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ADDISABABA UNIVERSITY SCHOOL OF COMMERCE

LOGISTICS AND SUPPLY CHAIN MANAGEMENT UNIT

THE ROLE OF ACHIEVING COMPETITIVE EXCELLENCE OPERATING SYSTEM IMPLEMENTATION ON COMPANY'S INTERNAL SUPPLY CHAIN INTEGRATION: ETHIOPIAN AIRLINES IN FOCUS

By: Chernet Tesema

Advisor: Tariku Jebena (PhD)

May 2018

Addis Ababa, Ethiopia

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**A Thesis Submitted to Addis Ababa University School of
Commerce Department of Logistics and Supply Chain
Management for Partial Fulfillment of the Requirements for
Degree of Masters of Art in Logistics and Supply Chain
Management**

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Addis Ababa University
College of Business and Economics Graduate Studies
Department of Logistics and Supply Chain Management

**"The role of Achieving Competitive Excellence Operating System Implementation on
Company's Internal Supply Chain Integration: Ethiopian Airlines in focus"**

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Declaration

I, the undersigned, declare that, this study “**The role of Achieving Competitive Excellence Operating System Implementation on Company’s Internal Supply Chain Integration: Ethiopian Airlines in focus**” is my original work and has not been presented for a degree in any other university, and that all sources of materials used for the study have been duly acknowledged.

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List of Acronym

AFRAA: African Airlines Association

ACE: Achieving Competitive Excellence

DM: Decision Making

EAL: Ethiopian Airlines

IATA: International Air Transport Association

ISCI: Internal Supply Chain integration

KPI: Key Performance Indicator

MFA: Market Feedback analysis

MISPRO: Mistake Proofing

MRO: Maintenance, Repair and Overhaul

P&WC: Pratt and Whitney Canada

PM: Process Management

QCPC: Quality Clinic Process

RCCA: Root Cause Corrective Action

SLA: Service Level Agreement

SCS: Supply chain strategy

SCM: Supply chain Management

SPSS: Statistical Package for Social Science

SCI: Supply Chain integration

SS: 5 S+1 Visual control

TQM-Total Quality Management

UTC: United Technologies Corporation Company

VSM: Value Stream Mapping

VIF: Variance inflation factor

ABSTRACT

ACE (Achieving Competitive Excellence) is a *company-wide strategy*. It is an approach to relentlessly improving the value that we deliver to our customers. ACE guides the setting of strategic priorities, establishes processes for translating strategies into actions, and set up feedback mechanisms for assessing improvement and performance (Roth 2010). EAL started implementing ACE since 2007 as an operating tool. This study was empirically examined by aiming the key roles of ACE implementation on Ethiopian Airlines Internal Supply Chain Integration as the airlines is using ACE as an operating system. The study had employed questionnaire and interview which administered on a sample of 138 Ethiopian Airline's ACE cell Agents or department representatives. Questionnaire using random sampling and five top management of the airline change and performance management for interview using purposive sampling carried out to examine the roles of ACE implementation on Ethiopian airlines internal Supply Chain Integration. In order to analyze, interpret and present the data captured via questionnaire, Statistical Package for the Social Sciences (SPSS) were used. Descriptive analysis methods i.e., percentage, means, standard deviation, correlation, regression were used. Validity, reliability, and multicollinearity tests were conducted on the data. The data analysis was based on result conducted through correlation and linear regression. With regard to the survey output, internal supply chain integration had statistically positive significant relationship with some ACE Operating Tools like RCCA, MISPRO, and DM. The dependent variable Internal Supply Chain Integration is well explained by the model/ACE Operating Tools (DM, TPM, RCCA, QCPC, MISPRO, SS, PM). These finding will provide the necessary resource in light of the possibility of future research projects.

Keywords: ACE (Achieving Competitive Excellence), ACE Operating system, Internal Supply Chain Integration

CHAPTER ONE: INTRODUCTION

1.1. Background of The Study

In the airline industry, services are composed of very complex mix of intangibles as the airlines sell not physical objects but performances and experiences (Gursoy et al., 2005). Airline industry has always been famous for its continuous struggle: cutting costs, managing fluctuating demand, keeping up with tight quality requirements while trying to maintain superior services and satisfy needs of various customer groups. Customer satisfaction has been on very low levels for decades, and e.g. according to American Customer Satisfaction Index, airline industry scores lowest out of 47 other industries, (CNN.com, 2011).

The dynamic nature of Airline industry necessitates fast responsiveness to the market demand, particularly to the ever changing customer needs and tastes, company have work to meet its customer need and expectation (Foon and Eurn, 2011, Dadashkarimi and Asl, 2013; Jenatabadi, 2013). It is extremely important for carriers not only to understand the perception of passengers of their service offerings, but as well find out what customers expect from the services (Chen & Chang, 2005) and what kind of services customers consider most important. Therefore, company needs to have strategic plan and operating system to penetrate and remain profitable and competitive in the tight competition by fulfilling and exceeding customers' demands. Supply chain strategy as part of the overall business strategy designed around a well-defined basis of competition (innovation, low cost, service, quality) (Cohen and Rousell, 2005).

Ethiopian Airlines (EAL) is the flag carrier airline based in Ethiopia which was founded as international airline in the year 1946. The airline appendices has been a member of the International Air Transport Association (IATA) since 1959 and of AFRAA since 1968 and Ethiopian is joined the largest alliance of airlines named star alliance on December 2011. It commands a lion's share of the pan African network including the daily and double daily east-west flight across the continent. EAL's current Vision - "Vision 2025" - was coined in the year 2009 as "*Ethiopian Airlines will be the most competitive and leading aviation group in Africa by providing safe, market driven and customer focused passenger and cargo transport, aviation training, flight catering, MRO (Maintenance, Repair & Overhaul) and ground services by 2025*". Accordingly, EAL is working towards Vision 2025 by stretching its direct service routes to 96 international destinations over different continents and 20 domestic flight sectors operating the newest and youngest 92 fleets. EAL has more than 11,284 permanent employees as of June

30, 2017 (EAL portal page, 2009).

As major African airlines face difficult situations and heavy losses, EAL remained one of the most successful airlines in the world. In 2013, IATA ranked the airline as the 17th profitable airlines in the world and the most profitable airline in Africa. EAL is also a multi-award winning airline from reputable organizations. Some of the awards on 2017 are; SKYTRAX4 Star Certification on Nov, 2017, SKYTRAX and passenger choice awards in Africa in June 20th 2017, most promising airlines award and has been registering an average growth of 25% per annum for the past ten years, African Airlines of the year Award for 2017, for the second year in a row held in Johannesburg, and African cargo airline of the year Award held in Johannesburg, February 2017.

