ST. MARRY UNIVERSITY

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF PROJECT MANAGEMENT

AN ASSESSMENT ON THE PRACTICE OF QUALITY ASSURANCE ON PREVENTIVE MAINTENANCE: IN THE CASE OF ETHIOPIAN AIRLINES GROUP EQUIPMENT AND FACILITY MAINTENANCE

BY

TEWODROS ASSEFA ID NO: SGS/0547/2015A

JUNE, 2024

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SCHOOL OF GRADUATE STUDIES

FACULTY OF BUSINESS

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List of Abbreviations

ACE ..... Achieving Competitive Excellence

EASA .....European aviation safety audit

E.F.M……Equipment and facility maintenance

ETAG …. .. .. Ethiopian Aviation Group

GSE/GTV..... Ground support equipment/Ground Transport Vehicles

GOM. .... Ground Operation Manual

ICAO ..... International Civil Aviation Authority

IATA..... International Air Transport Association

MRO..... Maintenance Repair and Overhaul of an Aircraft

Q.A……Quality Assurance

QMS..... Quality Management System

Abstract

*This study had been conducted to examine "**An assessment on the practice of quality assurance on preventive maintenance: in the case of Ethiopian airlines group equipment and facility maintenance**" The research would be attempted to examine the management practices of the ensuring quality assurance on maintenance, engineering and recovery department spare part ensuring quality assurance provided under the main logistics department of the Ethiopian Aviation Group is to identify the variables that affect quality assurance in outfit and installation conservation and that may have an implicit effect on the air line's decertification or result in a frontal acquiring permit limitation because of non-compliance with safety regulations. This was mostly caused by the strategic business units' Quality Assurance sections' repetitive internal micro inspection reports. In this research mixed approach and descriptive and explanatory design would be used. Data source was review, data collection, interviews, and observation were all part of the exploratory system that was employed. There were 109 questionnaires distributed in total the 105 questionnaire responses that were gathered. The significance of the variables gathered using the Likert scale was ascertained through the application of factor analysis. The most crucial components were also thought to be identified by the relative importance indication. the finding showed that certain personnel working at the airside had incomplete safety information and past-due conservation schedules, which could have hampered their ability to fulfill their functional responsibilities and arrive on time According to the study, in order to improve quality assurance for conservation services, policy and strategic objectives are needed, as well as worker engagement and part-taking to be elevated through the construction of a quality team, which in turn helps to foster organizational culture and conservation quality. A better approach that tackles quality must also be developed regarding pricing and the acknowledgment of employees' performance dimensions and styles. Part of the recommendation is the quality assurance department dedicated to the conservation section, which reviews the quality assurance separately for internal visitors for the ground handling support services.*

Keywords- **Quality Assurance, preventive maintenance,**

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

To stay in the business, it is important to maintain high-quality and safety standards in ground handling and related support activities in the aviation industry. To ensure maintenance quality, standards, and flight/ground safety, TQM training is necessary for engineers, maintenance planners, and maintenance crew to enhance their technical skills in their respective maintenance departments (Oakland, 2014).

One of the major challenges for current-day leaders is the pursuit of continuous improvement in the performance of an organization. Safety, on-time performance, and customer satisfaction are all directly related to this challenge in the airline industry. The business requires these prerequisites for an airline to stay competitive and grow. The Quality Assurance in Air craft Ground support Equipment and Facility maintenance is required to meet Standard of regulatory bodies like IOSA, EASA, as well as ISO 6966-2:2014, which in-detail explains about Air craft Ground Equipment dependability and the related safety requirements in the Air craft maintenance support and Ground handling Operations(.Daft, 2014).

Ground handling is a vital part of an airline's operation and the cornerstone of their passenger and cargo transportation service. Standards must be adhered to in order to maintain safety and operational efficiency. To ensure operational reliability, it is necessary to maintain well-maintained equipment involved in the operation. In accordance with the European plan for Aviation Safety (EPAS), the directive details the necessary serviceability standards for vehicles (motorized GSE) (SI-1034). The serviceability of vehicles/motorized airport GSE including belt loaders, baggage, trucks, catering trucks, and pushback equipment, etc. must meet the required safety standard, since it may cause damage and/or injuries if not maintained properly. A well-functioning operational environment would allow for effective serviceability and maintenance of vehicles/motorized airport GSE, which would facilitate safe operations of vehicles/motorized GSE (Wouldiam A. Levinson, 2013).

The European plan for Aviation Safety (EPAS) for 2021-2025 is available on page 24. The safety of an aircraft can be exposed to an accident due to human factor occurred while it is parked on the ground or during the ground handling service provision. The incident could be caused by equipment and machinery that interact with the aircraft on ground directly or indirectly. It is important to set the quality of maintenance performed on the machines and equipment in accordance with the expected standards. In the final quarter of 2019, IATA reported that 7,000 ramp accidents and incidents occur worldwide every year, with one occurring every 1,000 departures. This indicates that ground handling operations can bs considered as a significant and persistent source of avoidable accidents, injuries and deaths that continue to endanger airport staff and passengers while also impacting on time performance of the operation. To ensure safe ground handling operations with an established culture of rigorous safety, quality maintenance must be provided. (dawit,2022)

This research is focused on examining the quality management systems for ground support equipment and machinery maintenance that are currently in place, prioritize and sort out the factors that impact their implementation in Ethiopian airlines. The help of this would be given to researchers and the organization to take corrective actions to address gaps and prioritize measures for the subject that could result in decertification for non-compliance with safety requirements (TKF, 2022).

The purpose of this research is to examine the existing Ground support Equipment and machineries maintenance quality management systems, its implementation, sort out and prioritize the factors affecting their implementation in Ethiopian airlines. This would help researchers and the organization in taking corrective measures on the gaps and setting priorities of action to the subject which can expose the organization safety to decertification due to non-compliance of safety requirements.

1.2. Background of the Organization

Ethiopian Airlines, one of the fastest growing airlines, is the leading Africa airlines that connects Africa to the rest of the world .Ethiopian airlines human resource needs; Inflight catering, Aircraft as well as ground handling service and related maintenance within the structured and self-contained Aviation Groups, i.e Aviation Academy, MRO service, ET catering, ADD hub operations, and ground handling , Equipment & Facility maintenance.

As per the company's organizational structure, the department of Equipment and Facility Maintenance is headed by a Chief Operation Officer, who is responsible for overseeing Ground support Equipment, Transport Vehicles, Machinery, and Facility maintenance. The Director of Equipment and Facility Maintenance oversees four managerial positions. Manager Facility Maintenance, Manager GSE/GTV (Ground support Equipment/Ground Transport Vehicles) maintenance, Mgr. Engineering Planning & Inspection, and Mgr. Civil work. The initial two portions of this study, categorized by their respective managers, are primarily focused (Z., 2022).

Five sections report directly and functionally to Mgr. Facility Maintenance regarding the maintenance of workshop support machines in MRO, food production machines in in-flight catering, loading and unloading machines at cargo and logistics, passenger service equipment and machines at the airport, and any other facility-related equipment. Conversely, the Engineer, Planner, and Inspector-staffed department under Manager Planning, Engineering, and Inspection offers technical and back office assistance to the maintenance sections (Stevenson, 2015).Therefore, this study focuses on factors affecting Quality preventive maintenance in the section since it has direct and indirect impact over the operation on time performance as well as Customer satisfaction of the Strategic business units.

1.3. Statement of the Problem

In the aviation industry, quality assurance and safety go hand in hand. Within the hasty operational environment of Ethiopian Airlines, different sectors strive to contribute to the success of company’s set strategy goal. One sector alone cannot achieve its goal without the cooperation of the other sector.

There is no denying the necessity of having a quality assurance system in place for ground handling operation support, aircraft repair shops, and aircraft maintenance. In addition to internal micro audits carried out by sections tasked with ensuring quality assurance across the air line's major business divisions, Ethiopian Airlines' work culture and tight discipline are deeply in-built with quality assurance, and it is regularly assessed by external regulatory agencies. Important business units depend on the equipment and facilities maintenance division of operation support to supply services in a timely, safe, and high-quality manner (Goetsch, 2018).

The Ethiopian Aviation Group has implemented Total Quality Management (TQM) across its strategic business units, with a notable impact on maintaining industry standards based on international regulatory body requirements. However, the Quality Assurance sections of the strategic business units' internal micro audit reports consistently highlight findings and observations regarding the maintenance quality of equipment and machinery. Corrections are made right away before external regulatory agencies begin their audit. To name a few in this respect, there were reports on MRO Quality and Safety audits, ADD HUB QMS & SMS, and Cargo Quality and Safety. The results showed that certain airside equipment had unmet maintenance requirements, was lacking safety components, had poor maintenance quality, and experienced unexpected malfunctions that might have hampered operational reliability and timely performance (Abid & Ahmed 2020). Quality assurance sent the same pre-audit inspections and suggestions for the kinds of machinery maintenance that were neglected and fled, despite being planned and urged to be performed. In addition, users and maintenance departments had multiple concerns over the unanticipated breakdown. If the reports are ignored, the company may be subject to de-certification and findings from an external preventive.

Ensuring quality assurance management is essential for the organization; however, there are problems that occur for efficient and effective ensuring quality assurance management from organization to organization. A proper ensuring quality assurance management system is guaranty for organization assets to safeguard from different wastage like improper use (Goetsch, 2020).

Basically, this study is on ensuring quality assurance management practice of the main logistic in Ethiopian Aviation Group. When there is no proper ensuring quality assurance management, the defense mission and day to day army activity cannot be going well, and it affects the nation’s security

directly. If ensuring quality assurance management is weak, the accumulated spare parts would not manage properly and the mission of the Ethiopian Aviation Group would be interrupted (Knowles, 2021).

The study explored gaps of spare part ensuring quality assurance management, storage system, shelves design standard and quality of Ethiopian Aviation Group, fire protection and ensuring quality assurance personnel safety condition. Moreover, the study would showed the strengths and weaknesses of the ensuring quality assurance management and practices provided under the departments and to recommend possible solutions to make the service better and improve future performances of the department. In the previous studies did not attempt to look spare part ensuring quality assurance management system at Ethiopian Aviation Group. The research would be attempted to examine the management practices of the ensuring quality assurance on maintenance, engineering and recovery department spare part ensuring quality assurance provided under the main logistics department of the Ethiopian Aviation Group by formulating the following central research questions.

1.4. Objective of the study

1.4.1. General objective

The general objective of this study is to investigate factors affecting quality assurance on preventive maintenance practice: in the case of Ethiopian airlines group equipment and facility maintenance.

1.4.2. Specific Objectives

The research would accomplish the following objectives:

- To investigate the quality control in the delivery of GEFM services,
- Determine the company's policies, procedures to preventive maintenance quality GEFM service.
- To assess the quality assurance of equipment and facility maintenance GEFM services.

1.5. Research Questions

- What are the main quality controls in the delivery of GEFM services?
- How far along are company's policies and procedures for preventive maintenance and quality GEFM service?
- Are there any gaps the of quality assurance of equipment maintenance **GEFM** services?

1.6. Significance of the Study

This study gave the researcher the chance to concentrate on evaluating the factors influencing quality assurance of preventive maintenance. The organizations would use the research as a source of information when they reevaluate the section's implementation of quality assurance of preventive maintenance. The research concentrated on how policies, processes, leadership, and employees work together to create a positive workplace culture, foster effective communication, and form teams that meet the desired quality standards. The study was worthwhile since it may assist the business examine the issues and consider other options. It can also serve as a reference and a springboard for researchers who wish to go deeper into the subject in the future. Additionally, it would facilitate Ethiopian Air Lines' efforts to standardize the provision of equipment and facility maintenance services to other air lines on the African continent for ground handling operations support, partnerships, along with other air lines.

