



ST. MARY'S UNIVERSITY

**SCHOOL OF POSTGRADUATE STUDIES, SCHOOL OF
BUSINESS**

**THE PRACTICE AND CHALLENGES OF ACHIEVING COMPETITIVE
EXCELLENCE (ACE) AS A PROCESS ENRICHMENT SYSTEM: THE
CASE OF ETHIOPIAN AIRLINES GROUP MRO**

PREPARED BY

YONATAN DANIEL

ID NO. SGS/0503/2013A

ADVISOR NAME

MULUADAM ALEMU (PH. D)

DATE: Dec,2022

ADDIS ABABA, ETHIOPIA

St. Mary's University
School of Postgraduate Studies, School of Business
Department of Project Management

The practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system: the case of Ethiopian Airlines Group MRO.

By

Yonatan Daniel

Advisor: Muluadam Alemu (Ph.D.)

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CERTIFICATE OF PROPOSAL APPROVAL

I hereby certify that the Thesis entitled: “**The practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system: the case of Ethiopian Airlines Group MRO**” by **Yonatan Daniel** has been prepared after due consultation with me. The proposal has my approval and has, to my knowledge, the potential of developing into a comprehensive Thesis Work. I also agree to supervise the above-mentioned thesis till its completion.

Approved by Board of Examiners:

Advisor _____ Signature _____ Date _____

Internal Examiner _____ Signature _____ Date _____

External Examiner _____ Signature _____ Date _____

_____ Signature _____ Date _____

Chair of Department of Graduate Programs Coordinator

Declaration

I hereby declare that the work entitled: The practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system: the case of Ethiopian Airlines Group MRO.is the result of my own effort and study, and all sources of materials used for the study have been properly acknowledged. Except for the guidance and suggestions of my Research Advisor, I created it entirely on my own. This research has not been submitted for a degree at this or any other university. It is provided in partial fulfillment of the requirements for the award of a Masters of Arts in Project Management.

Declared by:


Name: _____

Signature: _____

Date: _____

Confirmed by Advisor:

Name: _Muluadam Alemu (Ph.D)

Signature: 

Date: 29/12/2022

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List of Acronyms and Abbreviations

ACE – Achieving Competitive Excellence

AEP- Aircraft Engineering and Planning

BMT- Aircraft Base Maintenance (Hangar)

BPI – Business process improvement

CMGT- Change management

CMT- Component Maintenance

EAG – Ethiopian Aviation Group

ET-MRO- Ethiopian Airlines Maintenance, Repair and Overhaul

EMT- Engine Maintenance

ETCAA - Ethiopian Civil Aviation

EASA – European Aviation Safety Agency

FAA – Federal Aviation Administration

FGD -Focus Group Discussion

IATA – International Air Transport Association

LMT- Line Maintenance

MRO – Maintenance and Repair Overhaul

MSM- MRO Sales and Marketing

SOP- Standard Operational Procedure

UTC- United Technologies Corporation

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Abstract

Process enrichment is an essential function of any growing firm. Process development tools are the approaches and procedures that organizations employ to improve their processes. The main objective of this study was to assess the practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system in Ethiopian Airlines Group Maintenance, Repair, and Overhaul division. To be successful in study three basic questions were raised. The research design employed in the study was a descriptive survey. The research method was both quantitative and qualitative approaches employed. The sampling techniques employed were purposive, and Stratified sampling was used for quantitative analysis in this study. In order to analyze, interpret and present the data captured via questionnaire, Statistical Package for the Social Sciences (SPSS) was used. The sample size was 245 employees chosen from seven departments. The data gathering tools were a questionnaire, focus group discussion, and interview as well as document analysis. The participants of the interview and focus group discussion were ACE managers, ACE team leaders, and Ex-ACE agents. The questionnaire was administered to 245 employees but 219 of them properly filled and returned. In doing that, according to the descriptive analysis, though Ethiopian MRO implements ACE as an operating system the actual practices are poor due to the training inconsistent. In addition, ACE is not fully utilized as a working language, and the company standard operating procedure is not strong enough to enhance appropriate ACE implementation, besides training lack of commitment shown. ACE tools in general have relatively better awareness among respondents in six ACE tools: Visual Control (5s+1), Total Productive Maintenance (TPM), Market Feedback Analysis (MFA), Quality Clinic Process (Q C P C), and Mistake Proof (MP). But the detailed knowledge and practical experience lacking in Process Management, Root Cause Corrective Action (RCCA), and Decision Making. To overcome the challenges encountered, recommendations have been forwarded. These include orienting or training the employee ahead of time on the overall contents of Achieving Competent Excellence (ACE), motivating the employee to willingly take on more responsibilities in the implementation process, using measurement and feedback methods to confirm improvements, establishing a consistent technique for closing the gap, and properly utilizing the ACE tool.

Chapter One

Introduction

1 Background of the Study

Business process creation helps firms to increase performance and prepare for tougher competition, along with proper and beneficial execution. According to (Techopedia™, 2012), “Business Process Improvement (BPI) is a method for assisting firms in redesigning their existing business operations in order to achieve significant production improvements. Effective BPI contributes to positive outcomes in operational efficiency and customer focus”.

A process is simply the processes and decisions involved in the completion of a task. For instance, creating work orders, repairing components, ordering parts, testing components, etc. According to Powell, P. K. (1999), a process is a collection of procedures, tools, or systems for changing inputs into outputs. Some processes are adaptable. However, while they are less crucial to the overall operation of the command, such routine operations are still critical to the efficient operation of an office or work center.

Moreover, Standard operating procedures are typically developed to help firms to organize their operations, keep all team members and other stakeholders on the same page at all times, and move forward in a unified & consistent way. According to Brush, K. (2021, October 15), A standard operating procedure is a series of written guidelines explaining the step-by-step process that must be followed to accomplish a repetitive activity. A good process has distinct steps and is a distinct step within a broader process that benefits customer in contrast a faulty process exists in isolation and has little to no bearing on the creation of value for consumers Brush, K. (2021, October 15). However, there must be a balance maintained between processes that provide value and those that impede the flow of work. Improving business process and maintaining acceptable levels of performance quality are critical components of any firm's success Lynn, R. (2021, April 7).

According to IATA (2022), “there are around 290 airlines in 120 countries today and IATA members include the world's largest passenger and freight carriers, which account for 83% of worldwide air traffic”.

Because the aviation sector necessitates large investments, it is characterized by an oligopoly market structure, in which a few enterprises dominate the industry (Rose M Rubin, Justin N Joy, 2005). Nature of competition in the airline industry firstly, Economies of scale: When new airlines enter the market or current airlines expand their services to the markets, competition in the airline business will be intensified. Existing airlines benefit from economies of scale and airport slot rights, making it easier for them to enter new markets than new aircraft carriers. Secondly, to own aircraft the cost is high, which may frighten new airlines from entering the market. The effect of this is decreased due to the availability of leasing alternatives and external finance from banks, investors, and plane manufacturers. And thirdly, Low prices enable businesses to acquire market share by attracting new consumers. Although loyalty programs are excellent for maintaining customers between carriers, they are not very effective at retaining clients within an airline's carriers (Kramer, 2022). This issue is one of the natures of competition in the airline industry.

1.1 Background of Ethiopian Airlines

Ethiopian Airlines Group was established in June 1945 and had its first scheduled flight in April 1946. As early as 1958, Ethiopian Airlines commenced long-distance flights to Frankfurt in 1962, and in January 1963, the company operated its first jet service from Addis Ababa to Nairobi (Ethiopian Airlines, 2022).

Ethiopian Airlines joined the world's largest airline alliance called the star alliance on 13 December 2011. Ethiopian airlines are the flag carrier of Ethiopia and one of the biggest and most successful airlines in Africa. Ethiopian serves 127 international and 23 domestic destinations including daily and twice-daily flights across the continent (Ethiopian Airlines, 2022). Ethiopian Airlines is now pursuing Vision 2025, a 15-year strategic plan that will see it become Africa's largest airline group was coined in the year 2009 as; By 2025, Ethiopian Airlines will be Africa's most competitive and leading aviation group, offering safe, market-driven, and customer-focused passenger and cargo transportation, aviation training, flight catering, MRO (Maintenance, Repair, and Overhaul), and ground services on 2025 (Ethiopian Airlines, 2022).

Ethiopian MRO Services was founded in 1957 to provide maintenance and repair services for Ethiopian and third-party customers' aircraft, engines, and components. Ethiopian's principal hub is Bole International Airport in Addis Ababa, Ethiopia (Ethiopian Airlines, 2022). Ethiopian MRO

now employs approximately 2800 fully qualified technical professionals and operates a facility that has been accredited by competent regulatory authorities such as ETCAA, FAA, and EASA.

“Vision; Ethiopian MRO Services shall be the most competitive and leading provider of commercial aircraft Maintenance, Repair, and Overhaul (MRO) services in Africa by 2025.” (Ethiopian Airlines, 2022).

Ethiopian Airlines MRO now has three more wide-body hangars. One full Paint and General Maintenance hangar combined with different offices and shops. Each facility can accommodate one B747-800 (the largest Boeing plane) at a time and other types of aircraft in various configurations. The third hangar can also accommodate one B777-200 or three B737 aircraft at the same time (Ethiopian Airlines, 2022).



Figure 1 Ethiopian Airlines MRO Wide body hangar from Ethiopian Airlines

The values of Ethiopian MRO focus on the following four exceptional customer satisfaction. Top quality, Short turnaround time, Highly competitive Price, Excellent customer service. The system allows for the effective management of all maintenance tasks for each aircraft in a fleet. It coordinates various tasks, from the client request to part delivery, while also tracking work orders and enabling simple access to crucial information (Ethiopian Airlines, 2022).

Based on the variables, the Ethiopian Aviation Group did a critical analysis, and airline company competitiveness is expanding both within and outside of Africa. Other African Airlines carriers, for example, are now striving to duplicate Ethiopian's success; huge European airlines are gaining ground in Africa, despite wealthy Middle Eastern airlines flooding the African market with aircraft capacity, excessive frequency, and low pricing so Higher performance is mandatory to achieve this (Fadugba, 2006).

Ethiopian Aviation Group introduced Balanced Scorecard (BSC) since July 2007, a strategic management tool that provides a manager with a clear and comprehensive picture of the business's health and progress toward its goals, to monitor organizational performance.

BSC is a way of resolving difficult issues while balancing the standards and implementation of a plan, and it possesses the following characteristics: Its strategy is appropriate for dealing with business strategy because it employs a common language at all levels of the corporation, employs an unusual set of principles to manipulate everyday operations as well as to frame the corporation's method, is designed to identify and manipulate business purposes, and strikes a balance among positive strategically opposing forces. The BSC is a strategic management technique that forms a connection between the objectives and metrics based on organizational standpoints (Chriyha, 2012).

Ethiopian Airlines implemented ACE in Maintenance and Engineering in 2005 to improve its processes and performance. Ethiopian Airlines sought to transition from a single business unit to a multi-strategic business unit, thus it founded Ethiopian Aviation Group in 2010 and deployed ACE as a process improvement system across the corporation. Human Capital Management Strategy Vision 2025 (EAL, 2010) states that the BSC's internal process perspective will use ACE (Achieving Competitive Excellence) as a process improvement strategy.

