requirements such as skills, tools and management process in order to undertake project successfully. According to Williams (2008) project management is everything you need to make a project happen on time and within budget to deliver the needed scope and quality. Wallance (2012) in its inference from PMI (2013), Project management, then, is the application of knowledge, skills and techniques to execute projects effectively and efficiently. It's a strategic competency for organizations, enabling them to tie project results to business goals – and thus, better compete in their markets.

Historically, projects have existed for thousands of years in the human art of work. The Great Wall of China, the Egyptian Pyramids, the Lalibela Castle, the Axum monument, etc. are the greatest achievements of human race in history; and they have the project features of endeavoring work. However, project management is a recent professional field of study unlike the existence of projects for millennia. And, the trends for managing these projects have been a whim. Even though projects have been said to be conducted in today's organizations, the management habit is contemplated in traditional manner where people manage on-going projects the same way as they manage routine tasks. Unfortunately, people assume that they are doing project management simply because they have ongoing projects in their organizations. Kerzner (2009) has articulated this distorted conceptualization about project management as "the art of creating the illusion that any outcome is the result of series of predetermined, deliberate acts when, in fact, it was dumb luck."

Project management comprises of the term project and management. And by integrating the two terms' meaning, Kerzner (2009) has forwarded the meaning of project management as "project management is the planning, organizing, directing, and controlling of company resources for a relatively short-term objectives that has been established to complete specific goals and objectives."

2.2.Project Management Context

Projects are unique in nature as refereed in the above section. Every project has distinguishing feature that makes it challenging in devising a formula in executing projects successfully. The environment in which projects are entertained is broader and in most cases elusive. Subsequently, one of projects uniqueness ascribes to project context broadness and complexity. The project management context emphasizes about the two factors that forms the context of project management. These are project stakeholders and the organizational influences. Brief explanation about the two is followed below.

2.2.1. Project Stakeholders

Stakeholders are individuals or organizations that can be favorably or unfavorably impacted by the project (Kerzner, 2009). PMI (2013) also states that stakeholders are individuals and organizations that are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or project completion; they may also exert influence over the project and its results.

Stakeholders are those people who hold a stake in the project—they're people who care about the project's outcome. "Stakeholders" is really a catch-all term that can be used to describe such disparate groups as senior management, end users of systems, customer representatives, administrators, members of the local community, and union representatives. Anyone who feels that the project might affect them could regard themselves as a stakeholder (Williams, 2008).

Stakeholders influence the processes of a project both in negative or positive manner. Hence, identifying and managing of stakeholders is one of the critical tasks of project managers. PMI (2013) has also supported the above by stating that, the project management team must identify the stakeholders, determine their requirements, and then manage and influence those requirements to ensure a successful project.

According to Kerzner (2009), an organization has its own categorization system for identifying stakeholders and a typical system can have the following stakeholders:

- **Organizational stakeholders**
  - ✓ Executive officers
  - ✓ Line managers
  - ✓ Employees
  - ✓ Unions
- **Product/market stakeholders**
  - ✓ Customers
  - ✓ Suppliers
  - ✓ Local committees
  - ✓ Governments (local, state, and federal)
  - ✓ General public
- **Capital market stakeholders**
  - ✓ Shareholders
  - ✓ Creditors
  - ✓ Banks

Williams (2008) has suggested the best technique in identifying the stakeholders of a project is through the organization chart. Project organization chart is a simple graphical illustration of who's involved in the project and where they fit in the overall organizational, or project plan.

However, the organizational chart does not inclusively give all stakeholders of a project because external stakeholders are not outlined in the internal organizational chart. Hence, scrutinizing the project process, organizational policies and procedures are the technique in identifying the external stakeholders.

PMI (2013) has identified some stakeholders in a project. Accordingly, Project manager, customer, performing organization, project team members, and sponsors are the key stakeholders of a project. The book has also mentioned that naming and grouping of stake holders is primarily an aid to identifying which individuals and organizations view themselves as stakeholders.

2.2.2 Organizational Influence

Organizations can be defined as groups of people who must coordinate their activities in order to meet organizational objectives. The coordination function requires strong communications and a clear understanding of the relationships and interdependencies among people. Organizational structures are dictated by such factors as technology and its rate of change, complexity, resource availability, products and/or services, competition, and decision-making requirements (Kerzner, 2009).

According to Wallace (2012), Organizations that are based around functional groupings are often referred to as functional organizations. Organizations that are wholly based around their functional

structures are often referred to as pure function organizations. Generally the larger an organization becomes the more likely it is to adopt a functional structure.

Projects can take different forms depending on the context they are working on. Wallace (2012), states that it is important to understand that project teams can be set up and managed in numerous different ways depending on the characteristics of the project and of the organizations concerned. The most basic classification system for project forms comes under two headings:

- ***Internal project management*** exists when project teams operate on existing organizational structure.
- ***External project management*** exists when the project manager tends not to be an employee of the organization concerned, but is usually a private professional consultant who offers professional project management services to the organization or client in return for a fee.

According to PMI (2013), project based organizations can hold two forms. The first is organizations that derive their revenue primarily by performing project works for others and organizations that adopted management by proje*ct*. And non-project based organizations often lack management systems designed to support project needs efficiently and effectively.

2.3 Project Manager

The project manager is a person who primarily works at the discretion of project success. Heagney (2012), has strengthen the above by stating: "The primary responsibility of the project manager is to ensure that all work is completed on time, within budget and scope, and at the correct performance level."

Project managers tend to operate in one of two alternative forms. Internal project managers are generally employees of a given company and are put in charge of projects within that company. External project managers operate as independent consultants and provide project management services to a client in return for a fee (Wallace, 2012).

Projects are in demand of resources in order to be conducted. And a project manager is responsible to ensure that all resources are available during inquiry. Unfortunately, project managers cannot access most resources (i.e. money, manpower, equipment, facilities, materials, and information/technology) directly by their own but perhaps the project budget. The interface of the project manager with the line managers is the path whereby the availability of resources can be ensured. Hence, the project manager needs to negotiate with the line managers for the resource availability to the project.

2.3.1. Role of Project Manager

Kerzner (2009) states that it is imperative that project managers must understand totally the operations of each line organization in addition to understanding their own job description. The project manager is responsible for coordinating and integrating activities across multiple, functional lines (Kerzer, 2009).The major responsibility of a project manager is planning (Kerzner, 2009). The book has subsequently described the role of the project manager as an architect of the project plan to be the following:

- Complete task definitions
- Resource requirement definitions (possibly skill levels)
- Major timetable milestones
- Definition of end-item quality and reliability requirements
- The basis for performance measurement

2.4 Project Life Cycles

Projects are unique in nature as refereed in the above section. Every project has distinguishing feature that makes it challenging in devising a formula in executing projects successfully. The environment in which projects are entertained is broader and in most cases elusive. Subsequently, one of projects uniqueness ascribes to project context broadness and complexity.

In order to manage the broad and complex nature of projects, dividing projects into phases is very important. According to (PMI, 2000), project life cycles are the collection of project phases. Every project phase is marked by completion of one or more deliverables. Project phases are very important in indicating the continual, change, postponement or termination of the project. The project life cycles explained in most book including (PMI, 20013), Kerzner (2009) are project initiation, planning, execution, monitoring & evaluation and closure.

2.5 Project Planning and Scheduling

2.5.1 What is project planning?

Project planning is one of the five process groups in project management. This phase accounts to, (PMI, 2013), definition of work requirements, quality and quantity of work, definition of resources needed, scheduling the activities, and evaluation of various risks.

Project planning is the heart of good project management because it provides the central communication that coordinates the work of all parties (Oberlender, 2000). Williams (2008) also advocate to the same point as the above by stating that Planning is arguably the most important phase of a project because investing in planning will lead to smooth operation in the later process stages of a project. Project planning ensures that the phases, activities and tasks in a project processes are undertaken in a coordinated fashion.

Planning is a process and not a discrete activity. As changes occur, additional planning is required to incorporate the changes into the schedule (Oberlender, 2000). Good planning detects changes and adjusts the schedule in the most efficient manner.