1.7. Scope of the Study

In particular, the sections under Manager Facility Maintenance and Manager GSE/GTV (Ground Support Equipment/Ground Transport Vehicles) maintenance, which are directly involved in the maintenance support activities, are where the study is focused on identifying factors affecting Quality Assurance in Equipment and Facility Maintenance. This is due to the researcher's improved access to information, opportunities, and expertise of the study area, which aids in the researcher's acquisition of pertinent data on the issue. The researcher made use of unpublished records, internal QA sections, Micro Audit reports, and performance reports that were submitted on time.

1.8. Limitation of the study

The researcher was unable to conduct in-depth investigation and analysis during the study due to time and financial constraints.

1.9. Organization of the thesis

There are five chapters in the study. The study's background, issue statement, purpose, significance, scope, and research technique are all addressed in the first chapter, which serves as an introduction. The second chapter dealt with related literature review and conceptual framework of the study area. The study's methodology is covered in the third chapter. The fourth chapter of the study presents,

analyzes, and interprets the facts that were gathered. The study's summary is covered in the final chapter.

CHAPTER TWO

2. REVIEW OF THE RELATED LITERATURE

Quality maintenance and Service are the main topics of the literature review. This literature review is conducted to enable the researcher to understand the concepts of quality in maintenance service. They were intended to permit the researcher to understand the concept of quality in maintenance service. They were intended to permit the researcher to recognize and cover the objectives and establish a base for an overall understanding and identifying of the quality control of maintenance service in Ethiopian.

2.1. Quality Management

2.1.1. Quality

Different meaning could be attached to the word quality under different circumstances. The word quality does not mean the quality of manufactured product only. It may refer to the quality of the process (i.e. mean material and machines) and even that of management. Where the quality manufactured product referred as or defined as "Quality of Product as the degree in which it fulfills the requirement of the customer. It is not absolute, but it judged or realized by comparing it with some standards". (S. ANIL & N Suresh ,2008)

Quality can be defined as fulfilling specification or customer requirement, without any defect. A product is said to be high in quality if it is functioning as expected and reliable. Quality control refers to actions to ensure that produced items are fulfilling the highest possible quality. Most of tools and techniques to control quality are statistical techniques.

Quality control techniques can be classified into three: - Basic, intermediate and Advance level. But there is no consensus among researchers in the classification. (Hairulliza et al.)2011).

Quality has become, for most of today's compares, a strategy for success, growth and competitiveness. Furthermore, the continuous increasing levels of automation and manufacturing process complexity has moved the production processes from the worker's hands to machines, requiring paying more attention to monitoring aspects, maintenance quality control and production costs reduction. (Amaud Lesage,2012).

2.1.2. Quality Control

The purpose of quality control is to assure that processes are performing in an acceptable manner, companies accomplish this by monitoring process output using statistical techniques. Quality control is processing that measures output against to the standard and acts when output doesn't meet standards. If the results are acceptable, no further actions required, unacceptable results call for corrective action (Stevenson, 2005).

Quality controlling can be made in two stages of production. According to Stevenson (2005) a control which intended to assure quality that relies primarily on inspection of previously produced items is referred to as acceptance sampling. The other quality control effort which occurs during production is referred to as statistical process control.

Techniques and methods for checking he quality of materials and the building of houses, temples, monuments and roads have been used over the centuries. For example, the ancient Egyptians had to make and use precise measurements and adopt very high standards of work in order to build the Pyramids. (HELM,2004).

2.1.3 Measuring Quality Control

According to Deming, (2008), a few quality methodologies, programs, and standards for measuring quality have developed and are used, to varying degrees, in industry to present. These include:

Total Quality Management (TQM): TQM is a people focused management system that focuses on increasing customer satisfaction while continually reducing costs. Although it uses scientific methods for assessing quality and associated costs and constraints and implementing improvement, it takes total systems approach in which all functions, processes, and departments across the organization, and all employees at all levels, are integral to ensuring success in the manufacture of products or delivery of services. TQM stresses learning and adaptation to continual change as essential to achieving this success.

Six Sigma: The term Six Sigma was coined by Motorola as its methodology for improving business processes by minimizing defects and refers to the statistical measurement indicating there are only 3.4 defects out of every 1 million opportunities to produce a defect, or virtually zero. It is an organizational approach where companies make decisions based on data, seek roots of problems, define defects based on customer requirements, and track leading indicators of problems to prevent them from happening.

Lean production: Lean production refers to the continuous flow of products or services to the customer now it is needed and to the customer's specification. It focuses on increasing productivity and quality while reducing inventory and shortening lead time from floor to customer. Its principles include workplace safety, order and cleanliness; just-in time production; built-in- Six Sigma quality; empowered teams. Visual management to track performance and provide immediate feedback on a daily or even hurly basis; and continual pursuit of perfection.

International Standards Organization Quality Management Standards: The international Standards Organization (ISO) has developed a series of quality management standards that support the quality philosophy, Specifically, it has developed a set of five such standards that support the quality philosophy. Specifically, it has developed a set of five such standards, ISO 9000-9004. The American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) developed the ANSI/ASQC Q9000-Q9004. In addition, specific standards also exist for automotive, aerospace, and telecommunication industries and for environment management. These standards have been revised over the years, and organizations must continually address these revisions. Organizations competing in the global market must achieve the quality levels dictated by these standards.

2.2. Maintenance Management

2.2.1. Basic Concept

Maintenance is a routine and recuring Activity of keeping a particular machine at its normal operating condition so that it can deliver its expected performance or service without causing any loose of time on account of accidental damage or breakdown.

Past and current maintenance practices in both the private and Government sectors would imply the maintenance is the actions associated with equipment repair after it is broken. The dictionary defines maintenance as the "the work of keeping something in proper condition, upkeep". This would imply that maintenance should be actions taken to prevent a device or component from failing or to repair normal equipment degradation experienced with the operational the device to keep it in proper working order. data obtained in many studies over the past decade indicates that most private and Government facilities do not expend the necessary resources to maintain equipment in proper working order, they wait for equipment failure to occur and then take whatever actions are necessary to repair or replace the equipment. Nothing lasts forever and all equipment has associated with it some predefined life expectancy or operational life (S. ANL & SURESH.2008).

2.2.2. Type of Maintenance

According to S. Anil & N. Suresh (2008) there are four types of maintenance: Breakdown (Reactive) maintenance. Preventive maintenance predictive maintenance and reliability centered maintenance

2.2.2.1. Breakdown (Reactive) Maintenance

Break down maintenance is basically the 'run it till it breaks' maintenance mode. No actions or efforts are taken to maintain the equipment as the designer originally intended to ensure design life is reached. Studies as recent indicate that, this is still the predominant mode of maintenance.

2.2.2.2. Productive Maintenance

Preventive maintenance can be defined as “Actions Performed on a time or machine-run-based schedule that detect, preclude, or mitigate degradation of component of system with the aim of sustain or extending its useful life through controlling degradation to an acceptable level”

Preventive maintenance is a means to increase the reliability of their equipment. By simply expending the necessary resources to conduct maintenance Activities intended by the equipment designer, equipment life is extended, and its reliability is increased.

2.2.2.3. Corrective Maintenance

Predictive maintenance can be defined as “Measurements that detect the onset of a degradation mechanism, thereby allowing causal stressors to be eliminated or controlled prior to any significant deterioration in the component physical state, results indicate current and future functional capability.”

Basically, predictive maintenance differs from preventive maintenance by basing maintenance need on the actual condition of the machine rather than on some preset schedule. preventive maintenance is time -based. Activities such as changing lubricant are based on time. Like calendar time or equipment run time. For example, most people change the oil in their vehicles every 3,000 to 5,000 nukes traveled. This is effectively basing the oil change needs on equipment run time.

2.2.2.4. Reliability centered maintenance

The reliability of a system/ product depends on many factors. So, we should concentrate at the grassroots level to improve product’s reliability.

Some of the ways of improving systems reliability are listed below:

- Improved design of components
- Simplification of product structure
- Usage of better production equipment
- Better quality standards

- Better testing standards
- Sufficient number of standby units
- Usage of preventive maintenance, if necessary, at appropriate time.

2.2. Factors affecting quality assurance implementation

2.2.1. Organizational structure

The organizational structure is a framework of rule and power relations that exist to formally control and coordinate the activities in an organization since it has direct impact on individuals' motivation and performance it is a corner stones to achieve the organization goals. It is also one of the important aspects that must be considered in the development of maintenance culture is the organization structure (Budi, 2014).

Organization structure is vital as a guideline to clarify the sense of duty and activities for everyone in an organization. According to John Oakland, defining the corporate vision, strategies and critical success factors might make it necessary to review the organizational structure. Director, manager and other employees can be fully effective only if an effective structure based on process management exists. This includes both the definition of responsibilities for the organization management and the operational procedures they would use. These must also be agreed best ways of carrying out the core process in an intact organizational structure (Oakland, 2014) It typical hierarchy, an organization arranges its lines of authority and communications, allocate responsibilities and duties that has been illustrated by the organizational chart.

The process in the development for maintenance culture requires a comprehensive organizational management and structure to represent the practice of the work that should be executed by each member in the organization. Objectively aligned with the overall mission of the organization. The interdependent relationship between organizational structure and organizational culture even stretch in determining the attitudes, behaviors, characters and ethics that create the work culture (Chinchu Mary Jose, 2017).

2.2.2. Quality Management system

On challenging jobs like maintenance, TQM program quality circles are most beneficial to employees. Employee participation in a quality circle can contribute both to quality and productivity, because it enables them to pool their knowledge and solve interesting problems. It also tends to be most successful when it enriches jobs and improves employee motivation.in addition, when participating in the TQM program, it improves workers problem solving skills. Finally, a quality circle program would open windows for better chances of creating success in a corporate culture that values quality and steers continuous improvement. Quality circles offer one technique for implementing TQM and include affecting the quality of their work. (daft,2014 page 676). Quality circles are usually supported by total quality control (TQC) this would help in developing management attitudes and practices oriented towards quality of process and creating a culture conducive to defect free operations.

The team could face several obstacles, still better mutual understanding and management support is secured. Once a suitable atmosphere is created within the organization the quality circle creates discussion plat form between different layers of organizational structure: with higher management, department heads, section heads, and supervisors or team leaders. The very important activity is gathering feedback from participants and clearing the doubts in everybody's' minds to make them interested to the concept. Quality circles usually form a steering committee to give overall direction towards improvement. The team raises and discusses best practices, points out major issues, collaborate solutions, Brian storm ideas and streamline how a problem can be fixed (Conger and Kanungo 1988), (Thomas and Velthouse 1990)), (Spreitzer 1995, Menon 2001).

2.2.3. Self -directed/ managed team.

A self – directed team is an asset of individuals in an organization who incorporate various abilities and talent in coordinating their effort to work toward common objective without violating the standards set. self – directed team to work toward common objective without encouraging them to do whatever is required to be done, including big decisions. Self-directed teams add value in most organizations, but it is not easy to put them in place (Stevenson, 2005).

However, the teams could be in a better position if they are responsible for the entire work process as well. This would enable them to independently manage without interference of other work units, which has ultimate result of interdependence to achieve the common goal. The main empowerment tool for self-directed teams is granting them full autonomy and making them equipped with technology to support their communication and coordination. (principles of management, 2006, p.261). However, it is important for the management to support the team and provide proper knowledge on the boundaries, regulation and principles of the company (SURESH, 2008).

Self- directed team has five features that are integral to assemble collective responsibility harmony encouragement shared goals and communication. Communication is vital that would leave no room for error and means to facilitate success. these teams usually develop more effective decision-making practices that combine considering different viewpoints incorporating the principles of give and take, moving toward action by remove problems and obstacles to safety focused on the shared outcomes to be achieved (Crosby, 2019).

