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Safety Management System Practice in Ethiopian Airlines Maintenance Repair and Overhaul (MRO) Base Maintenance

By

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A Project Work Submitted to the School of Graduate Studies of AAU in Partial Fulfillment of the Requirement for the Degree of Master of Arts in Project Management

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APPROVAL SHEET

This MA thesis entitled with "Safety Management System Practice in Ethiopian Airlines Maintenance Repair and Overhaul (MRO) Base Maintenance" has been approved by the following examiners in partial fulfillment of the requirement for the degree of Master of Art in Project Management.

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STATEMENT OF DECLARATION

I, the undersigned, declare that this research paper entitled with "Safety Management System Practice in Ethiopian Airlines Maintenance Repair and Overhaul (MRO) Base Maintenance" is a result of my own investigation, except all sources of materials used for the study have been duly acknowledged. I conducted the research on my own, with the advice and help of my research advisor. Other sources have been recognized with citations that lead to more resources.

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STATEMENT OF CERTIFICATION

This is to certify that Asbe Dagnachew Fisiha has conducted this project work entitled "Safety Management System Practice in Ethiopian Airlines Maintenance Repair and Overhaul (MRO) Base Maintenance" under my supervision.

This is an original project work and suitable for the submission in partial fulfillment of the requirement for the award of Master of Arts Degree in Project Management

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Acknowledgment

I would like to express my sincere gratitude to my advisor Dr. Zegeye Muluye (PhD) for his constructive comments, guidance and suggestions contributed in this study. My gratitude also belongs to the whole community of Ethiopian Airlines in general, and MRO Base Maintenance section in particular, for being cooperative to the success of this project research by permitting and spending their precious time to the study to be conducted.

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ABSTRACT

Aviation industry from its nature it is one of the safety demanding sectors. This safety demand has been addressed by implementing different safety measures throughout the aviation history. Currently safety management system is in place in the aviation sector as a safe guard of safety. The goal of this research is to assess the current practice of the safety management system in Ethiopian Airlines Maintenance Repair and Overhaul (MRO) section especially the case of base maintenance. Descriptive method of analysis is applied for conducting the research; both primary and secondary data sources for the study. Quantitative research approach is taken for this research, and questionnaires were distributed to 298 sample population with a return rate of 76.5% for primary data collection. Secondary data are collected from different books, literatures, journals, and reports. The collected data was analyzed using descriptive statistics focusing on frequency, percentage and mean value. These results were generated using the statistical program for the social sciences (SPSS) version 26 and MS excel. The safety management system practice was assessed by taking four of its pillars separately with their elements, and assessing the practice of each of them independently. The finding shows that there is good overall safety management practice in the MRO. But there is also lots of room for improvement in the overall SMS practice specifically the fourth pillar, education and communication should be enhanced to improve its contribution to the overall safety management system practice in the MRO.

Keywords: Maintenance repair and overhaul, Base Maintenance, Safety Management System pillars, SMS Practice in MRO, ICAO

ABBREVIATIONS

ATM- Air Traffic Management

ANSP- Air Navigation Service Providers

ATO -Air Traffic Organization

CANSO- Civil Air Navigation Services Organization

EASA- European Aviation Safety Agency

ECAA - Ethiopian Civil Aviation Authority

ECARAS- Ethiopian Civil Aviation Rules and Standards

EI-Effective Implementation

ERP- emergency response plan

FAA-Federal Aviation Administration

GASP- Global Aviation Safety Plan

ICAO- International Civil Aviation Organization

MRO - Maintenance, Repair and Overhaul

MROHRM- Maintenance, Repair And Overhaul Human Resource Management

OECD- Organization for Economic Co-Operation and Development

RASG-AFI- Regional Aviation Safety Group for Africa

SA- Safety Assurance

SMS- Safety Management System

SPSS- Statistical Package for Social Science

SPT- Safety Performance Target

SRM- Safety Risk Management

SSO- State Safety Oversight

TQM-Total Quality Management

TWA - Trans World Airlines

USOAP -Universal Safety Oversight Audit Program

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CHAPTER ONE

INTRODUCTION

The introduction part of the research will be presented under this chapter. Specifically, the research background, problem statement, research objectives, research questions, purpose of the study, limitation and scope of the research, and organization of the research will be discussed in this chapter of the research.

1.1 Background of the Study

Since aircraft flies thousands of feet above the ground, and with a speed of hundreds of miles per hour, this especial feature gives air transportation higher risk when compared to other modes of transportation. But unlike this risky nature it is the safest form of long-range transportation system with number of accidents per million departures being 2.14 (ICAO, 2021). But apart from the accidents, which result in fatality to the passengers and total loses to the aircraft; there are also minor to major accidents that can be cause for human injuries and material damage.

Suspension of concorde aircraft not to fly again, grounding of different aircraft models including the recent new aircraft B737 MAX until all the remedial actions have been taken, and get the required airworthiness are examples of action taken in the aviation to increase its safety. Safety cannot be compromised in the aviation industry since the consequence is mostly irreversible and catastrophic.

Matthew Syed (2015) describes how the aviation world becomes the safest by learning from each incident/accident and taking lesson for its future. He compares the avoidable medical errors happening in the United States as if it is to be like two B747 crashing every day or 911 occur every two months.

Air transport is considered the safest way to travel, even with rapid growth in air traffic demands, and technological developments which have resulted in complex aircraft systems. To maintain safety into the future, novel programs and tools will play an

increasingly important role in enhancing aviation safety and reducing safety occurrences. In its history of operation, the aviation industry has done a lot to eliminate avoidable errors by employing several approaches, the most recent of which is SMS.

But the concern of aviation SMS is not only about accident happening on air, and catastrophes that becomes breaking news on media, it also take care of every minor accident and actions that may lead to human injury or material damage. Every incident/accident is investigated for the root cause and information distributed for every concerned body to take the required corrective action and take lesson for the future. Apart from providing corrective action and taking lesson from incidents that happened, the current safety attitude goes to proactive form of accident prevention. Unlike its predecessors that were taking reactive actions as a safety net, safety management system mostly concerned on the proactive and predictive measures.

Ethiopian Civil Aviation Authority the signatory representative of ICAO for Ethiopia, enforces the implementation of rules and recommendations of ICAO. Under ECARAS part 23 sub sections 3, approved maintenance organizations are required to have SMS in place (ECAA, 2019). The intention behind SMS implementation is for monitoring the compliance with regulatory requirements rules and standards, company policy, procedures and operator ‘s manual system, as well as any other standards set by the operator or the authority to ensure safe operations and the airworthiness of the aircraft (ECAA, 2013).

Maintaining the excellent safety record of Ethiopian Airlines is one of the core areas on its 2025 strategic plan (Ethiopianairlines, 2009). Safety management system should be addressed and managed in all areas of the air operator activities; such as flight operation, maintenance of aircraft, customer/passenger handling, cargo handling and ground handling activities etc. However, the focus area for this paper will be on the maintenance and repair section specifically Ethiopian Airlines Maintenance Repair and Overhaul (MRO) Base Maintenance.

1.2 Background of the Organization

Ethiopian Airlines the country flag carrier founded on 21st December 1945 with the help of Trance World Airlines (TWA). Moreover, it commenced operation on April 8th 1946 with a weekly flight between Addis Ababa to Cairo via Asmara (EthiopianAirlines, 2022).

Having the motto of "Bringing Africa Together and Beyond", Ethiopian Airlines has created a link to 62 African cities as well as 127 international cargo and passenger destinations (EthiopianAirlines, 2022). Ethiopian Airline is a member of star alliance the world largest airline network. The outstanding service in the commercial aviation sector makes Ethiopian Airline a multi-award-winning airline.

After a decade from Ethiopian Airline establishment, in 1957 Ethiopian Airlines Maintenance Repair and Overhaul (MRO) established. Ethiopian MRO the Ethiopian Airlines maintenance division performs maintenances starting from the preflight inspection to major maintenances and modifications, like passenger aircraft to cargo conversion that is undergoing now. The MRO is not only saving the hard currency by performing Ethiopian Airline fleets in house, but it also generates foreign currency by providing maintenance service to third party aircrafts, engine and aircraft components. The MRO has approval from ECAA, FAA and EASA to perform different levels of maintenances. It is Africa's largest MRO service, serving the Middle East and Africa. The MRO is fully furnished with the facilities needed to perform overhaul of aircraft, engine and component maintenance (EthiopianAirlines, 2022).

Line maintenance, base maintenance, component maintenance, and engine shop are the major divisions under the maintenance section of Ethiopian Airlines. From the listed maintenance sections for this paper, I will focus on the MRO Base Maintenance, where mostly aircraft heavy maintenance, overhaul and repair are performed. Ethiopian MRO has a total of 2959 employees; from these 1161 employees are working under MRO base maintenance as of April 2022 (MROHRM, 2022)

1.3 Statement of the Problem

Aircraft maintenance is the one highly responsible for the airworthiness of an aircraft and it plays the major role in accident reduction, which makes the air transportation the safest.

Maintenance safety is the major component of overall aviation safety: “Safety in the air begins with quality maintenance on the ground” (Key, 2014). And apart from the safety on the air, ground operation requires implementing safety measures. Aircraft maintenance is performed within high time constraint since aircrafts are required to be on air to generate revenue as much as possible. SMS is a well-organized procedure that mandate companies to handle safety at the same level of importance to other core business processes.

Aircraft accident rates can be reduced and, stakeholders in the air transport industry can get a strong incentive by implementing SMS. However, reaping the benefits of SMS requires evaluating the practice of implementation, and taking measure on those deficient areas. The below global, national, and organizational accident/incident reports suggest that there is some gap on the implementation of SMS.

Measuring the accidents that did not happen is impossible, and it makes challenging to measure the impact of SMS. SMS implementation period being relatively short, and a low baseline accident rate that result difficulty to draw meaningful conclusions due to cyclical fluctuations makes establishing a ‘before’ and ‘after’ SMS comparison of accident rates problematic (Fox, 2009). However, it is possible to identify shortcomings in risk management practices that may have contributed to an incident or accident.

As per the data IATA 2021 annual review presented by Walish and Willie (2021), the number of accidents per on million flights was 1.71. This was higher when compared to the five year (2016-2020) average rate of 1.38 accidents /million flights. Both jet and turboprop hull losses have increased in 2020 to 0.21 and 1.59 when compared to the five average of the year (2016-2020) which is 0.20 and 1.07 respectively.

As presented in the ICAO safety report (2021) that shows the fatality trend in the air transportation from the year 2016 to 2020, even if there are ups and downs in the graph the recent figure shows increment of the fatality trend, where number of fatalities increase from 239 fatalities in 2019 to 298 in 2020.

On the other ICAO 2021 safety report regarding fatality and accident rate for the year 2009- 2019 even if there is some improvement from the starting year, the accident rate is increasing for the year 2016 to 2019 continuously.

Effective implementation (EI) is shown as a percentage of function performed by a state to ensure that individuals and organizations perform an aviation activity with safety related national lows and regulations, which is a unit of measurement for the State's safety oversight capability. On the Effective Implementation (EI) of State Safety Oversight (SSO) System posted by the 2019 ICAO safety report, Ethiopia is under 75% implementation, (ICAO, 2019). 75% is the target value set by ICAO to be reached by 2022 in all contracting states. Even if this data is for the whole operation in the country, not specific for Ethiopian airlines and the MRO in particular it tells the SMS practice development of aviation operators in the country. ICAO recommends all states to improve their score for the effective implementation (EI) and set the following targets to be achieved by contracting states;

- 75% by 2022
- 85% by 2026 and
- 95% by 2030.

As indicated in the safety report of Ethiopian airlines (2021) air turn back/ diversion data per 10000 flights per one year shows as it doesn't meet the set safety performance target (SPT). The target set being 0.5 flight diversion/ air turn back per 10000 flights, but it is above 1.0 for some category of the airline fleets. it also shows increment rather than reduction for some fleets. As presented in the MRO air turn back per fleets ratio the number of air turn backs encountered from July to February for the season of 2020/2021 and 2021/2022 the total air turn backs are equal, that means no reduction or improvement have been observed.