According to Kerzner (2009) planning is determining what needs to be done, by whom, and by when, in order to fulfill one's assigned responsibility. Subsequently, the book has mentioned the nine major components of planning phase;

- **Objective**: a goal, target, or quota to be achieved by a certain time;
- **Program**: the strategy to be followed and major actions to be taken in order to achieve or exceed objectives;
- **Schedule**: a plan showing when individual or group activities or accomplishments will be started and/or completed;
- **Budget**: planned expenditures required to achieve or exceed objectives;
- **Forecast**: a projection of what will happen by a certain time;
- **Organization**: design of the number and kinds of positions, along with corresponding duties and responsibilities, required to achieve or exceed objectives ;
- **Policy**: a general guide for decision-making and individual actions;
- **Procedure**: a detailed method for carrying out a policy;
- **Standard**: a level of individual or group performance defined as adequate or acceptable;

2.5.2. Types of Project Planning

Planning is not definite and also not easy. It is a systematic forecasting on how to formulate and carry out a task. The degree of uncertainty of planning can vary on the period of predication. According to Kerzner (2009), planning can be defined as strategic, tactical or operational. Strategic planning is generally for five years or more, tactical can be for one to five years, and operational is the here and now of six months to one year. Although most projects are operational, they can be considered as strategic, especially if spin-offs or follow-up work is promising.

If project planning is strictly operational, then these factors may be clearly definable. However, if strategic or long-range planning is necessary, then the future economic outlook can vary, say, from year to year, and re-planning must be done at regular intervals because the goals and objectives can change (kerzner, 2009).

2.5.3 Result of Project Planning

Oberlender (2000) has summarized the desired results of project planning and scheduling as the following lists below.

- Finish the project on time
- Continuous (uninterrupted) flow of work (no delays)
- Reduced amount of rework (least amount of changes)
- Minimize confusion and misunderstandings
- Increased knowledge of status of project by everyone
- Meaningful and timely reports to management
- You run the project instead of the project running you

- Knowledge of scheduled times of key parts of the project
- Knowledge of distribution of costs of the project
- Accountability of people, defined responsibility/authority
- Clear understanding of who does what, when, and how much
- Integration of all work to ensure a quality project for the owner

2.5.4. Project Planning Process

There must be an explicit operational plan to guide the entire project. The plan must include and link the three components of the project: scope, budget, and schedule. Too often, planning is focused only on schedule without regard to the important components of scope and budget (Oberlender, 2000).

In planning process the first step should be to know what to plan. Here, Williams (2008) has stipulated two approaches to comprehend what to plan. These are based on tasks and deliverables. A task-based plan will literally give you a list of items that you need to do, like a to-do list for the entire project. However, Williams (2008) has mentioned that measuring the tasks and following the project progress is challenging because the tasks does not equivalently indicate the percentage completion of the project. Hence, Williams (2008) advocates planning based on deliverables which means based on the actual end-products of your project, is the best choice.

(Williams, 2008), after knowing what to plan the next step is how to plan the project.

Planning a project for the first time is a six-step process:

1. Break down the project into pieces small enough to work with

It means to break the single end-goal of your project into individual deliverables that are small enough to be both achievable and measurable.

2. Identify dependencies.

Identifying dependencies can be as simple as drawing some arrows on your list of deliverables to indicate which items precedes others.

3. Estimate how long each piece will take

Estimating is to predict how long the production of the various deliverables will take, so that you can build an initial project schedule. It is probably the most maligned (and most frequently overlooked) part of the planning process.

4. Add some contingency

Contingency is extra time that's allowed in the schedule to cover unexpected events, such as a milestone that takes longer to achieve than you planned, a problem that's harder to solve than you realized.

5. Consider the risks

Risks are unforeseen events that can lead the project in undesirable processes or endings. Hence, considering risks proactively is crucial in the planning process of a project.

The process for creating a Risk Management Plan is as follows:

1. Identify potential risks.
2. Rate them by likelihood and severity.
3. Choose which risks to plan for.
4. Make plans for dealing with those risks.

6. Represent the plan in a format that the team, board, and stakeholders will understand and follow. It is important knowing how to represent and communicate the project plan to the people involved in the project.

2.5.5 Tools and Techniques for Planning and Scheduling of Projects

Project management is a challenging task with many complex responsibilities. Fortunately, there are many tools available to assist with accomplishing the tasks and executing the responsibilities.

It is common practice for each line organization to establish its own tools and techniques. During transition, no attempt should be made to force the line organizations to depart from their current practices. Rather, it is better for the project managers to develop tools and techniques that can be integrated with those in the functional groups (Kerzner 2009). Some of the tools that are helpful in planning and scheduling of projects are presented below.

The Work Breakdown Structure

A Work Breakdown Structure (WBS) is a representation of the scope of the project. It comprises a tree structure that hierarchically represents the project and its component deliverables. A WBS for your project should show 100% of the scope and the deliverables—literally everything that has to be delivered for your project (Williams, 2008).

The project schedule is the time-based and/or sequenced description of all of the project activities. The time element is one of the triple constraints that every project leader must contend with: scope, schedule, and resources/budget. There are a variety of techniques for both displaying the project schedule and analyzing the project schedule. Each technique focuses on a different aspect of the project. Depending upon the project objectives and major risks, different techniques should be used by the project leader. A brief description of each technique is listed below. The tools and techniques are extracted from sheen (2009) which is scripted by Ray Sheen.

The Gantt chart

A Gantt chart is diagram representing the project schedule in a particular type of bar chart. This format is excellent for tracking progress or activity for tasks once they have been scheduled. In the Gantt chart, every task is represented by a bar of a time line chart.

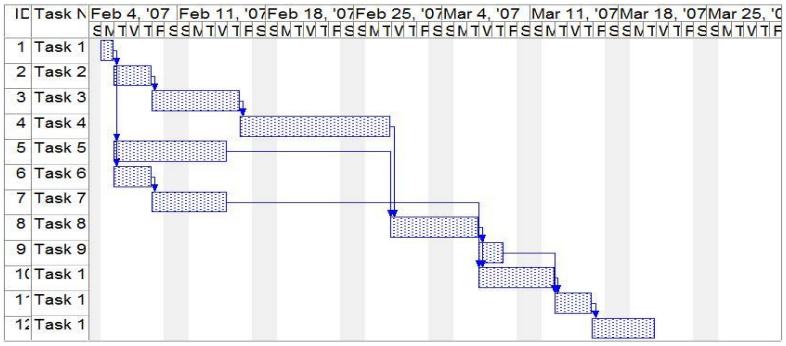


Figure1. Gantt Chart Example

Milestone Chart

The milestone chart is portrayed on a project time line. It displays only the key project milestones. Each milestone is represented by a diamond or triangle. These milestones normally become major reporting points to senior management. Large complex projects may have hundreds or even thousands of tasks.

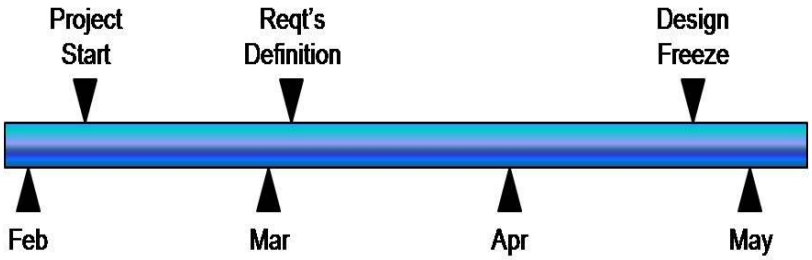


Figure2. Milestone Chart Example

Task List

The Task List is the simplest of the schedule format tools, yet it can be the most powerful and useful tool with extended members of the project team. A Task List is just an action item list for the team member that contains all of the tasks that individual is responsible for completing. This provides a focus for the individual as to what they need to do. This format works very well with extended team members on large projects. In those cases, the project may contain hundreds of tasks but often the extended team member is only involved in a small number of those tasks. The extended team member can review their task list and understand what they must do on the project without going through the hundreds of tasks, searching for those requiring their effort. If the team has many extended team members with limited involvement in the total project, this technique usually is the

best method for communicating and tracking scheduling of the work from those extended team members

Task	Date
Conduct ABC analysis	4/25
Prepare test plan	5/15
Build test samples	5/15
Analyze test data	6/7

Figure3.Task List example

Network diagram

The Network Diagram is essentially a flowchart of the project tasks. This format is a foundational technique for several analytical techniques. The network is created by determining predecessor and successor relationships and connecting the tasks based upon those relationships. In a complex project with many organizations/individuals involved, this technique can provide guidance as to who is the internal customer for each task. The technique is often viewed as a foundational technique since most of the advanced analytical scheduling tools start with the Network Diagram. When task durations are uncertain, the Network Diagram is often a better technique to use than the Gantt (bar) chart. The Network Diagram shifts the focus for uncertain tasks from arbitrary start and end dates to completion of the work and a handoff to the next task/activity.