Following the PW4062 Ethiopian MRO, Services ACE is implemented in the Engine Maintenance department as a pilot project in 2005. On December 14, 2002, Ethiopian and PWA signed an Engine Purchase Agreement, which protected the supply that PWA will provide Ethiopian with the license to use the ACE methodology as well as train and teach Ethiopian to implement ACE free of charge throughout Ethiopian ACE implementation, which was released in 2007. The strategy was not supported or incorporated by company policy, but rather by a document titled "Standard Operational Procedure (SOP) developed in June 2005 for maintenance and engineering implementation and then revised in June 2008 to launch ACE implementation throughout Ethiopia Airlines". As a result, Ethiopian airlines MRO was used as a unique reference in this study to examine the Practices, contribution and limitations of ACE deployment as a process improvement system.

1.2 Statement of the problem

ACE (Achieving Competitive Excellence) one of EAL operating system implemented throughout the organization. It focuses to enrich the processes inside the company and delivers quality and also the value to its customers. According to Harrington (2002) “The only way improvement gain can be effectively & permanently embedded in the fiber of a company is through changing the system & processes that control its operation”. Moreover, ‘85 % of all quality problem are a result of the systems(processes);15% are a result of the workers’ (Juran, 1999). Therefore, Organizations innovate, adapt, or adopt numerous techniques and performance improvement tools to mitigate such difficulties and others. Similarly, Ethiopian Airlines' strategic management unit was compelled to create "Vision 2025," which aimed to broaden the abilities and talents required to maintain its historic successful journey and to remain in the marketplace, to be a competitor and the best Aviation Group on the continent and in the world (Ethiopian Airlines, 2022).

Following the PW4062 Ethiopian MRO, Services ACE is implemented in the Engine Maintenance department as a pilot project in 2005. On December 14, 2002 and in June 2008 start ACE implementation throughout Ethiopia Airlines”. The fact that few improvements are seen identifying problem, problem reporting mechanism, planning and implementation documentation and identifying processes but still problems are seen lack of engagement on ACE.

In addition, Despite being established and documented, the majority of MRO work processes are not always effective. For instances, there is an absence of synchronization between various processes.

The ACE project, which will serve as the organization's operating system, is being adopted to address the issue. However, the project is moving very slowly, and certain MRO cells were unable to maintain the level of success they had already attained as a result of a portion of the project and were issued a decertification notice as a result of the project's poor implementation and integration. Although all divisions or units use ACE in their day-to-day operations and incorporate it into the company's working system, most MRO sections see it as an added burden in comparison to its goal. Furthermore, the department's middle and control managers lack the confidence to link the ACE project to the organizational plan.

Moreover, the performance of one department on ACE project has a direct impact on the performance of another department due to the relationship of MRO activities. This will encourage the strategic alignment, integration, and efficient implementation of ACE projects.

This study along these lines fills the gaps by investigating the commitment and difficulties of the ACE execution as a process enrichment framework in ET-MRO, and lights the path to successful ACE execution.

1.3 Research Questions

The project aims to answer the following basic research questions based on the aforementioned issues:

- What are the practices of using ACE as process enrichment in Ethiopian airlines services?
- What role does ACE play in terms of increasing ET-MRO service performance and quality?
- What are the major challenges that hinder Ethiopian airlines service performance and quality?

1.4 Research objectives

1.4.1 General Objective

To assess the practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system: the case of Ethiopian Airlines Group.

1.4.2 Specific Objectives

- To assess the ACE practice in ET-MRO in day-to-day activity.
- To find out the factors that affect the effectiveness of ACE implementation in ET-MRO in terms of process and quality improvement

1.5 Significance of the study

This research is a detailed examination. Beginning with the implementation strategy and progressing through the ACE three foundations, the study's conclusions are thought to be largely relevant to the Ethiopian Maintenance, Repair, and Overhaul strategic business unit and the rest of the company sections. It can, however, provide insight into other strategic business units within the organization, such as the change management office and senior management, to recognize the value and difficulties of ACE implementation and to review the implementation plan. Furthermore,

the study will assist in becoming aware of various techniques for analyzing the contribution and problems of implementing performance and quality improvement tools in different public and private companies. For that purpose, researchers can utilize the same input for other organizations' research or future studies on the subject. For that purpose, researchers might utilize the findings as a starting point for more research on different organizations or further research on the same organization from a micro-level and from diverse perspectives.

1.6 Scope/Delimitation of the study

The scope of this study is assessing the practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system with special reference to Ethiopian Maintenance, Repair, and Overhaul (ETMRO) section based on ACE philosophy, culture, and ACE tools. The study used input data restricted to Ethiopian Aviation Group Bole International Airport Head Quarter ET-MRO and changes management office employees to achieve this. Other EAL's ACE cells outside headquarter like all ticket office in the country, domestic branches and out station (outside Ethiopia) is not included due to time and budget/resource limitation.

1.7 Organization of the Study

This research report is organized into five chapters. Chapter one has presented the background of the study. Chapter two presents the review of related literature and research related to the problem being investigated. The methodology and procedures used to gather information for the study are presented in Chapter three. The results of analyses and findings that emerged from the study and discussion are presented in Chapter four. Chapter five presents the summary of findings, conclusion and recommendations.

Chapter Two

Literature Review

2 Introduction

This chapter provides a theoretical and empirical literature review. Under the theoretical literature, Achieving Competitive Excellence (ACE) foundations; a theoretical background of continuous improvement and strategy; and performance measurement are reviewed; and under the empirical part improvements, barriers to progress and accelerating ACE.

2.1 Theoretical review

2.1.1 ACE background

United Technologies Corporation (UTC) created the ACE operating system, which began in the late 1980s. Achieving Competitive Excellence (ACE) is a management philosophy and technique developed by Yuzuru Ito to increase productivity and quality. This approach has been implemented into UTC's current "tailored service" business strategy (Roth, 2010). ACE focuses on the drivers of competitive excellence of people and work processes. The results emphasize excellent quality, on-time delivery, highly motivated personnel working in a safe environment, and best-in-class financial returns (Raytheon Technologies, 2020).

As an operating system, ACE defines the management system used by individuals and organizations across UTC to delight its customers and provide returns to its shareholders and its employees. ACE directs the development of strategic priorities to build systems for turning strategies into actions and creates feedback mechanisms for evaluating success and improvement (Roth, 2010).

The ACE operating system is a set of tools that aid in the identification and resolution of problems, the improvement of processes, and the formulation of strategic decisions. Organizations drive the ACE operation to close gaps between actual performance and corporate goals and remove waste through the repeated application of these tools Nightingale., D. (2005, June 2). ACE is built on three pillars.

A philosophy about competitive excellence: Customers determine our competitive superiority every day, in practically every country across the world, when they decide whether to buy our

products and services or those of a competitor. Ethiopian Airlines will only continue to develop and prosper if we provide exceptional value to our customers. However, value standards are elusive due to shifting client preferences, which are prompted by new competitors, new technology, and a slew of other economic, social, political, and environmental variables.

An operating system (with tools) for controlling and improving our processes and eliminating waste; An airline is made up of a series of interconnected processes. Flight Operations, Scheduling, Maintenance, Logistics, and Customer Service are a few examples. To manage these procedures, an airline should ideally employ an operating system. The operating system is a mechanism that controls and improves processes to achieve desired business goals, beginning with customer value and satisfaction. The ACE operating system is a collection of technologies that assist a business in identifying and resolving problems, improving processes, and making strategic decisions.

The entire organization's competence, commitment, and involvement in living the concept and applying the operating system to all us do. The ACE culture is relentless in its pursuit of closing gaps between actual achievements and ambitions. Before implementing the process, it focuses on the customer, stakeholders, and staff. ACE culture fosters a common language through cultivating excellent hearts and minds, as well as boosting employee and leadership participation for Process Improvement, with equal emphasis on Quality and Flow. It regards challenges as Treasure and utilizes their learning potential, simplifies the work environment, employs visual techniques for Process Improvement, and collects Feedback to find problems, suggest solutions, and validate improvements. It is propelled by the rigorous application of ACE tools for process improvement and waste elimination, issue resolution, and decision making.

Therefore, ACE affects all of our processes that develop and deliver customer value, and it involves all personnel, both leaders and employees. It seeks feedback from our consumers on what we can do to boost our value to them and their pleasure with us. It also solicits comments on areas where our company's, products, or service's performance has fallen short. ACE is the method by which we manage and enhance processes that result in customer happiness and business results. We use ACE to solve problems, make important decisions, and avoid waste. And ACE pushes our partners and suppliers to compete at the same level as us. In short, ACE is the way that we run our business (ACE, 2005).

2.1.2 Tool and classification

The ACE operating system consists of a set of tools that help an organization identify and solve problems; improve its processes; and make strategic decisions. In keeping with the ACE philosophy, the ACE tools are relatively easy to use, and they are accessible to everyone in an organization. The tools supporting the ACE operating system are categorized into three according to their nature and contribution to an operating system Nightingale., D. (2005, June 2).

2.1.2.1 Process Improvement and Waste Elimination

The term "continuous improvement" refers to organizations in which all employees work together to discover and eliminate all forms of waste and non-value-adding activities within a firm, regardless of whether it is a manufacturing or service organization. Tools that are used to improve the process by eliminating the waste are given below,

- 5S-Visual Workplace
- Value Stream Management and Standard Work
- Process Control & Certification
- Total Productive Maintenance (TPM)
- Set-up Reduction

2.1.2.2 Problem-Solving

some issues are minor, and we can quickly resolve them. Others, on the other hand, are complicated problems that necessitate collaboration, ingenuity, and a significant amount of effort to solve. Identifying the problem is the first step in problem-solving. Tools that are used to solve the problem are given below,

- Market Feedback Analysis (MFA)
- Quality Clinic Process Charting (QCPC)
- Root Cause Corrective Action (RCCA)
- Mistake Proofing (MP)

2.1.2.3 Decision Making

Identifying a decision, acquiring information, and evaluating possible remedies are all steps in the decision-making process.

- Passport Process

Each tool is briefly described below;

2.2 Process Improvement and Waste Elimination

2.2.1 5S-Visual Workplace

5s define as a state in which anyone can enter into a work environment and visually comprehend the existing situation. When a workplace is effectively structured, everyone can physically observe and comprehend the organization's work process, scheduling condition, and current operational circumstances, and any abnormalities are promptly discovered. According to Hutton (2004) 5S focused on instilling workplace discipline, cleanliness, and attention to detail. Communication boards, visual signs, and photos were employed to create a workplace that everyone who approached the Jobsite could easily understand. Weekly audits using thorough checklists, team meetings, and management involvement all helped to guarantee that New 5S was used effectively. 5S was a spin-off of 5S, which was inspired by Japanese manufacturing principles. 5s stands for Sort, Straighten, Shine, Standardize, and Sustain. ACE's 5S included a sixth "S" for "Spirit" Nightingale., D. (2005, June 2).

- Sort: Eliminate what is not needed
- Straighten: Establishment a place for everything based on usage, and keep everything
- Shine: clean, inspect and look for ways to prevent problems
- Standardize: Maintain and monitor the first 3Ss.
- Sustain: Establish norms and respect them

2.2.2 Standard work and Value stream

The goal of Standard Work was to simplify and arrange work to ensure quality, consistency, and repeatable results across time. Standard Work in business process cells consisted of developing processes and systems, creating simplified work instructions and procedures, and documenting learning (Roth, 2010). Standard Work in the production cell included simplified work instructions, work sequencing, predetermined amounts of work-in-process inventory, and adherence to "Take time." For Standard Work to be effective, equipment and processes had to be dependable, which meant that the majority of ACE's other tools had to be in a developed stage of execution Nightingale., D. (2005, June 2).