Based on the above listed shortcomings presented about the aviation safety records in the international, national and organizational level, we can see that the reduction in accident rate is little and even it is raising both for the global and national level on some parameters. On the current aviation industry reduction and avoidance of accidents and incidents is assumed to be achieved by implementation of SMS. To know gapes that makes accident incident reduction difficult, assessing the practice of SMS implementation is crucial, which intern help to take action on areas which needs improvement.

1.4 Research Questions

The primary goal of this research is to answer the basic research question: "What is the practice of SMS implementation at Ethiopian Airlines MRO Base Maintenance?

Based on this basic question, the study has the following sub questions which focus on the four pillars of SMS and assessing them in the MRO SMS practice:

1. What is the practice of safety policy and objective in the MRO?
2. What is the practice of safety risk management in the MRO?
3. What is the practice of safety assurance in the MRO?
4. What is the practice of safety promotion in the MRO?

1.5 Objective of the Study

1.5.1 General Objective

The overall objective of this research is to assess the safety management systems practice of Ethiopian Airlines MRO specifically the base maintenance section.

1.5.2 Specific Objectives

Based on the general objective, this research has addressed the following Specific objectives:

- Assessing the practice of safety policy and objective in the MRO.
- Assessing the practice of safety risk management in the MRO.
- Assessing the practice of safety assurance in the MRO.
- Assessing the practice of safety promotion in the MRO.

1.6 Significance of the Study

The study could have the following significance:

- The study will examine the current SMS in Ethiopian Airlines MRO base maintenance section, and the findings of the study may assist the MRO to improve its SMS practices.

- Other sections of Ethiopian Airline MRO, different divisions of Ethiopian Airlines those implementing SMS, and private airlines operating within the country can take some lesson from this research regarding SMS implementation.
- It may serve as a starting point for additional research into the practice of SMS, particularly in Ethiopia's aviation sector.
- Other sector also can take lesson from the safest aviation industry about implementing SMS, and its contribution towards their safety record as well as improvement and increase of their profitability.

1.7 Scope of the Study

Even though safety management system has been practiced in different air operators in the country, and also on other division of the Ethiopian airlines, and other sections of the MRO, due to finance, time and labor constraints the study is limited in scope. Accordingly, the study area is limited to Ethiopian Airlines MRO Base Maintenance section where major aircraft maintenance is performed. The research is limited on assessing the practice of SMS and will work specifically on the four pillars of SMS with their elements.

1.8 Limitation of the Study

The limitation of the research is that the data is collected only from Ethiopian Airline MRO base maintenance employees, and the result may not represent the SMS practice of the airline as a whole.

1.9 organization of the Study

The paper is organized under five chapters. The first chapter is the introduction part of the study and includes statements of the problem, research problem, research objectives, significance of the research, limitation and scope of the study. On the second chapter different literatures regarding SMS practice will be addressed. The third chapter deals with the research design, target group and sampling techniques, data collection, and analytical techniques it states the methodology used to for data collection and analysis.. The outcomes or results and discussion are presented in chapter four. The final chapter focuses on a review of the observations, conclusions and suggestions or recommendation.

1.10 Definitions of Terms

- **Accidents** – an unplanned event or series of events that results in death, injury, occupational illness, damage to equipment or property or environment.
- **Aircraft Operator** – Person or Organization owning one or more Aircraft that are bought owned, leased and used for charter, private business, scheduled or nonscheduled operations.
- **Airworthiness of aircraft**- when an aircraft, engine, propeller, or part conforms to its certified design and is in a safe operating condition.
- **Aviation** - The activities around mechanical flight and the aircraft industry are referred to as aviation. For the case of this paper, I focus on the commercial aviation industry.
- **Hazard** -Any existing condition that can lead to death, injury or illness to people; damage to or loss of a system, equipment, or property; or damage to the environment.
- **Incident** – a near miss event with minor consequences which may have resulted in greater loss.
- **Safety management system-** A systematic approach to safety management, including the required controls, policies, procedures, accountabilities and organizational structures.
- **Safety oversight**- A state's function of ensuring that individuals and organizations engaged in aviation activities are safe and adhere with safety-related laws and regulations of the country.
- **Safety performance indicator**- A data-based measure utilized in assessing and monitoring safety performance.
- **Safety–** state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The works of various authors and academics regarding SMS in the aviation sector will be covered in this chapter, which leads to the conceptual frame work development. Definition of SMS, its historical back ground, legal back ground from international to local regulators which make implementing SMS mandatory or give recommendation for its implementation, its four pillars with their twelve elements, benefits gained from implementing SMS, factors affecting its implementation, level of SMS implementation, and methods used for SMS gap analysis and safety culture will be addressed in this chapter.

2.2 Theoretical Literature Review

2.2.1 Safety Management System (SMS)

In the complex and rapidly changing aviation environment air operators are facing an increased pressure on the operational as well as financial side. The secret to success in such environment is safety management system (SMS), which is a collection of procedures, that is combination of technical and operational system with human resource and financial management (Roland Mu¨ller, 2014). SMS is a collection of procedures, guidelines and a set of process to ensure safety performance. Paul R. Snayder and Gray M. Ulrich (2013) define SMS as it is formal, top down, business-like approach for safety risk management, which comprises a systematic method to manage safety, having the required accountabilities, organizational structures, procedures and policies (Paul R, 2019).

Compliance with rules was the primary focus of traditional methods to safety management. Reactions in the aftermath of accidents and incidents and a ‘blame and punish’ philosophy have been identified as inadequate to reduce accident rates (ICAO, 2018). On the contrary the intention of a SMS is to develop and sensitize the company away from a reactive to a proactive generative safety culture in order to identify possible

incidents and hazards before they can occur. SMS aims at continual enhancement of the overall degree of safety while measuring performance, analyzing processes to becoming an integral part of the company's business management activities and corporate culture. As a result, implementing SMS necessitates the development of processes that allow for the management of safety hazards as well as the introduction of the notion of an acceptable degree of safety (Roland Mu¨ller, 2014).

2.2.2 Historical Backgrounds of Safety Management System

Historical perspective of SMS evolution in the aviation industries will be covered in this section. The prevalent safety principles and the disciplines that nourished the prevailing safety principles, from which SMS would later emerge will be discussed.

The aviation SMS does not have a set start date; rather, it is the result of an evolutionary process. Daniel Maurino (2017) states that prior to the implementation of SMS, there have been three defined separate activities that have been implemented; includes: technical, system safety, human factor and business management. According to ICAO Doc.9859 (2018) the evolutionary process of SMS includes; technical era, human factor era, business management era and total system era.

2.2.2.1 Technical Era

Before SMS have been introduced to the aviation sector in the 1950s space exploration, the term system safety has been used which focus on fly-fix-fly approach to aircraft and space craft design. ICAO categorize this period starting from 1900 to 1950s as the technical era, where focus of safety endeavors was placed on the investigation and improvement of technical factor (ICAO, 2018). During this time, safety issues were caused by technical issues and technological breakdowns. In this era safety was largely concerned with accident investigation, which is a very reactive procedure.

2.2.2.2 System Safety Era

As per the paper presented for international transport forum by Daniel M., system safety has been introduced in 1950s that replace the fly- fix- fly system used before (Maurino, 2017). System safety is an engineering field that can be characterized as "safety by

design," in which technical systems are made safe by "designing" safety into them during the development process: The system is designed to provide safety throughout the full life cycle of the system, including production, testing, operations, and maintenance (Maurino, 2017). On the ICAO doc 9859 this period also called technical era since focus of safety actions was therefore placed on the investigation and improvement of technical factors (ICAO, 2018).

2.2.2.3 Human Factor Era

Since System safety alone can't increase the safety, so in 1970s the human factors have been considered. By the early 1970s focus of safety endeavors was extended to include human factors, including things such as human-human and human-machine interfaces. Despite the investment of resources in error mitigation, human factors continue to be cited as a recurring factor in accident (ICAO, 2018).

2.2.2.4 Organizational Era

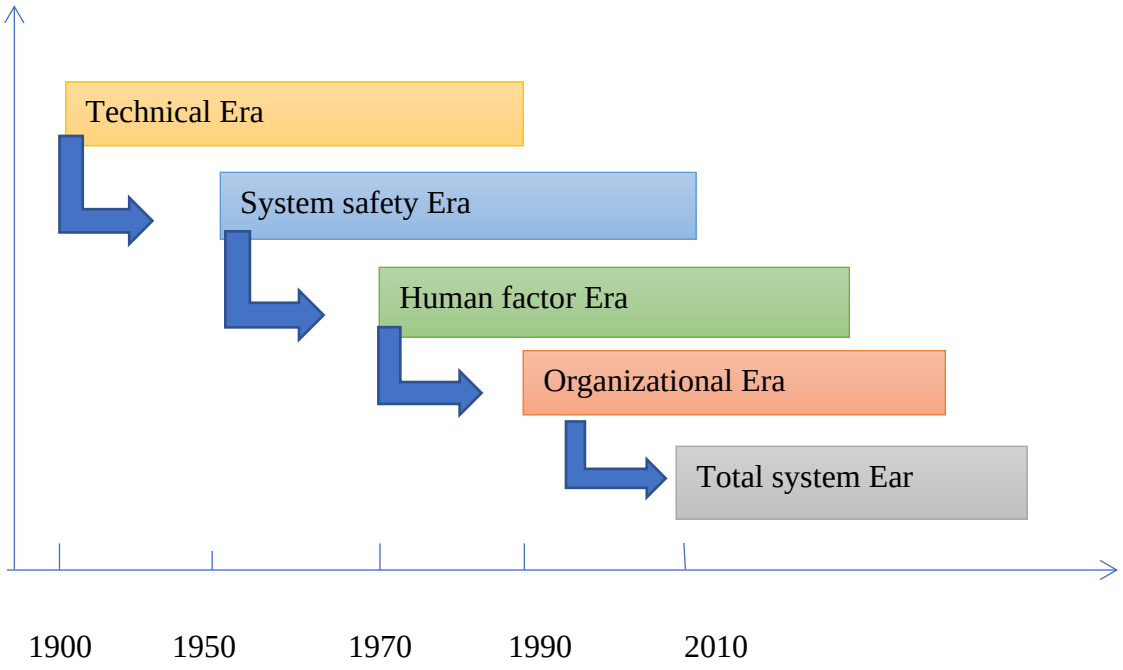
It was not until the early 1990s that it was first acknowledged that individuals do not operate in a vacuum, but within defined operational context. Organizational culture impact and policies about the efficacy of safety risk controls start to be considered in the mid-1990s. Routine safety data collection and analysis utilizing reactive and proactive approaches allowed firms to monitor known safety risks, and detect developing safety trends, laying the groundwork for today's safety management practice (ICAO, 2018). Safety began to be viewed from a systematic perspective, to encompass organizational, human and technical factors.

2.2.2.5 Total System Era

After the start of 21st century, many States and service providers had embraced the safety approaches of the past and evolved to a higher level of safety maturity. And start to implement SMS and are earning the safety benefits (ICAO, 2018). The aviation sector shift itself from the reactive to the proactive era. Total aviation system approach requires all aviation stakeholders and their interfaces to be understood and managed for the purpose of safety performance. In addition, this concept of implementation of safety management by various stakeholders and service providers offers a more proactive approach to safety

compared to the traditionally reactive approaches to aviation safety adopted in the past. SMS have evolved from a combination of concepts in system safety, quality management systems, and other inputs (Eranga Batuwangala, 2018).

Figure 2.1 Historical evolution of SMS



Source: own summary ICAO Doc 9859, (2018)

2.2.3 Legal Back Grounds of Safety Management System (SMS) Implementation

On the International Civil Aviation convention (Chicago Convention) and its annexes responsibility regarding aviation safety given to its individual contracting states. Each state has responsibility for the secure and effective aircraft operations, continuing airworthiness of aircraft, and the licensing and/or certification of personnel (ICAO, 2006). So, from the ICAO to regional and local regulatory bodies all make it implementing SMS crucial to safeguard the aviation safety.