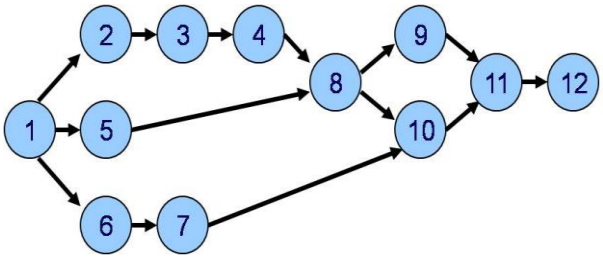


Figure 4. Network Diagram Example

2-D Task List

The 2-Dimensional Task List is only needed occasionally. However, in those situations it both simplifies planning and tracking while improving the ability of the project manager to manage many of the project tasks effectively. This technique is used for scheduling and tracking a large quantity, or batch, of items through the same set of project tasks or activities. The 2-D task list is a matrix with the vertical side being a list of the items in the batch and the horizontal being the set of tasks. The

planned date for task completion of each item through the set of tasks is set in the corresponding box of the matrix.

	Req	Des	Code	Test	D'bug	UAT	Rel
Module 1	3/5	3/20	4/8	4/15	4/22	5/15	6/1
Module 2	3/5	3/20	4/8	4/15	4/22	5/15	6/1
Module 3	3/5	3/27	4/21	4/29	5/6	5/15	6/1
Module 4	3/5	3/27	4/15	4/22	4/29	5/15	6/1
Module 5	3/5	3/20	4/8	4/22	4/29	5/22	6/1
Module 6	3/5	3/27	4/15	4/29	5/6	5/22	6/1
Module 7	3/5	3/27	4/21	5/6	5/13	5/22	6/1

Figure5. 2D Task List Example

Techniques for Analyzing Project Schedules

Critical Path

The Critical Path method is used to determine what the shortest time is to complete the project, or a phase of the project. The method analyzes every possible sequence of tasks based upon the network diagram to determine which sequence is the longest. This sequence is called the critical path because it sets the minimum time in which the project can be completed. A caution when using critical path; it assumes that you have all the resources you need at all times. This is seldom a valid assumption, so the minimum time indicated by the critical path is seldom actually achieved on a project.

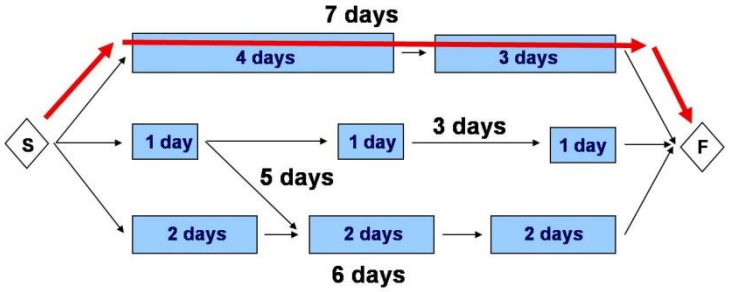


Figure6. Critical Path Example

Critical Chain

This technique builds on the analysis done using critical path and resource leveling techniques. It is used when the resource leveling technique has delayed the end date of the project. Critical chain reprioritizes the work, applying principles of the Theory of Constraints, and provides simple tracking principles to accelerate the project and ease the burden on project management. This is done by determining the best allocation of the critical or constraining resource and shifting the tracking approach to concentrate on this resource. The critical chain approach requires the development of the network diagram and the critical path and resource leveling calculation to have been done.

PERT

PERT, which stands for Program Evaluation and Review Technique, is a way to put boundaries around overall project durations. The PERT estimate is a simple risk-mitigation approach that considers the best case and worst case of a task estimate but also includes a most likely estimate that is between the two and is heavily weighted. The three estimates are averaged using the PERT formula to create the PERT estimate for the task.

Resource Leveling

Resource leveling is a technique used to smooth out the peaks and valleys in the required project resources. This leveling process usually results in changes to the project schedule. Through the use of leveling, the best allocation of resources assigned to the project can be determined. The resource leveling technique applies when the project has been planned with a high degree of parallelism.

Schedule Acceleration

Schedule acceleration techniques are used to shorten the overall length of the project. However, they are not free. While they reduce the planned total duration of the project, they do so by increasing risk in some other aspect of the project. They need to be deployed carefully, and always with an update to the project risk management plan. There are five schedule acceleration techniques - each with unique set of risks. Selecting the technique or combination of techniques, to be used depends on the characteristics of the activities to be accelerated and the overall risk sensitivity in the project**.**

Buffer Management

Buffer management reduces the buffer that is inherent in the estimates of uncertain activities. When estimating uncertain activities, project managers tend to allow for the uncertainty by using a conservative estimate. (This is not the same as "padding" an estimate which just arbitrarily adds time or money to an estimate - rather this is a conscious decision to prepare for the unknowns associated with the uncertain activity.) Buffer management removes the buffer from the activity estimate, thereby creating an aggressive activity estimate. The setting of aggressive activity goals will often result in reduced activity duration. However, the risk is that now there is a much higher probability that the activity will finish late as compared to the plan. When this technique is used, the project manager needs to maintain a project-level schedule reserve to compensate for the activities that will be late.

Crashing

Crashing accelerates an activity by adding additional resources. Some activity durations are limited by resource availability - more resources would allow a faster completion. While this is not true for all activities, it is true for some. (A 72-hour burn-in test on a printed circuit card module cannot be

accelerated by adding additional test technicians - it still takes 72 hours. However a dedicated courier can deliver a report overnight that would normally take three days to deliver by mail.) This will often increase the overall cost of the project as the additional resources are often added at a premium.

Fast-tracking

Fast-tracking accelerates the project by starting activities prior to the completion of all the predecessor activities. This can only be done when there is a preliminary result of the predecessor activities. For instance, a preliminary Bill of Materials may be developed during a design process and raw materials for production may be ordered based upon the preliminary Bill. (This is often done when ordering Long Lead Material.) If the Bill of Material does not change during the final design review and baselining process, the project is accelerated. However, if the final Bill of Material does change, the material ordered from the preliminary Bill may need to be reworked or scrapped - increasing the effort and cost to the project. This technique is viable when the predecessor activity has a preliminary deliverable that the project management team believes is stable.

Split-to-Phases

The Split-to-Phases technique is used when the project has multiple, separable objectives. The scope of the project is divided into phases based upon the activities that are unique to a project objective. This allows a focusing of project resources on the activities supporting one of the objectives at the expense of the activities supporting a different objective. This will result in an early completion of a portion of the project, but usually causes a delay in another portion of the project and often an increase in cost because of activities that must be repeated for each of the phases. (For instance there may be a User Acceptance Test that would now need to be done twice instead of just once.) This acceleration technique is appropriate only when the completion of the first phase is able to immediately start producing some business benefit, without the completion of the succeeding phases.

Mainline-Offline Scheduling

The Mainline-Offline technique separates the work within an activity into two components. The first is that which can be done generically without specific knowledge of the results of predecessor activities. The second is that which can only be done once the predecessor activities are complete. An example would be creating a project requirements document. A generic template can be created based upon the general understanding of the project. The specific requirements are identified based upon meetings with stakeholders or analysis of business processes. (One of the business benefits of a Project Management Office is that it develops and maintains these templates and generic activities, allowing projects to be accelerated through the use of them.) This technique only works with some activities, and requires the foresight to anticipate the need for the generic portion of the activity to be accomplished prior to the completion of the predecessor activities. Once an activity has started, there is no advantage to do the activity first in a generic manner and then in the project specific method.

These methods can be used in a stand-alone manner or in combinations. However, they all result in some level of increased risk to the project. Whenever a schedule acceleration technique is used, the risk analysis must be updated to include the risk associated with the technique failing to deliver the potential benefit.