2.2.4. The process and quality improvement team

A process improvement team is a team or group of people that are organized to improve a selected process within an organization. The team is organized by a process owner and team leader, consisting of those in the workforce who are involved directly or indirectly with the process. This team is sponsored by the management to improve the gaps and obstacles in the process (Garvin, 2023).

Quality needs a mindset that has to be assimilated into the organization operations to get executed by the management teams at all levels of the organization. According to the American quality guru Deming, he compared the degree of senior management for being responsible to94% of quality problems that occurred in an organization. On the other hand, according to Juran's view the role of employee have also share to quality problems that reach up to 20%. (Oakland ,2014). Although according to Deming the degree of responsibility for senior management is high, the bedrock of its implementation is the employees, mainly the maintenance crew in such organizations (Chism, 2020).

Contrary to organization structure, quality improvement teams do not appear visible on the organization chart. each “floats” has no personal boss. Instead, the team is supervised impersonally by its mission statement and by the quality improvement road map. The quality team does have its own internal organizational structure. This structure invariably includes a team leader which cloud be chairperson and team secretary. In addition, there is usually a facilitator (Juran, 1979).

2.2.5. Workplace policy and procedure manuals

Every organization should develop and state its policy on quality together with its arrangements. Although managing all elements together is not that easy, the dream of every business management is to have efficient employees, effective communication, and growth. The more companies grow, the hard they get to effectively communicate and eventually more difficult it becomes to ensure that employees carry out their tasks efficiently aligned with their objectives (Zeithaml, 2023).

Documentation is the foundation of all human progress. When people cannot read or write, their ability to teach and retain skills is limited to whatever they can transmit through oral tradition. To standardize a method is to choose out of many methods the best one, and use it what is the best way to do a thing? It is the sum of all the goods ways we have discovered up to the present. Today’s best, which superseded yesterday’s would be superseded by tomorrow’s best (Levinson, 2013).

In this regard, documenting the best work practices in a company and keeping them recorded in a better way would help the organization to transfer knowledge.

According to John s. Oakland (2014), every chief executive must accept the responsibility for commitment to quality policy that deals with the organization for quality, the customer needs, and the ability of the organization, supplied materials and services, education and training, and review of the management system for never- ending improvement (Oakland, 2014).

To maintain a successful cycle of activities for a smooth workflow, a company needs rules and guidelines to manage employees. However, accomplishing all this can be devastating without creating a policies and procedures manual. Every company needs a policies and procedure manual to guide its operation, strategy and workflow. Where policies set the expectation for employee behaviors, the procedures outline the steps for it. This ensures consistency in practice and helps in maintaining quality output (Daft, 2010).

Employee behavior is determined by the goals that must be met, provided that the work plan, strategy, and policy framework are all understandable and straightforward. Each employee should be more driven as a result to carry out upholding the quality requirements. A quality policy would decrease errors and cut waste while facilitating more efficient production or service operations through ongoing monitoring and execution. John S. Oakland contends that management ought to be committed to continuous quality improvement rather than just a one-time boost to a tolerable level. All staff members should be concerned about the quality policy, and it is imperative that the goal and guiding principles are shared broadly to ensure understanding at all organizational levels. (2014, Oakland) The organization's policy owner must set up protocols for managing newly amended documents that are necessary for the quality management system to function. Control over documents of external origins is also necessary. The process should be created to guarantee that the documents require permission, are routinely examined, and are changed as needed. In addition, for the document to function effectively, it must be circulated and made available at all responsible sites.

2.3. Planning and Scheduling

Quality planning consists of the activities carried out during the product/Service development and design stages. Also, during process engineering, before the product/service is put into production, these activities start from I identify customers, their needs, developing features of the product/service, developing processes and transferring the plans and features to the production. In order for an organization to achieve its objective effectively, it needs to have proper integration of maintenance planning and scheduling with policies in place. (K.S Krishnamoorthi,V. ram Krishnamoorthi. Arunkumar pennathur, 2019)

The road map for quality planning, according to DR Juran, is first to identify the customer,

The customer is someone who is impacted by the product/service. A customer can be external or internal. It can be someone outside the organization or someone inside the organization, who further processes the product/service to be delivered. Maintenance planning is part of an organized and structured process to achieve the efficient and effective implementation of maintenance tasks scheduled. Maintenance planning starts from clear understanding and reviewing of the company’s

corporate policy, strategy and maintenance service delivery plans. In order to develop effective equipment and maintenance plans to ensure maintenance priorities, strategic plans are relevant and should align with business directions. Maintenance planning involves the collection and analysis of all relevant data, strategy and available resource then deploy process to develop a plan for the short – term, medium term and long – term maintenance practices (Garvin, 2023). The management activities focusing to meet the organization's objectives are achieved through an effective planning. The maintenance planning provides appropriate maintenance programme and procedures for execution of tasks based on frequent basis (daily, weekly, monthly, yearly etc.). Depending on available maintenance manuals, where the planning standard and procedures are laid down.

2.4. Organizational culture

Richard L Daft defined as patter of shared values and assumptions about how members are done within the organization. He also stated that this pattern is learned by members as they cope with external and internal problems and thought to new members as the correct way to perceive, think, and feel. (Daft & Lane, 2014)

The underlying beliefs and values help members deal with problems of survival in the external environment and problems of internal integration. the culture may be strong or weak, and there may be one dominant culture for the organization or several different cultures within subunits. An organization's culture is a situational influence on leaders, but over time leaders can also influence culture (Yukl, 2013)

According to Richard, (2012) & daft, (2014), an organization culture can be analyzed at two levels. At the surface level, where visible artifacts that include manner of dress, patterns of behavior, physical symbols, organizational ceremonies, office layout these are visible arti facts and things that one can see, hear, and observe by watching employees of the organization. Whereas, at deeper and less obvious level, the values and beliefs which are not observable. But can be recognized from how people explain and justify (Daft, 2014) organizational culture is the "social glue" that bonds people together and makes them feel part of the organizational experience. This social glue can be the main motivating element in attracting new staff and retaining high performs, when if it is maintained and institutionalized.

2.5. Organization Management

Management can influence the culture of an organization in a variety of ways. Written values statement, chatters and philosophies can be useful, but they would have little credibility unless supported by the leaders' actions and decisions. A strong corporate culture can be a weakness rather than an advantage, if shared and values are not consistent with the strategies necessary for the organization to prosper and survive. On the other side it is sometimes difficult for leaders to change culture in a mature organization but easy to create it in new ones. This cloud occurs because many of the underlying beliefs and assumptions shared by people in an organization are implicit and unconscious (Yukl, 2013)

Richard l daft mentioned in his book that creating and maintaining a high – performance culture is not easy in today's turbulent environment and changing workplace. But cultural leaders, through their words and particularly their actions let everyone in the organization know what really counts. (Lane, 2018)

Maintenance culture determines the values, way of thinking, behavior, perception and the underlying assumptions of employees that consider maintenance as a matter that is important (priority) and practice it in tier life. When maintenance personnel have maintenance culture, shaped and developed by their leaders, it does mean that they would have the attitude to maintain, preserve and protect the company's property. Maintenance culture is usually followed or learned through a person making maintenance through his natural daily practice that can be followed and emulated by others (Florence, 2011). On the other side Maintenance cultures are not easy to develop. It takes time and occurs in response to changes by the individual in fact it is not something that is impossible to implement, if the determinant factors of maintenance culture accessible to changes. The key advantage of giving quality as a cultural variable is that, it would diminish the ambiguity associated with the multiple definitions and dimensions of total quality management.

2.6. Review of QA in Ethiopian Aviation Group and EFM

Ethiopian airlines established quality management system, for the purpose of ensuring and Monitoring compliance with international regulatory bodies as well as maintaining safety and quality. The group CEO is the prime responsible person for the quality system of the company, that

ensure periodic verification of quality achievement to be carried out and to take any corrective and / or preventive actions against quality deficiencies being clearly defined and effectively implemented. Ethiopian airlines have associated quality management system for accountabilities, resources and process necessary to establish and promote a system of continuous quality assurance and improvement, while delivering a product or service. The quality policy of Ethiopian airlines reflects achievement and continued compliance with regulatory body's requirements as well as Ethiopian civil aviation rules. Per the airline police, all sections indicated in the structure, including all operational managers are responsible to implement quality management System Company wide. (Ethiopian airlines group QMS manual, 2021).

Considering equipment and facility maintenance section as part of the aviation groups support service provider, the corporate QMS, SMS and compliance section took the responsibility to monitor its quality assurance and quality management issues along with other activities of safety management and environment management system. Due to this EFM has no independent quality assurance section unlike other strategic business units.

2.7. QMS Structure in Ethiopian Group

Ethiopian Aviation Group (EAG) has established TQM in its various strategic business units playing significant role to keep the aviation industry standard based on international regulatory body requirements. In Ethiopian aviation group, the issues of quality management system, safety management system, compliance and business sustainability is directly monitored by the group CEO. the activities are structured and managed under vice president, director, divisional manager, team leader and quality auditors. With this structure, the divisional quality assurance and safety sections provides auditing of all functions in the aircraft maintenance and all related ground handling operation business units to ensure the company compliance with applicable regulation and procedure. the above structure indicates Ethiopian aviation group has given emphasis for strict

implementation of quality and safety management system implementation across the airline strategic business units (Conger and Kanungo 1988).

2.8. QMS Structure in ETAG Strategic Business Units

The strategic business units as well as the operation support have in total about 9 QMS managerial and team leader positions. All are accountable to Dir. Group QMS, SMS, ERP and compliance to handle divisional QMS and SMS issues. Pools of auditors carry out audit activities per audit activities per audit schedule. During auditing, there is no direct and scheduled audit on equipment and facility maintenance. However, prior to audit of external regulatory bodies, divisional QMS, SMS, ERP and compliance sections conduct self-assessment and micro audit that rarely involve equipment and facility maintenance section based on the regulatory body requirement. (Ethiopian airlines group QMS manual, 2021). Although there are several quality assurance sections across the strategic business units, equipment and facility maintenance sections don't have its own quality assurance sections.

However, to fill the maintenance quality gaps, an inspection department provides quality control service to motorized equipment maintenance section only. According to David Hoyle in his book quality management essentials, he sated, What inspection does is measure quality in a way that allows us to make decisions on whether or not to reals a piece of work. Work that passes inspection should be quality work, but inspection unfortunately is not 100% reliable.

He also added that most inspection relies on human judgment, and this can be affected by many factors, some of which are outside our control (such as the private life, health or mood of the inspector). (quality management esseniatls,2007). Also, according to Jhon S. Oakland, employing more inspectors tightening up standards, developing correction, repair and rework team does not improve quality. (Oakland, 2014).it is critically important to bring quality assurance into workforce to deploy their skill and drive productivity.

2.9. Workplace Policy Manuals in ETAG

As per Ethiopian airlines company procedure, all divisional QMS and SMS section are responsible to develop divisional QMS manual for their respective operations which is in compliance with

Ethiopian civil aviation authority, star alliance (world largest global airlines alliance), ISO and industry practice. The manuals developed under each strategic to supervise the synergy, since they have got regulatory bodies approval. Tehes manuals are approved by Ethiopian civil aviation authority and regulatory bodies as wheel. To mention few, Ethiopian MRO maintenance procedure manual (MPM), Cargo internal evaluation and audit process manual and Business sustainability manual can be taken as an example.

All quality assurance department and safety section administer the safety management policies and procedures so that safety policy and objectives are met. They also ensure adequate resources are allocated for effective implementation. of safety management system (SMS). The section are check and balance point of all functions of the management system for maintenance operation to ensure Ethiopian is complying with applicable regulations and procedures of the standards, satisfying the maintenance operation's needs, identifying undesirable conditions and areas that require improvement, identify hazards in maintenance operations. In this regard all sections have the required policy and procedure manuals. The maintenance planning scheduling requirement and implementation across the company is assessed and monitored by the respective sections (Lewis RC, 2019).