According to ICAO safety management manual ICAO, doc 9859 SMS seeks to protect safety risks prior to resulting aviation accidents and incidents (ICAO, 2018). States, who implement safety management, may coordinate their safety efforts in a more holistic,

disciplined and focused manner. Having a comprehensive knowledge of the role of SMS, and how it contributes to safe operations allows a state and its aviation sector to prioritize safety issues, and manage resources more efficiently to achieve the most possible value from aviation safety.

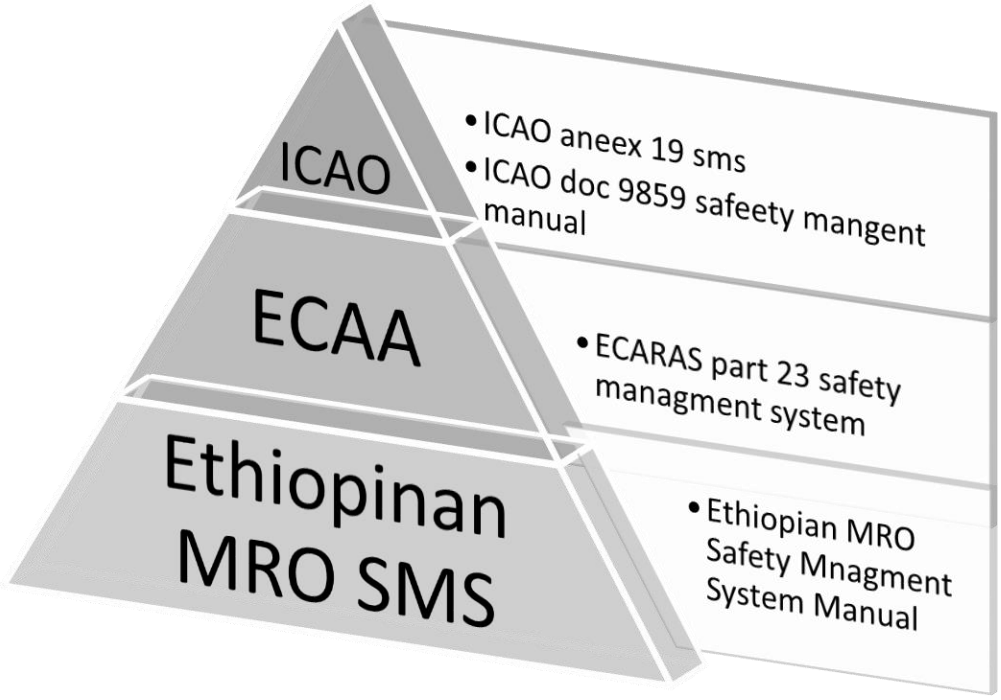
The ICAO Global Aviation Safety Plan (GASP) call for states to put in place strong and sustainable safety oversight systems, and to progressively evolve these into a more complex approach to safety performance management (Alblowi, 2019).

ICAO the specialized agency of the united nation regulates worldwide standardization of international civil aviation practice. As stated on ICAO Annex 19, the service provider must design and maintain methods for verifying the organization's safety performance and validating the effectiveness of safety risk controls (ICAO, 2016). In addition, the service provider's safety performance will be assessed in relation to the SMS's safety performance metrics and targets.

It is the responsibility of ICAO 191 member states to put in to practice the standards and recommendations it provides. For our case, Ethiopian Civil Aviation Authority, which is Ethiopia's counterpart, follows such activities. As per Ethiopian Civil Aviation Rules and Standards (ECARAS) part 23, every aviation service provider in the country is required to develop and implement SMS (ECAA, 2019). As per ECARAS part 23 The following service providers shall implement and maintain a safety management system (SMS) that is appropriate to the size and complexity of the operations authorized to be conducted under its certificate, and the nature of safety hazards and risks related to the operations:

- Approved training organizations (ATO)
- Operators of airplanes or helicopters authorized to conduct international commercial air transport
- Approved maintenance organizations (AMO) providing services to operators of airplanes or helicopters engaged in international commercial air transport
- Air traffic service (ATS) providers
- Operators of certified aerodromes

Figure 2.2 Regulatory bodies from international to organizational on SMS implementation



Source: author, (2022)

2.2.4 Identifying Variables, the Four Pillars of Safety Management System

According to the safety management hand book, SMS implementation has four steps; plan, do, check and act (Warren Askew, 2016). And on ICAO safety management manual they are expressed as the four SMS pillars which are: safety policy, safety risk management, safety assurance and safety promotion respectively (ICAO, 2018). As expressed on ICAO annex 19 (2013) appendix 2, given the minimal requirements for SMS implementation, the framework for the implementation and maintenance of an SMS consists of four components and twelve elements. The four pillars and their elements of SMS will be discussed as below:

2.2.4.1 SMS Pillar I: Safety Policy and Objectives

Safety policy is the documented organizational policy that defines management's commitment, responsibility, and accountability for safety. It identifies key safety

personnel and assigns them responsibilities. Elements of first SMS pillar listed in the below table 2.1.

Table 2.1 Elements of SMS pillar I

Elements of safety policy and objective	**Description**
Management commitment	The safety policy describes the organizational commitment towards safety, the allocation of resources for implementation of the safety policy, the safety reporting procedures, and the delineation between acceptable and unacceptable behavior. The safety objectives form the basis for safety performance monitoring in reflection of the organization's commitment.
Safety accountabilities and responsibilities	Designation of an accountable executive for the implementation and preservation of SMS, the definition of lines of safety accountability in the organization, the definition of management levels with the authority to decide about safety risk tolerability, and the documentation and communication of the safety responsibilities, accountabilities, and authorities in the organization.
Appointment of key safety personnel	Appointment of a safety manager who would be in charge of SMS deployment and maintenance.
Coordination of emergency response planning	Establishment an emergency response plan for accidents and incidents in aircraft operations and other aviation emergencies, which is well coordinated with the emergency response plans of related organizations. ERP coordinates the transition from normal to emergency operation and back to normal operation.
SMS Documentation	Development and maintenance of an SMS manual that describes the safety policies and objectives, SMS requirements, SMS processes and procedures, and the related accountabilities, responsibilities, and authorities.

Source: own summary from ICAO Doc 9859 (2018)

2.2.4.2 SMS Pillar II: Safety Risk Management (SRM)

A process in this SMS pillar composed of describing the system; identifying the hazards; and assessing, analyzing, and controlling risk. SRM includes processes to define strategies for monitoring the safety risk management. Under SRM the below sub parts found:

Table 2.2 Elements of SMS pillar II

Elements of Safety Risk Management	**Description**
Hazard Identification	Creating and maintaining a strategy for identifying dangers with an organization's aviation products or services, which includes both reactive and proactive approaches.
Safety Risk Assessment and Mitigation	Creating and maintaining a procedure that guarantees the safety risks associated with recognized hazards are analyzed, assessed, and controlled.

Source: own summary ICAO Doc 9859 (2018)

2.2.4.3 SMS Pillar III: Safety Assurance (SA)

Safety assurance is a process inside the SMS that verifies that the company satisfies or surpasses its requirements in terms of security performance targets, and that works systematically to determine the efficacy of safety risk controls, analyzing, and evaluating data. Safety assurance ensures that aviation service providers continuously practice their safety program and their safety program continuous to remain effective even as their operating environment changes. Safety assurance is performed through the below elements listed under table 2.3;

Table 2.3 Elements of SMS pillar III

Elements of Safety Assurance	**Description**

Safety Performance Monitoring and Measurement	Safety performance monitoring and measurement focus on assessing the health of the organization. It should include monitoring of external sources of safety information and include participation in regional safety groups.
The Management of Change	There should be process to manage organizational response for hazards introduced from internal or external changes
Continuous Improvement of the SMS	From safety assurance internal evaluation or independent audit regarding organizational health from safety perspective or, on site assessment of operational management system it will provide opportunity for continuous improvement.

Source: own summary from ICAO Doc 9859 (2018)

2.2.4.4 SMS Pillar IV: Safety Promotion

The communication and distribution of information to improve the safety culture, the development and implementation of programs and/or processes that support the integration, and continuous improvement of the SMS. The Air Traffic Organization ATO can communicate and give evidence of successes and lessons learned through Safety Promotion (ATO, 2019).

Table 2.4 Elements of SMS pillar IV

Elements of Safety Promotion	**Description**
Training and Education	Developing and maintaining a safety training program that ensures that the personnel are competent to perform their SMS duties.
Safety Communication	Developing and maintaining formal means for safety communication regarding the SMS, safety-critical information, explanation of safety actions, and changes to safety procedures.

Source: own summary from ICAO Doc.9859 (2018)

2.2.5 Phases of Safety Management System Implementation Practice

Series of phases are employed in the implementation of SMS through its maturity to perform the intended purpose. Some of the common SMS implementation methods with their phases are listed below.

2.2.5.1 Yu (2004) Six Phases of SMS Implementation (Yu, 2004)

As presented by Yu (2004), the following phases are critical for implementation of a successful SMS:

Phase 1: Review safety policy and safety plan. The safety policy, clearly defined and disseminated to all employees, is an integral part of the business strategic plan. Managements show commitment for assigning resources and giving priority for safety issues in the safety policy and plan.

Phase 2: Examine hazard identification and also control plans and make sure involvement of all workers in the process to enhance their ownership to program. There should be clearly defined roles and responsibilities. For those lacking knowledge and skills in identifying and controlling risk training is provided.

Phase 3: Evaluate safety management practices. Employees empowered to work safely and to refuse unsafe jobs. Observing, measuring and analyzing are performed by statistical technique when critical safety-related behaviors are observed and feedback is provided to employees for improving safety. To ensure adequate knowledge and skills to work safely, there should be ongoing education and training.

Phase 4: Clearly described emergency plans, and incident investigation and made it known. Incident investigation and emergency-plan implementation should involve teams with continuous efforts to reduce variation in practices. The costs of both safety and of accidents are calculated and compared.

Phase 5: Analyze safety communication and documentation. Well-planned SMS, hazards recorded documented and communicated to employees. All safety management practices and standards are documented and made available to employees for reference. Safety

teams and safety committees are established, and safety responsibilities and roles are written into work instructions and job descriptions. Employees know their duties regarding safety.

Phase 6: Review safety program evaluation and audits. Safety programs are assessed on a regular basis to ensure that the total quality management (TQM) concept and safety management requirements are being followed. Well-structured audit can serve as useful tools and provide feedback for continuous safety improvement.

2.2.5.2 A Five-Phase Implementation by the Cornerstone Consulting Group:

As initiation of SMS is considered and service providers move toward complete integration of processes, Edwards sets forth a five-phase implementation by the Cornerstone Consulting Group (Edwards, 2002):

Phase 1: Define the engagement in terms of audience, purpose, and the way findings will be used, as these are critical to build the assessment instrument.

Phase 2: Establish an information base which including mission statements, progress reports, program manuals, and formal evaluations. Determining what is most important and target those items is the challenge

Phase 3: Capture individual perspectives of stakeholders through structured interviews with project leaders and other concerned groups. Interviews should offer privacy and time for personal reflection. Analyze achievements, challenges, and elements considered critical by stakeholders should be the goal

Phase 4: report which provide an accurate and informed view regarding the service provider’s status should be prepared and participants should review the document before distributed.

Phase 5: Report should be presented in a formal setting in which participants can reflect and react. This will allow participants to reflect on whether they are following the right course, how others view their efforts and achievements, and necessary changes. This report becomes a crucial instrument for determining the service provider's future direction.

2.2.5.3 The Four Phases of SMS Implementation Outlined by ICAO

The following steps outlined by ICAO in a four-phase implementation of SMS:

Phase 1: During this phase, basic planning and assigning of responsibilities occurs. An implementation team and plan are established and a gap analysis is performed. Key safety personnel will be appointed, training and education planned, and a strong safety communication system put into place.