EAL is facing fierce market competition from European and Middle East airlines such as KLM, Turkish Airlines, Emirates, Qatar and Fly Dubai, (EAL Newsletter 2015). EAL is implementing Achieving Competitive Excellence (ACE) as a company business model to improve its performance and stay competitive in the market since 2007. ACE is a custom-made system developed by United Technology Cooperation (UTC) and yet not proved useful in other organizations. Its implementation highly depends on organizational culture, company resource and existing quality management system.

The organization recently restructured itself into seven profit centers or Strategic Business Units (SBU); namely, Ethiopian Domestic and Regional Airline, Ethiopian International Passenger Airline, Ethiopian Cargo and logistics service, Ethiopian Maintenance and Repair Overhaul (MRO), Ethiopian Aviation Academy, Ethiopian In-flight Catering Services and Ethiopian Ground Services. These SBUs require seamless linkage to work in synergy towards attaining the corporate visions, Ethiopian Weekly, (2014). The engine to attain these visions and remain competitive is through ACE as an operating strategic tool since 2007 under control and supervision of change management.

Change Management is a department which directs the implementation of various change initiatives and programs by active participation and coordination with respective divisions that are impacted by the change; Acts as advisor and counselor to Sr. management and all divisions on matters relating to the Change initiatives and Management; develops change management programs for changes of strategic nature which are initiated within the Airline. GCEO of EAL has a direct contact with Director of change management (see App. 1). Accordingly, the ACE initiative will continue to transform EAL into a process centric organization starting from ACE cells to product value streams aligned to EAL's mega process.

Roth (2010) and ACE hand book (2005) defines as below; as an operating system, ACE defines the management system used by individuals and organizations across UTC to delight its customers, provide returns to its shareholders, and satisfy its employee. ACE guides the setting of strategic priorities; establish processes for translating strategies in to action, and sets up feedback mechanisms for assessing improvement and performance. It uses tools and methods, adopted from lean, quality, and statistical process control practices (Thomas, 2004).

As stated by Chris (2015) on his blog, *everyone in the organization needs to understand the strategy, offer ideas, and craft a supporting strategic plan that aligns with the overarching strategy of the business*. And ACE is a good operating strategy to participate and play important roles to involve every employee and leader in a day to day airline operation. It also tries to make an improvement the whole company processes that create and deliver customer value through continuous improvement (Roth 2010, Thomas 2004 and ACE Hand book 2005).

Unless company have excellent ISCI among departments, it would be difficult for the company to remain competitive in this volatile market environment. A prerequisite for successful SCM is internal integration (Lambert, Cooper & Pagh, 1998). Companies with a low internal integration strategy will achieve low level of external integration and companies implementing the full internal integration strategy will have the highest levels of external integration (Gimenez and Ventura, 2005). When the internal supply chain functions are working together, problems can be easily sorted out, and there is a better opportunity for interactions among the functions. This has been realized by Service Level Agreement (SLA) among internal chain. It is very clear that EAL is becoming the leading carrier with bright future. For all this achievement its effective and efficient operating systems have a great role to penetrate and remain competitive & profitable airlines and ACE take the lion share as an operating system.

The major purpose of this study was to the relevance of ACE implementation on company's internal SCI via ACE Operating Tools. As there was no or little research conducted in this area; the study tried to create better understanding about ACE implementation and ISCI.

1.2. Statement of the problem

According to International Air Transport Association 2017 report, different Airlines in Africa are expected to deliver the weakest financial performance with a net loss of \$800 million (broadly unchanged from 2016). The region's weak performance is being driven by regional conflict, less productivity and the impact of low commodity prices. Kenya Airways for instance which is 26.7 percent owned by Air France/KLM has reported losses for the past three years, including \$252m

in the year to March 2015, the largest in Kenyan corporate history. As major African airlines face difficult situations and heavy losses, EAL continues to spread its wings. According to a data from IATA; Ethiopian Airlines recorded a full-year profit of more than all other African carriers combined. In 2013, IATA has also ranked the EAL as the 17th profitable airlines in the world and the most profitable airline in Africa. EAL has made a record high net profit of six billion birr (273 million dollars) in the 2015-2016 fiscal year ending June 2016. (EAL portal page 2017).

The company recalls that an aggressive expansion strategy has helped the state-owned carrier transform itself from a competent regional player to the continent's leading carrier in just five years. Airlines Group Chief Executive Officer, Tewolde Gebremariam, said its recent performance means it has already met most of its goals for its 15-year master plan to 2025 in the first five years. Being established and operate with seven profit centers or Strategic Business Units (SBU) and having more than 11,284 employees. EAL have a strong and effective strategic operating system to create a synergy among all the business units and inter- departmentalization called ACE operating system since 2007 to meet its vision 2025.

As stated by (Chris 2015) on his blog, *everyone in the organization needs to understand the strategy, offer ideas, and craft a supporting strategic plan that aligns with the overarching strategy of the business.* And ACE is a good operating strategy to participate and play important roles to involve every employee and leader in a day to day airline operation. It also tries to make an improvement the whole company processes that create and deliver customer value through continuous improvement (Roth 2010, Thomas 2004 and ACE Hand book 2005).

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Besides to the researcher preliminary interview with some Change Management Officials, observation and documentation review of sample cells portal page, the researcher had noticed

that there is inefficiency in maintaining the process changes. Some of the indicators are: there are few cells which didn't understand how ACE can be implemented aligning with their day today operation, all cells didn't achieve the four competence level in time as per the Change Management time frame. According to the company ACE master data, among 227 Cells, 142 achieved ACE Gold, 59 Silver, 25 of them achieved Bronze level and 1 cell is still at Qualifying level till the end 2016 budget year. This shows only 63% of the cells achieved ACE Gold competence level (very crucial achievement level which highly influence on the company's value stream mapping) during the past 10 years of ACE implementation. Having all these challenges researcher believed ACE have played a great role on EAL's ISCI. Based on these, it has been aimed to analyze roles of ACE practices on ISCI within EAL.

Consequently, within the general framework of assessing the level of ACE influence on internal supply chain integration at EAL, the study attempts to answer the general research question. As there was no or little research conducted in this area, the study tried to create better understanding about ACE and ISCI by identifying the roles of ACE implementation in the EAL's ISCI.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of this study is to assess the roles of ACE implementation on EAL's internal SCI.

1.3.2. Specific Objectives:

The specific objectives of the study are:

1. To assess the level of ACE influence on internal SCI of EAL,
2. To identify the significant dimension of ACE affecting internal SCI of EAL.
3. To identify the level of internal SCI of EAL.
4. To assess the relationship among the eight ACE Operating Tools.
5. To assess the level of ACE training.

1.4. Research Questions:

This study been initiated to seek answers for the following questions:

1. To what extent ACE has influence on EAL's internal SCI?
2. What are the significant dimensions of ACE in determining the internal SCI of EAL?
3. What is the level of internal SCI of EAL?