ACE's central philosophy is the creation and improvement of customer value. Products and services are created by a series of activities, each step of which "adds value." The value stream is made up of two parts: "value" to the consumer and the "stream" of activities or operations that create it. Value stream management necessitates a focus on customer value as well as an attempt to arrange activity sequences and optimize these processes to deliver it consistently. In actuality, focusing on value requires paying attention to things that divert attention away from creating value. People and resources that do not generate value are deemed unproductive and must be addressed through active efforts to "reduce waste" in the value chain. The only tool that was recently identified as an ACE tool was Value Stream Management. Value Stream Management (VSM) is a collection of tools and procedures based on lean principles. As they find and enhance the processes that deliver value, these strategies identify and improve value to customers. Interviews and customer survey data are used to understand, measure, and assess customer value and satisfaction as part of the value identification and enhancement process (Roth, 2010).

2.2.3 Process Control & Certification

This tool is defined as a disciplined approach to achieving business process effectiveness, efficiency, and agility. Beyond data collection, identifying, mapping, and making process adjustments, improvements are accomplished by certifying and growing the maturity of processes in terms of their reliability to produce what is needed when it is expected. Process certification is defined in six stages which is the highest level of maturity. This denotes that a process is stable, predictable, and repeatable and that it is capable of consistently generating products or services that fulfill consumers' expectations (based on numerical targets). The variation in a certified procedure is also negligible.

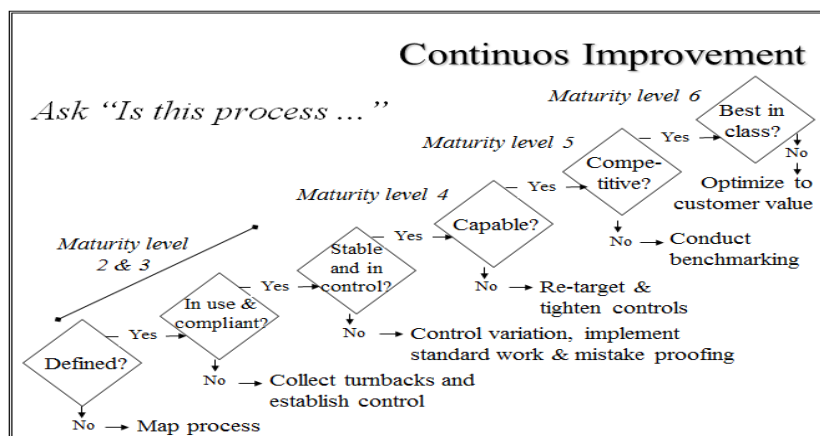


Figure 2 UTC ACE Process Management

Source: ACE: UTC ACE Process Management Training Manual, 2003 Pratt, and Whitney, Canada

2.2.4 Total Productive Maintenance (TPM)

TPM is defined as a method to achieve maximum equipment effectiveness through employee involvement. Successful implementation of TPM creates a culture that raises equipment reliability and accuracy to a level where machine downtime and inaccuracies are essentially eliminated as a cause to product quality and overall operational effectiveness Nightingale., D. (2005, June 2). Moreover, TPM can be used on a wide variety of machines in different situations, such as offices, where it includes computers, copiers, plotters, and printers. It is also an appropriate way for material handling and CNC grinding, drilling, milling, and other material operations. TPM is linked to other lean strategies like 5S and visual workplace. While new 5S focused on the workplace, TPM focused on equipment maintenance, with the idea that well-maintained equipment promotes good quality (Roth, 2010). The TPM approach minimized unexpected downtime and boosted machine reliability by combining cooperation, data gathering, and root cause investigation. The method included tearing down the machine, inspecting it, and rebuilding it, as well as developing a preventative maintenance schedule, daily operator checks, and regular audits.

2.2.5 Set-up Reduction

According to Hutton (2004) the technique of reducing setup time from one part to another or from one model to another was known as setup reduction. Shorter setup times lowered the requirement for buffer inventories, shortened lead times, increased capacity, and increased manufacturing

process flexibility Nightingale., D. (2005, June 2). The setup methods were observed and analyzed, and RCCA and Mistake Proofing were used to reduce the setup time.

2.3 Problem Solving

2.3.1 Market Feedback Analysis (MFA)

The use of unemotional market data to focus on the issue generating the most pain and irritation to customers is known as market feedback analysis. This is usually the first tool used by a company to assess which processes it needs to enhance Nightingale., D. (2005, June 2). Through MFA, customer feedback was included in ACE. MFA, like the other ACE tools, was an organized and fact-based approach to addressing escapes, which are defined as faults that escaped to the customer, and had strict standards for customer reaction times. MFA's main strength was in communicating consumer feedback on product quality issues to the production work cell and involving the operators in the problem-solving process.

2.3.2 Quality Clinic Process Charting (QCPC)

Hutton (2004) state that the QCPC tool was an organized approach for finding and prioritizing turn-backs that was used by a team. This definition of the QCPC tool distinguished it from the earlier-mentioned concept of QCPC "activity," which included the employment of the QCPC, RCCA, and MP tools. QCPC is commonly described as a five-step process.

Step I. Putting together a team of knowledgeable and involved individuals who will decide on specific aspects of the process to investigate, map that process using a data collection framework, and establish criteria for how the process should be carried out. Those involved in the process should be included on the team, and they will be expected to generate turn-backs in the future as they carry out their duties and complete the process. To examine turn-backs, summaries of turn back data can be created using several charting approaches, which can be used to either use previous data or collect fresh data.

Step III. For Pareto charting and analysis of linked turn-backs or quality problems, the team should identify a focus area (component or process subsection). The focal point offers improvements that are then implemented. Setting aggressive goals is a recommended goal for QCPC activities. The typical objective is to establish a precise baseline and then minimize turn-backs to half in three months and a tenth in nine months. Recognizing that it takes time for individuals to work in the

field is a problem in reaching these objectives. For Pareto charting and analysis of linked turn-backs or quality problems, the team should identify a target region (component or process subsection). The focus generates ideas for improvement projects, which are then implemented. Setting aggressive goals is the recommended goal for QCPC activities. The standard expectation is to establish a precise baseline and then reduce turn-backs to half in three months and a tenth in nine months. The difficulty in attaining these objectives is realizing that it takes time for people involved in the process to acquire trust in how their turn-backs are handled and confidence that they will be responded to, as well as confidence in reporting all turn-backs that occur.

Step IV. Implementing improvement initiatives is part of the QCPC process. The QCPC clinic and charting processes aid in the identification of problems and, as such, are part of D(define) in the DIVE problem resolution framework. The QCPC clinic and charting processes aid in the identification of problems and, as such, are part of D(define) in the DIVE problem resolution framework. A meeting with QCPC teams, support, and staff management are recommended to identify and review baseline process data and improvement initiatives. A regular evaluation of these initiatives aids in the sharing of trends, project status, and successful efforts. It is critical to create and keep a list of improvement projects available to everyone in the workplace so that everyone is aware of and can track their progress.

Step V. To document the outcomes of improvement projects, celebrate and share achievements, and update process standard work. The success criteria are that problems have been mistake proofed, evidence for harmful effects on other parts or processes has been sought but not found, a design or process change has been applied, and the QCPC charts show trends indicating improvement and no recurrences.

2.3.3 Root Cause Corrective Action (RCCA)

According to Roth (2010) the purpose of the RCCA was to get to the bottom of a problem in an organized, fact-based way. Collecting data, brainstorming explanations, and looking for connections with tools like fishbone diagrams, cause-effect diagrams, and the "Five Why's" were all part of a successful RCCA. The RRCA method sought a long-term solution rather than a short-term one. It was utilized as a standalone problem-solving tool as well as a subset of other ACE products like TPM and QCPC. To continue exploring deeper into the reason for an issue and

attempt to uncover the true root cause, the "Five Why's" entailed asking the question "Why?" five times in a row (Roth, 2010).

2.3.4 Mistake Proofing (MP)

Mistake Proofing entailed designing a work method, part, tooling, or work instruction to make it difficult to complete the task in any other way than the correct way. Mistake Proofing, like the other ACE techniques, requires a rigorous, structured team procedure to identify and assess all relevant elements. Despite the structure and rigor, imagination and innovation were highly valued in developing the Mistake Proofing solutions. Mistake Proofing, like RRCA, was utilized both as a standalone tool and as a subset of other ACE techniques such as TPM and QCPC (Roth, 2010).

2.4 Decision Making

2.4.1 Passport system

According to Roth (2010) the Passport System, which was largely used during the design and deployment phases of new products, was a collection of evaluations or checkpoints designed to ensure that all problems were recognized as early as possible in the new product development process. Using the Passport System, new product development teams could incorporate all feedback on existing product failures into the new product design while meeting quality, reliability, cost, and schedule criteria.

2.5 ACE Competency

Competence is defined as the ability and/or capability to function in a specific environment. Competency is concerned with one's real performance in a certain context. This suggests that prior to achieving competency, one must first demonstrate competence (Schroeter, 2008).

Employee empowerment and committed and involved leadership are essential for ACE competency. The foundation for developing ACE competency via a variety of methods:

- Awareness education and Supervised action learning engagements (ACE Change Agent training; High-Impact projects)
- Coaching, mentoring, and teaching by expert ACE Change Agents
- Doing: experience in many different improvement projects
- Sharing of best practices, teaching and training others
- Quality clinics

According to Hutton (2004), ACE has four major achievement levels which measure ACE Cells' competency level. These are:

1. **Qualifying** - Awareness education; local process identification and prioritization; waste elimination and cell organization.
2. **Bronze** - Advanced training; application of ACE tools to achieve important improvement in selected processes; substantial cell/workgroup involvement.
3. **Silver** - First demonstration of a step increase in customer satisfaction and business performance; major improvement in selected processes; improvement activities begun on all key processes; employee satisfaction target; significant organizational and leadership involvement.
4. **Gold** - Customer satisfaction and best-in-class business performance; total cell/workgroup and leadership involvement.

The next evolution in ACE will be the Gold Value Stream, "an organized group of processes that work together to provide value to customers". The integration of cells and workgroups into coordinated, end-to-end processes, referred to as a value stream, ensures that the customer is at the center of the action and that the whole organization's performance is optimized Nightingale., D. (2005, June 2).

2.6 Review of empirical studies on the ACE implementation

Pratt & Whitney's vice president of Manufacturing recognized in 1996 that P&W needed a comprehensive program to bring together the improvement initiatives. Even while pockets of excellence were emerging, there was no one, cohesive, quantifiable methodology similar to General Electric's Six Sigma to guide the multiple P & W worksites (Davis, 2008).