Phase 2: This phase consists of implementing crucial safety management processes while correcting possible deficiencies in safety management processes. Safety policies will be developed and communicated, accountabilities established, the emergency response plan (ERP) coordinated, and an SMS documentation system is set up and made operational.

Phase 3: The objective of Phase 3 is to establish safety risk-management processes. By the end of this phase, the organization will be ready to collect safety data and perform analyses based on information found. This phase involves managing change and developing processes and documentation.

Phase 4: This phase includes the mature deployment of safety risk management (SRM) and safety assurance (SA). All of the above elements are completely implemented, including management commitment and accountability, danger identification, safety performance monitoring and measuring, training and education, and safety communication.

2.2.6 Tools Used to Assess Safety Management System Implementation Maturity Level

Embarking on the implementation of state safety program performing a gap analysis before SMS will allow an organization to identify the gap between the current processes and organizational structures, and those required for effective SMS operation. A study of the Universal Safety Oversight Audit Program (USOAP) protocol questions, which are considered the core of the SSP (ICAO, 2018).

According to ICAO doc 9859 soon after the key components and elements of the SSP or SMS are implemented, periodic assessments on the level of implementation should be

conducted to monitor how effectively it is working (ICAO, 2018). As the system develops, the organization should seek assurance that it is operating as planned and is effective at achieving its stated safety targets and objectives. It takes time for safety management to mature, so the aim should be to maintain or continuously improve the safety trend of the organization.

Based on the gap analysis performed, the organization level of SMS implementation can fail in one of the following, and based on the current level of implementation the company will work to take it to the next higher level.

Table 2.5 Summary of level of SMS implementation

Level of implementation	Definition
No Action	No Action has been taken on this required element.
Action Initiated	Actions to achieve the criteria have been identified, but they are not yet complete.
Implemented	Observable activities in policies, procedures, organizational actions, and employee actions are sufficient to achieve this criteria.
Integrated	This important SMS feature has been integrated with the rest of the organization's SMS features and requirements.
Evaluated and sustained	Other SMS Elements have been integrated with this necessary element. This aspect has also undergone at least one previous cycle of evaluation/audit, and there is proof that the needed steps have been maintained throughout time. Furthermore, there are no obvious reasons why the program should not be continued.
State of the Art	Conformance with this requirement of the standard is considered state of the art; they could be used as a benchmark for other organizations to use.

Source: (Howell, 2019)

2.2.6.1 ICAO Gap Analysis Check List

The initial gap analysis checklist, provided by ICAO, can be used as a template to undertake the first phase of an SMS gap analysis and can be tailored to the needs of the company. The preliminary data should assist senior management in estimating the scope of the SMS implementation effort and, as a result, the resources required. This preliminary checklist would need to be followed by a detailed implementation strategy. Based on the ICAO assessment guide line different organizations develop their own gap analysis check list some of which are listed below. (ICAO, 2018)

2.2.6.2 EASA Questionnaire

The European Aviation Safety Agency (EASA) has developed a questionnaire to assess the effectiveness of safety management as part of accepted means of compliance, as well as advice material for the implementation and evaluation of safety key performance indicators. The questionnaire is based on a maturity assessment from EUROCONTROL's Air Traffic Management (ATM) Safety Framework, which was created to help air navigation service providers (ANSP) assess the maturity of their SMS (EASA, 2014).

2.2.6.3 Civil Air Navigation Services Organization (CANSO) Maturity Scheme.

A SMS Standard of Excellence has been developed by the Civil Air Navigation Services Organization (CANSO). For each of the thirty-six SMS objectives, it gives a five-level description of SMS maturity (CANSO, 2015).

According to CANSO SMS maturity pathway there are five levels of maturity. The below are the descriptions and definitions of this levels as set by CANSO

- **Level A –Informal Arrangements**

  SMS requirement or processes have not been agreed at the organizational level; not routinely undertaken or they are dependent on the individual assigned to the task

- **Level B – Defined**

  At this stage SMS requirements and process defined even if not fully implemented, constantly applied and documented

- **Level C- Managed**

  SMS requirements or processes constantly applied and formally documented
- **Level D- Assured**

  At this level there are positive, measured results that can be evidence as SMS process and requirements are being applied appropriately
- **Level E – Optimized**

  International best practice set for SMS process and requirements, and the SMS's effectiveness and initiatives to increase safety are being evaluated and measured against the defined improvement criteria.

2.2.6.4 SMS Maturity Assessment and Refinement Tool (SMART)

SMART tool is developed by using the CANSO SMS maturity scheme and the EASA questionnaire. SMART tool includes nine topics for Safety Policy and Objectives, six topics for Safety Risk Management, nine topics for Safety Assurance, and eight topics for Safety Promotion. For each of these 34 topics, five levels of maturity from A to E are defined, ranging from none or a bare minimum approach for addressing the topic (level A) to a most advanced way for addressing the topic, well beyond what is required (level E).

2.2.7 Safety Culture

IACO doc.9859 (2018) describes safety culture as "how people behave in relation to safety and risk when no one is watching". Both states and service providers are required by ICAO Annex 19 to develop a positive safety culture with the goal of supporting effective SMS deployment.

Teemu Reiman (2013) have identified six dimensions of a good safety culture:

- Safety is a genuine value, taken into account in a decision making and in a daily operation.
- Safety is understood as a systemic and complex phenomenon.
- Hazards and requirements of the core operations are thoroughly understood.
- The organization is conscious about uncertainties, and alert towards possible risks.

- Responsibility is taken for the safe functioning of the entire system.
- Operations are organized in a manageable way; activities are properly performed and the system is manageable.

ICAO Doc 9859 (2018) states that safety culture has higher influence on safety reporting, and safety culture itself influenced by national culture and organizational change. Assessing the safety culture of organizations and working for its improvement will have better contribution in safety management system.

Safety culture consists of four sub-cultures: just culture, reporting culture, informed culture, and learning culture (Lu, 2011).

- **Informed culture**: The personnel in charge of the system are aware of the dangers, and risks that come with day-to-day operations. They possess the necessary knowledge in all areas of human resources and maintenance, as well as environmental and organizational factors that are directly related to safety.
- **Reporting culture**: Reporting is the base for aviation safety improvement, and the basis for a reporting culture is an atmosphere of trust, where people are encouraged to report their errors or near misses.
- **Just culture**: Clear line should be drowning regarding acceptable and unacceptable behaviors, and which unsafe act calls for disciplinary action. Blame free culture should be developed which encourage employees to report safety related information.
- **Learning culture**: 'Lessons learned' must be shared and a company must strive for content improvement to draw the right conclusions from its SMS. It possesses the willingness to challenge its basic assumptions and should change processes when shortcomings have been identified.

2.2.8 Benefits of Safety Management System (SMS) Implementation

A proverb by Leonardo da Vinci says "Knowing is not enough; we must apply. Being willing is not enough; we must do." As per the ICAO SMS manual, by implementing SMS service providers will get the below benefits.

- Strengthened safety culture

- Documented, process-based approach to assure safety
- Better understanding of safety related interface and relationships
- Enhanced early detection of safety hazards
- Safety data driven decision making
- Enhanced communication of safety
- Evidence that safety is a priority
- Possible financial saving
- Improved efficiency
- Cost saving or avoidance

As per Paul Snyder and Gray M. Ulrich SMS should be considered as the main aspects of business management, and by doing so SMS provides for organizations (Paul R, 2019):

- A method for making organized decisions about safety risk management
- A method of proving safety management capability prior to a system failure.
- Increased risk control confidence thanks to a well-structured safety assurance procedure
- A useful interface for sharing information between the regulator and the certificate holder.
- As a framework for promoting safety and fostering a healthy safety culture

Tyler Britton (2019) identified benefits of implementing SMS summarized under table 2.6 below. The benefit of implementing SMS measured from different perspectives like; general safety benefit, financial benefit, benefit for employees and benefit with regard to quality management (Britton, 2019).

Table 2.6 Benefits of implementing SMS

Area of Benefit	**Benefits Gained from Implementing SMS**
General Safety Benefit	• Better safety culture • In the operational environment, there is a higher level of safety. • Better compliance results

	• There will be fewer unsafe situations. • Better safety-decision making • More safety data • Improved safety documentation • Better performance on inspections/audits.
Major Business Benefits	• Better consumer and media perceptions • Higher sales volume • More trust with investors • Better stability • Increased revenue and lower overhead costs • Better norms result from having a higher ratio of long-term employees. • Any organizational changes will be easier to implement. • Better decision-making in the long run • Better ability to plan for the long term
Benefits In Organizational Health and Productivity	• Capacity to meet higher product quality standards • Quality safety performance makes it easier to achieve quality goals. • Higher-quality QMS tools result from better resource management. • More comprehensive (well-rounded) productivity • Better ability to meet challenges
Major Financial Benefits	• Higher business reputation • Costs of lost/damaged equipment are reduced. • Reduced medical costs • Lower insurance premiums • Reduced legal fees • Reduced damage claims • Reduced number of fines

Source: own summary from Tyler Britton (2019.)

2.2.9 Factors Deterring SMS Implementation

Implementing SMS is costly since it requires additional budget from the normal operation and the real gains from having strong SMS may not be fully measurable since the cost of accident not happened yet can't be calculated.

Developing a safety culture is a huge task that requires culture change. As stated in the previous chapter development of safety culture includes: reporting culture, just culture, informed culture, and learning culture. And for Ethiopian MRO operating for more than 65 years, and having entrenched organizational cultures established it is not easy to change from the one accustomed with, and to have the new safety management system easily.

Process improvement is the consistent application of management review. If management review is not a routine part of the organization's calendar, all of the other components of the SMS system are useless. Monitoring the environment just as assessment of the business environment must be a regular part of strategic planning, SMS acknowledges a similar need to continuously monitor the operational environment to assess new threats and monitor existing ones. The safety assurance component must incorporate such assessments on a routine basis.

2.3. Empirical Literature Review

This part of the study attempted to examine certain empirical studies pertaining to safety management practices in the aviation industry. There hasn't been much research done on the particular topic under consideration because safety management system is a new idea for the aviation sector and it is on the beginning stage of implementation by most nations and their air carriers. The researcher makes an effort to cover research on SMS practice and its evaluation in many sources relevant to the subject.

The safety management practices of Nigerian air operators are the focus of a paper by Uhuego O.K. et al. (2013) titled "Assessment of Safety Management System Implementation in an Approved Maintenance Organization (AMO): A Case Study of Nigeria Operators." The study demonstrates that Nigerian airline operators do not apply safety measures in a coordinated manner. A significant obstacle to the SMS's

implementation in Nigeria is the lack of a national data base for maintenance tasks. The majority of the people working for AMO are highly skilled experts, however they lack safety management system training. Thus, it is perceived as a problem in a system that calls for a thorough knowledge of safety management principles.

Yeun R. et al. (2014) highlighted the requirement for SMS to be a crucial component in boosting safety for a dynamic and safety-critical business-like aviation in their paper titled "Aviation safety management systems". It also exemplifies the potentially complicated and difficult problems that any aviation authority would encounter when developing and putting into practice an SMS. The conventional approach of conducting audits to evaluate an SMS might not always be the best option. Therefor, there is an urgent need for each ICAO member states to develop a tool that can measure and assess the effectiveness of their SMS frame work.

According to Thomas (2012)'s presentation of a systematic review of the success of safety management systems for the Australian Transport Safety Bureau, the effectiveness of safety management systems may not always lay in the system's individual parts but rather in the level of sophistication and effort used throughout the system as a whole. As a result, the lack of proof for SMS effectiveness may probably be a reflection of the oversimplified methodology used in scientific research, and the lack of a scientific approach used to resolve this crucial issue.

The SMS matrices for the self-assessment of the maturity of the aviation safety management system developed by the Aviation Industry Corporation of China (AVIC) and presented by Nakitarios K. et al. (2018) cover a gap in the toolkit but are not meant to replace official audit. It is intended to supplement the SMS assessment methods now in use in audit and give organizations the ability to evaluate their SMS systematically to the extent required and identify strong and weak areas.