Plan Reviews

More a technique than a tool, plan reviews help you to keep your plan alive. A plan review is a short meeting (of not more than 30 minutes) in which a project planner review the project plan with a group of people. A plan review consists of taking people through the plan at a high level, and only going into the detail that's relevant to them (Williams, 2008).

2.6. Maintenance

The aircraft maintenance involves repairing or replacing failed or failing components to keep the aircraft operational (Samaranayake, 2006). Kinnisson (2012) states that, maintenance can be described as the process of ensuring a system continually performs its intended functions at its original level of reliability and safety.

Analyzing the operation side, Kinnisson (2012) explains that aircraft maintenance can be divided into scheduled and unscheduled maintenance. Scheduled maintenance is a preventive action to ensure that a product functions properly at pre-set intervals. Unscheduled maintenance is not planned or programmed, but it is required when an item has failed or broken down.

To be in compliance with the Federal Aviation Administration constraints, some companies have adopted maintenance policies that call for routine inspections at least every four days. There are four major types of check mandated by the FAA that each aircraft has to undergo (Clarke et al., 1997).

- **Type "A"** check- is the first major check (denoted as Type A) actually mandated by the FAA occurs at every 65 flight-hours, or about once a week. Type A checks involve inspection of all major systems such as landing gear, engines and control surfaces.
- **Type "B**" check -The second major check (designated as Type B) is performed every 300–600 flight-hours, and entails a thorough visual inspection plus lubrication of all moving parts such as horizontal stabilizers and ailerons.
- **Type "C**" and **Type "D"** check -The very major checks designated as Type "C" and "D" are done about once every one to four years, respectively, and require taking the aircraft out of service for up to a month at a time.

Heavy maintenance refers to a major overhaul of aircraft structures, includes scheduled maintenance, including inspections of various system components, as well as structural modifications and alternations (Samaranayake & Kiridena, 2012). In accordance, heavy maintenance is included in the type "C" and "D" checks.

One of the distinguishing features of aircraft heavy maintenance projects is the maintenance cost of direct and indirect. Dupuy et al. (2011) asserted that maintenance cost is not the only cost that aircraft operator has to support at the time maintenance is performed. They noted that operator is also subject to indirect maintenance cost. (Kumar et al. 2000) asserted that downtime should be considered only when the system is expected to be in operation.

They discussed that scheduled and preventive maintenance are usually performed when the system is not required to be operational. As direct maintenance cost is not cheap, so is downtime cost. Therefore, before preparing a maintenance schedule, operators need to calculate direct and indirect maintenance cost together with downtime cost in order to make a decision with the lowest possible total maintenance cost.

Aircraft maintenance programs can be performed either by the aircraft operator or by the Maintenance, Repair, and Overhaul (MRO) organizations. In both cases, they need to follow the specific procedures released by the aircraft, engine, and component manufacturers.

An MRO is simply a place where maintenance can takes place. According to EFNMS (2013) MRO may be defined as all actions that have the objective of retaining or restoring an item in or to a state in which it can perform its required function. The actions include the combination of all technical and corresponding administrative, managerial, and supervision actions.

2.6.1 Planning and Scheduling of Aircraft Heavy maintenance Projects

Planning and scheduling of Aircraft Maintenance is a very sophisticated operation because it entertains critical parameters. Some of the major parameters are varied maintenance requirements for different fleets, imposed commercial constraints, availability of skilled manpower and utilization of maintenance facilities. Another critical parameter in planning and scheduling of aircraft maintenance is the frequent changes necessitated due to operational requirements. And there should be a careful contemplation in the planning and scheduling regarding the parameters.

2.7. Empirical Literature Review

(Samaranayake, 2006),

Current Practices and Problem areas in Aircraft Maintenance Planning and Scheduling

Current practices and problem areas, common in many airlines, were evidenced through a recent study (internal report on investigation of an airline in the region, as part of a previously completed research project), on broader areas of unplanned maintenance, spare parts inventory and component maintenance are:

• Only about 50% of the work and parts replacement required during heavy maintenance can be planned. The other 50% is due to unplanned maintenance which is identified in inspection during lay-up.

• Inventory levels and planned purchases are based upon the forecast of historic usage, rather than any forward projection of parts usage based upon the aircraft schedule for future lay-ups.

• The cost of spare parts in inventory represents a significant investment for many airlines. However, by reducing spare parts inventory by the currently available methods without integrated planning, significant shortages are bound to arise.

• Where shortages occur in spare parts that have been sold off, the cost of re-purchasing these same parts is most likely greater than the selling price that an airline received and re-purchasing can also cause delays, as well as inconvenience, in maintenance.

• The purchase of spare parts currently appears to be primarily for unplanned replacement of unserviceable spare parts discovered during a lay-up.

US Bureau of Transportation Statistics (2010), has reported Maintenance accounted for an average of 9.9% of the total operating expenses between 2008 and midyear 2010 of US air carriers. Additionally, scheduled aircraft maintenance reduces the availability of the aircraft to generate revenues.

2.8. Conceptual Framework

A conceptual frame work is the theoretical assumptions, principles and rules that hold together the ideas which maneuver a research study. In this paper maintenance planning and scheduling is the point where the study revolves around. Subsequently, maintenance requirement, organizational standards, policies &procedures, commercial constraints, resources availability and changes made

are assumed to be the guides that shape the maintenance planning and scheduling process. And this frame work is formulated based on contemplation on the subject matter. In addition, this study is guided by these elements of the framework inorder to meet the objective of the research. The assumption of this framework is that by studying the variables that affect the maintenance planning and scheduling, it is possible to examine the practice of the Ethiopian airline in the aircraft heavy maintenance planning and scheduling of projects.

Maintenance Requirement- dictates the deliverables that the maintenance action shall bring on. And maintenance planning and scheduling defines the entire requirement that a maintenance output is based on.

Organizational standards, policies and procedures- the rules and regulations, the steps on how to take an action, the organizational policies are the bases where maintenance plan is formulated. Abiding to this rules and regulations outlines the standard of the industry and manifests the reliability of the work performed.

In aviation industry, safety and reliability is the prime factor. Hence, standards, policies and procedures are not only confined in the organizations but also manifested in global. Hence, during planning and scheduling maintenance consideration of these factors should be a mandate.

Commercial Constraint – an airline industry is the most competitive one. Airlines are always in demand of their airplane to be in operation as much as possible. Unfortunately, airplanes are machines and need maintenance to safe guard their reliability to operation. And there is a down time in aircrafts operation. And there is always a constraint in the commercial activity due to maintenance works and recursively there is constraint on the maintenance work due to commercial activities.

Resource availability – resources such as facilities, skilled man- power, spare parts, tools, manuals, are important to conduct a maintenance work. In particular, an airlines industry is a high technology business which demands intensive resources. And consideration of these inputs is very crucial in planning and scheduling of aircraft maintenance.

Changes- Airline industry is a dynamic environment. Changes exist in most aspect of its operation including the maintenance spectrum. Even in scheduled maintenance, 50% of the maintenance work is unscheduled one as stated above by **(Samaranayake, 2006).** Planning and scheduling effectiveness is constrained by these changes.



Figure7. Frame work of the study

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

3.1. Research Design and Methodology

According to (Bhattacherjee, 2012), our design and conduct of research is shaped by our mental models or frames of references that we use to organize our reasoning and observations. These mental models or frames (belief systems) are called *paradigms*.

(Bhattacherjee, 2012); When a researcher sees a social order, he or she seek to study the patterns of ordered events or behaviors, there are two approaches to conduct a research; i.e. objective and subjective.Objective approach is performed independent of the person conducting the observation or interpretation, such as by using standardized data collection tools like surveys, then they are adopting a *paradigm of functionalism*. And, subjective approach interpretation of participants involved, such as by interviewing different participants and reconciling differences among their responses using their own subjective perspectives, then they are employing an *interpretivism paradigm.* If researchers believe that the world consists of radical change and seek to understand or enact change using an objectivist approach, then they are employing a *radical structuralism paradigm.* If they wish to understand social change using the subjective perspectives of the participants involved, then they are following a *radical humanism paradigm.*

Henceforth, this research is designed in paradigm of interpretivism. Since the paradigm results in subjective approach because the participants' interpretation of the problem studied is assumed to be critical for the remedies to follow.