4. To what extent the eight ACE Operating tools are relate each other?
5. What is the level of training conducted on ACE related issues?

1.5. Significance of the Study

This study is a micro level investigation of an organization; hence the findings of the study were believed to be primarily significant to the organization. However, it can also give insight in to the practice and roles of ACE implementation in other organizations especially other service providing organizations like Ethio-Telcom, Ethiopian Revenue Customs Authority, Ethiopian Electric Power, other public administration. The overall output of this study contributed to the general knowledge on the roles that can be harvested in implementation of such types of customer focused operating system to improve private and public organization service quality level and ISCI in particular and to the economy in general: since ACE has the real potential to be adopted and utilized by other companies (Thomas, 2004).

This study is significant in terms of providing the necessary resource in light of the possibility of future research projects that might be proposed or even carried out in the same area or other service provider & manufacturing organization.

1.6. Scope of the Study

The scope of this study was limited to assess the roles of ACE implementation as an operating system, and EAL's ISCI focusing on the eight ACE operating tools, operation strategies, ACE, SCI, and other SC related issues. The researcher used quantitative research technique, and questioner, interview report and documentation review as data collection method. The researcher only considered EAL headquarter ACE cells. Other EAL's ACE cells outside headquarter like all ticket office in the country, domestic branches and out station (outside Ethiopia) were not included due to time and budget/resource limitation, and also lack of research experience.

1.7. Definition of Terms

ACE: Achieving competitive excellence (ACE) is a companywide operating strategy. It is an approach to relentlessly improving the value that we deliver to our customers (ACE Hand book 2005).

Operating Tools: refers to the eight ACE operating tools namely Process management, Total preventive maintenance, 5S+1 and visual control, Market Feedback Analysis, Quality Clinic

Process Chart, Root Cause Corrective Action, Mistake proofing, and decision Making (Passport process) (ACE Hand book 2005).

Cell: Refers to a group of employees who work closely together on similar processes and share common ACE objectives to improve their products and services. Each cell is responsible for fulfilling all the ACE criteria at each ACE level (ACE Hand book 2005).

Internal SCI: the extent to which inter-functional integration, collaboration, coordination, communication and cooperation that bring functional areas together in to a cohesive organization (Flynn et al, 2010).

CHAPTER TWO: REVIEW OF RELATED LITERATURE

The review covers assessment of the theoretical aspects of Business Model and strategy, ACE, empirical evidence that support ACE implementation, and it also Flesh out concepts of operation strategy and internal SCI, which are the central issue of the study. Even if there was shortage of literature on ACE, the researcher tried to assess critically on some important research trends/literature and identify potential gaps in knowledge, which was established a need for current and/or future research projects on the study area.

2.1. Theoretical Review on Business Model and strategy

It is good to review business model and strategy to give a brainstorming on the research central points which are ACE and ISCM in detail. The present day economy, characterized by dynamic and turbulent changes, forces enterprises to implement new management concepts and ideas. During their selection, the concepts of building competitive advantage play an important role. Due to unpredictability and instability of the environment, internal changes within companies are necessary for survival and commercial success (Joanna 2013). The most important business changes to be considered by managers today include the different playing field and change in the key resources – moving away from raw materials and financial resources to focus on intellectual property and human capital (Leszczewska, 2013, as cited by Joanna 2016). A concept that may ensure successful building of competitive advantage of an enterprise during turbulent times is a business model.

A business model as a concept has been in place in the theory and practice of management for only about 20 years. The term owes its origin and huge popularity to the development of the Internet and emergence of enterprises running business referred to as e-business. Due to its short history, this concept still has no clear-cut definition. The literature review has shown that approaches to defining and establishing components forming the business model differ.

One of the definitions given by Magretta (2002) Business models are “stories that explain how enterprises work. A good business model answers Peter Drucker’s age old questions: Who is the customer? And what does the customer value? It also answers the fundamental questions every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?”

Michalak also add up on the Magretta’s point on business model by stating as articulate the logic and provides data and other evidence that demonstrates how a business creates and delivers value

to customers. It also outlines the architecture of revenues, costs, and profits associated with the business enterprise delivering that value. The issues related to good business model design are all interrelated, and lie at the core of the fundamental question asked by business strategists. It shows how does one build a sustainable competitive advantage and turn a super normal profit (Michalak, 2012 as cited by Joanna 2016).

Chesbrough and Rosenbloom, (2002) offer a detailed and operational definition, state that “the functions of a business model are to: articulate the value proposition, identify a market segment, define the structure of the value chain, estimate the cost structure and profit potential, describe the position of the firm within the value network, and formulate the competitive strategy.”

In short, a business model defines how the enterprise creates and delivers value to customers, and then converts payments received to profits. Developing a successful business model is insufficient to assure competitive advantage as imitation is often easy: a differentiated (and hard to imitate) yet effective and efficient business model is more likely to yield profits. Business model innovation can itself be a pathway to competitive advantage if the model is sufficiently differentiated and hard to replicate for incumbents and new entrants alike (David 2010)

The notion of business model has been used by strategy scholars to refer to “the logic of the firm, the way it operates and how it creates value for its stakeholders.” On the surface, this notion appears to be similar to that of strategy (Ramon and Ricart 2009).

The field of strategy has evolved substantially in the past twenty-five years. Firms have learned to analyze their competitive environment, define their position, develop competitive and corporate advantages, and understand threats to sustaining advantage in the face of challenging competitive threats. Different approaches including industrial organization, the resource-based view, dynamic capabilities, and game theory have helped academicians and practitioners understand the dynamics of competition and develop recommendations on how firms should define their competitive and corporate strategies. However, drivers such as globalization, deregulation, or technological change, just to mention a few, are profoundly changing the competitive game. Scholars and practitioners agree that the fastest growing firms in this new environment appear to have taken advantage of these structural changes to compete “differently” and innovate in their *business models*. IBM’s 2006 and 2008 “Global CEO Study,” for example, show that top management in a broad range of industries are actively seeking guidance on how to innovate in their business models to improve their ability to both create and capture value.

Strategy is often defined as a contingent plan of action designed to achieve a particular goal. As (Ghemawat 1991) point out, an essential element of strategy is the set of “committed choices” made by management. Similarly, (Porter 1996) states: “strategy is the creation of a unique and valuable position, involving a different set of activities” (emphasis added). The word “creation” implies choice of the particular way in which the firm competes. Moreover, the resulting activity system that is “created” is a reflection of the firm’s strategy. Strategy proper, however, is not the activity system itself but the creation of the activity system. Consistent with this notion, strategy refers, in our development, to the contingent plan as to what business model to use. Strategy is a high-order choice that has profound implications on competitive outcomes. Choosing a particular business model means choosing a particular way to compete, a particular logic of the firm, a particular way to operate and to create value for the firm’s stakeholders.