In his study titled "Quality and Safety Management Practices in Private Aviation in Ethiopia," Zegeye (2020) found that the private aviation industry in the nation is implementing a quality and safety management system. Even if QMS and SMS implementation has already begun, they are not fully effective for the following reasons: a

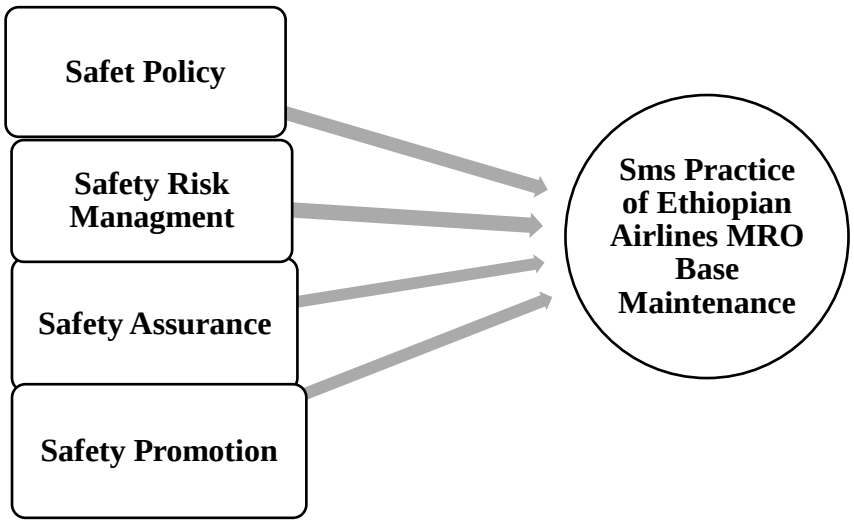
lack of management commitment; a lack of resources to regularly organize training; a lack of regular training for managers and employees; a lack of full employee participation in QMS & SMS activities; and a lack of a motivational and reward system.

As stated in the presentation made by Gerede, E. (2015) for the paper titled "A Qualitative Study on the Exploration of Challenges to the Implementation of the Safety Management System in Aviation Maintenance Organizations in Turkey." It is determined that a weak positive safety culture may result in substantial difficulties. Challenges may also arise from top management support and civil aviation authority procedures. Other difficulties are anticipated as a result of stakeholder SMS integration requirements and SMS training.

2.4 Conceptual Framework

conceptual framework is presented under this section. To give an introduction, it is a diagram that illustrates the relationships between the four safety maangment system pillars which affect the overall safety management practice of the MRO Base MAintanance.

Figure 2.3 Conceptual frame work



Source, (self-constructed,2022)

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1. Introduction

On this part of the study details of procedures to compile the study will be discussed. Research design, research approach, population and sampling approach, methods, and procedure of data collection, the target population and issues related to sampling technique, sample size determination, and methods for analysis of the collected data will be discussed.

3.2. Research Design

Descriptive research method is used to obtain information related to the research and it is found suitable for collecting, analyzing quantitative data. As stated by Kothari (1990) descriptive research studies are ones that focus on characterizing the features of a single person or a group of people. Descriptive Statistics (frequency and percentage) will be used for analysis purpose. Microsoft Office Excel and Statistical Package for Social Science (SPSS) will be used for analysis and to generate data presented.

Cross-sectional type of research survey used to collect data from the target population. Cross-sectional is used over a longitudinal research survey as it is the most popular form of survey used in education and suitable for the researcher to collect data at one point in time (Creswell, 2012).

3.3 Research Approach

Quantitative research approach used for this research, as quantitative technique helps to explore, present, describe and examine relationships and trends within data and as it also supports to collect results in numerical and standardized data (Saunders M., 2009). Thus, qualitative research is indeed the most appropriate way for this study since the goal of this study is to assess the safety management system practices of Ethiopian Airlines MRO Base

Maintenance, where questionnaires are used to obtain quantitative data required for analysis.

3.4 Source of Data

Both primary and secondary data sources are used. Accordingly, the primary data is collected from Ethiopian Airlines MRO Base Maintenance employees using questionnaire. The secondary sources of data are from the information which has been collected in the past that are found from the research journals, published research articles, books and reports.

3.5 Sampling Methods

There are several alternative ways of taking a sample. The major alternative sampling methods may be grouped into probability techniques and non-probability techniques. In probability sampling every element in the population has a known nonzero probability of selection. The simple random sampling is the best-known probability sample, in which each member of the population has an equal probability of being selected. Probability sampling designs are used when the representativeness of the sample is of importance in the interest of wider generalization. As a result, simple random sampling is used in this research.

3.6 Sample Size

One of the most important parts of this section is determining the sample size of respondents. There are different ways of determining sample size from a given population. According to Fowler Jr. (2013) there is no a single right way to determine sample size. In this research, the questionnaire will be distributed to the sample population of MRO base maintenance employees.

Confidence interval of 95% used, it is the range of values above and below a finding in which the finding in which the actual value is likely to fall. 5% margin of error is the amount of error from difference in the responses the researcher can tolerate when drawing a conclusion from the data. The sample size will be determined based on the following

Slovin's sampling formula. The population of the study will comprise of 1161 employees of Ethiopian Airlines MRO Base Maintenance section as of April 2022.

$n= N / [1+ N*e^2]$ ……..……. Equation 1

Where:

- N = total number of populations
- n = number of sample size
- e = error margin / margin of error, a 95% confidence level will be taken and e = 0.05.

n= N / [1+ N*e2]

n = 1161/ [1+1161*(0.05)2]

n = **298,**

Therefore, the number of respondents that will be selected are 298 employees.

3.7 Data Collection Methods

According to John Adams (2007) obtaining the required data within the available time period and also the accessibility to the field site depends on consideration and planning of data collection method. The main aim of data collection is obtaining the required data that might answer the research question from various perspectives.

For this research the primary data was collected through self-administered questionnaire from Ethiopian Airlines MRO Base Maintenance employees. After identifying the sample respondents, the questionnaire was distributed and enough time has been given to respond. The questions in the questionnaire were closed-ended or structured with pre-determined 5-point Likert scale ranging from strongly disagree, disagree, neither agree nor disagree, agree, to strongly agree having a numeric value assigned from 1 to 5 respectively.

The Research Questionnaire used in this research has five parts. The first part assesses the general demographic information about the participants which includes their gender, age, educational background and work experience. From section two to section five of the questionnaire questions used to assess the safety management practice in the MRO for the four SMS pillars presented.

The secondary data which was used throughout the research was obtained from Ethiopian Airlines analysis reports, Ethiopian Airlines fact sheet, published and unpublished information about the study area, books and journals.

3.8 Reliability and Validity of Instruments

3.8.1 Validity

According to Lakshmi and Lakshmi (2013) Validity is the extent to which a test accurately measures what it claims to measure. Content validity is the extent to which the item in an instrument covers the entire range of the significant aspects of the area being investigated (Kindy, A., et al. 2016). "Validity is described as the degree to which a research instrument measures what it intends to measure" (Radhakrishna, 2007)). It is the degree to which the measurement device, in this case, the measuring questions in the questionnaire, provides sufficient coverage of the research investigative questions. Questionnaires are adjusted as per the feedback obtained from the pilot test conducted. In general research validity is how will the result among participants represent true findings among similar individuals outside the study.

3.8.2 Reliability

According to Kothari, (2004) reliability refers to consistency, where internal consistency involves correlating the responses to each question in the questionnaire with those other questions in the questionnaire. Reliability is the measure of consistence or stability in which similar outcomes should be found if the research repeated in other situations. The most common method of testing for internal consistency in the behavioral sciences is Cronbach‟s alpha. Cronbach‟s alpha coefficient which is a measure of reliability/consistency normally ranges between 0 and 1. As stated by Gliem & Gliem (2003) the following rule of thumb is provided.

These are:

- ✓ "$\alpha > 0$ .9 Excellent
- ✓ $\alpha > 0.8$ Good
- ✓ $\alpha > 0.7$ Acceptable
- ✓ $\alpha > 0.6$ Questionable

- ✓ α > 0.5 Poor and
- ✓ α < 0.5 Unacceptable".

Table 3.1: Reliability test for the four pillars of safety management system

No.	SMS pillars	Cronbach"s alpha	No. of Items	Reliability α > 0.7
1	Pillar 1: safety policy	0.82	13	Reliable
2	Pillar 2: safety risk management	0.84	6	Reliable
3	Pillar 3: safety assurance	0.76	5	Reliable
4	Pillar 4: safety promotion	0.70	10	Reliable
	Over all	0.86	34	Reliable

Source (author, 2022)

As shown in the above table 3.1, the four pillars of SMS were tested to detect their reliability in measuring the safety management system practice in Ethiopian Airlines MRO Base Maintenance. Accordingly, the Cronbach's alpha coefficient was computed and first pillar: safety policy, second Pillar: safety risk management, third pillar: safety assurance and the fourth pillar: safety promotion, which has Cronbach's alpha score of 0.82, 0.84, 0.76 and 0.70 respectively. This result indicates that all the explanatory variables or factors have a good and acceptable reliability.

To reduce problems related to reliability and validity, previous literatures from research papers and articles from relevant journals and research institutes were used in the questionnaire, survey that directly and indirectly relate to safety management system practice were reviewed, examined and taken as a base for the questionnaire preparation. ICAO doc.9859 (2018), CANSO maturity scheme (2015), EASA (2014) questionnaires for assessment of SMS effectiveness, and other institutions maturity and gap analysis survey check list used to develop questionnaires for this research.

3.9 Data Measurement

The level of measurement must be understood in order to select the appropriate method of analysis. In this research, ordinal scales will be used. Ordinal scale is a ranking or a data rating that normally uses integers in descending or ascending order. The numbers assigned

to the degree of influence or agreement (1, 2, 3, 4, and 5) doesn't indicate that neither absolute quantities nor the interval between scales is equal. They are merely numerical labels.

3.10 Data Analysis Methods

After collection of the data, its completeness was verified, coded and entered and analyzed using Statistical Package for Social Sciences (SPSS) ver.26.00 and MS excel software. According to Boone, H. N., & Boone, D. A. (2012), The interval measurement scale is used to examine data from the Likert scale. As a result, the interval scale was used to examine the composite score for Likert scales. In descriptive statistics for interval scale items there are mean and standard deviation. The mean used for central tendency and standard deviations for variability.

3.11 Ethical Considerations

The researcher conducted this research with a clear understanding of ethical considerations as a result respondents were treated with respect and their response was handled with at most confidentiality. Moreover, respondents were asked for their willingness to participate in the questionnaire, and the purpose of the questionnaire was explained in clear terms. Besides, the gathered data were used for this research only.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

This chapter presents the data analysis, research findings and discussions in the light of the research objectives and research questions raised in the first chapter of this research. The main goal of this study is to assess the safety management system in use at Ethiopian Airlines MRO Base Maintenance. Respondent's demographic information will be presented on the first part of this chapter. In the second part descriptive analysis of the collected data on variables of the study will be discussed. Statistical Package for Social Science (SPSS) version 26 of computer software program and Microsoft excel were used to make the necessary calculations.

4.1 Response Rate

The questionnaires distributed to 298 sample population from which 235 questionnaires were collected. Data checked for completeness in order to make the raw data that was collected through questionnaire to make it ready for conducting statistical analysis. Thus, out of the collected 235 questionnaires, 7 questionnaires were rejected due to incompleteness of some part of the survey sections. So, a total of 228 questionnaires were used for this study with a return rate of 76.5%

Table 4.1 Questionnaires distribution data

Total Questionnaires Distributed	Questionnaires Returned	Questionnaires Rejected	Usable Questionnaires	Response Rate
298	235	7	228	76.5%

Source own survey (2022)

According to Mugenda (2003) A response rate of 60% or more is considered good, and a rate of 70% or more is considered excellent; therefore, the above response rate is excellent for analysis and reporting. The questionnaire was developed using five scales ranking i.e.,

Linkert scale; where 1 represents strongly disagree, 2 disagree, 3 neutral, 4 agree and 5 strongly agree. To analyze the collected data with that of the objective set for this research, statistical procedures were carried out using SPSS version 26.00.