Ontological Perspective

According to Mason (2002), merely having the research question is not enough to establish a research; rather the Ontological perspective is predominantly mandatory. The ontological perspective enlightens about what is the nature of the phenomena or entities, or social reality that one wish to investigate.

Hence, in this respect, the establishment of this paper is a keen interest to understand the practice of Ethiopian MRO in planning and scheduling of Aircraft Heavy Maintenance projects. Here, the ontological manifestation is Ethiopian MRO is an organization with ordered events and realities which have been conducted in a defined way to achieve strategic goal. And Heavy Aircraft maintenance has been a project to foster their organizational strategic objective. In endeavoring the Aircraft Heavy Maintenance, planning and scheduling has been laid out as a crucial activity in the project process.

In the process of comprehensive study, the research will analyze and reflect on the practice in comparison to related works that has already been set in.

In general, this research is qualitative and further descriptive in nature. In qualitative research, decision about design and strategy is an ongoing process as stated in (Mason, 2002). In this study, the enquiry for the facts is designed in unstructured approach.

3.2. Type and Source of Data

Primary and secondary sources are used to collect data for the study. The primary sources of data such as Semi-structured interview & Focus group discussion and the secondary source such as document review are used in order to comprehend and describe the area of study thoroughly. In designing the different methods of gathering information, it is aimed at bringing an integrated explanation to the problem in the study.

3.3. Sample and Sampling Methods

The technique to be used for the selection of sample from the given population is non- probability sampling. Specifically, the research implemented purposive non-random sampling because of the behavior of the research design. According to Creswell (2014), purposive sampling will best help the researcher understand the problem and the research question.

The ET- MRO's internal structure is clearly depicted in its MRO Organization Exposition (MOE) document. And it is comprehended that organizational units are depicted based on organizational functionality which refers to grouping individual according to function they perform.

Hence, in determining the target population for the study, the document has been used in identifying the target population that is involved in the function of planning and scheduling of the Aircraft Heavy Maintenance Projects. In the process of identifying the target population, the functional units of Maintenance Planning, Production Planning, and Base maintenance have been used as a sample target.

3.4 Data Analysis

Qualitative data analysis has been adapted to this research. Qualitative data analysis is the process in which we move from the raw data that have been collected as part of the research study and use it to provide explanations, understanding and interpretation of the phenomena, people and situations which we are studying.

3.5 Validity and Reliability

Validity and reliability are the essence of any research work. Accuracy, dependability and credibility of information depend on them. Validity refers to whether the findings of a study are true and certain. Reliability involves the accuracy of your research methods and techniques.

In quantitative research, the reliability of a research is tested by ensuring the ability to replicate the result of the study. However, according to Simon (2011), there is no expectation for replication in qualitative research.

Therefore, there are different ways of testing the validity and reliability of a research. One of the ways in ensuring the validity and reliability of a qualitative research is triangulation method.

Methodological triangulation involves the use of multiple qualitative and/or quantitative methods to study the program. For example, results from surveys, focus groups, and interviews could be compared to see if similar results are being found. If the conclusions from each of the methods are the same, then validity is established.

The benefits of triangulation include "increasing confidence in research data, creating innovative ways of understanding a phenomenon, revealing unique findings, challenging or integrating theories, and providing a clearer understanding of the problem", Thurmond (2001). The primary disadvantages of triangulation is that it can be time-consuming. Collecting more data requires greater planning and organization—resources that are not always available to lead researchers (Thurmond, 2001). However, weighing the outcome from using triangulation method and deciding to use or not to use is at the discretion of the researcher.

And, in this research, triangulation method, in specific, methodological triangulation, has been used since it is contemplated that the method is necessary to clearly understand the practice and issues of Ethiopian MRO in the planning and scheduling process of Aircraft Heavy Maintenance Projects from different methods of data collection. Henceforth, methodological triangulation is used in ensuring the validity of the research. In respect, in depth interview, document analysis and focus group discussion are the methods implemented in achieving triangulation test.

3.6 Ethical Issues

Ethics is the ground of research works. It is mainly reflected from data collection to analysis. Hence, in the process of inquiring data from the target population, the intention of the paper has been explained in impartiality. In addition, the analysis of the data has been performed without distortion in its inference.

CHAPTER IV

RESULTS AND DISCUSSION

This section of the paper is dedicated in presenting the data results which aimed at addressing the questions raised in the first chapter.

There are two sub sections in this unit. The first sub-section introduces the data which are gathered using three methods I.e. in-depth interview, document analysis and focus group interview. And the analysis will be presented respectively one by one. The second sub-section addresses objective statements and reflecting ideas will be presented from the analyzed data.

First, it is important to put forward the number of respondents on overall data gathering methods and for each methods used (i.e. for the in-depth interview and focus group interview)

Organizational unit	Respondents for the in-depth interview	Participants of the focus group discussion	Total number of respondents & participants
Maintenance planning	1	-	1
Task card planning	1	-	1
Production planning	-	5	5
Base maintenance	1	-	1
Total	**3**	**5**	**8**

Table 1. Population Size

In the process of the inquiry in the interview, the respondents' response is embeded in aspect to answer the research question. For the sake of coding the respondents, the alphabets of (A), (B) & (C) are given to the individuals from Maintenance Planning, Task Card Planning and Base Maintenance respectively.

- Respondent (A)-is the first respondent from Maintenance planning unit. (A) Is senior engineer who have been in the position for 6 years
- The second interview was conducted with the Task card planning unit member regarding the Job instruction task card (JIC). The respondent is given Code of (B) who is a senior task card planner with 4 years of experience.
- The third in- depth interview is conducted with a personnel who is from the base maintenance. The individual is given code name (C) who holds a managerial position. (C) has an experience of ten years in the maintenance area at Ethiopian Airline.

Focus group discussion is used in gathering information from the production planning unit. It is chosen because of the availability of the unit members in the same office and on the applicable time.

The participants have been coded with letters (D), (E), (F), (G) & (H). The first three have the responsibility of duties related to production planning and the following two have production controlling duty.

In understanding the practice of the planning and scheduling practice of Ethiopian Airlines for Aircraft Heavy Maintenance Projects, thorough document review has been performed in addition to in-depth interview and focus group discussion. Hence, the Technical procedure manual (TPM) has been scrutinized in order to comprehend the process of planning & scheduling and identification of stakeholders in the project.

4.1. Results

The results are integrated from the three sources of data, aiming to address each objectives of the research. Henceforth, in-depth interview, focus group discussion and document review results are formulated respectively in order to meet the objectives of the study.

The important document which has emphasized the ontological perspective of the study are the following.

- ✓ The ET-MRO has manifested in its TPM document section (9.7.2) that *"each major maintenance (e.g "A" check, "C " check, major component change) of an aircraft shall be executed as an independent projects, led by a project manager. "*

- ✓ *"Ethiopian Airlines shall have a Maintenance Program approved by ECAA for all aircraft it operates. The purpose of Ethiopian Airlines aircraft customized Maintenance Program (MP) is to provide maintenance planning instructions necessary for the safe operation of its aircraft. The MP outlines inspection and maintenance requirements in order to keep the aircraft, its power plant, systems, and equipment in a continuous state of airworthiness."*

- ✓ *"For planning scheduled maintenance checks subcontracted AMO (ET MRO) will prepare a scheduled maintenance forecast, and work package that contains MPD tasks, modification tasks, ADs, SBs and other maintenance requirements"*

- ✓ *"The work scope planning meeting will be conducted for A, C and major checks between Operator (Director Maintenance and Engineering of OPERATOR), Maintenance Planning and Records Control (subcontracted planning function for OPERATOR) and ET MRO per the existing SLA and technical procedures manual of ET MRO. Major work scope definition and planning must be included and agreed on seasonal SLA before the start of a season. The work package shall be released by Aircraft Maintenance Planning and Records Control (subcontracted planning function for AMO) to Aircraft Base Maintenance and Quality Control section of ET MRO for review before 15 days. The detail work scope planning meeting will be conducted after releasing the work package and before 12 days of the maintenance /work package performing event in Ten Days Plan Meeting."*

The objectives of the research in correspondence with the results from the data gathered is presented here below.

a) **Objective One-** is to identify the steps where by Ethiopian MRO follows to plan and schedule for Heavy Maintenance Projects.