Policy and procedure manuals across Ethiopian aviation group are controlled and revised every two years counting from the revision date. This practice is mandatory. However, the duration may not be necessarily followed when a revision/updating is recommended by safety or regulatory body. It is enforced, controlled, and managed by group QMS, SMS and ERP and compliance section across all operational units. The main reason for this is to incorporate changes and updates due to the dynamic nature of the airline industry's requirement on safety, service quality and standards. It also helps the company to meet regulatory bodies' requirement in the alliance which the world global airlines created.

2.10. Continues Quality Improvement Tools In ETAG

Continual improvement of the organization's overall performance should be a permanent objective of the organization. This means that everyone in the organization should be continually questioning its performance (David Holye ,2007)

The section under director group QMS, SMS, compliance and ACE ensure such practices in all divisional areas through continuous audit and monitoring. While conducting the audit, the quality assurance objective are achieved by using PDCA cycle along with ACE (achieving competitive excellence), tools for continuous improvement. This quality management tool, ACE, is a proprietary continuous quality improvement system developed by united technologies corporation, (UTC) and adopted by Ethiopian airlines. It is a day to day operating system ensuring the company in continuously driving towards operational and quality excellence and meting the milestones through making ACE as its working culture. The group QMS, SMS, compliance and ACE section, train and expose quality auditors and operational staff of all divisions to IATA, ECAA, ISO and industry standard.

To engage all employees in appropriate level and throughout this change management tool ACE structure is stretched across the organization that enabled employees to carry out tier assigned role within tier structure.

Similar to other sections, ACE is a widely exercised quality management tool in equipment and facility maintenance. the progress and continuous improvement tool in ACE are monitored on monthly basis.

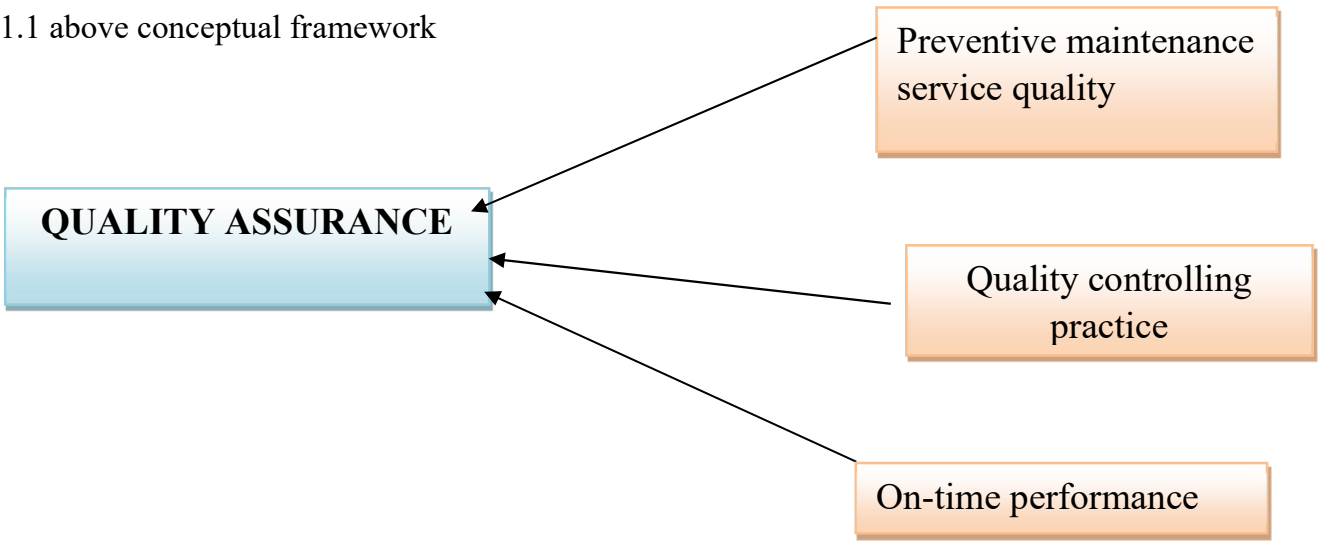
2.11. Empirical Review

Different studies define service quality differently, according to Lewis and Booms (2023), the degree to which the level of service provided satisfies customer expectations is a measure of service quality. Meeting client expectations on a regular basis is essential to providing quality service. Nonetheless, the majority of academics and managers of service companies concur, according to Parasuraman et al. (2015), that evaluating service quality entails contrasting expectations with performance.

According to Gronroos (2014), there are two categories of service quality: functional and technological. What the client truly receives from the service is what is referred to as technical quality. A customer's ability to objectively measure the service outcome is common. The way a service is provided, or the interaction between the service provider and the client, is referred to as its functional quality. Gronroos (2024) created the first conceptual model of service quality with the aim of improving comprehension of customers' perceptions of service quality and the variables influencing such perceptions.

2.12. Conceptual framework

1.1 above conceptual framework



2.13. Variables

The quantitative phase has four independent variable s. namely Preventive Maintenance service quality, Quality control practices and on-time performance. The dependent variable of the study was Quality assurance practice. The control variables for the study included number of units, operation seasonality, and other departments of the enterprise. The effects of these control variables had measured, and property controlled.

2.13.1. Dependent variables

Here, we have quality assurance as a dependent variable.

Quality assurance ensure that products or services consistently meet or exceed customer satisfaction. By setting clear quality goals, defining criteria, and implementing control measures, organizations can ensure that their offerings are high quality reliable and efficient. The dependent variable in this study was operationalized in terms of items that measure preventive maintenance with respect to service and actual service delivery of the maintenance section.

2.13.2. Independent variables

The preventive maintenance quality, its quality controlling practices, and on-time performance will be the four independent we will have and focus on.

CHAPTER THREE

3. RESEARCHER METHDOLOGY

3.1. Introduction

This chapter describes research methodology Specifically, research design, research approach, it mentions the population, target populations, type and source of data, the method of sampling and its size, method of data collections, method of data analysis and presentations, measuring instruments used pertaining to its validity and reliability; the procedure used to follow to gather data and the statistical methods that would be used to analyze data.

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3.2. Research Design

The study has used descriptive and explanatory cross-sectional research design. Because It focuses on acquiring and conveying facts. On the other hand, explanatory research aims to explain why a phenomenon occurs by working to understand the causes and correlations between variables. Explanatory study used to determine and explain the relationship between the dependent variable. Cross-sectional study is a onetime study at one time and not over several years. The grounds for the choosing an explanatory research design is that, it is appropriate for studies that create causal relationship between two or more variables (Creswell 2009)). The study was conducted in Ethiopian aviation group S.C, which is located in Addis Ababa bole sub city. The specific area where the study focused was equipment and facility maintenance that provides preventive maintenance service for all Ethiopian aviation group strategic business units in providing maintenance service to ground support equipment, shop service facilities and machineries maintenance at the head office. The study mainly focused on factors that affect quality assurance of preventive maintenance in the section while providing maintenance service. The total number of employees in the section is 100, which was used as the sampling frame of the study.

The study adopted descriptive research design by using both qualitative and quantitative to obtain the desired results of the company and to explore about the factors affecting quality assurance in equipment and facility preventive maintenance. In accordance with Mugenda, O., & Mugenda, A.

(2003) Quantitative and Qualitative Methods, furthermore, the method helps to engage quantitative and qualitative statistics to organize information in meaningful ways. A descriptive research design was used in this study since the researcher intended to look at the problem at hand thoroughly to define it, clarify it, and obtain pertinent information that could be of use in factors that affect the quality assurance of preventive maintenance at Ethiopian airline Group Equipment and Facility Maintenance.

3.3. Research Approach

A research approach is the procedure selected by the researcher to collect, analyze, and interpret data. There are three approaches to research: mixed methods. This study would be used a quantitative research approach and qualitative research approach to conduct this study, so the researcher used mixed research approach to conduct the study.

3.4. Sources and types of data

The study used both primary and secondary data sources. In the primary data sources, the data would be collected from respondents through questionnaires whereas the secondary data was collected from internet, magazine, journal, different articles and different books where it is related with the employee empowerment on organizational performances on Ethiopian airline. To attain the aim of the study, to secure sufficient and relevant information the researcher used a primary source of data. The main data gathering tools would both primary and secondary data sources which were used to answer research questions. Primary source data were mainly obtained through self-administering structured questionaries, surveys, and observation. Also, personal interview was used to check the reliability of the information collected.

The researcher collection techniques mainly primary collection techniques primary data was collected from selected representatives' respondents; viewpoint, information on the factors affecting quality assurance implementation in maintenance sections. The interview made with the management at the same time is believed that they have valuable insight and deep understanding about the status of quality in the section. The collection of secondary data was done through an extensive literature review from books, journals, archives, internet, and from different websites.

3.5. Target Population and Sampling Technique

Target population is an aggregation of elements from which sample is elected (Mugenda and Mugenda, 2008) the target population of the study was 150 (male and female) permanent employees of the section that included functionally reporting facility maintenance teams. The sample contained employees involved in team management, maintenance planning, Inspection, engineering, and maintenance service provisions which currently are organized under three managers.

3.5.1. Sampling Techniques

To select the appropriate representative samples of the total population and to make the research findings more relevant and accurate the sample design was structured. The target population, techniques of selecting samples and sample size are clearly stated as follows:

The techniques the researchers used purposive sampling techniques. Therefore, it was important to divide the total population in different sections or strata that represented of the population. Each category or strata representative was selected by purposive sampling method. Non -probabilities sampling/ purposive sampling/ was used as a convenience of the researcher, to include the respective sections' team leaders. It was decided to use this method to gain relevant data about the present status of factors affecting quality assurance of preventive maintenance in the section.

In order to strengthen the reliability of data gathered from questionnaires, an interview was conducted based on purposively selected two managers. To make the data more reliable the director of group facility maintenance was also included. About nine interview questions were prepared and conducted.

3.5.2. Sample size determination

The sample size selected was based on sample size determination from known population by (Yamane, 1967) It is computed in the following manner:

$$\mathbf{n} = \frac{N}{1+N(e)2}$$

N: is desired population

n: is sample size.

e: margin of error 0.05

1: is constant number

Therefore, the total sample size of the study 150 employees of the maintenance sections.

$$n = \frac{150}{1+150(0.05*0.05)} = 109$$

Hence, the total sample size of 109 was chosen from the selected departments using convenience sampling for the study.

3.6. Method of Data Collection

Structured questionnaires and semi-structured interview data collection instruments were used to collect data. The questionnaire is adapted in two modified parts. Part one demographic information of the respondents: personal background: sex, no. of service years in the section, educational background, position in the section, and employee service stream.

The second part measured the Factors affecting quality assurance on preventive maintenance practice: in the case of Ethiopian Group equipment and facility maintenance and the employee's role and participation in quality assurance improvement activities. Those questionaries would distribute to employees who are currently working in different expertise and team leading positions.

The degree of the factors affecting quality assurance presents to respondents through questionaries would rate the extent of effect on the basis of Likert scale. Semi structured interview questionnaires were prepared for the director and managers to collect the data.

3.7. Data Analysis

The data that were collected from employees through questionnaires were analyzed with the help of SPSS software version 26. Descriptive statics was used to analyze the demographic data of respondents. Demographic variables, reliability, descriptive statistics, correlation analysis and factor analysis test were conducted to analyze the collected quantitative data. First demographic information about the participants is reported .it included the frequency distribution of demographic variables such as gender, service year, education, etc. second, Cronbach's alpha was calculated for testing the reliability of the scales used in this study. Third, descriptive statistics were calculated to get information about the means and standard deviations for each of the variables of interest. The general form of the multiple regression equation with k independent variables is

Y=b0+b1x X1+ b2xX2 ••• bkxk+£

Where Y = the Predicted Dependent Variable

bo = Constant b1, b2 and bn unstandardized regression coefficients

X1, X2 and xn are the explanatory variables and the error term ε (the Greek letter epsilon) is a random variable. In multiple regressions, the strength of the relationship between the independent variables and the dependent variable is measured by a correlation coefficient. This multiple correlation coefficient is symbolized by R.