According to Ryanair, (2000), Strategy entails designing business models (and redesigning them as contingencies occur) to allow the organization to reach its goals. Business models are *reflections* of the realized strategy.

Although it is uncontroversial that for organizations to thrive managers must have a good understanding of how business models work, the academic community has, so far, only offered early insights on the issue. In truth, there is not yet agreement on what are the distinctive features of superior business models. We believe that the dispute has arisen, in part, because of a lack of a clear distinction between the notions of strategy, business model, Business model refers to the logic of the firm, the way it operates and how it creates value for its stakeholders (Ramon and Ricart 2009). EAL is using ACE an operating system to create a value for its customer and succeeded on its business model (ACE hand book 2005).

2.2. Theoretical review on ACE: Concept, meaning, Characterizing, and Background information.

UTC has executed a license agreement with EAL for use of the UTC-created Achieving Competitive Excellence (ACE) trademark and operating system. The origins of ACE lay with P&W’s Quality Group and Continuous Improvement Office, two separate initiatives begun in the late 1980s. In the early 1990s, the Quality Group was implementing quality programs such as Root Cause Analysis, Quality Teams and Temporary Preventative Maintenance (TPM), while the Continuous Improvement Office implemented lean manufacturing and productivity tools, including flow lines, cellular manufacturing, and Standard Work. In 1996, Mark Coren, then

P&W vice president of Manufacturing, determined that P&W needed a comprehensive program to bring together the improvement initiatives. No single, coherent, measurable process comparable to General Electric's Six Sigma existed to guide the many P&W worksites even though pockets of excellence were forming. In addition, no common metrics of savings existed to document and publicize the successes. Dave Haddock, then manager of the P&W Continuous Improvement Office, was asked to create a process that would link the Quality tools and Continuous Improvement tools together and provide metrics for accountability. This was where the development of ACE began.

As a 35-year veteran of UTC, Haddock knew that achieving the buy-in of all P&W employees would be important. To take it a step farther, a bottom-up process would be much more powerful than a top-down process, although strong elements of both were needed for a truly powerful change. Haddock also believed that discrete goals and criteria would be essential not only to give employees targets to work toward, but to create a common understanding of what was expected and a common language for comparison. Just as he was starting to pull the pieces of ACE together, he received a call from someone else who would strongly influence ACE—Yuzure Ito.

Around the same time that P&W began to develop ACE, UTC embarked on a path of radical quality improvement led by a Japanese quality expert named Yuzure Ito. After his retirement from a successful career with Matsushita in Japan, Ito agreed to work with UTC as its senior quality advisor to help teach UTC managers new ways to improve quality in their manufacturing and business processes. Ito's influence spread throughout UTC and, in 1998, Ito University was established to teach UTC senior managers the importance of building quality into the company's operations. When Ito learned about P&W's ACE development process, he recognized its enormous potential. By linking manufacturing improvement tools with Ito's quality philosophies, ACE could become a very powerful element of change for P&W and UTC overall. While never a formal member of Haddock's development team, Ito worked hard to influence the inclusion of the powerful quality tools to complement the Continuous Improvement group's productivity tools, giving ACE its strong quality focus. For the next two years, ACE was developed and refined at P&W's manufacturing plants. ACE, however, was destined to move beyond P&W. George David, CEO of UTC, strongly believed that consistently high quality and manufacturing excellence would be vital for maintaining a competitive advantage in the workplace. In order to give quality greater focus and visibility within UTC, David created a new executive position, vice president of Quality. He appointed P&W's vice president of Quality,

Tes Aklilu, to the position.

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. Using ACE, P&W experienced a 17 percent drop in effects, a 14% drop in shop costs, and a 29% drop in "escapes" (products with defects that were shipped to the customer). With the agreement of the divisional vice presidents of Quality, who formed the UTC Quality Council, Aklilu presented the proposal to the Council of Presidents, composed of George David and the heads of each of the UTC divisions. In mid-1998, the Council of Presidents gave their approval to develop ACE into a corporate quality improvement process. Because of the Council's strong support, the economic cost-benefit analyses that were normally required for the initiation of large programs like this were waived for the ACE process. According to one UTC company president, "We already know ACE is practical, it has been applied, and it works." Another UTC manager noted, "We took a leap of faith that there would be longer-term payoffs." With the Council of Presidents' concurrence, a significant process change was about to begin (Davis, 2008)

ACE (Achieving Competitive Excellence) is a *company-wide operating strategy*. It is approach to relentlessly improving the value that we deliver to our customers. It focuses on the drivers of customer value: our processes and the people who fuel them (ACE Handbook 2005).

As an operating system, ACE defines the management system used by individuals and organizations across UTC to delight its customers provide returns to its shareholders, and its employees. ACE guides the setting of strategic priorities, establishes processes for translating strategies into actions, and set up feedback mechanisms for assessing improvement and performance (Roth, 2010).

ACE operating system consists of a set of tools that help an organization identify and solve problems, improve its processes, and make strategic decisions. Through the repeated applications of these tools, the organizations drive the ACE operating to close gaps between actual results and business goals and eliminate waste (Roth 2010 and Thomas 2004). ACE stands on three foundations, which will be explained in the next sections:

- A. A philosophy about competitive excellence;
- B. An operating system (with tools) for controlling and improving our processes and eliminating waste; and

- C. The competence, commitment, and involvement of the entire organization to live the philosophy and to apply the operating system to everything that we do.

ACE involves all employees, leaders and employees alike and it touches all of our processes that create and deliver customer value. It solicits feedback from our customers on what we need to do to strengthen our value to them and to increase their satisfaction with us. It also seeks feedback on where our business, product, or service performance has fallen short. ACE is the way that we control and improve processes that deliver customer satisfaction and business results. ACE is how we solve problems, make critical decisions, and eliminate waste. And ACE drives our partners and suppliers to match our level of competitive excellence. In short, ACE is the way that we run our business (ACE Hand book, 2005).

Every day, in almost every country in the world, customers define our competitive excellence when they decide to purchase our products and services or those of a competitor's. Only by offering superior value to our customers will Ethiopian Airlines continue to grow and prosper. But the standards for value are elusive, because of changing customer preferences, motivated by new competition, new technology, and a host of other economic, social, political, and environmental factors. Therefore, our quest for competitive excellence has no end (Roth, 2010).

An airline consists of a set of connected processes. Examples include Flight Ops, Scheduling, Maintenance, Logistics, and Customer Services. Ideally, an airline uses an operating system to manage these processes. The operating system is a mechanism for controlling and improving processes to achieve desired business goals, starting with customer value and satisfaction. 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. Through the repeated application of these tools, the organization drives the ACE operating system to: *Close gaps between actual results and business goals; and Eliminate waste (achieve lean process flow)* (ACE hand book, 2005). According to ACE hand book, there are three major ACE tools.