The planning and scheduling process for aircraft heavy maintenance project is first and for most outlined in the strategic maintenance program plan as stated above in the document review data. In addition, it is triangulated in the interview conducted with (A) & (B) who responded for the following question raised:

- *How is Aircraft Heavy Maintenance planning & scheduling conducted?*
- *What is your input in preparing the plan?*
- *What is the deliverable from the planning process of your unit?*
- *How do you do resource planning?*
- *How do you estimate the time required for the duration of the task to be done?*

- ✓ (A) has stated *"There is already strategic maintenance program plan for each fleet that Ethiopian airline owns. Subsequently, depending on the flight hours and flight cycle of the Aircrafts, maintenance plan will be prepared based on the maintenance program plan. Here, duration of the maintenance including the start and end date, the tasks description, spare part requirement, facility requirement are contemplated and planned."*
- ✓ According to **(A),** *maintenance planning documents (MPD), technical procedural document, service letter agreement (SLA) are documents which are used in the planning process. In addition, the department (i.e. maintenance planning unit) uses JIC (job instruction cards) which are prepared by the task card planners.*
- ✓ The delivery expected from the process of the planning of the aircraft heavy maintenance project is a work package. This is manifested in the interview with (A) who explained as the following:
- ✓ "*Complete work package is the output of the process. In addition, the start and end date of the project will also be communicated with the complete work package." Subsequently,* (A) has described work package as *"Work package is the package of tasks that are implemented for the maintenance project. It also constitutes the man-hour requirement associated with the tasks. It also lists the tools and equipment needed to implement the tasks. It calls for the functional unit that is accountable for conducting the tasks."*
- ✓ (B)- *The maintenance planning request us to prepare the task card for the work to be done regarding the fleet type and type of maintenance. All specification regarding the plan of the work is received from the maintenance planning unit. And we contemplate their request and draw a template suitable for their request. And then we prepare the ask card.*
- ✓ (B)- *Depends on the plan of work that the planning requested. At some time, the same fleet with similar type of check may have different type of JIC (JIC consists of the task instructions where by the maintenance personnel should do, which maintenance personnel should do the task and how much time is needed to do the task) because the templates themselves are updated every time with the request of the manufacture or the operator. In other example, there may be additional integrated tasks like the Engineering orders (EO). Therefore, JIC can differ on circumstances.*

The process of planning and scheduling of aircraft heavy maintenance project comprise of the following two major phases which are tipped off from the interview data above and also triangulated from the document review which is outlined below. The distinguishing features of the two phases is based on the deliverables from the process. In consequence, the input the process, and the output also differs.

a) Phase One

In this phase of the process the deliverables, the input and the process are depiced in the following TPM document.

ET-MRO mega process input and output mapping detail is a part of TPM of section (9.00B) and depicts the strategic objectives of MRO. Hence, the following points have been drawn in relation to the research study.

- ✓ One of the strategic objectives of the division is the optimum maintenance planning and subsequently ET- Airplane Heavy Maintenance.
  - In the strategic objective of optimum maintenance planning and process, the key process of the division is Aircraft Maintenance Planning Process.
  - The inputs for the process are level of operation, Seasonal Flight Schedule, Maintenance Program, Task cards, Engineering Orders, Weekly A/C engine & APU status report, up-to date aircraft flight information, Aircraft Maintenance Schedule change request, Man hour data and Post Mortem Report. The sources of data related to this study's conceptual frame work are Aircraft Base Maintenance and Maintenance Planning Engineering (MP).
  - The output from the process are Aircraft Maintenance Forecasts, Man-hour Plans & Aircraft Maintenance Work Packages, Timely Maintenance & Optimum Decisions on change request, Aircraft Maintenance Performance & analysis Reports.

The TPM document of the above deliverables is aligned to be the task of Maintenance Planning and Records control which has been referred as Maintenance Planning unit in this study and infact comprises Task card Planning as well. In regards, the below document has been excerpted from the MCM.

- ✓ *"Aircraft Maintenance Planning and Records Control is responsible for forecasting, planning and scheduling of ET aircraft/engines/components for maintenance, collection and storage of aircraft records, ensuring the proper maintenance is accomplished on ET aircraft timely and per agreed standards by the subcontracted AMOs. The unit is also responsible for coordinating with the Commercial division, IOCC and subcontracted AMO to ensure the maintenance schedule is aligned with ET operation in an optimized way. More specifically, she/he shall be responsible for the Plans and schedules the maintenance of ET aircraft, engines and components strictly in accordance with the approved Maintenance Programs and time limits of ADs, and any other special maintenance requirements." (MCM, 2016*)

b) Phase Two

In the focus group discussion with the production planning unit (F) has explained about the responsibility of the unit which actually is accountable for the phase two process. Hence, the following response implicitly describes the activities within the phase two process.

(F)- Our responsibility begins right away after the work package which has been created by the Maintenance planning section, reached us. And then there are two major events in our process. These are the Pre –Event Preparation and Event Preparation. Pre- Event preparation, we review the turnaround time (TAT) for the scope, part, tool, facility, hangar space, and man hour. This is the phase where most of the activities in the planning is takes place. In the Event preparation, flow chart which consists of the lists of tasks, technician assigned, duration of task, start and end time of the project are depicted. In addition list of materials kit (LM kit) are designed, work package will be printed, headcounts (maintenance crew planning) will be done. In the head count the maintenance crew should not be 25% and above shortage because the Quality Assurance unit will not allow us.

- ✓ The strategic objective of the MRO which shows the phase two process of the planning and scheduling process is Et-Airplane heavy maintenance. And the following points have been drawn in relation to the framework of the study.

    - The key process for the strategic objective division is Heavy maintenance Process.
    - The inputs for the process are Aircraft Maintenance Forecasts, Man-hour plan, Aircraft Maintenance Work packages, aircraft in & out time, Aircraft Material and part, Ground Service Equipment (GSE), facilities, and tools.
    - The output of the process is Airworthy Aircraft with minimum cost, turnaround time (TAT) and high quality, Maintenix data recording and Maintenance release.

The risk associated with the unforeseen events during implementation are explained here below.

- ✓ *(C)- There are maintenances which are not on the scheduled. Most of them are found during inspection. Hence, our duty is to make the aircraft worthy to fly, depending on the found faults severity, the project manager will communicate with the higher management officials whom he assembled earlier at the start of the project, and the relevant action plan will be devised. And even if there are additional plans of work to be performed, he will be advised to integrate the tasks.*

If there are unscheduled maintenance, it implies that there will be scope change, resource and time variation. Hence, the production planning personnel has replied on how these events are entertained in the following statement.

- ✓ (A) –*What identifies the airline industry from most industries is that it imposes lots of rules and policies which safe guard the air transport. Aircraft is a machine, and it is prone to failures. And as an operator and maintenance facility purpose is to ensure that the aircraft is safe to fly. So it means unscheduled maintenance and scope change, by referring the manuals, we take action even there are resource changes or time variations. After all the aircraft should fly and in order to do that, we adhere to the procedures.*
- ✓ (A) – *there are unforeseen events, but yet the planning process mostly accommodates those events. For example, the tasks performed on the C- check are called scheduled planning. But yet, most of the tasks encountered at the maintenance area when doing the C check is unscheduled planning. Technicians find faults that need remedy during inspection, which are totally not on the schedule maintenance. Hence, as the whole purpose of the maintenance action is to make the aircraft safe for the flight, there are procedures on how this event should be carried on.*

- ✓ (A) – *when we do the maintenance planning, it is based on the standard, policy and procedures. We are abiding to these rules. And these things are devised from the start with great contemplation and careful study. Most of the procedures on planning, say C check are based on manufactures manuals, regulatory bodies and company policies. In this regard I believe that the procedures, policies and standards are devised in consideration of risks too. Our department's functionality is to adhere to this rules, standards, and manuals and so on.*

As discussed with (A), the unforeseen events and risks plans are suppose to be included in the standard, policies and procedures. And consequently, regarding the impecaablity of these standards, policies and procedures, (A) has stated the following.