3.8. Reliability and validity

Reliability concerns the extent to which a measurement of a phenomenon provides stable and consistent results (Carmines and Zeller, 1979). Reliability is also concerned with repeatability. According to George and Mallery (2003, as cited in Joseph & Rosemary, 2003) Cronbach's alpha is a coefficient of reliability. It is commonly used as a measure of the internal consistence or reliability of a psychometric test score for a sample of examinees. Cronbach's alpha reliability coefficient normally ranges between 0 and 1.

Table 1 Reliability Statistics

Reliability Statistics		
Variables	Cronbach's Alpha	N of Items
Organization Policy and structure.	.744	9
Spare Part Controlling and supply in the preventive maintenance quality	.855	7
Management role	.823	6
Task execution and teamwork	.703	7
Knowledge of the Job	.711	8
Factors affecting preventive maintenance quality.	.712	11
Major factors impact on-time performance in Equipment preventive maintenance	.732	10

(Source survey-2024)

On the other hand, Reliability is concerned with the internal consistency of the items (Hair et al,2007) defined reliability as the extents to which a variable or a set of variables is consistent in what it is extended to measure. As the current study uses multiple items in all variables, internal consistency analysis would be carried out through Cronbach alpha reliability tests. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. However, there is no lower limit to the coefficient. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. (George & Mallery, 2003) provide the following rules of thumb: "_ > .9 – Excellent, _ > .8 – Good, _ > .7 – Acceptable, _ > .6 – Questionable, _ > .5 – Poor, and _ < .5 – Unacceptable."

3.9. Ethical Considerations

The researcher has used proper citation, follows systematic collection and analysis of data techniques, maintains data confidentiality, obtained the consent of the case organization and staffs and based on their consent to meet the ethical obligation of research. Prior to actual data collection respondents would be informed about the objectives of the study. Ethical considerations in research are a set of principles that guide your research designs and practices. These principles include voluntary participation, informed consent, anonymity, confidentiality, potential for harm, and results communication.

CHAPTER FOUR

4. DATA PRESENTATION AND INTERPRETATION

4.1. Introduction

This part of the study presents data analysis and discussion. It first presents socio-demographic and economic characteristics of the three types of respondents in the study. Next, it mainly dwells on core performance of the employees in a triangulated manner. Specifically, those major issues which have been running throughout the chapter would be recapitulated and put together in the form of summary.

4.2. General Characteristics of the Respondents

The main purpose of the study was to identify the major factors that affect quality assurance of preventive maintenance in Ethiopian airlines equipment and facility maintenance. Questionnaires were designed and distributed to 109 employees under equipment and facility maintenance. Out of total 105(96.3%) questionnaires were filled and returned. Interview was also designed and conducted with the director and managers. The first part of the questionnaire consists of the demographic information of the participants. This part of the questionnaire requested a limited amount of information related to personal and professional demographic characteristics of the respondents.

Table 2 frequency distributions of respondent with respect to their gender

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Male	90	85.7	85.7	85.7
	Female	15	14.3	14.3	100.0
	Total	105	100.0	100.0	

Source: Own Survey (2024)

In the above table indicate that the gender allocations of the sample of respondents from the section employees which the research was conducted .out of the total respondets,85.7% of them were males, and the remaining 14.3% were females. The result indicates that there is gender disparity this can be

interpreted that the majority of the respondents' male in the demographic characteristics of the respondents can be seen as it is displayed in table

Table 3 distributions of respondent with respect to their service year

Service year in the section					
		Frequency	Percent	Valid Percent	Cumulative Percent
	< 5 years	21	20.0	20.0	20.0
	5-10 Years	59	56.2	56.2	76.2
	10 – 15 Years	17	16.2	16.2	92.4
	15 and above	8	7.6	7.6	100.0
	Total	105	100.0	100.0	

Source: Own Survey (2024)

Table 2 indicates the employees' work experience. There were 20% employees who worked below 5 years, however, 56.2.% of them served the company 5 years to 10 years, 16.2% of employees served 10 to 15 years and the remaining 7.6%, 15 and above years. This indicates that there is potential threat that the section must work on knowledge transfer and build work culture on half of the employees to achieve future objectives of the company's growth strategy.

Table 4 distribution of respondents with respect their educational background

Educational Background					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Diploma	47	44.8	44.8	44.8
	Degree	55	52.4	52.4	97.1
	Masters	3	2.9	2.9	100.0
	Other	0	0.0	0.0	100.0
	Total	105	100.0	100.0	

Table 3 indicates 44.8% of the employees were diploma holders whereas 52.4%-degree holders and the remaining 2.9% were MA holders respectively. Hence, we can say that respondents are educated. This implies that the company has the advantage of utilizing its human resources for its long-term strategy which can give a competitive advantage were ever the competition exists.

Table 5 position of employees in the section

Position					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Team leader	6	5.7	5.7	5.7
	Maintenance Team	94	89.5	89.5	95.2
	Inspector	1	1.0	1.0	96.2
	Engineer	4	3.8	3.8	100.0
	Total	105	100.0	100.0	

Source: Own Survey (2024)

Table 4 indicates that 89.5% of the employees are maintenance crew that provides the maintenance service across the section, whereas 8.5% of the section employees are serving in leadership, for the maintenance as well as the support service. Looking at the respondents‟ year of experience, most of the respondents served the organization from six to ten years taking the highest percentage or 89.5% of the total respondents, this can be interpreted that most of the respondents served the organization neither for a short period of time nor for longer years. Further information, on the demographic characteristics of the respondents can be seen as it is displayed in table.

Table 6 over all respondent's distribution in GEFM

Division					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Group GSE/GTV Maintenance	1	1.0	1.0	1.0
	Facility Maintenance	104	99.0	99.0	100.0
	Total	105	100.0	100.0	

Source: Own Survey (2014)

Table 5 indicates that 99 % of the employees are under Facility equipment maintenance services stream whereas the remaining 1% of the employees was under Group GSE/GTV Maintenance. The demographic profile can vary depending on the specific survey or study being conducted. Typically, demographic factors such as age, gender, ethnicity, education level, income, and geographic location are considered when collecting data from respondents (dani, 2023).

4.1.1. Mean Values of Variables

The means of the 7 factors stated were calculated and presented in table 6. From this table, it can be noted that the means scores of 2 variables are above the midpoint (30) of the scale. The highest mean score recorded was for Organization related factors(M=34.7) while the lowest score was recorded for supplier related factors(m=14.86).

4.1.2. Factors affecting quality assurance on preventive maintenance practice

Determine the involved, set goals for the preventive maintenance plan, inventory the facility equipment and assets, create preventive maintenance procedures, develop preventive maintenance schedules, train your team and analyze, correct, improve. Facility managers and their teams are responsible for securing these risks and upholding safety in a facility. A strong preventive maintenance plan can effectively reduce two types of risk to your buildings. According to Iyagba (2005), it is impossible to produce buildings that are maintenance- free, but maintenance work can be minimized by good design, and proper workmanship carried out by skilled experts or competent craftsmen using suitable codes of installation, requisite building materials and methods. Although the building is a capital asset of the organization, instead of building owners assume maintenance of the building as a vain liability and not a priority. On a particular occasion, the building owners often find themselves are no longer comfortable with building cracks on walls and floors, leaking water pipes, and corrosion of steel structures. Maintenance is made not only to maintain the building but also for the sake of public safety, including safe consumer building occupants. Maintenance management is responsible for using tools and methods to improve efficiency and to reduce the effects of unplanned stoppages and reduce costs (Oliveira et al., 2014).

Table 7 Factors affecting quality assurance on preventive maintenance practice

Organization Policy and structure.				
	Variables	Mean	S. D	N
1	Maintenance planning starts from clear understanding and reviewing of the company's corporate strategy.	4.05	.917	105
2	Planning activities focus to meet the organization's objectives effectively	4.69	1.070	105
3	The goals are accomplished through the framework of rules and relationships provided by the organizational structure.	2.50	1.17	105
4	Organizational structure guide and clarify activities of everyone in the organization	2.17	.751	105
5	The preventive maintenance documents and manuals are updated whenever there are machines and equipment are bought and replaced	2.146	1.004	105
6	The Organization has grouped machines according to their function (e.g. power generations and distribution, water treatment, pumps fire and safety…etc.)	3.15	.952	105
7	The Company avails policy and procedure manuals to guide maintenance operations and workflows	1.477	.7596	105
8	There is established controlling systems status for new and revised policy documents.	3.292	1.081	105
9	The goals are accomplished through the framework of rules and relationships provided by the organizational structure.	3.86	1.284	105
10	Access to the organizational structure allows for formal management and coordination of section activity.	3.169	1.540	105

(Source: SPSS 25 output results)

Based on the provided data, the Organization Policy and structure appears to have a relatively Maintenance planning starts from clear understanding and reviewing of the company's corporate strategy. The mean values for most of the statements related to clear understanding and reviewing of the company's corporate are above the midpoint of the scale, indicating a generally favorable.

The statement with the highest mean value is “Planning activities focus to meet the organization's objectives effectively “with a mean of 4.69. This suggests that Planning activities focus to meet the organization's objectives effectively, indicating a commitment to ensuring that Planning activities focus to meet the organization's objectives effectively. Based on these one of the interviewees added that Organizations' internal control systems can have a significant impact on the work Planning activities focus to meet the organization's objectives effectively Interviwee-3)

On the other hand, there are a few statements that have lower mean values. For example, " The goals are accomplished through the framework of rules and relationships provided by the organizational structure " has a mean of 2.50, indicating that The goals are accomplished through the framework of rules and relationships provided by the organizational structure " has a mean of 2.17, suggesting that rules and relationships provided by the organizational structure a lack of consistent enforcement and accountability.

Regarding transparency, the statement “Organizational structure guide and clarify activities of everyone in the organization “has a mean of 2.146, This implies that employees may perceive a lack of transparency in how decisions are made within the organization, potentially indicating a need for improvement in this area.

Overall, while the organization generally demonstrates positive ethical behavior, there are areas that may require attention. These include fostering a the Company avails policy and procedure manuals to guide maintenance operations and workflows, there is established controlling systems status for new and revised policy documents, The goals are accomplished through the framework of rules and relationships provided by the organizational structure and Access to the organizational structure allows for formal management and coordination of section activity. By addressing these areas, Factors affecting quality assurance on preventive maintenance practice.

4.1.3. Spare Part Controlling in the preventive maintenance quality

We show that a proper inspection of spare parts pays back up to 92% in maintenance cost savings as the spare parts' quality deteriorates. The Spare Parts Management System is a cutting-edge computerized program developed to help businesses manage their spare parts inventory more effectively. Businesses can use this comprehensive system to easily track the location, number,

quality, and cost of spare parts and repairs. Spare Parts and Supplies means goods consisting of spare and replacement parts and supplies used in or to facilitate the production or manufacture of Finished Goods by a Person in the ordinary course of business but not including Raw Materials, Work-in-Process or Packaging Materials.

Table 8 Spare Part Controlling and supply in the preventive maintenance quality.