1. Process Management and Waste Elimination Tools:

- A. 5S + 1 and Visual controls
- B. Process Management (standard work and set up reduction)
- C. Total Productive Maintenance (TPM)

2. Problem Solving Tools:

- A. Market Feedback analysis (MFA)
- B. Quality Clinic Process (QCPC)
- C. Root Cause Corrective Action (RCCA)
- D. Mistake proofing (MSPRO)

3. Decision Making Tools:

A. Passport Process

Each tool is briefly described below;

New 5S (5S + 1 Visual Control): As the basic building block of ACE, Ito's New 5S represented a philosophy of "respect for workplace and employees." Through a systematic process of organizing, cleaning, and maintaining the workplace, New 5S focused on instilling workplace discipline, cleanliness, and an attention to detail. Another key to New 5S was the concept of the "visual workplace." Communication boards, visual markings, and pictures were used to create a workplace that could be visually comprehended by anyone who entered the worksite. Weekly audits using detailed checklists, team meetings, and management interest ensured that New 5S was being used effectively. New 5S was a derivation of 5S, which was adopted from Japanese manufacturing practices. As noted earlier, the original five Japanese words were seiri (organization), seiton (tidiness), seiso (purity), seiketsu (cleanliness), and shitsuke (discipline). The English translations are: Sort, Straighten, Shine, Standardize, and Sustain. ACE's New 5S included a sixth "S" for "Spirit."

Total Preventive Maintenance (TPM): While New 5S focused on the workplace, TPM targeted care of the equipment under the assumption that well-maintained equipment promoted good quality. Through teamwork, data gathering, and root cause analysis, the TPM process reduced unscheduled downtime and increased reliability of the machines. The process involved the teardown, inspection, and rebuild of the machine, as well as development of a preventive-maintenance schedule, daily operator checks, and regular audits.

Quality Clinic Process Charts (QCPC): The QCPC tool was a team-based, structured process for identifying and prioritizing turn-backs. This definition of the QCPC tool distinguished it from the definition of QCPC "activity," which involved the use of the QCPC tool, the RCCA tool, and the MP tool, as noted earlier.

Root Cause Corrective Analysis (RCCA): RCCA's goal was to drive to the root of a problem in a structured, fact-based manner. Successful RCCA involved collecting data, brainstorming reasons, and looking for connections using tools like fishbone diagrams, cause-effect diagrams, and the "Five Why's." The RRCA process looked for the permanent solution rather than a temporary one. It was used both as a stand-alone, problem-solving tool and as a subset of TPM, QCPC, and other ACE tools. The "Five Why's" involved asking the question "Why?" five consecutive times to continue delving deeper into the cause of a problem, and to attempt to determine the true root cause of that problem.

Mistake Proofing (MP): Mistake Proofing involved the design of a work process, part, tooling, or work instruction to make it impossible to perform the work in any way except the correct way. Like the other ACE tools, Mistake Proofing involved a rigorous, structured team process to identify and consider all contributing factors. Despite the structure and rigor, ingenuity and creativity were still highly emphasized in creating the Mistake Proofing solutions. Mistake Proofing, like RRCA, was used both as a stand-alone tool and as a subset of other ACE tools such as TPM and QCPC.

Setup Reduction: Setup Reduction was the process of shortening the changeover time from one part to another or from one model to another. Shorter setup times reduced the need for buffer inventory, improved lead time, created additional capacity, and improved the flexibility of the manufacturing process. Setup Reduction was achieved through observation and analysis of the setup procedures, RCCA, and Mistake Proofing.

Standard Work: Standard Work's purpose was to simplify and structure work to ensure quality, consistency, and repeatable results over time. In business process cells, Standard Work consisted of defining processes and systems, creating simplified work instructions and procedures, and documenting lessons. Simplified work instructions, work sequencing, defined amounts of work-in-process inventory, and adherence to the "Takt time" were all components of Standard Work in the manufacturing cell. For Standard Work to be effective, equipment and processes needed to be reliable so most of ACE's other tools had to be in a developed stage of implementation.

Market Feedback Analysis (MFA): Customer feedback was incorporated into ACE through MFA. Like other tools of ACE, MFA was a structured and fact-based approach to resolving escapes, which are defined as defects that escaped to the customer, with stringent criteria for response times to customers. MFA's key strength was in communicating customer feedback on

product quality issues to the manufacturing work cell and in involving the operators in the solution.

Passport System: Used primarily in the design and deployment phase of new products, the Passport System was a set of reviews or checkpoints designed to ensure all problems were identified as early as possible in the new product development process. Using the Passport System, new product development teams would be able to incorporate all feedback on existing product failures into the new product design and would meet their quality, reliability, cost, and time targets.

As directly cited from Davis, (2008) , In commenting on the ACE components and ACE terminology, Tes Aklilu voiced a strong preference for viewing ACE as an *operating system*—and not as a *process* or *program*. He noted:

When QCPC identifies a turn-back, if it is a process issue, you might apply Process Certification. If the turn-back is a machine failure, you might use TPM. If it is high setup time, you might use Setup Reduction as a solution. The identification of turn-backs (QCPC) drives the problem-solving process . . . that's why we refer to ACE as our operating system.

There was a significant amount of paperwork involved with the ten ACE tools in the system. On average, each tool required five to ten forms and checklists for each issue addressed. For example, each turn-back in QCPC, each machine in TPM, and each escape in MFA generated its own set of completed forms and checklists.

When faced with resolving specific process improvement opportunities, the ACE tools should be used in conjunction with one another. This model demonstrates how the ACE tools are linked to form a “closed loop” problem solving methodology:

ACE Handbook 2005 and Davis 2008, ACE has four major achievements level which measures 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 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.

In the EAL scheme, each cell had at least one full time ACE Change agent, depending on the size of the facility. They are responsible to facilitate the ACE activities in order to ensure the success of ACE in their cells and facilities. They also served as the information link for sharing best practices with other ACE cells. ACE Agent reported directly to their respective ACE managers, and had dotted-line responsibility to EAL Change Management (Davis 2008 and ACE handbook 2005). ACE manager is entrusted with a leadership role. He/She is responsible for overseeing a department or group of employees within a cell. He/She have to insure that everyday operation in his/her cell is performing as per ACE principles. Maintaining the section's/Cell's ACE Achievement level and move forward to the next ACE achievement level in satisfying internal and external customers. Assuring active participation of all employees on assigned ACE tools by working closely with ACE agents and all Cell members (SOP of ACE managers, 2017).