- ✓ (A) – *for the sake of planning, standards, policies and procedures . If you must know, the procedures for the tasks are adopted from the manufacturers which for example Boeing company. And when they prepare the manual I believe that it is from their best of knowledge on how to keep the aircraft safe and reliable.*

The scope changes that rise due to unforeseen events or other maintenance requirments are discussed as the following below with the base maintenance manager, (C).

- ✓ *(C)- Every new plan that come during the project progress is at the discretion of the project manager to accept or reject the tasks depending on the capability regarding the resources, the time, schedule and skills the project have. If the new plans or unforeseen events are a must do, the project manager shall asks for the requirement that he needs. In that regard, he communicates with the maintenance planning and the production planning for the requirements to be discharged*.

The time estimated to carry out the tasks are found to be adequate according to the response of (B) & (C).

- ✓ (B) – *The time given to perform the tasks is adequate because the hours estimated are not a mere estimation. They are based on the fleet manufacturer's time requirement associated with task.*
- ✓ (C) – *unless otherwise tasks other than the already scheduled plans are encountered, the tasks and time given is adequate. Actually most of the hours given to the tasks is based on the aircraft's manufacturer's manuals. So the estimation is adequate.*

The time sensitivity of the airline operation and the consideration of airlines of the downtime of aircraft heavy maintenance schedules, has been a challenge to the planning and scheduling process and has been stated by (A) as the following.

- ✓ *(A) – in our case, especially if the customer is Ethiopian airline, the operator and the airline is the same even if they are working on contract base. Hence, there are problems of such kind. But as I said before we must adhere to the procedure as much as possible.*

b) Objective Two- Identify the stakeholders and their impact on the overall planning and scheduling process of Aircraft Heavy Maintenance Projects

In meeting this objective of the research, the organizational functional unit analysis has been used. Hence, the Technical procedure manual (TPM) has been scrutinized in order to identify of stakeholders in the project. The organizational units such as the maintenance planning unit,

production planning and base maintenance are the stake holders who directly involves in the planning and scheduling process.

As a project essence, the project manager is one of the stakeholders of the project. In consequence, he/ she is also the stake holder in the planning process especially in the phase two of the process which is explained in the data result of objective one above. The role of the project manager in the planning and scheduling process is explained in the interview with the base maintenance personnel of code name (C). Subsequently,

- (C) has responded - *The project manager is assigned by the base maintenance manager like me, and he or she shall be in a team leader position which is one job position below me (the manager). The project manager is believed to have strong technical knowledge and skills and knows the whole work activity very well. And since the team leader knows the teams that he has and that are under the supervision of him, the team leader works with the production planning team in developing schedule of man power and assignments to the team. The other job expected of the team leader is to revise and sequence the work package's tasks in order of implementation. Most of his work is supposed to be done in collaboration with the production planner. However, due to some gap in the technical knowledge between the production planning team and the project manager, the schedule of teams and work assignment is mostly done by the project manager*.

In regard to the above statement of (C), the role of the project manager is to develop schedlule of man power and assignments to the team. And it has been observed that the role of the project manager is more emphasized in the implementation of the project stage. In addition the role of the project manager is more elaborated in the TPM section of 9.7.2 (Aircraft maintenance Pre-Preparation). Accordingly, the responsibilities of the project manager are:

- ✓ Review the work package 15 days before the scheduled maintenance event date on Maintenix, prepares detail flow chart on Maintenix and schedule/ request maintance personnel for the project in coordination with maintenance crew planner
- ✓ Update the workpackage, based on the issues during revision, if required
- ✓ Participate and lead the production input meeting for the work package
- ✓ Audit, sign and collect EO kits in coordination with the Hangar Material Controller and Production Planner.

The other stakeholders who have direct involvement in the planning and scheduling of aircraft heavy maintenance projects are Maintenance Planning Unit, Production Planning, and Base maintenance. And this has been exhibited in their responsibility description which is quoted in the following.

- ✓ **(A)-***Our department is responsible for any aircraft maintenance planning and scheduling. The checks that are performed in the MRO, such as A check, transit checks or c check maintenance plan is handled by this department. And regarding the Aircraft Heavy Maintenance, mainly the C-checks, all works regarding preparation of work package such as creation of the appropriate work package to the fleet is the responsibility of this department.*
- ✓ **(A)-** *Our main focus of responsibility is on preparing the works and tasks that should be implemented on the time of C check. It comprises what tasks should be done to adhere to the standard work to ensure the safety and reliability of the aircraft. And we also state the type of skills needed associated with the task; and the man hour requirement is also stated. But to*

check the availability of other resources needed, it is the duty of production planning. Our tasks end till the completion of preparing the work package. After completing preparing the work package we hand it to the production planner. They take over from that on.

- ✓ (B)- *Our responsibility is preparation of task cards based on the request from the maintenance planning. Depending on the fleet & type of maintenance we prepare the task card or JIC (job instruction card)*
- ✓ *(C) – Our department is mainly focused on the implementation. However, before we engage in those sorts of tasks, we are also involved in the planning and scheduling of the maintenance program. The project manager assembles with the Managing Director (MD) of MRO, managers of each maintenance section, Engineering planning and task card manager & sections who involves in the whole project process for the briefing on the Heavy maintenance project startups. From then on the project manager will work with everyone at stake in the project process. Especially, the project manager works with production planning in the work break down of the tasks and scheduling of the project. In addition the project manager works in the man power planning of the maintenance crew.*

In the discussion with the Production Planning Unit, the following has been forwarded as the responsibility of their department.

- ✓ (E) – *this unit responsible in breaking down the work package and arranging into tasks then duration of tasks, assignment to maintenance personnel, start and end date of the project are planned in this unit.*

- ✓ (D)- *Requirements for the tasks are also planned in this unit. These refers to the part requirement for the maintenance, facility needed, and personnel (man hour) requirement are arranged in this department*.

- ✓ (H)- *In overall, the department has two sub-sections. The first is production planning and the second is the production controller. The production planners' duties have already been explained by (E) & (D) already. And the production controller duty is to put all the task cards on the booth where maintenance personnel can access to, collecting completed task cards, informing and communicating about the progress of the maintenance check and also controlling weather things are going according to the plan or not.*

c) Objective Three- Examine the tools and techniques that are used in the planning and scheduling process of Heavy Maintenance Projects

All data sources have shown that a system named "Maintenix" is the main tool not only for the planning and scheduling but also it is the system where by Ethioian airline's MRO operation bases on. This has been manifested in the following data results.

- ✓ **(A)** has explained in the interview as the following:
  Maintenix is the essential and main tool or more like system software that is basically the system that ET- MRO uses for its whole operation. Work packages are also developed and established in this system. Every input that our department needs in planning an aircraft maintenance project, whichever type of maintenance can be, is gathered from the Maintenix

system. In general, our every activity in the process of planning is done though Maintenix system. In fact, any MRO activity is executed via the Maintenix.

- ✓ (C)- Every activity is done via Maintenix, and everything is recorded in it. Other than that we use a flow chart in scheduling and assigning man hour and tasks.

- ✓ The other evidence on the document review about the system software is TPM 9.7.3 section which defines "Maintenix is an MRO management system in which ET-MRO uses to process its maintenance planning, maintenance execution and material management. Following, the section has also mentioned Work Flow Chart is a Gantt chart that shows the scheduling of task cards with defined timeline. "

In the group discussion issues about the tools and techniques of planning and scheduling has been discussed. In regards the following points have been forwarded.

- ✓ (F)- Our main tool is Maintenix. But we also use MS- project office software for the purpose of scheduling. However, the graphical interface is not sociable to the maintenance personnel. Hence, we are obliged to use excel and produce simple flow chart. For devising the schedule, MS-Project office is better. Even we are demanding to integrate it with Mainenix system so make it more efficient in using it. Yet it has been difficult for the maintenance personnel to understand the output produce by MS-Project office.

- ✓ (G)- I have the information that some personnel have been send to take arranged MS-Project office classes, but after one or two have been sending it has been stopped. Some of the problem in the company on new ideas and activities is consistency.

On the interview with (A) about the efficiency of the company system "Maintenix" for the planning and scheduling process, A has responded the following:

- ✓ (A)– *I believe it is. Unless otherwise it is the skill gap in using the system. I believe it has so many features that have not even yet been harnessed.*

Regarding the experience of Ethiopian MRO in the usage of accelerating tools for fast tracking schedules of the aircraft maintenance period the following has been stated.