4.2 Demographic Characteristics of the Respondents

The demographic information of respondents will be presented in the following section, which includes gender, age, education level and work experience of respondents.

4.2.1 Gender

Table 4.2 Respondents' gender

Gender	**Frequency(n)**	**Percentage (%)**
Female	23	10.1
Male	205	89.9
Total	228	100.0

Source: own survey (2022)

As per respondent's demographic characteristics presented in the above table 4.2, 205 (89.9 %) of the respondents were male and 23(10.1 %) were female. Out of the total MRO employees of 2959 only 305 of are female, which makes the higher percentage of the respondent male. Females should be encouraged to join the aircraft maintenance department. But the female respondents being low doesn't affect the result of the finding.

4.2.2 Age

Table 4.3 Age of respondent

Age	**Frequency(n)**	**Percentage (%)**
20-30 Years	92	40.4
30-40 Years	136	59.6
Total	228	100.0

Source: own survey (2022)

Age of respondents was assessed as indicated in the above table 4.3 Accordingly, out of 228 participants 92 (40.4%) of respondents are in the age group of 20-30year and 136 (59.6%) of the remaining are in the age group of 30-40 years. The age of the respondents

suggest that they are mature enough to understand the questions and give response accordingly.

4.2.3 Educational Back Ground

Table 4.4 Educational back ground of respondent

Educational Back Ground		
Level of education	Frequency (n)	Percentage (%)
Diploma	44	19.3
First Degree	165	72.4
Masters	19	8.3
Total	228	100.0

Source: own survey (2022)

As indicated in table 4.4 above through the assessment of educational background of respondents out of 228 participants 44(19.3%), 165(72.4%), and 19(8.3%) of the respondents have diploma, first degree and master degree respectively. The respondents' academic qualification suggests that their educational qualification makes the acquired information reliable.

4.2.4 Work experience

Table 4.5 Work experience in years

Work experience in years		
Experience in years	Frequency (n)	Percentage (%)
0-5	16	7.0
5-10	160	70.2
10-15	52	22.8
Total	228	100.0

Source: own survey (2022)

From the above table 4.5 we can see that 16 (7.0 %) of the respondents have less than five years work experience, 160 (70.2%) of the respondent indicated that they have work experience of between 5 and 10 years, and 52 (22.8%) of the respondents had more than 10 years of experience at the organization. Majority of respondents have work experience

which is equal or more than five years, which shows as they have adequate knowledge of the study area and can easily understand the questionnaires.

4.3 Safety Management System Practice

To assess the safety management system, practice the questionnaire was categorized in to four main pillars of SMS and their twelve elements, the four pillars being; Safety policy, safety risk management, safety assurance and safety promotion. Date collected from 228 respondents was analyzed using SPSS software. The variables are ordinal having Likert scale values form strongly disagree (1) to strongly agree (5). Descriptive statistics used for the analysis in which frequencies, percentages, mean and standard deviation of the variables ware calculated as presented blow.

4.3.1 Practice of SMS Pillar I: Safety Policy

Table 4.6 Pillar I: Assessment of safety policy practice

Pillar 1 assessment questions	**Percent of response (%)**					**Response**	
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
Element 1of SMS pillar I: management commitment and responsibilities							
2.1) There is a safety policy in place in ET-MRO	0.9	8.8	18.0	42.1	30.3	3.92	0.954
2.2) I am aware of ET-MRO safety policies and objectives	3.5	16.2	46.1	33.3	4.4	3.26	0.779
2.3) The safety policy is appropriate to the size, nature and complexity of ET-MRO	1.3	16.2	28.1	43.0	11.4	3.47	0.940
2.4) The safety policy is relevant to improve the ET-MRO safety	2.2	16.7	20.2	31.6	29.4	3.69	1.127

2.5) The safety policy communicated throughout ET-MRO	2.6	17.1	36.4	26.3	17.5	3.39	1.046
Averages for element 1 of Pillar I	2.1	15	29.7	35.3	18.6	3.55	
sum	17.1			53.9			
Element 2 of SMS pillar I: safety accountabilities							
2.6) The safety policy periodically is reviewed to ensure it remains relevant and appropriate to ET-MRO	8.3	32.5	33.3	25.0	0.9	2.78	0.947
Averages for element 2 of Pillar I	8.3	32.5	33.3	25.0		2.78	
Sum	40.8			34			
Element 3 of SMS pillar I: appointment of key safety personnel							
2.7) ET MRO has appointed a qualified person to manage and oversee the day-to-day operation of the SMS	3.1	13.6	25.9	41.2	16.2	3.54	1.017
Averages for element 3 of Pillar I	3.1	13.6	25.9	41.2	16.2	3.54	
Sum	16.7			57.4			
Element 4 of SMS pillar I: coordination of emergency response planning							
2.8) ET-MRO has an emergency response/contingency Plan appropriate to the size,	3.5	13.6	33.3	36.0	13.6	3.43	1.002

nature and complexity of the organization							
2.9) There is a plan and record for drills or exercises with respect to the emergency response plan	3.1	14.5	38.2	28.5	15.8	3.39	1.016
2.10) ET-MRO has a process to distribute and communicate the emergency response plan to all concerned personnel.	3.5	19.7	32.5	28.5	15.8	3.33	1.072
Average mean for element 4 of pillar I	3.4	15.9	34.7	31	15.1	3.38	
Sum	19.3			46.1			
Element 5 of SMS pillar I: SMS documentation							
2.11) There is a top-level SMS manual which is approved by the accountable manager and accepted by et CAA	1.8	13.2	19.3	33.3	32.5	3.82	1.083
2.12) The SMS documentation address the organization's SMS and its associated components and elements	1.8	7.5	28.9	50.9	11.0	3.62	0.844
2.13) I am aware of the ET-MRO SMS manual and I can easily access it.	1.8	18.0	32.0	21.5	26.8	3.54	1.120
Averages for element 5 of Pillar I	1.8	12.9	26.7	35.2	23.4	3.66	

Sum for element 1	14.7			55.6			
Averages for pillar I	2.87	15.97	30.17	33.94	17.35	3.47	
Sum for pillar I	Sum	18.84		Sum	51.25		

Source own survey (2022)

The questions raised in the above table 4.6 is to assess the first SMS pillar, safety policy and objectives with its elements; management commitment, safety accountabilities and responsibilities, appointment of key safety personnel, coordination of emergency response plan and SMS documentation. And the findings listed in the above table 4.6 will be discussed as follows.

4.3.1.1 Management Commitment in the SMS Implementation

The first element of SMS pillar I, management commitment in the SMS implementation has an average mean of 3.55, 18.84% (43) disagree or strongly disagree and 51.25% (117) of respondents agree or strongly agree on the questionnaires raised, which shows as there is good management commitment practice towards SMS implementation.

4.3.1.2 Safety Accountabilities and Responsibilities

The second element of first SMS pillar which is safety accountabilities and responsibilities, have mean of 2.78, and 40.8% (93) of respondents disagree or strongly disagree where 34% (78) of respondents agree or strongly agree on the practice of these SMS element. This showing as there is no good practice in this element of the first SMS pillar.

4.3.1.3 Appointment of Safety Personal

The third element of the first pillar, appointment of safety personal which has a response with mean value of 3.54, and 16.7% (38) of respondents disagree or strongly disagree and 57.4% (131) of respondents agree or strongly agree on the practice of this element in the MRO. Which shows as there is good practice in appointing safety personal.

4.3.1.4 Safety Response Planning

The fourth element of the first SMS pillar, safety response planning has an average mean of response 3.38. and 19.3% (44) of respondents disagree or strongly disagree whereas 46.1% (105) of them agree or strongly agree on the practice of this element in the MRO, that shows as there is fairly good practice of safety response planning.

4.3.1.5 Safety Management System Documentation

The fifth element of the first SMS pillar, safety management system documentation has a mean value of 3.66, and 14.7% (34) of respondents disagree or strongly disagree whereas 55.6% (127) of respondents agree or strongly agree on the practice of this element, which shows as there is good practice in SMS documentation.

The overall mean of the first safety management system pillar, safety policy is 3.47 and more than half of the respondent 51.25% (117) agree or strongly agree on the practice of the first SMS pillar. Which shows as there is fairly good practice of the first safety management pillar, safety policy and objectives in the MRO base maintenance.

4.3.2 Practice of SMS Pillar II: Safety Risk Management

Table 4.7 Assemsnent of safety risk management practice

Assessment questions	Response percentage (%)					Response	
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
Element 1 of SMS pillar II: hazard identification							
3.1) There is a process for voluntary hazards/threats reporting by all employees	1.8	20.6	11.8	26.3	39.5	3.65	.993
3.2) I have several ways of reporting hazards/occurrences, such as through web-based reporting, email, offline, etc.	11.4	0.0	21.9	39.9	26.8	3.82	.956
Averages for element 1 of pillar II	6.6	20.6	16.85	33.1	33.15	3.74	
Sum	27.2			66.25			
Element 2 of SMS pillar II: safety risk assessment and mitigation							

3.3) ET -MRO have procedures for investigation of all reported incident/accidents	.4	16.2	25.4	35.5	22.4	3.63	1.018
3.4) There is a documented hazard identification and risk mitigation procedure in ET-MRO	1.80	9.60	31.60	39.50	17.50	3.61	.943
3.5) There is a procedure to prioritize identified hazards for risk mitigation actions	1.8	12.7	24.1	46.5	14.9	3.60	.950
3.6) Internal occurrence investigations identify hazards and safety deficiencies within the organization and there is no blame for those who reported it.	5.7	15.4	43.9	22.4	12.7	3.21	1.037
Averages for element 2 of pillar II	2.43	13.47	31.25	35.97	16.87	3.51	
Sum	15.9			52.84			
Averages for pillar II	3.81	12.41	26.45	35.02	22.3	3.6	
	Sum	**16.22**		**Sum**	57.32		

Source own survey (2022)

Questions in the above table 4.7 are intended to assess the practice of the second SMS pillar safety risk management with its elements; hazard identification, and safety risk assessment and mitigation. The results for the two SMS pillar elements discussed as below.

4.3.2.1 Hazard Identification

The first element of the second SMS pillar, hazard identification practice of the MRO base maintenance has an average mean of the respondent 3.74, and 27.2% (62) of respondents disagree or strongly disagree whereas 66.25% (151) of respondents agree or strongly agree, that can show as there is good hazard identification practice in the MRO Base Maintenance.

4.3.2.2 Safety Risk Assessment and Mitigation

The second element of the second SMS pillar, safety risk assessment and mitigation practice of the MRO has an average mean of 3.51, and 15.9% (36) of respondents disagree or strongly disagree whereas 52.84% (120) of respondents agree or strongly agree, which shows as there is good practice safety risk assessment and mitigation.

Having an overall mean of 3.6 and more than half of the respondents 57.32% (130) agree or strongly agree regarding the second safety management system practice in the MRO Base Maintenance, it shows as there is good practice of safety risk management in the study area.