2.3. Review of empirical studies on ACE implementation

Despite the challenges literature support that effective and efficient ACE implementation will have a higher impact on company performance. There is important qualitative information that confirms what is heard and seen in UTC companies. 2000 to 2009 decade has been one of the worst in stock market history with the valuation of companies in standard and poor's 500 downs 10% over that time. In the analysis done by Reuters, the industrial company during that decade with the best performance is UTC (Mnyandu, E, 2010 as cited by Roth 2010). Ask nearly anyone any one at UTC what has contributed to this long-term historic performance and the answer that you will get is ACE (Roth 2010).

As stated by Thomas's thesis work, he had mentioned four major items, in which ACE operating system is successful. These are:

- I. **The ACE tools and philosophy is a blend of lean manufacturing and quality improvement tools.**

The fact that ACE tools and philosophy are a blend of lean manufacturing and quality improvement, truly differentiate it from six sigma and most other quality improvement systems. Of the ten ACE tools, four of them, 5S Visual Work place, process Management, Standard Work, Set up Reduction and TPM originated from lean manufacturing. Five tools, Process Certification, Pass Port, MFA, and QCPC come from the Deming/TQM. One tool, MP, is difficult to assign in its entirety to either lean or TQM. Combining of both lean and TQM tools in to one operating system, in corporation that has such diverse product offerings as a UTC, is not only unique, but demonstrates high effectivity of the ACE operating system. This ability also demonstrates the opportunity for ACE to aid the UTC supply chain and value stream partners as well as most other companies. It is a great value to practitioners of ACE to be able to have one operating system versus multiple ones, in order to drive improvement across their business. Most company today require both cost reduction and productivity type of internal operating improvements as well as improved customer satisfactions and top line growth. ACE has the ability to deliver both in one system. There is a tremendous value in UTC having both combined and practiced in one system.

II. ACE Agents are selected from a broad range of skill types and job functions.

ACE Agents are types of people that are selected to act as experts in guiding the organization in their learning and use of the operating system tools. The ACE operating system tends to select and utilize agents that comes diverse educational and experiential backgrounds. This type of selection of ACE Agents has a tendency and capability to be far more successful, especially in the long term.

III. The utilization of capacity levels of prerequisite: qualifying, bronze, silver, and gold.

Thomas strongly believed that ACE can benefit significantly by adapting the sigma measurement methodology in its process certification element. While this is the case, the utilization of the ACE capability levels at the cell, site, and ultimately the value stream level is an excellent practice. It helped UTC to create a very constructive and collaborative method of accelerating improvement of its business globally.

IV. ACE was developed at UTC, and therefore, is a custom fit for that organization.

It is very much the case that UTC has demonstrated ACE successfully applies to all of its varied divisions and product offerings. It is also the case that ACE has the real potential to be adopted and utilized by other companies. Like all other organizations, UTC possesses unique measurements, goals, approaches and a culture that can dramatically influence the degree in

which a comprehensive quality management program is accepted (Thomas, 2004).

Roth (2010) had quoted from George D. CEO of UTC *“ACE is mature discipline for productivity and quality assurance. Without qualification, ACE is the reason for our operating income margin expansion from 6 to 14 percent for the last decade and for the corporation’s total shareholders return performance.”*

According to Roth (2010), as per survey in September 2006, from their analysis of the twenty-seven sites that had achieved ACE Gold, the ACE council found the following improvements.

- a) 35% increase in sales
- b) Significant percentage point return on sales increase
- c) 60% inventory turnover improvement
- d) 24% on time delivery improvement, and
- e) 35% customer satisfaction score increase.

Even if this operating system is less known, its effectiveness has been rectified by few literatures. Thomas has justified this system as broad based than other lean operating approaches like six sigma. ACE revolves around the three principle categories of process improvement and waste elimination tools, decision-making tools, and problem solving tools. This makes ACE as a combination of lean principles and quality improvement philosophies (Davis, 2008). Roth (2014), had also shared in his case study on operating system, ACE is very much the case that UTC has demonstrated that ACE has successfully applies to all its varied divisions and product offerings. It is also the case that ACE has the real potential to be adopted and utilized by other companies, that it works best for UTC. Although ACE assessment criteria are similar, people tailor the mix of tools and methods the use to achieve results to their context. This flexibility in application of ACE is important given that UTC’s divisions such as Pratt &Whitney’s, Military Engines and carrier’s air conditioners are so different.

"Since its inception Porsche Consulting has demonstrated that large improvements in operational performance and efficiency can be achieved through the adoption of advanced process optimization concepts," said Norman Firchau, President and CEO of the management consultancy in Atlanta, Georgia. *"We are excited to work with UTC and its suppliers to drive improved performance by using the ACE principles and tools"* (Hartford, 2014).

ACE hand book (2005) and Roth (2010) defines ACE as below; as an operating system, ACE defines the management system used by individuals and organizations across UTC to delight its customers, provide returns to its shareholders, and satisfy its employee. ACE guides the setting of strategic priorities; establish processes for translating strategies in to action, and sets up feedback mechanisms for assessing improvement and performance. It uses tools and methods, adopted from lean, quality, and statistical process control practices.

UTC is a large industrial conglomerate that designs, manufactures and service a broad range of products. At the end of 2008, UTC's sales were \$58.7 billion and making 39th company on the fortune 500 lists (UTC website 2017).

2.4. Review on Internal Supply Chain Integration and Value Stream Mapping: meanings, concepts, natures and dimension

Several past studies analyzed the viability of different sectors of the aviation supply chain. Some studies analyzed performance of individual sectors (airlines, airports, aircraft and component manufacturers, avionics suppliers (Charles and Ghobrial, 1995), but only a few have attempted to provide a comprehensive overview of sustainability across multiple sectors in the aviation value chain. A notable paper in this regard is that of Pearce, which focuses on performance and sustainability of the airline sector (passenger and cargo) of the aviation value chain in the post-deregulation period (Pearce, 2012). Therefore, the researcher will try to review literatures which were made on internal SCI, operating system, in other industries to dig out what it looks like the roles of operating strategies on companies internal SCI.

According to Martha (2000) and Roth (2010), operating an integrated supply chain requires continuous information flows, which in turn help to create the best product flows. The customer remains the primary focus of the process. Achieving a good customer-focused system requires processing information both accurately and in a timely manner for quick response systems that require frequent changes in response to fluctuations in customer demand as ACE also give high priority to customer satisfaction.

Kim et al. (2014) suggested an integrated process of strategy formation, indicating the roles of OS in forming SCI. He had also evidenced an improved translation of strategy into operational terms, enhancing the process so that it is continuous, and ensuring a greater alignment between the processes, services, competencies and units of an organization. With the increasing importance of SCM, supply chain strategies should play important roles in defining firms' Operational Strategies. From a strategic SCM perspective, a supply chain's design should be aligned with a firm's missions and

strategies (Qi et al., 2011) and the SCSs work as a logical bridge between firms' higher level strategy and its supply chain activities (Perez-Franco et al., 2016).