Furthermore, there were no uniform savings criteria to document and market the results. Dave Haddock the manager of the P&W Continuous Improvement Office, was tasked with developing a methodology that would connect the Quality and Continuous Improvement tools and offer metrics for responsibility. This was the starting point for the development of ACE. At the same time that P&W was developing ACE, UTC embarked on a path of radical quality improvement led by a Japanese quality expert named Yuzure Ito. After retiring from a successful career with Matsushita in Japan, Ito agreed to join UTC as a senior quality advisor to teach UTC managers new ways to improve quality in their manufacturing and business processes. Ito's influence grew

throughout UTC, and Ito University was founded in 1998 to teach UTC senior managers the necessity of incorporating quality into the company's operations. By connecting factory improvement tools to Ito's quality management system per Nightingale., D. (2005, June 2), ACE is a working framework that is less known, but extremely fruitful and is a mix of lean assembling and quality improvement methods of reasoning. (products with defects that were shipped to the customer). To give quality greater focus and visibility within UTC, in 1998, the UTC CEO, created a new executive position, vice president of Quality. He appointed P&W's vice president of Quality, Tesfaye Aklilu, to the position. Mr. Aklilu strongly supported the concept of a UTC-wide comprehensive improvement process. He proposed that ACE become UTC's standard platform of quality, and backed his proposal with evidence of P&W's success with ACE. According to Davis (2008) using ACE, P&W experienced a 17% drop in defects, a 14% drop in shop costs, and a 29% drop in "escapes" (products with defects that were shipped to the customer). While all business units within UTC after ACE implementation in 1996 strive to follow the program's strict formula for success. The manufacturing container refrigeration systems in Singapore since 1993 and opened the present site in 2004, without expanding the physical plant, the operation has increased capacity by 83 % through space optimization, waste elimination, initiatives, and better layout planning to meet growing demand.

According to Roth (2010) the UTC ACE council tracked November 30, 2010, ACE Bronze to Gold site performance changes and found consistent results: 35% sales increase, significant return on sales increase, 60% reduction in inventory levels, and 35% customer satisfaction improvement. These averages enabled executives to project the impact on UTC's results when 70% of its sites are certified ACE Silver or Gold. The magnitude of gains and their ability to sustain these improvements show that UTC has created a system comparable to that of high-performing Japanese automotive companies. Ten years after Pratt and Whitney were initially sent off in 1996, there were just 26 UTC ACE Gold locales in May 2006 (Roth, 2010). In 2006, they decided on the best five ACE deterrents.

1. The lack of management priority and commitment
2. Unclear understanding of the relationship between ACE and business results
3. Failure to provide recognition for ACE implementation

4. A perception that ACE is only for the factory
5. An inadequate allocation of time and resources

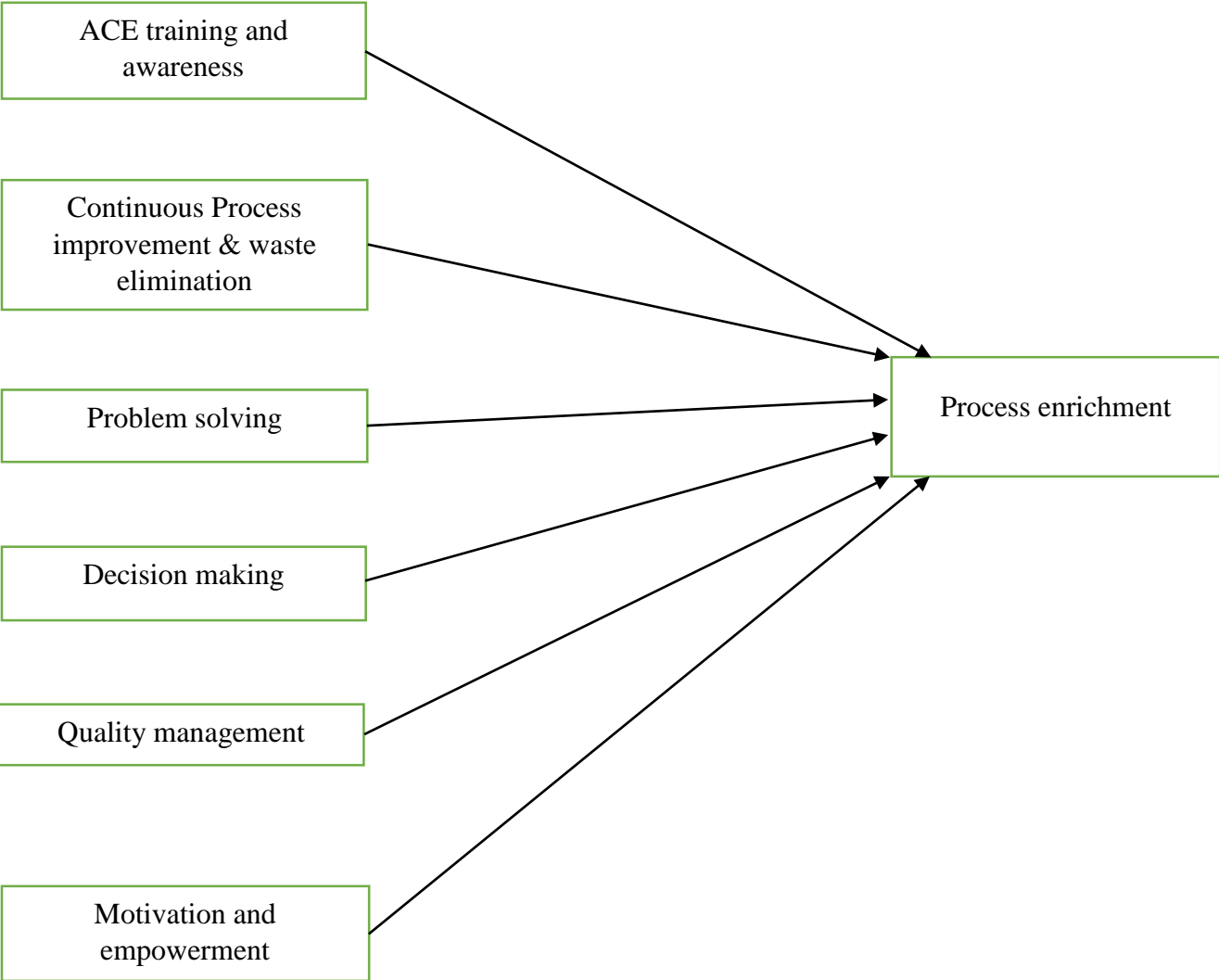
As indicated by Roth (2010) the corporate ACE office in 2006 asked every division for its ACE responsibility and the Division ACE chiefs figure their numbers in view of assumptions for destinations accomplishing ACE Silver and Gold. The overall ACE objective was then utilized as the establishment for ACE chamber plans, and arranging was finished with a “check the crate approach,” with accomplishments being “willful.” Before 2006, anything over nearby pioneers pulling for ACE would have likely upset, and there was a lacking foundation of talented subject matter experts, plentiful preparation, contextual investigation models, and ensured assessors to support the extent of exercises that came about because of corporate bearings.

George Roth (2010, PP 43) quantified that between 2003 and 2006, the individual ACE certification training typically had between 50 to 100 people across UTC enrolled at any one time. In 2006, as the ACE program was renewed 1,000 people were enrolled in these courses. By the end of 2008, there were 20,000 people joined in ACE certification training. The foundation that UTC had from its past efforts, including operations transformation and ACE certification training, and the materials developed to teach these skills, allowed a rapid expansion.

2.7 Conceptual framework

From a detailed review of UTC ACE implementation and practice, it is clear that ACE tools have a great influence on process enrichment. Therefore, this research had used the eights ACE operating tools as independent variable and process enrichment as dependent variables. The below figure illustrates the conceptual frame work of this study. This conceptual frame work helps as a model to analyze and discuss the study’s objectives.

Figure 3 Conceptual frame work of the study



Chapter Three

Research Design and Methodology

3 Research Approach and Design

Research design is the overall plan for collecting data to answer the research question and the specific data analysis techniques or methods the researcher intends to use. This research mainly aimed to identify the practices and challenges during ACE implementation as a process enrichment in Ethiopian Airlines company. The assessment becomes accomplished into account the three ACE foundations (ACE philosophy, ACE culture, and ACE gear), different relevant rules of the business enterprise, and inescapable information. This research used both quantitative and qualitative (mixed) approaches to satisfy the research objectives. The quantitative technique will assist the researcher in conducting a survey by allowing them to contact a large number of respondents through the questionnaire in a short amount of time while also allowing them to comfortably assess and evaluate the results. The qualitative approach, on the other hand, has been considered by conducting an in-interview to explore the views, constraints, behavior, and experiences of the focus group.

As a result, the qualitative data output (interview result) was utilized to better discuss, conclude, analyze, and make recommendations based on the researcher's perspective and practical experience. Secondary sources will also be reviewed in order to discuss and associate survey and/or interview analysis results, as well as to better compare trends and projections.

3.1 Population, Sample Size, and Sampling Procedure

3.1.1 Study Population

Ethiopian Aviation Group (EAG) has 15585 permanent employee including personnel at various outstations, domestic and foreign sites. Ethiopian Airlines MRO are employees are 2764, accounting for 18% of the total workforce (EthiopianMRO, 2022). Employees at Addis Ababa Bole International Airport were selected for this study only for the reasons stated.

106 Employees who are assigned as Flight Technicians (F.T) are not included in the target group due to their working conditions. 87 Employees who are assigned in Foreign Assignments are also excluded from the study since they are physically unable to participate. Because of the difficulties

in understanding the ACE concepts, 35 employees with less than one year of experience in the company were removed from the study.

According to Ethiopian airlines HR report is 2764 employees as of June,2022 are work in ET-MRO, Therefore, the target population is determined to be $2764-204= 2536$ employees in number.

3.1.2 Sampling Size Determination

In order to determine the sample size, the researcher took into account a variety of parameters. The following factors are considered: The organization's overall work culture, ET-MRO work culture, business pressures, respondents' time constraints, Redundancy of responses from respondents, company policy and regulations, Number of target populations, type of data required for the study, and data collection and analysis costs.

Based on the mentioned and remaining factors the researcher uses online Sample size calculator (Raosoft, 2004) and the required sample size determined at 90 % confidence level and with 5% margin of error. Therefore, the calculator determined that the recommended sample sizes are 245 from the targeted population 2536. However, as seen in Table 1, the departments of ET-MRO do not have an equal number of employees.

Table 1 Sample size distribution

Division	Qualified Employee	Target Population (2536) in %	Sample Size (245)	Distributed the Survey in quantity
EMT	258	9.88	24	24
AEP	143	5.48	14	14
LMT	829	31.76	78	78
CMT	396	15.17	37	37
BMT	950	36.4	89	89
MSM	18	0.69	2	2
MRO-HR	15	0.57	2	2

Source: own summary (Sep,2022)

Additionally, in this study, experienced and competent individuals from both management and non-managements personnel are chosen to collect qualitative data. 5(Five) ACE managers from Aircraft maintenance, 1(One) ACE manager from MRO marketing and sales, 2(Two) ACE change management supervisors, 2(Two) change agents from Engine maintenance, and 4(Four) Ex-change agents from Engine Maintenance are selected and interviewed off working hours, including break and lunch time; and a focus group discussion are carried on with the researcher and 2(Two) change management supervisors in the change management office.

3.1.3 Sample Method

Aircraft Line Maintenance (LMT), Aircraft Base Maintenance (BMT), Aircraft Engine Maintenance (BMT), Aircraft Component Maintenance (CMT), Aircraft Engineering and Planning (AEP), and MRO Sales and Marketing are the six major/core departments of Ethiopian MRO (MSM). As the name implies, they are all organized by Director Level due to their job category. Stratified sampling is used for quantitative analysis in this study. This method is used to divide the population into subgroups, or strata, with the goal of obtaining a more efficient sample and reducing random sampling error (Zikmund, 2009) . Internally, each employee is homogeneous or has the same qualification level, but there are comparative variances amongst employees due to work assignment distribution and other factors. Purposive sampling, on the other hand, is used to select interviewees for qualitative data analysis. This is selected due to the participants arbitrarily for their unique characteristics or their experiences, attitudes, or perceptions (Schindler, 2014). Therefore, the researcher is use purposive sample to swiftly and conveniently select important informants, with the specific goal of reaching ACE managers, Agents, Co-agents, Ex-change agents, and change management officers. As a result, both stratified and purposive sampling procedures used to obtain a representative sample from the target population.