Spare Part Controlling and supply in the preventive maintenance quality				
Variables		Mean	Std. D	No
1	There is enough spare parts inventory to do preventive maintenance program	3.59	1.286	105
2	The organization is using computerized inventory system	3.26	1.411	105
3	The organization has a numbering system for every machine for identification	3.42	1.15	105
4	The inventory system can identify spare parts obsolesce (no more available)	3.52	.966	105
5	Quality of spare parts and materials provided for maintenance	3.57	1.09	105

(Source: SPSS 25 output results)

Based on the provided data, it appears that the Spare Part Controlling and supply in the preventive maintenance quality are generally perceived positively in terms of demonstrating and promoting a preventive maintenance quality. The mean values for most of the statements related to There is enough spare parts inventory to do preventive maintenance program 3.59 and Std.D 1.286 are above the midpoint of the scale, indicating a generally favorable preventive maintenance quality.

The statement with the highest mean value is “The organization is using computerized inventory system “with a mean of 3.26 and Std.D 1.411. This suggests that the organization is using computerized inventory system. This indicates a strong emphasis on The organization is using computerized inventory system practices with these values.

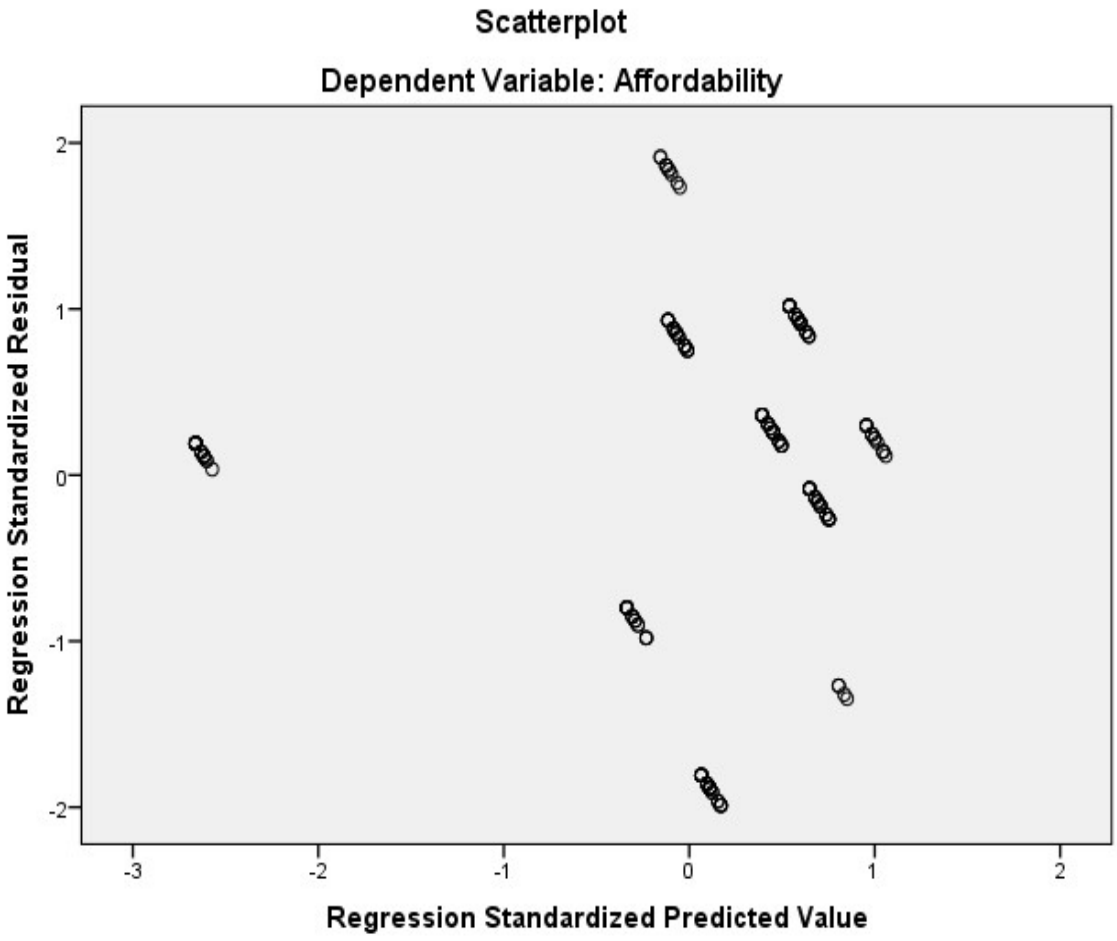
Similarly, the statement “The organization has a numbering system for every machine for identification" has a mean of 3.42 and Std.D 1.15, indicating that organization has a numbering system for every machine for identification. This suggests the organization has a numbering system for every machine for identification team. Towards this another interviewee pointed out

that It is known that l the inventory system can identify spare parts obsolesce (no more available) plays a pivotal role in shaping inventory system can identify spare parts obsolesce (no more available) principles. (Interviwee-8) and not Quality of spare parts and materials provided for maintenance in the company it means 3.57 and Std.D 1.09 low Quality of spare parts and materials provided for maintenance.

4.2. Normality Test

The following figure shows the frequency distribution of the standardized residuals compared to a normal distribution. As can been seen from the figure, the data points are close to the diagonal line confirming that there is normality.

Figure 1 Normality Test

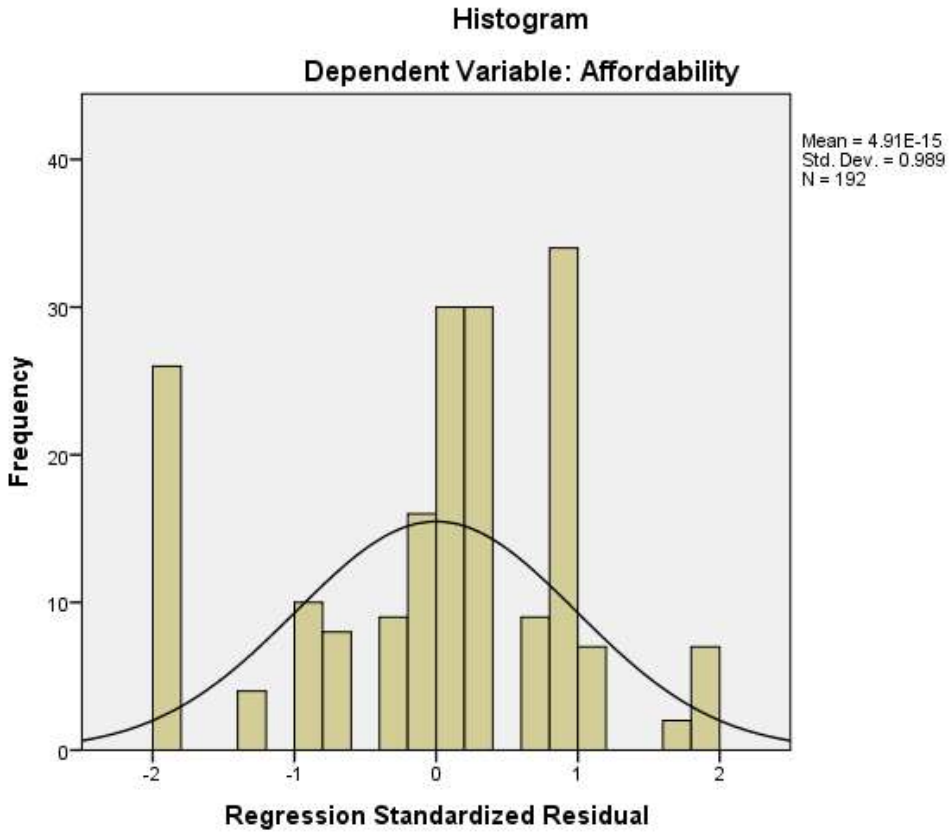


Source: own survey (2024)

4.3. Homoscedasticity

According to Tabachnick and Fidell (2001), this assumption requires that the variance of error terms is similar across the independent variables. This assumption can be checked by visual examination of a plot of the standardized residuals (the errors) by the regression standardized predicted value. The next figure shows that the amount of error or the distance from the line to the dots stays constantly similar and confirms that we have homoscedasticity.

Figure. 2. Histogram dependent variable



(Source: own survey, 2024)

A histogram is a plot of the data values (independent variable) and the count (dependent variable). Generally, the feature to be plotted represents the horizontal axis, while the count is the vertical axis It is something that depends on other factors. For example, a test score could be a dependent variable because it could change depending on several factors such as how much you studied, how much sleep you got the night before you took the test, or even how hungry you were when you took it. The

explanatory variable (or the independent variable) always belongs on the x-axis. ▪ The response variable (or the dependent variable) always belongs on the y-axis.

The general form of the multiple regression equation with k independent variables is

Y=b0+b1x X1+ b2xX2 ••• bkxk+£

Where Y = the Predicted Dependent Variable

bo = Constant b1, b2 and bn unstandardized regression coefficients

X1, X2 and xn are the explanatory variables and the error term ε (the Greek letter epsilon) is a random variable. In multiple regressions, the strength of the relationship between the independent variables and the dependent variable is measured by a correlation coefficient. This multiple regression correlation coefficient is symbolized by R.

Hence, PR= b0+b1AC+b2SE+b3CO+b4TFL+£ Where b1, b2, b3 and b4 are the Unstandardized regression coefficients.

Table 9 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.869a	.755	.750	.54789	1.776

a. Predictors: (Constant), preventive maintenance, equipment maintenance, facility maintenance

b. Dependent Variable: quality assurance

(Source: own survey, 2024)

Where PM= preventive maintenance

EM= equipment maintenance

FM= facility maintenance

QA= quality assurance

In the above table the model summary the multiple regression correlation efficient R=0.869a represent the correlation between quality assurance and independent variables which are (preventive maintenance, equipment maintenance, facility maintenance). R square represents the proportion of variance in the dependent variable which explained by independent variables (0.755). Adjusted square(R=0.750) this means 75% the variation of quality assurance is due to the predictors (preventive maintenance, equipment maintenance, facility maintenance). The remaining 25% of variations on quality assurance are explained by other variables out of this model or variables which are not incorporated in this study.

Table 10 ANOVA

Model		Sum of Squares	DF	Mean Square	F	Sig.
1	Regression	172.959	4	43.240	144.046	.000b
	Residual	56.134	187	.300		
	Total	229.092	191			

a. Dependent Variable: quality assurance

b. Predictors: (Constant), preventive maintenance, equipment maintenance, facility maintenance

Source: own survey (2024)

From the above ANOVA table F value is significant (significant value is less than 0.05) it means dependent variable is significantly affected by the respective independent variable.

4.4. Correlation Analysis

Table 11 correlation coefficients

		Organization policy and structure	Spare part controlling in the	Management role	Task execution and teamwork	Preventive maintenance service quality
Pearson Correlation	Organization policy and structure	1.000				
	Spare part controlling in the preventive maintenance quality	.660	1.000			
	Management role	.631	.940	1.000		
	Task execution and teamwork	-.228	-.739	-.743	1.000	
	Preventive maintenance service quality	.626	.658	.708	-.349	1.000

(Source: SPSS 25 output results)

The correlation matrix provided shows the Pearson correlation coefficients between Organization policy and structure, Spare part controlling and supply in the, Management role, and Task execution and teamwork. These correlation coefficients measure the strength and direction of the linear relationship between these variables. Correlation analysis is a useful way of discovering relationships among variables. The value of the coefficients(r) ranges from -1 up to +1. The value of coefficients of correlation (r) indicates both the strength and direction of relationship. If r =-1, it indicates that there is a perfectly negative correlation between the variables. If r= 0 it does indicate there is no relationship between the variable and r= +1 there is perfectly positive relationship between the variables for the values of r between +1 and 0 or between 0 and -1, different scholars have proposed different interpretations with slight difference. However, the researcher in this study used diction rule given by Bartz (1999) was used. Bartz (1999) described the strength of association among the variables as follows.