- ✓ (A) – *not in our case, maybe there are few things that we do in communication with the base maintenance and production planning. For example, we may pull out tasks that can be done to other time in the future. Yet, if the procedure and manual allows us to do so.*

d) Objective Four- Explore the problems which reside in the planning and scheduling process of Aircraft Heavy Maintenance Projects.

The role of the project manager in the event preparation process has been mentioned as an issue as stated below.

- ✓ (D)- Well according to the paper and policy, project managers are supposed to work in collaboration with production planning unit. Especially, in the Pre- Event Preparation. In this phase of the process, reviewing the work scope and scheduling the maintenance crew is expected to be worked out in coordination with the project planner. But in reality, they are not coming on the meetings for the activities of scheduling and work scope review. This is an issue and even a limitation for our efficiency.

(c) has replied on the above claim in the following statement.

- ✓ (C)- Well, the fact is that the production manager is a team leader who has quite experience on the area of maintenance. The team leader has the practical knowledge on what is happening on the field and even have the good insight about his crew members. In other way, scheduling and work package revision and sequencing is the duty of the production planners. They are basically the technical support stuffs. However, since they have no practical knowledge of the maintenance area it is sometimes hard to collaborate.

(C) has continued on his statement about the knowledge of the production planning personnel.

- ✓ (C)- Most of production planning personnel are engineering graduates. And they have also taken some aircraft system courses, and even some have taken the whole aircraft system courses. But that does not mean that they have grasped the firm technical skill. And in addition the department is not mature enough in its organization.

The other problem mentioned was the imposition of the airline operator on the overall practice of the planning and scheduling process. Accordingly,s

- ✓ (A)- *Maintenance planning is performed according to the procedure. But yet, there is imposition from the operator side especially regarding the scheduling of the aircraft in heavy maintenance projects. Even if the company is the one and the same on working for the same goal, every organizational unit sees it from its side of operation only.*

From the focus group discussion with the Production Planning unit, the following issues has been raised.

- ✓ (G)- There is communication problem among project manager and the project controller. Our job as project controller is to monitor the progress of the project. However, there is a negative reaction from the maintenance personnel about it.
- ✓ (D) – the project managers' involvement is not enough in devising the production planning events. Since, most of them passed though the previous ways of conducting maintenance activities which were not Projectized, the mentality of most "project managers" is not optimized to the project roll.
- ✓ (F) – there are some ambiguities between job classification between Maintenance Planning and Production Planning. In some occasions maintenance planners request us to make maintenance cost estimate. In other occasions they do it by themselves. And, as to the best of my knowledge, we are only responsible for the consumable costs.
- ✓ (E)- I wish there is industrial bench mark where some processes can be compared to. We do not have standard on work processes. As the industry is the only industry in the country, we need some bench marks from the best in the business.

4.2. Disccussion

The data results that have been exhibited in the above section are discussed in this section. Most of the data that have been gathered in the above section are have addressed the questions raised in the first chapter. Hence, conclusion drawn from the data will be discussed in the narration below.

One of the strategic objectives of the ET-MRO is the optimum maintenance planning and subsequently ET- Airplane Heavy Maintenance.

The process of planning and scheduling of aircraft heavy maintenance is entertained between three organization units such as Maintenance Planning, Production Planning and Base Maintenance. As it is manifested in its TPM document all major maintenance of an aircraft shall be executed as an independent project. Regarding, project manager is assigned from the Base maintenance.

The major works that resides in the planning process is to plan a maintenance program which does not affect the operation of the Ethiopian airline. Hence, the planning program should be effective and efficient in meeting the company's policy. In the planning program one of the major processes is preparing work package which comprises the list of major tasks to be done, duration of maintenance work, and the resources required in performing the maintenance.

In the process of creating the work package standards, policies and procedures are the key points for consideration. And in this process, the project manager is not included. The role of the project manager comes after the creation of the work package where there is a need to break down the work package into detail tasks. The project manger's role in the planning process also extends to schedule the tasks in collaboration with the production planner team.

The process of planning and scheduling has imposition from different stakeholders and vice versa. ET- MRO, Ethiopian Airline flight operation, project manager, base maintenance, maintenance planning, production planning, task cared, stores and material planning, tool planning are the internal stakeholders. And this are depicted in the work process and organizational structure. And regulatory bodies such as ECAA, FAA and EASA which are implicitly embedded in the procedures and policies that the planning process depends are the external stake holders.

The tools and techniques that have been used in the company for the planning and scheduling of aircraft heavy maintenance is mainly Maintenix. This has been described in the interview, focus discussion and document review. Most respondents believe that Maintenix is adequate for the planning process. However, one respondent from the production has mentioned they use also MS-Project. Unfortunately, they found that its output become a challenge to be understood by the other project crews including the project manager.

The major issues that have been discussed regarding the planning and scheduling of aircraft maintenance project are:

- ✓ Lack of bench marks for work processes.
- ✓ The low involvement of the project manager in the planning and scheduling of aircraft heavy maintenance affected the planning process.
- ✓ The integration of the MRO and the operator into same organization has influenced the planning process.
- ✓ Ambiguity in in one's job description regarding the planning process

CHAPTER V

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The objective of the study is to examine the practice of ET- MRO in planning and scheduling of Aircraft Heavy Maintenance Projects. Subsequently, the study is aimed at exploring the issues that exist in the process of planning and scheduling.

The research in general is purely qualitative. And qualitative methodology has been adopted in meeting the objective. The three methodologies, such as in-depth interview, focus group discussion and document review are the methods for gathering data. And methodological triangulation has been used in aim of validation and reliability test.

The ET-MRO has established a system of network for its operation, on the system software called "Maintenix". And, the planning and scheduling of aircraft heavy maintenance projects depends on this system as all its operation do. However, it has been evidenced that there are no any other tools and techniques that has been used in the organization specifically to planning & scheduling.

The ET-MRO is a management by project organization. Because, the structure of its organization is traditional, yet, it demands its operation especially the major one to be projectized. Hence, it can be inferred that the organization understood the advantage of project in its complex operation. However, there is still lack of consistency and hard work on the project management. This is exhibited in the issues raised by the respondents about the lack of the project manager in its active engagement in the planning and scheduling process. The other reflection to this claim is the lack of tools and techniques specifically helpful for the maintenance planning and scheduling process.

The fact that the MRO and the airline operator are embedded in the same organization has been an influence in the planning and scheduling process. This is defined in the tough airline operator schedule and the perception of down time of aircrafts during the heavy maintenance time. And in Ethiopian airline scenario, the operator has greater influence on the ET-MRO, subsequently on the planning and scheduling process.

The process of the planning and scheduling of aircraft heavy maintenance has been entertained with three major stakeholders who directly conduct the planning and scheduling process. However, even if there is a system established on how they communicate during planning and scheduling, it has been exhibited that there is still communication problem among the units. The lack of benchmark for the work processes is another issue that has been mentioned in the discussion.

5.2. Recommendations

- Though, there are already laid out system on how works should operate in the organization, there is a need to overview the project management concepts and practices such as how to plan a project, how to manage project plan changes and how to devise risk plans; especially when manifesting to do a project work. Scheduling is one of the issues in maintenance programs; therefore, looking into the tools and techniques from the project management

perspective is very important. As exhibited in the literature review section, there are myriad of tools and techniques that are used in scheduling a project plan. Hence, understanding, and choosing the tool that can accelerate and effectively scheduled the project of aircraft maintenance planning is important.

- Developing Project managers and the project team with the principles of project management will be a helpful strategy for the organization, in order to increase the project manager's engagement in the project planning and scheduling process of aircraft heavy maintenance.

- Visiting other organizations for experience sharing and setting benchmark in one's work process is very helpful in achieving Excellency in one's operation. This can be achieved by making research regarding the work processes the company is performing, and exchanging experience with fellow industries can be helpful in knowing ones' limitation. Establishing research team which can, not only study the qualitative but also the quantitative nature of planning and scheduling process, in order to model the process is crucial.

- Advanced communication between the planning & scheduling and the flight operator will be helpful in decreasing the planning & scheduling inconvenience due to downtime perception of airline operator about its aircrafts during heavy maintenance.

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