3.2 Data collection Instrument

3.2.1 Data source

This study is heavily reliant on primary data; a standard questionnaire (5-point Likert scale) developed by Zikmund (2009) is used to obtain input data for quantitative analysis. The questionnaire was created as a guideline for examining the practices, contribution and challenges of ACE implementation in ET-MRO from four primary perspectives: ACE implementation strategy, ACE philosophy, ACE culture, and ACE tools. Secondary data for this study gathered

and evaluated from the organization's web page. Furthermore, various types of secondary data such as documentations (from internal and external sources published and/or not), section reports (towards their KPI), library sources (books and articles), and information contained on Ethiopian Aviation Group web and portal pages used for the study. Existing conditions and physical presentations of workplace, business results, etc. towards ACE standard observed by the researcher in the study to strengthen the analysis and to recommend accordingly for those issues/concerns that are not captured and not addressed by questionnaires, interviews, and secondary data. The Advisor pre-test all sorts of surveys before distributing them to target groups to ensure their suitability (capability to collect all essential information).

3.2.2 Questionnaire Survey

For some security reasons, the researcher distributed the 245 questionnaires in hard copy with good follow up method (listing the distributed questionnaires) and additionally reached via company e-mail. The number of copies distributed purposefully increased to avoid discomfort from paper loss and damage around the technical working area from the specified sample in order to collect reasonably enough replies and improve analysis quality.

The questionnaires consisted of three major parts and of closed ends:

Part One: concerned with the respondents' profile, including their time with Ethiopian Airlines, present department and position, and role in ACE implementation.

Part Two: related to ACE implementation strategy in ET-MRO

Part Three: related to ACE philosophy, cultures and related to ACE tools employed in ET as whole and specifically in ET-MRO.

3.2.3 Interview

On the other hand, 10 employees from ACE managers and Change management staffs are interviewed one-on-one. The majority of the interviews had been scheduled ahead of time and conducted during off-peak hours, allowing for more in-depth discussion while still adhering to company policies. Furthermore, prior to beginning the interview, the researcher provides background information on the topic, as well as information on the purpose and length of the interview. In practice, each interview lasted about 10-20 minutes. The interview questions in this study were developed with coherence and well-structured for selected interviewees using the ACE

protocol manual. Four common interview questions sent to all respondents, with the fifth question aimed for Change agents, Co-change agents, and Exchange agents to obtain input on the weight of ACE assignments in their careers.

3.2.4 Observation

For the study, observation also used during survey data distribution and collection with the assistance of a developed format, because the researcher assumed the position he held (A/C technician IV and ACE team member) so as a functional position, allowing him to be a part of the observed phenomenon and act as both an observer and participant. Participant observation provided an opportunity for the researcher (observer) to understand the emotional reactions of the observed group and gain a more in-depth understanding of their experience.

3.2.5 Secondary Data

In addition, secondary data collected for research from Ethiopian Aviation Group Annual Reports (published or unpublished), Monthly Fact Sheets, ET-MRO performance Annual Reports, Selamta magazine (published), Ethiopian Aviation Group HR Reports (monthly basis), and change and Performance Management Office monthly ACE status review, using various official websites.

3.3 Method of Data Analysis

The collected data analyzed using quantitative data analysis methods. The data analysis for the questionnaire done using Statistical Package for Social Science (SPSS version 26). SPSS is selected for the reason that it is a readily available and user-friendly analysis tool with which the researcher is acquainted. In this study ordinal scale used to analyze quantitative data which are classified into non-numerical or named categories in an inherent order exists among the response agreement of the respondents' (1=strongly disagree, 2= disagree, 3=neutral, 4= agree, and 5=strongly agree). The study was used descriptive statistics method such frequency, percentage, mean and standard deviation for the data analysis and the data was presented using frequency tables.

Data editing is the process of analyzing the acquired raw data for errors and omissions and correcting them where possible. The act of editing occurs both during and after data collection, that is, immediately following interviews. completed questionnaires was verified to ensure that the responses provided were coherent and rationally recorded in order to provide appropriate information. This allowed the researcher to cross-examine the relationship between the questions and the responses in order to verify correctness, consistency, and uniformity. Furthermore, the

researcher conceptualizes the qualitative data and summarizes it to simple descriptive analysis to minimize the subjectivity of the interpretation. Finally, with maximum care, the result of the analysis is interpreted to address the research questions and the objective of the study. To ensure reliable and objective results and to quantify the outcomes the researcher used the following steps such as reading, describing, classifying, conceptualizing.

3.4 Reliability and Validity

3.4.1 Reliability

The degree to which a research instrument produces the same results on repeated measurements is referred to as its dependability. A reliability test was performed to ensure that the questionnaire consistently reflected what it was designed to measure. Cronbach's alpha was employed as a measure of internal scale consistency using SPSS software to examine the instrument's reliability.

Table 2 Reliability Test data

Items	No. of Items	Cronbach's Alpha	Over all Cronbach's Alpha
Training, and general ACE implementation practice	19	0.937	0.951
ACE Tools			
Process Management (PM)	13	0.915	
Total Preventive Maintenance (TPM)	6	0.875	
5 S +1 visual control (5S)	4	0.878	
Market Feedback Analysis (MFA)	3	0.828	
Quality Clinic Process (QCPC)	3	0.733	
Root Cause Corrective Action (RCCA)	3	0.774	
Mistake Proofing (MISPRO)	2	0.869	
Decision Making tools (DM)	3	0.859	

Source: own summary (Sep,2022)

3.4.2 Validity of the Instrument

The accuracy of the results obtained from data acquired utilizing research methods is referred to as validity. The degree to which an instrument measures what it is designed to measure is referred to as its validity. It refers to the appropriateness, meaning, and utility of evidence used to support interpretations (Cooper D.R.&Schindler P.S., 2014). The questionnaire's validity was determined through consultations with advisor comments in order to reduce errors caused by poor design aspects such as question phrasing, sequencing, and adequate coverage of questions.

3.5 Ethical Considerations

Given the importance of ethics in study, the researcher explored ethical considerations to the greatest extent possible. Permission requested to Ethiopian Aviation Group Human Resources Planning and Development and the study's goal thoroughly disclosed to all participants. The problem of anonymity is also explained to each participant in advance, and the questionnaires are expected to be completed anonymously. The analysis is done collectively based on the study population's participation.

Chapter Four

Data Presentation, Analysis and Interpretation

4 Introduction

This chapter addresses the presentation, interpretation, and analysis of the data gathered utilizing data-gathering tools (questionnaire, interview, and document analysis). Data were gathered from the sample Ethiopian Airlines aircraft maintenance, repair, and overhaul sector for analysis and interpretation (MRO).

4.1 Response rate

The first data analysis consists of profiling the respondents' background characteristics. These include gender, age, and level of education, professional experience, position they currently hold, responsibility in ACE and their department/division currently work. Regarding questionnaires, the total of 245 questionnaires distributed to the respondents, 219(89%) were collected. However, 27 respondents did not return the questionnaire paper. therefore, the overall response rate was 89% as shown in below Table 2.

Table 3. Survey data Distributed Vs Collected summary

Department	Distributed	Collected	Unreturned	Collected Vs. Distributed (%)
EMT	24	24	0	100
AEP	14	14	0	100
LMT	78	61	17	78
CMT	37	37	0	100
BMT	89	79	10	89
MSM	2	2	0	100
MRO-HR	2	2	0	100

Source: own summary (Oct,2022)

4.2 Respondents' Demographic Characteristics

As indicated Table 4. total of 184(84%) of respondents were male and 35(16%) were female. The majority of respondents are males. On the other hand, the value of 8(3.7%) respondents ages are below 25 years,91(41.6%) respondents ages are 25-30 years and 31-40 years, and around 29(13.2%) respondents ages are 41-50 years. Regarding their educational status 25(11.4%) hold master's degree, the majority of the respondents,132(60.3%) was hold first degree and a total of 62(28.3%) of respondents were having diploma. Therefor it implies the respondents can easily understand the questionnaire and reply appropriate answer.

Table 4. Respondents' Demographic Characteristics

Gender				
		Frequency	Percent	Valid Percent
Valid	Male	184	84	84
	Female	35	16	16
	Total	219	100	100
Age				
		Frequency	Percent	Valid Percent
Valid	Below 25	8	3.7	3.7
	25-30	91	41.6	41.6
	31-40	91	41.6	41.6
	41-50	29	13.2	13.2
	Total	219	100	100
Higher Education Level				
		Frequency	Percent	Valid Percent
Valid	Diploma	62	28.3	28.3
	Bachelor's Degree	132	60.3	60.3
	Master's Degree	25	11.4	11.4
	Total	219	100	100

Source: own summary (Oct,2022)

Concerning work experiences shown Table 5, in Ethiopian airlines MRO more than half of respondents 110 (50.2%) were found to have level of service 1-10 years were 89 (40.6%) respondent having 11-20 years of experience. While the remaining 20 (9.1%) had 21-30 years of service.

Table 5 Work experience

How long have you worked in Ethiopian Airlines (ET-MRO)?				
		Frequency	Percent	Valid Percent
Valid	1-10 years	110	50.2	50.2
	11-20 Years	89	40.6	40.6
	21-30 Years	20	9.1	9.1
	Total	219	100	100

Source: own summary (Oct,2022)

With regard to the current position in the organization 211(96.3%) or majority of respondents are non-management while the remaining 8(3.7%) respondents are management staff. A total of respondents 151(68.9%) engaged in different type of role were as 27(12.3%) are ACE agent and 32(14.6%) respondents are Co-ACE agent. The remaining 9(4.1%) respondents are ACE managers.

Table 6. Role or Responsibility in ACE, (Source: own summary (Oct,2022))

What is your role or responsibility in ACE?				
		Frequency	Percent	Valid Percent
Valid	ACE Manager	9	4.1	4.1
	ACE Agent	71	32.4	32.4
	ACE Co-Agent	32	14.6	14.6
	Another role	107	48.9	48.9
	Total	219	100.0	100.0

As presented on Table 6 respondents experience in the current department 68(31.1%) are below 5 years and 66(30.1%) respondents had 6-10 years on the current particular department while 85(38.8%) are 11-15 years of experience in the current section respectively.

Table 7. How long have you been in this division/department?

How long have you been in this division/department?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 Years	68	31.1	31.1	31.1
	6-10 Years	66	30.1	30.1	61.2
	11-15 Years	85	38.8	38.8	100.0
	Total	219	100.0	100.0	

Source: own summary (Oct,2022)

About 2(0.9%) respondents are currently work in MRO marketing and sales;14(6.4%) respondents in Aircraft engineering and planning;24(11%) respondents are in engine maintenance;37(16.9%) respondents are in Component maintenance;61(27.9%) respondents are in line maintenance; 79(36.1%) respondents are in base maintenance and 2(0.9%) respondents are work in MRO-HR.

Table 8. What is your division/department or where you are currently working?