4.5. Communalities

Factor analysis is a method that aims to uncover structures in large variable sets. If you have a data set with many variables, it is possible that some of them are interrelated, i.e. correlate with each other. These correlations are the basis of factor analysis. The aim of the factor

analysis is to divide the variables into groups. The aim is to separate those variables that correlate highly from those that correlate less strongly. Variance of the variables, which is explained by all factors, Sum of the squared factor charges of a variable. The communalities which indicate the amount of variance in each variable is as seen in the table below. It is also the squared multiple correlations between the item and other item as per standard the deal acceptable communalities are above 0.7. in this case the values are acceptable cut off values, ensuring the strength of relationship between the major factors (Wang, 2017).

Table 12 communalities

Communalities		
	Initial	Extraction
Organization policy and structure	1.000	.612
Spare part controlling in the preventive maintenance quality	1.000	.637
Management role	1.000	.742
Task execution and teamwork	1.000	.434
Knowledge of the job	1.000	.633
Preventive maintenance service quality	1.000	.694
Major factor impact on time performance in equipment preventive maintenance	1.000	.587

(Source: SPSS 25 output results)

Once the number of factors is determined, the communalities can be calculated. As written above, the communality indicates the variance of the variables, which is explained by all factors. If e.g. three factors were selected, the communalities give the variance portion of the respective variable at that with these three factors to be described can. These initial communalities represent the relation between the variable and all other variables (i.e., the squared multiple correlation between the item and all other items) before rotation. If many or most communalities are low (< . 30), a small sample size is more likely to distort results. When SPSS produces output associated with exploratory factor analyses (EFAs), that output usually includes parallel lists of communalities initial and extraction management role 74% Most significant and Factors affecting preventive maintenance quality 69% Significant, the first list for initial communalities and the second list for extraction communalities (Weigl, 2016).

Table 13. Guide for degree of significance

No	Degree of significance	rating
1	Most significant	0.76 and above
2	Significant	0.67 to 0.75
3	Less significant	0.45 to 0.66
4	Not significant	0.44 and below

(Source: SPSS 25 output results)

4.6. Relative Importance Index (RII)

Relative Importance Index (RII) is **used to determine the relative importance of quality factors involved**. The points of Likert scale used is equal to the value of W, weighting given to each factor by the respondent. The summary of result shows that the significant factor that affects quality assurance of preventive maintenance in GEFM is Management role and factors affecting preventive maintenance quality. The table below shows the details. Relative Importance Index (RII) is a non-parametric technique widely used by construction and facilities management researchers for analyzing structured questionnaire responses for data involving ordinal measurement of attitudes (Macášek, 2014).

Table 14 Relative importance index (RII)

Summary	RII	rank	degree of significance
Organization policy and structure	0.612	3	Less significant
Spare part controlling in the preventive maintenance quality	0.637	3	Less significant
Management role	0.742	2	Significant
Task execution and teamwork	0.434	4	Not significant
Knowledge of the job	0.633	3	Less significant
Preventive maintenance service quality	0.694	2	Significant
Major factor impact on time performance in equipment preventive maintenance	0.587	3	Less significant

(Source: SPSS 25 output results)

The above summary table of relative importance index leads to the findings that the factors that affect significantly affect quality assurance in preventive maintenance in Group equipment and facility

maintenance section are those which are related to management role and Factors affecting preventive maintenance quality. The other less significant factor are organization policy and structure, spare part controlling and supply in the preventive maintenance quality, knowledge of the job and major factor impact on time performance in equipment preventive maintenance, its implementation and clarity in guiding the employee to the standard of regulatory bodies' requirement. Easiness of the policy, spare part, knowledge of the job and major factors impact to understood by the section employee cloud have tremendous benefit and contribution in keeping preventive maintenance quality per the industry standards. The remaining factors that no significant impact based on relative importance index is task execution and teamwork. As per the outcomes, it is understood that the task execution and teamwork is not quality focused and does not consider and give emphasis for quality.

A multiple regression correlation R can also be computed to determine if a significant relationship exists between the independent variables and the dependent variable.

Multiple regression analysis is used when a statistician thinks there are several independent variables contributing to the variation of the dependent variable. This analysis then can be used to increase the accuracy of predictions for the dependent variable over one independent variable (bluman, 2007).

CHAPTER FIVE

5. SUMMARY, CONCLUSION AND RECOMMENDATION

Under this section of the research paper, summary of the findings, conclusion and recommendations are forwarded. Moreover, limitations of the study and directions for the future research shall be indicated as follows.

5.1. Summary of Major Findings

The main objective of the study was to assess the factors affecting quality assurance on preventive maintenance practice in Ethiopian airlines equipment and facility maintenance. The study was designed mainly to identify which factors are significantly affecting the quality assurance implementation and are main contributors for the repetitive micro audit findings that cloud have potential impact for decertification of the airline and restriction from getting permit due to non-compliance to safety standards.

According to a survey conducted and based on the interview made with the section director and mangers, there is no quality circle & teams in the maintenance section. Out of the seven parent factors which were presented for analysis, the management role and participation in quality assurance on preventive maintenance was one of the most significant factors that affect quality assurance in the section. Quality circles give an overall direction towards quality improvement. The absence of a cross-functional team that consists of representatives from the strategic business units, engineering, purchasing, cannot bring continuous improvement. Due to this there are no opportunities for the team to raises and discuss about best practices, point out major issues, collaborate solutions brainstorm ideas and streamline how problems can be fixed.

Factor analysis is a method used to identify structures in large variable sets by examining interrelated correlations. It divides variables into groups, separating highly correlated ones from less strongly

correlated ones. The analysis calculates variance, communalities, and squared multiple correlations between variables. A satisfactory communality is above 0.7, ensuring strong relationships between major factors.

The other significant factors affecting quality assurance are to management role and Factors affecting preventive maintenance quality.

Although it is widely in practice by other strategic business units, quality assurance internal audit is not independently in practice in GEFM and there is no quality assurance section structure in GEFM.

5.2. Conclusion

Ethiopian airline has a well-organized and intact quality management system established across all strategic business units. Preventive Maintenance management is a process that allocates and coordinates the resources, including the labor, spare parts and tools to enhance the maintenance performance. However, based on the relative importance index, the most significant factor affecting quality assurance in equipment and facility maintenance is absence of employee's role in the section quality team. The role of employees in quality circle, process improvement team, cross functional team in resolving the section inter departmental issues is found minimal. Although the participation of employees in this regard is the most valuable input in achieving best outcomes of quality assurance in the section activities, the outcome of the survey and the results of interview indicate the practice is not available.

The other outcome of the survey based on relative importance index Is the gaps found on the section policy prescription employees don't have clarity over the policy core values and beliefs about common goal across the strategic business units from this it can be understood that the available policy end procedure manual of the section doesn't have clarity and edginess to be understood by the

employees equivalently like other strategic business unit you need employees it is worth indicating that absence of employees in understanding the core values about the common goals to be achieved as an airline strategic business unit are not well understood.

A factor that has similar significant impact is preforming machine and equipment inventory help to develop preventive maintenance instruction , identify machine with common spare parts and track costs and help determine whether a piece of equipment needs to be replaced.

5.3. Recommendations

This study identified a factor that the managements role and Factors affecting preventive maintenance participation intersection quality team is very significant in affecting the quality assurance implementation in the section the other The other less significant factor are organization policy and structure , spare part controlling and supply in the preventive maintenance quality , knowledge of the job and major factor impact on time performance in equipment preventive maintenance of the section from this the researcher would like to recommend the company to review and incorporate employees quality team rule and participation in its quality policy and strategic objectives for the development of organizational culture and maintenance quality across all strategic business units including GEFM. The gaps in this regard must be addressed well. Based on the observation of the researcher equipment and facility maintenance section is recommended to revise its maintenance and procedure manual to play an important role in improving the gaps and avoidance of factors this also creates an opportunity to enable review and upgrade the section maintenance standards employee's skill which is necessary training for better and the strict implementation of quality

- The section is recommended to create better platform across sections that can build quality circle reorganized a process improvement team to construct strong bondage between cross functional teams this would create opportunity in strengthening the self-managed team and expand the management role and improve quality assurance.
- An important contributing booster for quality assurance is implementation of separate and independent quality assurance audit practice which is widely implemented across the strategic business units. The researcher recommends that such gaps can be alleviated through establishing QA department for the section independently.
- Preventive maintenance training on new machine and equipment's factor for longer life of equipment. The GEFM must give an attention on this training. The researcher recommends including this training in the purchasing package would result a good output.
- The availability of spare parts is highly concerned in preventive maintenance as it can affect the preventive maintenance performance.

In general, the primary requirement in airline industry is safety reliable maintenance quality service would make the section more dependable; therefore, keeping the standards of GEFM per industry requirement would uplift the section recognition and enable Ethiopian Airlines to see other strategic business opportunities in its effort of building aviation alliance across the African continent. The internal audit findings forwarded while conducting the micro audit are bad indications that can potentially lead to decertification of license as well as restriction of permit to fly if neglected.

5.4. Limitations of the study in directions for future researchers

This study was conducted based on the data collected from employees GEFM. The researcher also used survey and interviews to collect data for his input finally the research tried to assess the factors

interrelation based on the factors that have potential impact in affecting quality assurance since there were no similar researches conducted in this regard on the section just can enrich this study by using other data gathering tools like panel discussion, by including more channel members like strategic business units, corporate quality assurance section and other stakeholders in the industry it is possible to pinpoint challenges from each corner moreover further studies can also be conducted by adding more factors which might be crucial in the section activity so that the section can be.

References

Arnaud Lesage (2012) Maintenance & Quality Control

Bij H, Ekert JHW (1999). Interaction between production control and quality control. Int. J. Oper. Prod. Manag. 19(7):674-690.

Bowersox D., Closs D., Cooper B. (2007): Supply Chain Logistics Management. McGraw Hill, 2nd edition,

Budi, H. D. (2014). n empirically verified project risk maturity. *nternational Journal* , 7(2), 263–284. doi:10.1108/IJMPB-03-2013-0015.

Chinchu Mary Jose, A. S. (2017). ritical Factors Influencing Quality Performance . *International Journal of Recent Trends in Engineering & Research*, olume 03, Issue 04; [ISSN: 2455-1457].

Chism, N. A. (2020). Project delivery strategy: Getting it right. *KPMG*, pp.1-24.

Daft, R. L. (2010). New Era of Management (Ninth Edition). . *hina: Translation & Printers*.

DeAngelo L (1981). "Auditor size and audit quality. J. Acc. Econ. 3:183-199.

Defoe, J.A. and Juran, J.M (2010) Juran's Quality Handbook: The Complete Guide to Performance Excellence. McGraw-Hill, New York.

Feigenbaum, A.V. (1991).Total Quality Control, McGraw-hill,Inc, New York, NY.

Goetsch, David L, Stanley Davis, and David L Goetsch. (2010) Quality Management For Organizational Excellence. Upper Saddle River, N.J.: Prentice Hall.

Goetsch, D. L. (2018). Psychological empowerment and its relationship to trust in immediate managers. *Upper Saddle River, N.J.*, 23-43.

Goetsch, D. L. (2018). Psychological empowerment and its relationship to trust in immediate managers. *Upper Saddle River, N.J.*, 23-43.

Goetsch, D. L. (2020). The art of making quality certain. *McGraw-Hill, New York.*, 45-56.

Graeme Knowles (2011) Quality Management. Ventus Publishing

Gronroos C (1984). A service quality model and its market implications. European J. Mark. 18(4):36-44.

Hairulliza Mohamad Judi, Ruzzakiah Jenal and Devendran Genasan(2011) QualityControl Implementation in Manufacturing Companies

HELM (VERSION 1:April 8 2004):Workbook Level 1

http://www.ethiopianairlines.com [Accessed 10th January, 2017]

http://www.iso.org/iso/iso_9000_selection_and_use-2009.pdf [Accessed 10th January, 2017]

https://en.oxforddictionaries.com/definition/quality [Accessed 10th January 2017]

Ihde B., Lucas G., Merkel H., Neubauer H. (1984): Ersatzteilogistik, hussverlag, M¨unchen,

Knowles, G. (2021). Quality Management. *Ventus Publishing*, 543-567.