4.3.3 Practice of SMS Pillar III: Safety Assurance

Table 4.8 Assessment of safety assurance practice

Assessment Question	Response percentage (%)					Response	
	strongly disagree	disagree	neutral	Agree	strongly agree	mean	standard deviation
Element 1 of SMS pillar III: safety performance monitoring and measurement							
4.1) There are identified safety performance indicators for measuring and monitoring the safety performance of ET-MRO activities	0.9	17.1	32.0	40.8	9.2	3.4	.907
4.2) The safety performance indicators	0.9	16.7	34.6	39.0	8.8	3.38	.895

are relevant to the ET-MRO safety policy.							
4.3) The safety performance indicators include alert/target settings to define unacceptable performance regions and planned improvement goals	0.4	16.7	36.4	36.0	10.5	3.39	.901
Average mean for element 1 of Pillar III	0.73	16.83	34.33	38.6	9.5	3.39	
	17.56			48.1			
Element 2 of SMS Pillar III: The Management of Change							
4.4) There is a procedure for review of relevant existing ET-MRO safety-related facilities and equipment, whenever there are pertinent changes to those facilities or equipment.	.9	19.7	35.1	36.4	7.9	3.31	.906
Averages for element 2 of Pillar III	0.9	19.7	35.1	36.4	7.9	3.31	
	20.6			44.3			
Average mean for element 2 of Pillar III						3.31	
Element 3 of Pillar III: Continuous Improvement Of SMS							

4.5) There is a procedure for periodic internal audit/assessment of the SMS	3.1	43.0	32.0	21.9	0.0	2.73	.837
Averages for element 3 of Pillar III	3.1	43.0	32	21.9	0	2.73	
Sum for element 3 of pillar III	44.1			21.9			
Averages for Pillar III	**1.24**	**22.64**	**34.02**	**34.82**	**7.28**	**3.2**	
	Sum	**23.88**		**Sum**	**42.1**		

Source own survey (2022)

Assessment questions raised on the above table 4.8 are intended to assess the third safety management pillar, safety assurance and its elements; safety performance monitoring and measurement, the management of change and continuous improvement of the SMS. The findings in the above table 4.8 about the practice of the third SMS pillar discussed as follows.

4.3.3.1 Safety Performance Monitoring and Measuring

The first elements of the third SMS pillar, the practice of safety performance monitoring and measuring have an average mean of 3.39, and 17.56% (40) of respondents disagree or strongly disagree whereas 48.1% (110) of respondents agree or strongly agree, that shows as there is fairly good practice in this regard.

4.3.3.2 The Management of Change

The management of change, which is the second element of the third SMS pillar has an average mean of 3.31, and 20.6% (47) of respondents disagree or strongly disagree whereas 44.3% (101) of respondents agree or strongly agree, which sows as there is fairly good practice in management of change.

4.3.3.3 Continuous Improvement of SMS

The third element of the third SMS pillar, practice of continuous improvement of SMS has an average mean of 2.73, and 44.1% of respondents disagree or strongly disagree whereas

21.9% of respondents agree or strongly agree, showing as practice in the continuous improvement of SMS is not good.

Having an overall mean 3.2 and less than half of the respondents 42.1% (96) agree or strongly agree regarding the third safety management system pillar practice in the MRO Base Maintenance, it shows as there is slightly good practice of safety assurance with lots of room for improvement.

4.3.4 Practice of SMS Pillar IV: Safety Promotion

Table 4.9 Assessment of safety promotion practice

Assessment questions	Percentage of response					Response	
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
Element 1 of SMS pillar IV: Training and Education							
5.1 There is a program to provide SMS training/familiarization to personnel involved in the implementation of the SMS	2.6	28.9	15.8	43.4	9.2	3.28	1.061
5.2) I have received ET-MRO SMS training.	7.0	34.6	16.7	30.7	11.0	3.04	1.174
5.3) Safety briefings/seminars are held frequently, and consistently.	11.4	58.3	29.8	0.4	0.0	2.19	0.628
Averages for element 1 of Pillar IV	7	40.6	20.77	24.83	6.73	2.83	
Sum for element 1 of pillar IV	47.6			31.56			
Element 2 of Pillar IV: Safety Communication							

5.4) Safety bulletins are posted frequently and consistently.	8.8	54.8	30.7	5.7	0.0	2.33	0.717
5.5) I always attend safety seminars/briefings and also read posted safety bulletins.	13.6	57.9	27.2	1.3	0.0	2.16	0.660
5.6) Safety bulletins released/posted have helpful and relevant information.	6.6	24.1	52.2	14.9	2.2	2.82	0.844
5.7) I am communicated regarding internal occurrence investigation results and other industry safety issues.	5.3	34.6	38.6	18.4	3.1	2.79	0.908
5.8) When changes are made that affect the safety of operations, changes are communicated to concerned employees.	12.7	24.6	47.4	14.9	0.4	2.66	0.899
5.9) ET-MRO SMS manual and related guidance materials are accessible or disseminated to all concerned personnel	23.7	56.1	20.2	0.0	0.0	1.96	0.663
5.10) I have adequate knowledge of my role in the implementation of the	12.3	47.4	18.4	19.7	2.2	2.52	1.013

SMS and am able to perform my SMS duties.							
Average mean for element 2 of Pillar IV	11.85	42.78	33.52	10.7	1.12	2.46	
Sum for element 2 of pillar IV	54.63			11.82			
Average for pillar IV	**10.4**	**42.13**	**29.7**	**14.94**	**3.24**	**2.58**	
	Sum	**52.53**		**Sum**	**18.18**		

Source own survey (2022)

Questions raised on the above table 4.9 are intended to assess the fourth safety management pillar, safety promotion and its elements; training and education, and safety communication. The findings in the above table 4.9 will be discussed below for the two elements of the fourth SMS pillar.

4.3.4.1 Training and Education

The first element of the fourth SMS pillar, training and education as per the finding the responses have mean of 2.83, and 47.6% (109) of respondents disagree or strongly disagree whereas 31.56% (72) of respondents agree or strongly agree, this result shows that as most of the respondents suggest as there is no good practice of this SMS element.

4.3.4.2 Safety Communication

The second element of the fourth SMS pillar, safety communication has an average mean of response 2.46, and 54.63% (125) of respondents disagree or strongly disagree whereas 11.82% (27) of respondents agree or strongly agree showing as there is no good practice of this SMS element. And also, this is the lowest value of mean from the twelve elements of SMS showing there is more to do in communicating safety findings and increasing the awareness of employees.

Having an overall mean of 2.58 and more than half of respondent 52.53% (120) disagree or strongly disagree shows as there is gap in practicing the fourth SMS pillar, safety promotion. It also indicates as safety promotion has the least practice compared to the rest SMS pillars.

4.3.5 Over All Safety Management System (SMS) Implementation

Table 4.10 Over all SMS implementation

SMS pillar	Percentage response					Mean
	Strongly disagree	disagree	Neither	agree	Strongly agree	
Safety policy	2.87	15.97	30.17	33.94	17.35	3.47
Safety risk management	3.81	12.41	26.45	35.02	22.3	3.6
Safety assurance	1.24	22.64	34.02	34.82	7.28	3.2
Safety promotion	10.4	42.13	29.7	14.94	3.24	2.7

Source own survey (2022)

From the above table 4.10 comparing the practice of the four safety management pillars better understanding, and practice can be seen on safety risk management (pillar II) followed by safety assurance (pillar III) and safety policy (pillar I) having mean values of 3.6, 3.3, 3.2 and 2.7 respectively. The fourth pillar safety promotion has the lowest practice of implementation when compared with the rest of the three SMS pillars with an overall mean of 2.7.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

As explained in previous chapters, the primary aim of this research paper is to assess the safety management system (SMS) practice in Ethiopian Airlines MRO Base Maintenance. Therefore, this chapter focused on summarizing the research findings which are discovered during the study of the topic and sets out conclusion drawn from the research finding, and give some recommendation for better practice of safety management system in the MRO Base Maintenance in particular, and the MRO and the airline as a whole.

Considering the specific areas taken for the study and the specific measurement used for this study the researcher would like to emphasize that the findings under this content are specific to this case study, and may not say anything about the safety reputation of the organization where the specific case was selected. Any other research on different case study may confirm or reject findings.

5.1 Summary of Major Findings

From 1161 total employees of MRO base maintenance, 298 have been taken as sample population for the study. And out of 298 sample populations 228 of them responded for the distributed questionnaire to collect primary data for the research, that is 76.5% respondent rate.

As per the analysis performed in the previous chapter, the major findings on safety management practice of Ethiopian Airlines MRO Base Maintenance are stated as follow:

- ✓ According to the respondents view the practice of the first safety management system pillar, safety policy and objectives found to be in fairly good practice, having an overall mean of 3.47. An average of 51.52 % respondents agreed or strongly agreed whereas, 18.84 % of respondents disagreed or strongly disagreed while the rest 30.17 % of respondent remain neutral on the assessment questions.

- ✓ The practice of the second safety management system pillar, safety risk management is found to be good having overall mean of 3.6. And an average of 57.32 % respondents agreed or strongly agreed whereas, 16.22 % of respondents disagreed or strongly disagreed while the rest 26.45% of respondent remain neutral on the questions raised. Which implies that most employees in the study area agree as safety risk management implementation practice is in good stage.

- ✓ The third safety management system pillar, safety assurance practice is found have fairly good practice, with overall mean of respondent 3.2 and an average of 42.1 % respondents agreed or strongly agreed whereas, 23.88 % of respondents disagreed or strongly disagreed while the rest 34.02% of respondent remain neutral on those assessment questions. Considering the mean of respondent which is 3.2 and the percentage of respondents who agree greater than those disagree, it shows the safety assurance practice in the MRO is moderate having lots of room for improvement.
- ✓ The observed finding for the practice of the fourth safety management system pillar, safety promotion which has an overall mean of 2.58 and 18.18% of respondents agreed or strongly agreed and 52.53% of respondent disagree or strongly disagree while the rest 29.7% of respondent remain neutral on those assessment questions. More than half of the respondents disagree or strongly disagree on the practice of safety promotion and the average mean being 2.58 it shows as there is no good practice of the fourth SMS pillar, safety promotion.

5.2 Conclusion

According to several works of literature on SMS implementation in the aviation, it is a progressive and taking longer time to mature and become a culture by employees and for organizations. Assessing the practice of safety management system practice in the MRO is the ultimate goal of this research. The next conclusion is forwarded with regard to SMS practice of Ethiopian MRO Base Maintenance from literature reviews in chapter two and data analysis of chapter four.

Overall safety management system practice of Ethiopian Airlines MRO Base Maintenance was fairly good. Comparing the practice of the four safety management pillars, the fourth pillar which is safety promotion found to have the lowest practice in the MRO Base

Maintenance. As stated in chapter four of this paper better understanding and of practice seen on safety risk management (pillar II) followed by safety policy (pillar I) and safety assurance (pillar III). The fourth pillar safety promotion has the lowest practice of implementation when compared with the rest of the three SMS pillars.

5.3 Recommendation

As it is discussed in previous chapters the aviation industry is the safest way of long-range transportation, but there is still room to improve its safety record. The evolutionary safety management system from reactive to proactive makes the aviation sector safer and safer from time to time. States aim for zero aviation fatalities by 2030 through ICAO strategic planning, capacity-building and assistance activities (ICAO, 2022).

Looking the results of the research finding more emphasis should be given to the fourth pillar safety promotion. The fourth SMS pillar safety Promotion, and the overall safety management system practice can be enhanced by:

- Involving everyone in the risk assessment process, things related to safety and quality shouldn't be left for the quality control department.
- Avoiding blame and encouraging employees to report any safety concerns in their work area.
- Taking action and responding in a timely manner to safety concerns, hazards, risks and any incidents.
- Employees can take lesson from investigation results of incidents and near misses if communicated.
- Apart from the short generic lesson regarding safety management system it requires making safety a primary focus in the aviation educations. Even the two-year refresher course interval can be reduced until some level of safety culture achieved. Currently the SMS training is given on the aviation academy online platform. To give better emphasis at list the initial raining should be given in person.
- Promoting and attending safety meetings, safety seminars and safety training sessions.

- Safety management practice of the company is the total sum of each employee contribution. So, include safety management practice in to employee's performance evaluation with a considerable grade.

Taking the above listed measures can improve the awareness regarding safety management system, and help to have a better safety management system practice in the MRO in particular and for the company as a whole.

5.4 Suggestion for Further Study

Based on the selected study area of the maintenance section this study focused on assessing the safety management practice of Ethiopian airlines MRO Base Maintenance the following suggestions are provided for further study.

Due to limitations listed in preceding chapter to this study, this research focus only to one area of the maintenance section MRO base maintenance. To have the overall picture of the maintenance section as well as the whole company safety management system practice, studies should be conducted to other sections of Ethiopian airline divisions where SMS implemented.