What is your division/department or where you are currently working?				
		Frequency	Percent	Valid Percent
Valid	MSM	2	0.9	0.9
	AEP	14	6.4	6.4
	EMT	24	11.0	11.0
	CMT	37	16.9	16.9
	LMT	61	27.9	27.9
	BMT	79	36.1	36.1
	MRO-HR	2	0.9	0.9
	Total	219	100.0	100.0

Source: own summary (Oct,2022)

4.3 Descriptive Statistics Results

Participants in the study were asked to comment on the practices and challenges of implementing Achieving Competitive Excellence (ACE) as a process enrichment system within the Ethiopian Airlines Group MRO section. The respondents were given options on a 5-point Likert scale, with 1 being strongly disagree, 2 being disagree, =Neutral, 4 being agree, and 5 being strongly agree. The study data was analyzed using descriptive statistics such as frequency, mean, percentage, and standard deviation, as shown in the table below. here: Frequency (f) = The number of respondents who agreed on a rating. The mean is the average rating given by respondents. The mean value was interpreted using a Likert Scale ranging from 1 to 1.8 (strongly disagree), 1.81 to 2.6 (disagree), 2.61 to 3.4 (true to some extent), 3.41 to 4.2 (agree), and 4.21 to 5.0 (strongly agree) (strongly agree).

4.3.1 Training, and general ACE implementation practice

As shown in Table 9, about 11% of respondents strongly disagreed with training and general ACE implementation practices;19.7% disagreed with the training and general ACE implementation practices. and 20.9% of respondents were neutral. However,14% and 34.4% of respondent’s responses strongly agreed and agreed respectively. The mean value for “Training and General

ACE implementation practices” is 3.21 and the standard deviation is 0.777. From the mean value, the finding indicates that the respondents have a poor understanding of ACE philosophy and culture.

Table 9: Training, and general ACE implementation practice

		Responses		Mean	St. Deviation
		Frequency	Percent		
Training and general ACE implementation practices	Strongly Disagree	458	11.0	3.2079	.77674
	Disagree	819	19.7		
	Neutral	868	20.9		
	Agree	1432	34.4		
	Strongly Agree	584	14.0		
Total		4161	100.0		

Source: Own survey data (Oct, 2022)

4.3.2 Analysis of ACE Tools base on categories

4.3.2.1 Process Improvement and Waste Elimination

In accordance with table 10, with regard to process management the mean value for statements under process management is 2.997 and standard deviation is 0.75. According to the collected data 284(10%) of respondents were strongly disagreed, 734(25.8%) of respondents disagreed. Whereas 152(5.3%) of respondents were strongly agreed and 994(34.9%) of respondents agreed respectively. The remaining 24% of respondents were failed to make decision in process management. From the data, this signifies that a process is not in Control (stable, predictable, repeatable) and that it is capable of producing products or services that meet customers’ expectations.

In responses Total productive maintenance shown in table 10, 73(5.6%) of respondents were strongly disagreed and 285(21.7%) of respondents disagreed on total preventive maintenance; 9.4% and 45.6% of respondents indicated strong agreement and agreement, respectively, however 17.7% did not make a decision. This reveals that monitoring machine performance to take preventative action before breakdowns or malfunctions occur not follow up adequately.

In response to visual control of table 10, about 269(42.8%) respondents showed agreement whereas 33.6% of respondent disagreed concerning visual workplace. However, 85(13.5%) of

respondents failed to decide. thus, it can be concluded that the working environment is improved by 5s method to some extent, but it still required more work on the tools. The 5S technique improves the working environment to some level, but it still needs further work on the tools.

Table 10 Process Improvement and Waste elimination responses Analysis

		Responses		Mean	St. Deviation
		Frequency	Percent		
Process Management	Strongly Disagree	284	10.00	2.9986	0.74561
	Disagree	734	25.80		
	Neutral	683	24.00		
	Agree	994	34.90		
	Strongly Agree	152	5.30		
Total		2847	100.00		
Total Productive Maintenance	Strongly Disagree	73	5.60	3.3166	0.81944
	Disagree	285	21.70		
	Neutral	233	17.70		
	Agree	599	45.60		
	Strongly Agree	124	9.40		
Total		1314	100.00		
Visual Control (5S+1)	Strongly Disagree	63	10.00	3.3014	0.99248
	Disagree	211	33.60		
	Neutral	85	13.50		
	Agree	269	42.80		
Total		628	100.00		

Source: own summary (Oct,2022)

4.3.3 Problem Solving Analysis

In response to Market Feedback Analysis result shown on Table 11, about 29(7%) and 159(38.5%) of respondents strongly disagreed and disagreed respectively. whereas the 58(14%) of respondents do not make decision. According to the data collected 94(22.8%) of respondents strongly agreed and 73(17.7%) of respondent were agreed. The mean value for the MFA is 3.4384 and the standard deviation 0. 96927.The findings indicate customer feedback collected and analyzed but not properly addressing potential customer needs.

According to Table 11, about 27(6.2%) and 39(8.9%) of respondents indicated that they strongly opposed and disagreed with the Quality Clinic Process (QCPC), respectively, 60(13.7%) of respondents indicated that their opinions were neutral. The mean value for QCPC is 3.3638 and standard deviation is 0.92924 so the results show that the QCPC team is not consistently engaged in producing, gathering, analyzing, and applying data to guide improvement initiatives.

Regarding Root Cause Corrective Action (RCCA) on Table 11, about 40(7.6%) of respondents strongly disagreed, 130(24.8) % disagreed, while 39(29.33%) and 154(36.9%) of respondents strongly agreed and agreed. The remaining 162(30.9%) of respondents were unable to decide. According to the data collected the mean value for Root Cause Corrective Action 3.2344 and standard deviation is 0.83553. The results show that the root cause method failed to some extent to identify and separate issue symptoms from their underlying causes, preventing attention and effort from being directed toward what are supposed to be long-lasting solutions.

In response Mistake Proof (MP) on Table 11, about 16(3.7%) and 56(12.8%) of respondents strongly disagreed and disagreed respectively while 46(10.5%) and 203(46.3%) of respondents showed their level of agreement. The remaining 117(26.7%) of respondents do not make decision. According to the data collected the mean value for Mistake proof 3.4726 and standard deviation is 0.91078. Therefore, since the philosophy of mistake proofing is that "errors will occur, but it is possible to design tasks, processes, products and people's attitude to prevent errors", the findings indicate that the structured team able to identify the root causes of errors and prevent all contributing factors.

Table 11 Problem Solving

		Responses		Mean	St. Deviation
		Frequency	Percent		
Market Feedback Analysis	Strongly Disagree	29	7.00	3.4384	0.96927
	Disagree	159	38.50		
	Neutral	58	14.00		
	Agree	73	17.70		
	Strongly Agree	94	22.80		
Total		413	100		
Quality Clinic Process	Strongly Disagree	27	6.20	3.3638	0.92924
	Disagree	39	8.90		
	Neutral	60	13.70		
	Agree	168	38.40		
	Strongly Agree	143	32.70		
Total		437	100.00		
Root Cause Corrective Action (RCCA)	Strongly Disagree	40	7.60	3.2344	0.83553
	Disagree	130	24.80		
	Neutral	162	30.90		
	Agree	154	36.90		
	Strongly Agree	39	29.33		
Total		525	100.00		
Mistake Proof (MP)	Strongly Disagree	16	3.70	3.4726	0.91078
	Disagree	56	12.70		
	Neutral	117	26.70		
	Agree	203	46.30		
	Strongly Agree	46	10.50		
Total		438	100.00		

Source: own summary (Oct,2022)

4.4 Decision Making Analysis

When it came to the decision-making (DM) on Table 12, 119(18.1%) of respondents strongly disagreed, 102(15.5%) disagreed, and 201(30.5%) couldn't make a choice.45(6.8%) of respondents were strongly agreed and 192(29.1%) of respondents agreed. The mean value for the decision-

making part is 2.9178 and the standard deviation 1.02881. Thus, based on the results show that the passport review process, which is supposed to aid in an organization's strategic decision-making, somewhat appropriately applied.

Table 12: Decision Making

		Responses		Mean	St. Deviation
		Frequency	Percent		
Decision Making Tools	Strongly Disagree	119	18.10	2.9178	1.02881
	Disagree	102	15.50		
	Neutral	201	30.50		
	Agree	192	29.10		
	Strongly Agree	45	6.80		
Total		659	100.00		

Source: own summary (Oct,2022)

4.5 Qualitative Analysis

A one-on-one interview was done with ten staff members chosen from among ACE managers, ACE team leaders, and Ex-change agents. The majority of the interviews were organized ahead of time and performed during off-peak hours, allowing for more in-depth conversation while still following to business standards. Furthermore, before to beginning the interview, the researcher offered background information on the topic, as well as information on the goal and length of the interview. In practice, each interview lasted roughly 10-15 minutes. The interview questions in this study were coherent and well-structured for selected interviewees utilizing the ACE protocol manual.

Even though the staff is aware of the significance of these operating systems to some extent, inconsistent training practices were discovered from the data acquired through the interview and focused group discussion. Because of this, there are a knowledge and skill gap when new employees are hired by the organization. As a result, the staff generally opposes using the ACE tools. They claimed that there was insufficient follow-up training provided for the newly hired workers.

The data from the interviewed focused group discussion (FGDs) the majority of participants indicated that evaluation was done at the achievements level like local process identification and prioritization; waste elimination and cell organization; application of ACE tools to achieve significant improvement in selected processes; significant cell/workgroup involvement; first demonstration of step increase in customer satisfaction and business performance; major improvement in selected processes; improvement activities began Based on these evaluations, All progress reports and support requirements with regard to the implementation of ACE directed to the next higher level of the respective ACE structure, with a copy to the Change Management Office, which will facilitate the support requested. Whenever ACE cells achieve the bronze, silver, or gold certifications, the employees of those cells awarded a certificate of recognition to be given during a ceremony organized specifically for this purpose and a corresponding symbolic award in recognition of their achievement.

Interviewees were also asked about the difficulties of implementing ACE and retaining the advances obtained by its tools, culture, and philosophy. To that end, all interviewees agreed: "ACE has little investment in ET-MRO, no effective implementation strategy, insufficient ET-MRO training, and it is not appropriately considered a change instrument." "ACE should not be viewed as a vehicle for change," Instead than focusing on the means to an end, focus on the ultimate result. Internalization of ACE in the workforce Problems with customization throughout ACE implementation, management disengagement at all levels, and insufficient time allocation for ACE activities The old techniques impact managerial involvement by insuring it. In day-to-day activities, the ACE principle is not applied. In ET-MRO, targets lack the ACE protocol manual standard. Inadequate ongoing training and staff engagement efforts failure to accept responsibility, both by management and by staff Management dedication and ownership fell short of the mark. a cultural problem (not doing things differently than the old way), From middle to upper management, there is a lack of priority for ACE initiatives and lack of support for the program from upper management. Senior management engagement in the improvement initiative should be required, and it needs to be confirmed. In the lack of a motivated and encouraged workforce to use ACE in day-to-day operations, the fact that ACE has its own manager for each division at the director level is missing to sustain ownership.

4.6 Observation analysis

The researcher walked through and obtained information during his survey distribution and collection period and discovered the physical presentation of the work environment in ET-MRO, all areas are identified, all equipment, fixtures, tools, etc. are properly listed, a follow up method is established, and safety items provided per work condition. For designated areas such hazardous waste, flammable storage, moveable parts designated area, pressurized cylinders' storage area, etc., pictograms are partially posted in practically all ET-MRO working area murals. ineffective tools All workstations have adequate tool separation, and garbage can (bin) usage has been messed up. According to these hazards, the researcher finds that all workstations have safety and First Aid kits, but that most parts require refilling. Furthermore, despite the use of ACE tools in all parts, the researcher noted a lack of good documentation, with most documents generated in specific sections for audit purposes.