Lewis RC, B. B. (2019). The marketing aspects of service quality. *Emerging Perspective Service. Mark*, . pp.99-107.

Lewis RC, B. B. (2019). The marketing aspects of service quality. *Emerging Perspective Service. Mark*, . pp.99-107.

Lewis RC, Booms BH (1983). The marketing aspects of service quality. Emerging Perspective Service. Mark. pp.99-107.

Lian TKF (2001), Determinants of total quality management (TQM) implementation and impact:

Macášek, F. R. (2014). MEMBRANE EXTRACTION IN PRECONCENTRATION OF SOME URANIUM FISSION PRODUCTS. *Solvent Extraction and Ion Exchange,*, 2(2), 227–252. https://doi.org/10.1080/07366298408918446.

Macášek, F. R. (2014). MEMBRANE EXTRACTION IN PRECONCENTRATION OF SOME URANIUM FISSION PRODUCTS. *Solvent Extraction and Ion Exchange,*, 2(2), 227–252. https://doi.org/10.1080/07366298408918446.

Palmrose Z (1986). Audit fees and auditor size: further evidence. J. Acc. Res. 24(1):97-110.

Parasuraman A, Zeithaml VA, Berry LA (1985). "A conceptual model of service quality and its implications for future research", J. Mark. 49:41-50.

Pfohl H.Chr. (1990) Logistiksysteme, betriebswirtschaftliche Grundlagen, 4.Aufl, Springer, Berlin Heidelberg New York,

Richard L. Daft, P. G. (2014). Management, Twelfth Edition, Cengage. *Cengage*, 45-56.

Richard L. Daft, P. G. (2014). Management, Twelfth Edition, Cengage. *Cengage*, 45-56.

Ridley J (1994). Does Quality Control Services? TQM Mag. 6(6):17-18. Simunic D (1984). Auditing, consulting, and auditor independence. J. Acc. Res. (Autumn) pp.679-702.

S. ANIL & N. SURESH (2008) PRODUCTION AND OPERATION MANAGEMENT SECOND EDITION. Published by New Age International (P) Ltd., Publishers Siew-Phaik Loke, Ayankunle Adegbite Taiwo, Hanisah Mat Salim, and Alan G. Downe, International Conference on Financial Management and Economics, IPEDR vol.11 (2011) © (2011) IACSIT Press, Singapore

S.Oakland, J. (2014). Total Quality Management and operational Excellence, Fourth. *Routledge*, 12-24.

S.Oakland, J. (2014). Total Quality Management and operational Excellence, Fourth. *Routledge*, 12-24.

Stevenson, W. (2005) “Operations Management”, 8 editions. Irwin McGraw-Hill. New York,

Stevenson, W. (2015). “Operations Management”, 8 editions. Irwin McGraw-Hill. . *Irwin McGraw-Hill.*, 34-60.

Stevenson, W. (2015). “Operations Management”, 8 editions. Irwin McGraw-Hill. . *Irwin McGraw-Hill.*, 34-60.

TKF, L. (2022). Determinants of total quality management (TQM) implementation. *University of Georgia*, 57-86.

TKF, L. (2022). Determinants of total quality management (TQM) implementation. *University of Georgia*, 57-86.

Wang, Y. D. (2017). Customer awareness, intention and loyalty toward innovative product ‘PureWater’: An empirical study. *Journal of Interdisciplinary Mathematics*, 20(6–7), 1527–1531. https://doi.org/10.1080/09720502.2017.138220.

Wang, Y. D. (2017). Customer awareness, intention and loyalty toward innovative product ‘PureWater’: An empirical study. *Journal of Interdisciplinary Mathematics*, 20(6–7), 1527–1531. https://doi.org/10.1080/09720502.2017.138220.

Weigl, M. G. (2016). Kinetics of Americium(III) Extraction and Back Extraction with BTP. *olvent Extraction and Ion Exchange*, 24(6), 845–860. https://doi.org/10.1080/07366290600948582.

Weigl, M. G. (2016). Kinetics of Americium(III) Extraction and Back Extraction with BTP. *olvent Extraction and Ion Exchange*, 24(6), 845–860. https://doi.org/10.1080/07366290600948582.

William A. Levinson, 2. L. (2013). Lean Management System LMS: 2012, First Edition,. *Taylor and Francis Group, LLC*, 85-90.

Wouldiam A. Levinson, 2. L. (2013). Lean Management System LMS: 2012, First Edition,. *Taylor and Francis Group, LLC*, 85-90.

Z., P. (2022). A conceptual model of service. *J. Mark.*, 41-50.

Z., P. (2022). A conceptual model of service. *J. Mark.*, 41-50.

Appendix I

Questioners for respondents

Letter of consent to participate in research.

Dear Sir/Madam

My name is Tewodros Assata, I am a post graduate student St. Mary's university in the department of Project management and currently, I am doing research on "Factors affecting quality assurance on preventive maintenance practice: in the case of Ethiopian Group equipment and facility maintenance" for the partial fulfilment of Master of Art Degree in Project Management. You are requested to participate in this research by filling the following questionnaires.

The outcome of the research would be very important for the company, researchers and policy makers. Accordingly, your response is highly valuable, and participation is completely voluntarily.

The report of the study would only be communicated in aggregate form to protect the respondents and the study would be used only for academic purpose.

Part I

1. Gender
   1.1. Male □ Female □
   1.2. Service year in the section
   □ < 5 years □ 5-10 Years □ 10 – 15 Years □15 and above
   1.3. Educational Background
   □Diploma □ Degree □ Masters □Others(Specify)……..
   1.4. Position
   □Team leader □ Maintenance Team □ Inspector □Engineer

1.5. Division

□Group GSE/GTV Maintenance □Facility Maintenance □Support Service

1.6. What type of maintenance management practice is carried out in the company?

□Préventive maintenance □Corrective Maintenance □Routine maintenance

Part II

1. Take a few minutes to give your most considerate answer. Mark (□) on the points you agree.

Organization Policy and structure.						
	Mark (✓) on the points you agree.	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
1	Maintenance planning starts from clear understanding and reviewing of the company's corporate strategy.	□	□	□	□	□
2	Planning activities focus to meet the organization's objectives effectively	□	□	□	□	□
3	The goals are accomplished through the framework of rules and relationships provided by the organizational structure.	□	□	□	□	□
4	Organizational structure guide and clarify activities of everyone in the organization	□	□	□	□	□
5	The preventive maintenance documents and manuals are updated whenever there are machines and equipment are bought and replaced	□	□	□	□	□
6	The Organization has grouped machines according to their function (e.g. power generations and distribution, water treatment, pumps fire and safety…etc.)	□	□	□	□	□
7	The Company avails policy and procedure manuals to guide maintenance operations and workflows	□	□	□	□	□
8	There is established controlling systems status for new and revised policy documents.	□	□	□	□	□
9	The goals are accomplished through the framework of rules and relationships provided by the organizational structure.	□	□	□	□	□

10	Access to the organizational structure allows for formal management and coordination of section activity.	☐	☐	☐	☐	☐
Spare Part Controlling in the preventive maintenance quality						
11	There is enough spare parts inventory to do preventive maintenance program	☐	☐	☐	☐	☐
12	The organization is using computerized inventory system	☐	☐	☐	☐	☐
13	The organization has a numbering system for every machine for identification	☐	☐	☐	☐	☐
14	The inventory system can identify spare parts obsolesce (no more available)	☐	☐	☐	☐	☐
15	Quality of spare parts and materials provided for maintenance	☐	☐	☐	☐	☐

Management role.						
	Mark (✓) on the points you agree	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
		1	**2**	**3**	**4**	**5**
16	The management is committed for preventive maintenance execution.	☐	☐	☐	☐	☐
17	Management effort in develop of attitude of employees to perform and understand the maintenance tasks very well.	☐	☐	☐	☐	☐
18	Management influence exerted over employees in creating quality culture	☐	☐	☐	☐	☐
19	Management influence on employees to enable employees understand and agree about what and how to do.	☐	☐	☐	☐	☐
20	There is management facilitation for individual and collective efforts to accomplish shared objectives and to keep corporate culture	☐	☐	☐	☐	☐
Task Execution and Teamwork						
21	Group work occurrence across employees in working together to achieve a goal.	☐	☐	☐	☐	☐
22	There is mutually supporting employees' relations targeted toward common goal	☐	☐	☐	☐	☐
23	Acknowledging specific people in the section as they express their opinions	☐	☐		☐	☐

24	Team cooperation has increased effectiveness of Teamwork in the section.	☐	☐	☐	☐	☐
Knowledge of the Job						
25	There is lack of proper follow-up on Equipment's Preventive or Scheduled maintenance.	☐	☐	☐	☐	☐
26	There is failure to use equipment's Operating manual.	☐	☐	☐	☐	☐
27	There is Lack of Latest tools and advanced maintenance system	☐	☐	☐	☐	☐
28	The organization has a numbering system for every machine for identification	☐	☐	☐	☐	☐
29	There is Lack of skilled Technicians	☐	☐	☐	☐	☐
30	There is Lack of suitable work environment	☐	☐	☐	☐	☐

Preventive maintenance quality						
	Mark (✓) on the points you agree.	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
31	Lack of required training	☐	☐	☐	☐	☐
32	Unavailability of proper maintenance manuals & parts catalogue	☐	☐	☐	☐	☐
33	Failure to use equipment's maintenance manual.	☐	☐	☐	☐	☐
34	Unavailability of spare parts when needed.	☐	☐	☐	☐	☐
35	Inadequate inspection while equipment delivery and takeover	☐	☐	☐	☐	☐
36	Urgency of the equipment needed for the operation (Short Maintenance time frame)	☐	☐	☐	☐	☐
37	The preventive maintenance program is audited timely.	☐	☐	☐	☐	☐
38	Performance of preventive maintenance meets accepted standards and reliable.	☐	☐	☐	☐	☐
39	The overall structure of the Maintenance department is logical to accomplish preventive maintenance program.	☐	☐	☐	☐	☐
40	Critical machines and equipment have preventive maintenance done as per the schedule	☐	☐	☐	☐	☐
Major factors impact on-time performance in Equipment preventive maintenance.						
41	Lack of proper maintenance standards and Procedures	☐	☐	☐	☐	☐
42	Employees engages breakdown or Unplanned maintenance	☐	☐	☐	☐	☐
43	Users not woulding to release the machines for preventive maintenace	☐	☐	☐	☐	☐
44	Lack of capability	☐	☐	☐	☐	☐
45	High turnover of senior Technicians	☐	☐	☐	☐	☐

Appendix II

2: Interview questions

Interview questions for the supervisor

1. Does your section have policies and procedure manuals accessible to direct strategy, operations, maintenance, and quality in accordance with industry standards? Does the section also have a regular, independent self-audit plan as per your quality policy manual?
2. How frequently do you provide preventative maintenance training to your staff? Do you award certificates to those who complete training?
3. In your opinion, is maintenance department manpower is satisfactory in terms of quantity(number) and quality (education and experience) to accomplish preventive maintenance program.
4. Do you agree that Spare part and Materials management and supply have impacted the maintenance Quality and performance?
5. The goal of the quality control program was achieved. Is the management provided with a timely calculation of efficiency?
6. How would you rate the preventive maintenance program? Do you have quality control(audit) on your preventive maintenance program?
7. Do you agree that there is transparency in exchange of facts, ideas, suggestions, and emotions across the section?
8. Do you have easy access of Maintenance data supported by IT?
9. Is the leadership influence on Employees has shaped the maintenance Quality Culture positively?