In addition, business strategies are important for the effectiveness of SCI. Much of the prior SCI literature has focused on validating the benefits of SCI practices (Huo et al., 2014a, 2014b). When a firm has a predetermined strategy, the kind of SCI that is appropriate for its corresponding SCS design is a significant issue. However, few studies have explored enablers of SCI (Wang et al., 2016), especially from the strategic perspectives, which are very important to understanding the role of SCI in a supply chain (Zhao et al., 2011).

When developing an Operation strategy, firms should identify their customers' needs for different products and translate them into either order winner to differentiate themselves from competitors or order qualifiers to bring themselves to the market. Based on the order winner and qualifier classifications, firms are required to build operational infrastructures and capabilities accordingly, such as supply chain development and management infrastructures and capabilities. Thus, following an Operation strategy, the development of an appropriate SCS is necessary. Kim (2014) as cited by Douglas M & Martha C. (2000) suggested an integrated process of strategy formation, indicating the roles of operating strategy in forming SCS.

As SCS describes how a firm can gain competitive advantages through its supply chain capabilities, such as cost efficiency, response speed and flexibility (Qi et al., 2011). Prior literature has classified SCSs into two generic categories: lean and agile (Fisher, 1997; Yusuf et al., 2004). While a lean SCS efficiently streamlines the whole supply chain, an agile SCS focuses on the reconfiguration of a supply chain in response to uncertain and dynamic environments (Naylor et al., 1999). A lean supply chain follows the tenet of lean thinking that emphasizes waste and interruption reductions when providing a flow of goods, services and technologies from suppliers to customers. Thus, the 'lean thinking' and subsequent lean supply chains adopt various management techniques and practices such as JIT, Kanban and TQM to reduce overall costs, enhance product quality, and shorten delivery times (Ardalan and Diaz, 2012). Such objectives of the lean supply chains are aligned with the operating systems of firms that have order winners on cost, quality or delivery.

Supply chain integration is defined as "the extent to which all activities within an organization, and the activities of its suppliers, customers, and other supply chain members, are integrated together" (Narasimhan, et al.1998). According to Tutuncu and Kucukusta, (2008), they consider integration in two levels: internal integration and external integration. Stevens (1989) also

classifies supply chain integration into three levels, from functional integration to internal integration and to external integration. However, this study focuses only on roles of ACE on the internal integration, because functional integration is a pre-requisite for all firms to implement and achieve Internal Integration (Otchere et al, 2013). The dominant belief is that SCI is a useful approach to improve various measures of firm performance. The basis of integration can therefore be characterized by cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes (Pagell, 2004).

Supply Chain Integration (SCI); when integration is achieved, the supply chain operates as a single entity driven directly by customer demand (Farhoomad, 2005) and (ACE hand book, 2004). However, evidence found in the supply chain literature shows a number of challenges faced by organizations regarding the construction of SCI (Awad & Nassar, 2010; Sweeney, 2011). One of the challenges is the necessity to change business processes to support SCI. However, redesigning business processes is difficult; the increase of complexity in business processes in supply chains results in the need for new methodologies on how to integrate process information in enterprise networks (Roder & Tibken, 2006). Some literatures evidenced an improved translation of strategy into operational terms, enhancing the process so that it is continuous, and ensuring a greater alignment between the processes, services, competencies and units of an organization.

Bowersox et al. (2000) and Stank et al. (2001) as cited by Boon-Itt and Paul (2002) further discuss the supply chain integration framework by extending the scope of production and information flows. In their study, six critical areas used in the framework to achieve supply chain logistics integration include: 1) customer integration, 2) internal integration, 3) supplier integration, 4) technology and planning integration, 5) measurement integration, and 6) relationship integration.

Internal integration is defined as a process of inter-functional interaction, collaboration, coordination, communication and cooperation that bring functional areas together into a cohesive organization, (Flynn et al, 2010). Furthermore, Supply chain partners who exchange information regularly are able to work as a single entity, and can understand the needs of the end customer better and hence can respond to market change quicker (Stein, 1998). Internal integration is a prerequisite for successful SCM is internal integration. Companies with a low internal integration strategy will achieve low level of external integration and companies implementing

the full internal integration strategy will have the highest levels of external integration (Gimenez and Ventura, 2005, Lambert, Cooper & Pagh, 1998). Internal integration can help functions to leverage each other's resources and capabilities to jointly design products, ensure product quality and reduce duplicated tasks (Schoenherr and Swink, 2012). For example, Tan (2001) found that internal integration could create a close link between manufacturing and distribution processes to deliver products and services in a timely and effective manner. Generally, it is believed that firms achieve a relatively high degree of internal integration before they attempt to develop a higher degree of external integration. Internal integration can be accomplished through automation and standardization of each internal logistics function, the introduction of new technology, and continuous performance control under formalized and centralized organizational structure (Pagell, 2004).

Internal integration involves cross functional teams that may bring together a carefully selected array of specialists who share information and make product, process, and manufacturing decisions, jointly and simultaneously (Frohlich and Westbrook, 2001).

VSM used to achieve process effectiveness, efficiency and agility through waste elimination and standardization of work. The goal is to identify and focus on improvements to the group of processes that delivers value to customers by taking a system-level view and focus on creating lean process by eliminating wastes. It is a set of tools and methods guided by lean precepts (Thomas, 2004).

Even if ACE is a major operating system used in UTC, currently different other organizations (manufacturing and service providers) are adopting this operating system. Singapore airline, EAL and Porsche are some of the companies which are implementing ACE. UTC ACE director John Papadopoulos repeatedly emphasized the importance of ACE as the enabling framework for a global business, providing common operating methods, essentially a common language, for all UTC sites in all countries across the world. If we take one of the business units from UTC which is currently in production in three different continents, Otis Elevators Manufacturing, we can understand that ACE can be implemented without culture and language barriers. Currently Otis elevators are working in China (Tianjin and Guangzhou), USA (Bloomington, Indiana), and South America (Nogales, Mexico). These show how ACE can be implemented across different languages & national cultures and different organizational types.

According to Davis (2008), the goal of value stream mapping is to identify and focus on improvements to the group of processes that delivers value to customers by taking a system-level

view and focus on creating lean processes by eliminating wastes. The improvement cycle starts with collecting data on the sequence of activities, drawing diagrams that show these process steps, adding information about those steps (time, resources, delays, inventory, quality), and assessing the overall end-to-end performance of the process. From the depiction of the process and information on its steps, changes are considered. These changes improve improves end-to-end performance by eliminating wasteful or non-value adding and connect activities in different and better ways.