Chapter Five

Summary, Conclusion and Recommendation

5 Introduction

This section reveals the summary major findings, conclusion and recommendation based on this study's results obtained from quantitative and qualitative data analysis. The objective of this study was to assess the practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system: the case of Ethiopian Airlines Group. ACE is not a reform tool it is a performance enrichment system. The ACE tools and philosophy are a blend of lean manufacturing and quality improvement systems.

5.1 Summary of Findings

The object here is to present the findings from the survey, interview, secondary data review and observations which are analyzed on the practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system. In the basis of the analysis and interpretation of the data gathered through all the instruments, the following major findings were indicated.

Training and general ACE implementation practices. The mean value for “Training and General ACE implementation practices” is 3.21 and. From the mean value, the finding indicates that the respondents have a poor understanding of ACE philosophy and culture.

Process Improvement and Waste Elimination the average mean for Process Management, Total Productive Maintenance, and Visual Control (5S+1) is approximately 2.9986, 3.3166, and 3.3014, respectively. Eliminating operations that do not add value and eliminating wastes are not fully addressed and controlled in ET-MRO; all processes in ET-MRO are not examined, combined, optimized, standardized, and documented to ease for the next production or service and to retain data as required, and employees' knowledge of standard work is limited to work procedures only, including manuals, company policies, and so on.

The average mean for decision-making is 2.9178, which indicates the lack of a process review board for go/no-go approvals of newly changed procedures following process management. Because ET-MRO lacks an independent staff and attention, the decision-making process is partly defective.

5.2 Conclusion

Both the general ACE implementation and the ACE training were not carried out satisfactorily. General ACE-based process improvement techniques confound employees. The survey findings from ET-MRO show that about 51.7% of participants disagreed, strongly disagreed, or are neutral, suggesting that ET-MRO's lack of trainings and awareness of the ACE guiding principles may pose a risk to ACE implementation. ACE is not understood by the employees; hence process improvement is needed.

Regarding the practices of ACE tools, the result indicates that a process is not in control (not stable, not predictable, and not repeatable) and is incapable of providing products or services that fulfill customers' expectations. And also, monitoring machine performance to take corrective action before malfunctions or breakdowns happen is required for follow-up. Strategic decision-making is somewhat appropriately applied but still needs to take smart and timely decisions, requiring policy deployment, program management, and portfolio management.

Improper execution. This is typically related with ignoring relatively simple approaches and/or processes that serve as the foundation of ACE tools.

The above finding show that middle and higher managements only focuses on production they didn't give much attention on ACE implementation. Lack of support for the program from high management.

5.3 Recommendation

The following recommendations are made based on the study's major findings and conclusions.

- Establish goals that are unambiguous and understandable to all staff. Make an effort to clarify strategic goals so that they may be communicated to everyone and understood. As much as possible, involve every employee in the process of improvement.
- Training must be provided by qualified specialists with in-depth knowledge of the subject. Employees must be supplied with continual courses regarding ACE and training across departments in order to maintain ACE.
- Managements should involve on ACE practices and should be committed to the successful implementation of ACE.

- Maintain a clear link between an ACE implementation strategy and corporate goals ACE basic training and certification for ACE agents and ACE managers should be continued; ACE agents and ACE managers should be recognized for their accomplishments. enhance the existing ACE online training and build a means of follow-up.
- Utilize measurement and feedback methods to confirm improvements actual, and provide easy and visually appealing approaches to process optimization.
- Establish a consistent technique or follow-up for closing the gap between actual results and goals.
- ACE tools are used to align internal processes, structures, and systems inside the working system. therefore, all divisions should properly utilize the ACE tool.

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Appendix 1: Data Collection Instruments: Questionnaires

ST. MARY'S UNIVERSITY SCHOOL OF GRADUATE STUDIES

MA IN PROJECT MANAGEMENT

Survey on the Contribution and Challenges of Achieving Competitive Excellence (ACE) Implementation in Maintenance, Repair and Overhaul (ET-MRO) Strategic Business Unit.

Dear Participant,

This questionnaire is designed to conduct a research on the topic “*The practice and challenges of Achieving Competitive Excellence (ACE) as a process enrichment system*”. The purpose of the study is for the partial fulfillment of the requirements of Master’s

Degree in Project Management. The information you provide remains confidential and is to be used for academic purpose only.

General Instructions: -

Writing your name is not necessary.

Put tick mark “v” for each question as required and consider the key/description/values “for Part Two, Part Three, Part Four and Part Five Queries while ticking.

Please use the following definition while answering questions related with key words:

ACE- (Achieving Competitive Excellence): - is the standard operating system for Improving and sustaining quality and productivity throughout all of Ethiopian Aviation Group based on three major elements: The culture, Tools and Competency.

Culture: A culture of full employee engagement at every level, with a relentless focus on continuous improvement.

Tools: A set of tools aimed at transforming and sustaining business performance, and divided into three groups: Process improvement and waste elimination, Problem solving, and Decision making.

Competency: The ability to understand the needs of the customer and the business, and apply the tools in a structured manner to deliver continuous improvement.

ET-MRO: Ethiopian Aviation Group Maintenance, Repair and Overhaul.

Part One: Respondent Profile

1. Sex

Male: Female:

2. Age(Years)

Below 25 25-30 31- 40 41-50 above 50

3. Highest Education Level

Below Diploma Diploma Bachelor's Degree

Master's Degree Above Master's Degree

4. How long have you worked in Ethiopian Airlines (ET-MRO)?

1-10 years 11-20 years 21-30 years 31- 40 years
41-50 years > 50 years

5. What is your current position in the Organization?

Management Non- Management

6. What is your role or responsibility in ACE?

ACE Manager ACE Agent ACE Co-agent

Another role, please specify,

7. What is your division/department where you are currently working?

MSM AEP EMT CMT LMT BMT

MRO-HR

8. How long have you been in this division/department?

< 1 year 1-5 years 6-10 years 11-15 years

16-20 years 21-25 years above 30 years

Part Two: - Questionnaires

Please carefully read each statement in the first column and indicate the extent to which you agree. Using the following rating scale (Likert Scale) on the statements by putting (√) this in the next column. The scale is as follows: 1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, and 5 = Strongly Agree.

Training and general ACE implementation practice

No.	Question item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Training and education has been given about ACE before ACE implementation launched					
2	EAL consistently gives training and education on ACE tools					
3	EAL provides necessary material for training about ACE					
4	Training and education given by appropriate professionals having sufficient skills					
5	New employees get indication training and attach to a mentor.					
6	Employees are cross-trained across departmental boundaries.					
7	Your ACE Cell portal page properly updated on time per Ethiopian Airlines ACE protocol					
8	All employees in your cell are assigned in ACE tools					
9	ACE changes your working culture and environment					
10	ACE is implemented in Ethiopian Airlines as an operating system					
11	Teams celebrate your ACE cell achievements and expected success					
12	Human talents are fully used					
13	Costs are reduced to produce products, in comparing to previous cost and sales are increased.					

14	The company has made the key mind-shift from quality defect detection to active prevention.					
15	Employees are now responsible for inspecting their own work and know exactly the standards they have to meet.					
16	The defect rate has been reduced.					
17	Employee use ACE tools to solve any operational problem					
18	Efficient utilization of resources improved: - it is possible to produce services/products by using less inputs than before.					
19	Cells sustained in all ACE tools implementation as an operating system.					

Part Three: ACE Tools

No.	Question item (Process management (PM))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	All tools in process management elimination have addressed in your section properly.					
2	Key processes identified and prioritized.					
3	Every process in your section have been mapped properly					
4	Every process has reached matured level					
5	Cross functional meeting held appropriately to interface process between inter departmental/Cells					
6	Section improves their process by benchmarking other internal departments					
7	Your section process interface with another department					
8	Your section fully aligned with other department in the value stream					
9	New processes are designed to maximize value-added activity.					
10	Product/Services produced as per pre-established standards.					
11	Process waste reduced i.e. scrap, rework, order cycle time, process steps, transport, reject etc.					
12	Unnecessary motions are reduced					
13	Inventory and work in progress for almost everything is the lowest in EAL					

No.	Question item (Total Productive Maintenance (TPM))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Equipment Safeguarding has completed in accordance with equipment safety norm					
2	Your section Equipment Safety is controlled and maintained per their schedule.					
3	Your working environment is safe for your daily operation					
4	Change in technical efficiency: In EAL there is improvement in utilization of EAL equipment, tools etc.					
5	Equipment breakdown are virtually eliminated.					
6	Decrease number of accidents, injuries.					
No.	Question item (5 S +1 visual control (5S))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	5S+1 is fully implemented in your section efficient work place and your section can visually comprehend the existing situation					
2	5 S + 1 Audit executed monthly					

3	For all 5 S + 1 Audit turn backs corrective actions taken accordingly.					
4	Your department's internal supply chain function are located together to supply each other					
No.	Question item (Market Feedback Analysis (MFA))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	All internal and external customers are listed carefully at cell level and ET-MRO					
2	In ET-MRO Collecting customer feedback as part of monitoring and reporting customer satisfaction (feedback score)in monthly basis					
3	Customer Feedback score meets for silver > 5 and for Gold achieved levels > 6					
No.	Question item (Root Cause Corrective Action (RCCA))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Solution's provided by RCCA is pertinent enough and last long					
2	Recurrent problems/turn backs resolved using RCCA					
3	The 8 RCCA steps are registered in system for any returned order.					
No.	Question item (Mistake Proofing (MISPRO))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

1	Mistake proofing solutions are applied to recurrent turn backs					
2	Your section implements and document mistake proofing devices					
No.	Question item (Decision Making tools (DM))	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Your ACE section use passport concept to key business decision making process properly					
2	Problems that need management involvement escalate on time for higher management decisions					
3	Management staffs give high emphasize for effective ACE implementation					

Appendix 2. In-Depth Interview Questions

1. How do you see the essence of Achieving Competitive Excellence (ACE) understanding among the staff members?
2. How do you evaluate the change (out) come of Achieving Competitive Excellence implementation in Ethiopian Airlines MRO?
3. How do you evaluate the current process as compared to the previous?
4. What challenge have you faced so far in displaying roles expected of you?
5. Can you enumerate some main indicative achievements on the processes which are brought about by Achieving Competitive Excellence implementation program to Ethiopian Airlines?
6. Would you say something on the level of commitment of leaders and employees in different stages of the hierarchy in Ethiopian Airlines company administration to process enrichments? How can this be measured?
7. Have you been facing some challenges during the Achieving Competitive Excellence implementation period? Would you mention some of these challenges please?