Furthermore, for this newly emerging management sector, safety management system its implementation and practice in other airlines operating in the country should be assessed to get the overall safety management system practice of the aviation industry in the country.

Bibliography

Alblowi, M. (2019). Global aviation safety plan. *Middle East air navigation and implementation regional group.* cairo.

ATO. (2019). *Safety management system manual* . Washington,DC.

Boone, H. N. (2012). Analyzing likert data. *Journal of extension*, 1-5.

Britton, T. (2019). *SMS pro aviation safety software blog for airlines & airports,*. Retrieved from SMSPRO: http://aviationsafetyblog.asms-pro.com/blog/author/tyler-britton

Britton, T. (2022). *SMS PRO*. Retrieved from SMS management tool: http://aviationsafetyblog.asms-pro.com/blog/author/tyler-britton

CANSO. (2015). *Standard of excellence in safety management systems.* Schiphol, the Netherlands: Civil Air Navigation Services Organization.

Creswell, J. (2012). *Educational research planning, and evaluation quantitative and qualitative research.* Boston.

EASA. (2014). *AMC and GM for the implementation and measurement of safety Key performance.* Cologne, Germany: European Union Aviation Safety Agency.

ECAA. (2013). *ECARAS Part 9, Air operators certification.* Adddis Ababa.

ECAA. (2019). *Part 23 safety management system* . Addis Ababa .

Edwards, S. &. (2002). Reflective assessments. *A tool for learning, the evaluation exchange*.

Eranga Batuwangala, J. S. (2018). The regulatory framework for safety management. *aerospace*.

Ethiopianairlines. (2009). *vision 2025 and strategic road map.* Addis Ababa.

EthiopianAirlines. (2022). *Ethiopian fact sheet.* Addis Ababa.

Fowler Jr, F. J. (2013). *Survey research methods.* SAGE publications .

Fox, K. (2009). *How has the implementation of Safety Management Systems (SMS) in the transportation industry impacted on risk management and decision making?* Lund.

Gliem, J. A., & Gliem, R. R. (2003). *Calculating,iInterpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales.* Columbus, Ohio: Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.

Howell, C. (2019). *why gap analysis in aviation SMS performed.*

ICAO. (2006). *Safety oversight manual.* Montreal.

ICAO. (2016). *Annex 19 safety management* . Montréal, Quebec, Canada.

ICAO. (2018). *Annex 8 - Airworthiness of Aircraft.* Montréal (Quebec) Canada.

ICAO. (2018). *Doc 9859 safety management manual.* Montréal, Quebec, Canada.

ICAO. (2019). *State of global aviation safety, ICAO safety report 2019 edition.* Montréal, Canada.

ICAO. (2021). *Safety report.* Montréal, Quebec, Canada.

J., T. M. (2012). *A systematic review of the effectiveness of safety management systems.* Canberra, Australia: Australian Transport Safety Bureau.

John Adams, H. T. (2007). *Research methods for graduate business and social science students.* New Delhi: SAGE Publications.

Key, L. (2014, July). *Safetys in the air begins with quality maintenance on the ground.* Retrieved from The Grapevine: http://www.amfanational.org/grapevine/AMFA-GRAPEVINE72014.pdf

Kothari. (1990). *Research methodology: methods and techniques* . New Delhi: Prakashan.

Kothari. (2004). *Research methodology* . New Delhi: new age international publishers .

Lakshmi, M. M. (2013). Issues in reliability and validity of research. *International Journal of Management Research and Reviews*.

Lu, C. T. (2011). Safety culture: The perception of taiwan's aviation leaders. *International Journal of Applied Aviation Studies*.

Maurino, D. (2017). Why SMS: An introduction and overview of safety managment system. *The International Transport Forum.* Paris.

MROHRM. (2022). *Active employees list as of april 2022.* Addis Ababa.

NeKaranikas, N. P. (2018). The AVAC-SMS metric for the self-assessment of maturity of aviation safety management systems. *AUP Advances*, (pp. 40-57). Netherlands Aerospace Center, the Netherlands.

Olive M. Mugenda, A. M. (2003). *Research methods quantitative and qualitative approches.* Nairoby.

Paul R, G. M. (2019). *practical safety amangement system.* Newcastle: Aviation Supplies & Academics, inc.

Radhakrishna, R. (2007). Tips for developing and testing questionnaires/instruments. *Journal of Extension*.

Roland Mu¨ller, A. W. (2014). *Aviation risk and safety managment* . New York: Springer International.

Saunders M., L. P. (2009). *Research methods for business students.* Edinburgh Gate Harlow, England: Pearson Education Limited.

Syed, M. (2015). *Black box thinking.* New York: John Murray.

Teemu Reiman, C. R. (2013). Does the concept of safety culture help or hinder systems. *ELSEVIER*.

Uhuego O.K., G. O. (2013). Assessment of Safety Management System Implementation in an Approved Maintenance Organization: A Case Study of Nigeria Operators. *Research Journal of Applied Sciences, Engineering and Technology*, 3879-87.

W., Z. (2010). *Business research methods.* Ohio: Mason, OH.

Walish, W. (2021). IATA annual review 2021. *Iata annual review 2021*, (p. 46). Boston .

Warren Askew, L. M. (2016). *Safety management system hand book.* Montréal, Canada: ACI World.

Yeun R., B. P. (2014). Aviation safety management systems. *World Review of Intermodal Transportation Research*, 168-196.

Yu, S.-K. &. (2004). A fresh approach to safety management systems in Hong Kong. *The TQM Magazine*, 210-215.

Zikmund, W. G. (2009). *Business research method.* South-Western College.

APPENDIX

Assessing safety management system practice in Ethiopian Airlines MRO (ET-MRO) Base Maintenance

(Questionnaire)

Dear respondents,

Dear Sir/Madam

My name is Asbe Dagnachew, Final year project management student at School of commerce –Addis Ababa University. I am conducting a study "**Safety Management System Practice at Ethiopian Airlines MRO Base Maintenance.**

Thank you very much in advance for being a volunteer and for giving your valuable time in filling up this questionnaire. Please take up only few minutes to fill up this questionnaire. This questionnaire is designed to get the relevant information for the current study on assessing the safety management system practice in Ethiopian Airlines MRO Base Maintenance. This study is only for academic purpose. Hence, your responses will be kept confidential. The soundness and the validity of the findings highly depend on your genuine responses. Therefore, I kindly request you to fill the questionnaire carefully and back to me.

Instructions: -

- Not need of writing your name.
- Put the (√) mark in the box for your answer.
- With great excuse, please reply your response on time.

For any problem and suggestion contact the researcher through the following addresses:

- Email: asbe2015@gmail.com
- Phone: +251901964316
- Asbe Dagnachew

I. Part one Demographic Data

1.1) Gender

1. Male ☐ 2. Female ☐

1.2) Age

1.20-30 ☐ 2. 31-40 ☐ 3. 41-50 ☐ 4. Above 50 ☐

1.3) Educational level

1. BA/BSC ☐ 2. MA/MSC ☐ 3. PHD ☐ 4. Othe ☐

1.4) How long you have worked in ET-MRO?

1. Less than 2 years ☐ 2. 2-5 years ☐ 3.6-10 years ☐ 4. above 10 years ☐

II) Part two

Table A1 Part two questionnaires

No.	**Questions**	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	PILLAR I — SAFETY POLICY AND OBJECTIVES					
2.1	There is a safety policy in place in ET-MRO	☐	☐	☐	☐	☐
2.2	I am aware of ET- MRO safety policies and objectives.	☐	☐	☐	☐	☐
2.3	The safety policy is appropriate to the size, nature and complexity of ET-MRO	☐	☐	☐	☐	☐
2.4	The safety policy is relevant to improve the ET-MRO safety	☐	☐	☐	☐	☐
2.5	The safety policy communicated, with visible endorsement, throughout ET-MRO	☐	☐	☐	☐	☐
	Element 2 of SMS pillar I: safety accountabilities					

2.6	The safety policy periodically reviewed to ensure it remains relevant and appropriate to ET-MRO	☐	☐	☐	☐	☐
2.7	ET MRO appointed a qualified person to manage and oversee the day-to-day operation of the SMS	☐	☐	☐	☐	☐
2.8	ET-MRO has an emergency response/contingency Plan appropriate to the size, nature and complexity of the organization	☐	☐	☐	☐	☐
2.9	There is a plan and record for drills or exercises with respect to the emergency response plan	☐	☐	☐	☐	☐
2.10	ET-MRO has a process to distribute and Communicate the emergency response plan to all concerned personnel.	☐	☐	☐	☐	☐
2.11	There is a top-level SMS summary or exposition document which is approved by the accountable manager and accepted by et CAA	☐	☐	☐	☐	☐
2.12	The SMS documentation address the organization's SMS and its associated components and elements	☐	☐	☐	☐	☐
2.13	I am aware of the ET-MRO SMS manual and I can easily access it.	☐	☐	☐	☐	☐
	PILLAR II -SAFETY RISK MANAGEMENT					

3.1	There is a process for voluntary hazards/threats reporting by all employees	☐	☐	☐	☐	☐
3.2	I have at least several ways to report hazards/occurrences, such as through web-based reporting, email, offline, etc.	☐	☐	☐	☐	☐
3.3	ET -MRO have procedures for investigation of all Reported incident/accidents.	☐	☐	☐	☐	☐
3.4	There is a documented hazard identification and risk mitigation procedure involving the use of objective risk analysis tools	☐	☐	☐	☐	☐
3.5	There is a procedure to prioritize identified hazards for risk mitigation actions	☐	☐	☐	☐	☐
3.6	Internal occurrence investigations identify hazards and safety deficiencies within the organization and do not attribute blame/liability.	☐	☐	☐	☐	☐
	Pillar III — SAFETY ASSURANCE					
4.1	There are identified safety performance indicators for measuring and monitoring the safety performance of ET-MRO activities	☐	☐	☐	☐	☐
4.2	The safety performance indicators are relevant to the ET-MRO safety policy as well as management's high-level safety objectives/goals	☐	☐	☐	☐	☐

4.3	The safety performance indicators include alert/target settings to define unacceptable performance regions and planned improvement goals	☐	☐	☐	☐	☐
4.4	There is a procedure for review of relevant existing ET-MRO safety-related facilities and equipment, whenever there are pertinent changes to those facilities or equipment.	☐	☐	☐	☐	☐
4.5	There is a procedure for periodic internal audit/assessment of the SMS	☐	☐	☐	☐	☐
	PILLAR IV— SAFETY PROMOTION					
5.1	There is a program to provide SMS training/familiarization to personnel involved in the implementation or operation of the SMS	☐	☐	☐	☐	☐
5.2	I have received ET-MRO SMS manual training.	☐	☐	☐	☐	☐
5.3	Safety briefings/seminars are held frequently, and consistently.	☐	☐	☐	☐	☐
5.4	Safety bulletins are posted frequently and consistently.	☐	☐	☐	☐	☐
5.5	I always attend safety seminars/briefings and also read posted safety bulletins.	☐	☐	☐	☐	☐
5.6	Safety bulletins released/posted have helpful and relevant information.	☐	☐	☐	☐	☐

5.7	I am communicated regarding internal occurrence investigation results and other industry safety issues.	☐	☐	☐	☐	☐
5.8	When changes are made that affect the safety of operations, such as new/revised procedures, new technology, new tools/equipment, new trainings, etc. these changes are communicated to concerned employees.	☐	☐	☐	☐	☐
5.9	ET-MRO SMS manual and related guidance materials are accessible or disseminated to all concerned personnel	☐	☐	☐	☐	☐
5.10	I have adequate knowledge of my role in the implementation of the SMS and am able to perform my SMS duties.	☐	☐	☐	☐	☐

Source: compiled by own, from Ethiopian MRO safety management system gap analysis check list, ICAO Doc.9859 (2018) gap analysis check list, CANSO maturity scheme (2015), EASA (2014) questionnaires for assessment of SMS effectiveness.