Appendix 3. Reliability Test data

Items	No. of Items	Cronbach's Alpha	Over all Cronbach's Alpha
Training, and general ACE implementation practice	19	0.937	0.951
ACE Tools			
Process Management (PM)	13	0.915	
Total Preventive Maintenance (TPM)	6	0.875	
5 S +1 visual control (5S)	4	0.878	
Market Feedback Analysis (MFA)	3	0.828	
Quality Clinic Process (QCPC)	3	0.733	
Root Cause Corrective Action (RCCA)	3	0.774	
Mistake Proofing (MISPRO)	2	0.869	
Decision Making tools (DM)	3	0.859	

Appendix 4. Descriptive Statistics (Mean and standard deviation)

Training and general ACE implementation practices mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
Training and education has been given about ACE before ACE implementation launched?	219	3.5434	1.29632
EAL consistently gives training and education on ACE tools	219	3.0411	1.24633
EAL provides necessary material for training about ACE	219	3.1324	1.28713
Training and education given by appropriate professionals having sufficient skills	219	2.7671	1.20990
New employees get indication training and attach to a mentor.	219	2.7671	1.38326
Employees are cross-trained across departmental boundaries.	219	2.6484	1.26333
Your ACE Cell portal page properly updated on time per Ethiopian Airlines ACE protocol	219	3.8311	1.03327
All employees in your cell are assigned ACE tools	219	4.1598	1.11989
ACE changes your working culture and environment	219	4.0913	0.89385
ACE is implemented in Ethiopian Airlines as an operating system	219	3.6484	0.96243
Teams celebrate your ACE cell achievements and expected success	219	2.9041	1.19053
Human talents are fully used	219	2.6119	1.10878
Costs are reduced to produce products, in comparing to previous cost and sales are increased.	219	3.5114	0.94024
The company has made the key mind-shift from quality defect detection to active prevention.	219	3.5114	0.94024
Employees are now responsible for inspecting their own work and know exactly the standards they have to meet.	219	3.0046	1.08153
The defect rate has been reduced.	219	3.0548	1.14006
Employee use ACE tools to solve any operational problem	219	2.8174	1.20909
Efficient utilization of resources improved: - it is possible to produce services/products by using less inputs than before.	219	3.0046	0.95060
Cells sustained in all ACE tools implementation as an operating system.	219	2.8995	1.15693
Valid N (listwise)	219		

Process Management mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
All tools in process management elimination have addressed in your section properly.	219	3.2877	1.09811
Key processes identified and prioritized.	219	3.4292	0.98998
Every process in your section have been mapped properly	219	3.4384	1.04907
Every process has reached matured level	219	2.8037	1.10162
Cross functional meeting held appropriately to interface process between inter departmental/Cells	219	2.5616	1.13315
Section improves their process by benchmarking other internal departments	219	2.8584	1.13859
Your section process interface with another department	219	3.1689	1.27565
Your section fully aligned with other department in the value stream	219	2.8082	1.02256
New processes are designed to maximize value-added activity.	219	2.7808	0.86066
Product/Services produced as per pre-established standards.	219	3.2603	0.97248
Process waste reduced i.e. scrap, rework, order cycle time, process steps, transport, reject etc.	219	3.3333	1.04633
Unnecessary motions are reduced	219	2.7900	1.09699
Inventory and work in progress for almost everything is the lowest in EAL	219	2.4612	0.91976
Valid N (listwise)	219		

Total Preventive Maintenance mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
Equipment Safeguarding has completed in accordance with equipment safety norm	219	3.4110	0.84325
Your section Equipment Safety is controlled and maintained per their schedule.	219	3.7260	0.91261
Your working environment is safe for your daily operation	219	3.2557	1.33355
Change in technical efficiency: In EAL there is improvement in utilization of EAL equipment, tools etc.	219	3.2922	0.98451
Equipment breakdown are virtually eliminated.	219	2.7489	1.01183
Decrease number of accidents, injuries.	219	3.4658	1.10564
Valid N (listwise)	219		

Visual Control (5S+1) mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
5S+1 is fully implemented in your section efficient work place and your section can visually comprehend the existing situation	219	3.4795	1.08927
5 S + 1 Audit executed monthly	219	3.6986	1.14160
For all 5 S + 1 Audit turn backs corrective actions taken accordingly.	219	3.2283	1.17814
Your department's internal supply chain function are located together to supply each other	219	2.7991	1.22878
Valid N (listwise)	219		

Market Feedback Analysis (MFA) mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
Your sections improvement efforts continue to achieve customer satisfaction	219	3.4795	1.08927
Customers are satisfied with your section's service/products	219	3.6073	1.10093
Spend time discussing future customer needs.	219	3.2283	1.17814
Valid N (listwise)	219		

Quality Clinic Process (QCPC) mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
Data collection activity is alive	219	3.8584	1.11826
Attain turn back resolution ratio of 80%	219	3.1644	1.17716
Demonstrate level of maturity of quality clinic	219	3.0685	1.15729
Valid N (listwise)	219		

Root Cause Corrective Action (RCCA) mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
Solutions provided by RCCA is pertinent enough and last long	219	2.9224	0.90280
Recurrent problems/turn backs resolved using RCCA	219	3.4429	1.03169
The 8 RCCA steps are registered in system for any returned order.	219	3.3379	1.07728
Valid N (listwise)	219		

Mistake Proof (MISPRO) mean and Std.

Descriptive Statistics			
	N	Mean	Std. Deviation
Mistake proofing solutions are applied to recurrent turn backs	219	3.4475	0.99574
Your section implements and document mistake proofing devices	219	3.4977	0.94030
Valid N (listwise)	219		

Appendix 5. Descriptive Statistics (Respondents data)

Training and general ACE implementation practices												
Item	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Training and education has been given about ACE before ACE implementation launched?	17	8	48	25	10	5	87	40	57	26	3.2100	0.78000
EAL consistently gives training and education on ACE tools	30	14	47	22	54	25	60	27	28	13		
EAL provides necessary material for training about ACE	29	13	49	22	37	17	72	33	32	15		
Training and education given by appropriate professionals having sufficient skills	32	15	76	35	41	19	51	23	19	9		
New employees get indication training and attach to a mentor.	52	24	60	27	18	8	65	30	24	11		
Employees are cross-trained across departmental boundaries.	49	22	61	28	45	21	46	21	18	8		
Your ACE Cell portal page properly updated on time per Ethiopian Airlines ACE protocol	9	4	23	11	15	7	121	55	51	23		
All employees in your cell are assigned ACE tools	11	5	17	8	5	2	79	36	107	49		
ACE changes your working culture and environment	5	2	5	2	33	15	98	45	78	36		
ACE is implemented in Ethiopian Airlines as an operating system	-	-	28	13	69	32	74	34	48	22		
Teams celebrate your ACE cell achievements and expected success	39	18	36	16	64	29	67	31	13	6		
Human talents are fully used	35	16	81	37	44	20	52	24	7	3		
Costs are reduced to produce products, in comparing to previous cost and sales are increased.	9	4	14	6	80	37	88	40	28	13		
The company has made the key mind-shift from quality defect detection to active prevention.	9	4	14	6	80	37	88	40	28	13		
Employees are now responsible for inspecting their own work and know exactly the standards they have to meet.	27	12	46	21	45	21	101	46	-	-		
The defect rate has been reduced.	22	10	49	22	64	29	63	29	21	10		
Employee use ACE tools to solve any operational problem	45	21	41	19	49	22	77	35	7	3		
Efficient utilization of resources improved: - it is possible to produce services/products by using less inputs than before.	17	8	47	22	73	33	82	37	-	-		
Cells sustained in all ACE tools implementation as an operating system.	21	10	77	35	42	19	61	28	18	8		
Total	458		819		868		1210		477			

Respondents on the ACE tools

Process Management												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
All tools in process management elimination have addressed in your section properly.	9	4	58	27	37	17	91	42	24	11	2.9900	0.75000
Key processes identified and prioritized.	9	4	38	17	37	17	120	55	15	7		
Every process in your section have been mapped properly	54	25	54	25	72	33	-	-	39	18		
Every process has reached matured level	18	8	81	37	69	32	28	13	23	11		
Cross functional meeting held appropriately to interface process between inter departmental/Cells	44	20	69	32	53	24	45	21	8	4		
Section improves their process by benchmarking other internal departments	38	17	45	21	46	21	90	41	-	-		
Your section process interface with another department	37	17	30	14	32	15	99	45	21	10		
Your section fully aligned with other department in the value stream	21	10	68	31	70	32	52	24	8	4		
New processes are designed to maximize value- added activity.	9	4	83	38	74	34	74	34	53	24		
Product/Services produced as per pre-established standards.	9	4	48	22	46	21	109	50	7	3		
Process waste reduced i.e. scrap, rework, order cycle time, process steps, transport, reject etc.	21	10	25	11	40	18	126	58	7	3		
Unnecessary motions are reduced	36	16	51	23	55	25	77	35	-	-		
Inventory and work in progress for almost everything is the lowest in EAL	33	15	84	38	70	32	32	15	-	-		
Total	338		734		701		588		205			

Total Productive Maintenance (TPM)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Equipment Safeguarding has completed in accordance with equipment safety norm	-	-	42	19	54	25	-114	52	9	4	3.3166	0.81944
Your section Equipment Safety is controlled and maintained per their schedule.	-	-	29	13	42	19	-108	49	40	18		
Your working environment is safe for your daily operation	34	16	37	17	21	10	93	43	34	16		
Change in technical efficiency: In EAL there is improvement in utilization of EAL equipment, tools etc.	5	2	62	28	22	10	124	57	6	3		
Equipment breakdown are virtually eliminated.	21	10	83	38	45	21	70	32	-	-		
Decrease number of accidents, injuries.	13	6	32	15	49	22	90	41	35	16		
Total	73		285		233		253		124			

VISUAL CONTROL (5S+1)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
5S+1 is fully implemented in your section efficient work place and your section can visually comprehend the existing situation	9	4	51	23	9	4	126	58	24	11	3.3014	0.99248
5 S + 1 Audit executed monthly	11	5	33	15	20	9	102	47	53	24		
For all 5 S + 1 Audit turn backs corrective actions taken accordingly.	10	5	69	32	34	16	73	33	33	15		
Your department's internal supply chain function are located together to supply each other	33	15	68	31	52	24	42	19	24	11		
Total	63		221		115		343		134			

Market Feedback Analysis (MFA)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Your sections improvement efforts continue to achieve customer satisfaction	9	4	51	23	9	4	126	58	24	11	3.4384	0.96927
Customers are satisfied with your section's service/products	10	5	39	18	15	7	118	54	37	17		
Spend time discussing future customer needs.	10	5	69	32	34	16	73	33	33	15		
Total	29		159		58		73		94			

Quality Clinic Process (QCPC)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Data collection activity is alive	9	4	17	8	49	22	65	30	79	36	3.3638	0.92924
Attain turn back resolution ratio of 80%	9	4	68	31	61	28	40	18	41	19		
Demonstrate level of maturity of quality clinic	22	10	50	23	61	28	63	29	23	11		
Total	40		135		171		168		143			

Root Cause Corrective Action (RCCA)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Solutions provided by RCCA is pertinent enough and last long	22	10	32	15	106	48	59	27	-	-	3.2344	0.83553
Recurrent problems/turn backs resolved using RCCA	9	4	47	22	16	7	132	60	15	7		

The 8 RCCA steps are registered in system for any returned order.	9	4	51	23	40	18	95	43	24	11		
Total	40		130		162		154		39			

Mistake Proof (MISPRO)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Mistake proofing solutions are applied to recurrent turn backs	7	3	37	17	49	22	103	47	23	11	3.4726	0.91078
Your section implements and document mistake proofing devices	9	4	19	9	68	31	100	46	23	11		
Total	16		56		117		203		46			

Decision Making Tools (DM)												
	SD		D		N		A		SA		Mean	Std. Deviation
	F	%	F	%	F	%	F	%	F	%		
Your ACE section use passport concept to key business decision making process properly	22	10	16	7	75	34	91	42	15	7	2.9178	1.02881
Problems that need management involvement escalate on time for higher management decisions	41	19	38	17	63	29	62	28	15	7		
Management staffs give high emphasize for effective ACE implementation	56	25	48	22	63	29	39	18	15	7		
Total	119		102		201		192		45			