Roth (2010), has also seconded on Edward's point, by stating VSM as new invention of ACE operating tools. Historically from 1980 to 2002, UTC focused ACE on improvements in cells. Without integrating across cells, however, the local gain from improvement efforts didn't readily transfer to organizational results or customers. In 2003 the focus for ACE shifted to sites. When the same tools and methods used in cell where used at site levels they created improvements that translated to the bottom line and customers. One new method, value stream mapping, played a crucial role. VSM allowed people to integrate improvement efforts across different cells that have a chain effect one another.

2.5 Review of literature on measurement tools of ACE implementation

As stated by Roth (2010), Davis (2008) and ACE Handbook (2005), ACE has created a four-level of achievement structure for the ACE Process: Qualifying, Bronze, Silver, and Gold. Each level required specific actions and progress using the eight ACE operating tools. Progressing from Qualifying to Bronze, Silver and Gold level requires learning and demonstrating appropriate use of ACE tools, establishing cells, defining and measuring processes and improving process maturity while making and sustaining performance improvements.

At qualified level, the focus is on an awareness, education, and learning of ACE methods, in essence demonstrating both commitment and involvement of leaders and employee cells improvement efforts. It is designed to promote an awareness of the ACE tools through training, and to initiate baseline ACE activities. Based on its learning efforts and organizational commitment, the cell is qualified to move forward with ACE. The initial use of ACE method helps the managers to identify, define, and develop measures of its key processes.

At the Bronze level, the focus is developing competency with ACE tools and methods, and demonstrating knowledge for their appropriate application by implementing improvements. Per

the ACE Hand book Bronze certification required demonstrating the use of six ACE tools among the total ten. There are expectations at each level that people have learned ACE tools, and where applicable, and demonstrate that they use these tools appropriately. Cells attain a comfort level and to start using the tools on a daily basis.

When a Cell progress to ACE Silver level, all its process has been defined, measured, and improved using appropriate ACE tools. ACE silver requires the evidence of these improvements, demonstration of using ACE tools appropriately. This level required demonstration of quality results, and was intended to positively influence the facilities' profits (e.g., through increased inventory turns or more productive workforce).

The Gold level required actual business result measures and is defined as, "achieving world-class status in the eyes of the customer". ACE Gold is based on going beyond internal and historical standards to achieving performance levels based on outside benchmarks of competitive excellence. Competitive advantages require operating at a world class performance level. Excellent performance often requires improving inputs or changing outputs for the internal processes. Internal process improvement is often constrained by the timeliness, quality and cost of inputs from or outputs to partners in the value stream, which requires working with suppliers and customers to improve overall performance. Cells with Gold level can develop new innovative applications of product and process technologies that achieve and sustain high, best-in-class, performance level.

For a facility to attain a specific achievement level, all cells within the facility—including both Manufacturing and Business Process areas—had to pass that level's achievement criteria. In addition, the cells must have maintained their gains from the previous achievement level for a specified amount of time.

According to Davis (2008) Black knew that the ACE Council could influence the requirements for these four levels. He wondered whether the criteria, as developed by P&W, were too complicated. On one hand, the comprehensive lists of criteria provided common targets and a common language for the facilities. On the other hand, this amount of detail might make the process too intricate to administer effectively on a global scale. As a second concern, Black noticed that the Qualifying and Bronze levels appeared to focus more on training, whereas, business results were part of the criteria only in the Silver and Gold achievement levels.

ACE audits conducted by the central ACE council, Change and Performance Management in EAL case to check and confirm Cells are maintaining their ACE achievement level.

According to EAL ACE protocol ACE Certification Process, all ACE assessments will be conducted by two certified ACE assessors from the ACE Central team or EAL Change and Performance Management teams. ACE Leaders should also seek to become certified ACE assessors. Assessments must be scheduled by the ACE Leader and communicated to the ACE Central Team of EAL. In addition to the two assessors; Cell Change Agent; Area ACE Leader; Cell supervisor(s), foreman: and Area Quality Manager has to be presented.

Then the assessment carries on in the cell where the physical evidence of conformity to the criteria is examined, for example: “ACE Activity board, 5S+1, TPM, Control tower”. It is also during this visit that the assessors ask questions to some employees. Once all criteria have been examined, the assessors write their report that they will then present to the same team present at the start of the assessment (ACE Handbook, 2005).

Table on Appendix 2 shows ACE implementation measurement criteria for each ACE tool from ACE Qualifying to ACE Silver level which is used ACE tools measurement

At Gold Level the followings are conditions criteria are for ACE Gold eligibility.

1. All the previous level criteria mentioned in the above table are maintained.
2. High level business result has to be maintained.
3. Cells must insure that a sufficient number of employees have to be trained at each work stations to meet service and manufacturing needs.
4. There has to be high responsiveness to customers changing needs to expectations.
5. Products and service consistently meet or exceed customer’s expectations and MFA data consistently high across customer base (score of 6.0 or higher)
6. Individual Cells are fully aligned with other cells which are in the same product line stream.

2.6. Review of Literature on determinants of Internal Supply Chain Integration

In a competitive environment, an increase in the level of partnership among businesses is required. Spekman et al. (1998) summarize the development of partnership into three stages, starting from cooperation, to coordination, and then to collaboration. Cooperation, whereby firms exchange essential information and engage some suppliers into a long-term contract, has become the threshold level of interaction. In other words, cooperation is a starting point for

supply chain management and it has become a necessity for business. However, it is not a sufficient condition. The next stage is coordination whereby specified material and information are exchanged among partners to create seamless linkage among trading partners. Again, this process is important, but it is not a sufficient condition for integration due to the lack of integrated information flow. At the highest level, collaboration, also known as supply chain integration, requires that all trading partners throughout the supply chain become integrated into their suppliers'/customers' processes. For example, supply chain partners cannot only plan the future production scheduling together, but they also share technology as well as future design, product requirement, and long-term strategic intentions. The movement from coordination to collaboration or integration requires high levels of trust and information sharing among partners (Boon-Itt and Paul, 2002).

A smaller stream of research is focused on the antecedents of internal integration. Most of the studies on internal integration have sought to determine the performance benefits of integration. Chen *et al.*, (2007) as cited by Basnet (2008) for instance, found that marketing-logistics collaborative activities led to firm-wide integration, which in turn led to performance. Ellinger (2000) also investigated marketing–logistics collaboration and posited that “evaluation and reward system”, “cross-functional collaboration”, “effective inter-departmental relations” and “distribution service performance” were serially linked.

A complementary theme of research seeks to identify the antecedents of integration, with the ultimate goal of normatively suggesting to management what it can do to foster integration. Flynn, (2010) suggested the following six parameters to determine the level of supply chain integration. These are:

1. Data integration among internal supply functions
2. Different departments in Ethiopian Airlines have effective data integration in among themselves.
3. Integrative inventory management
4. Real-time integration and connection among all internal functions from raw material management through production, shipping and sales.
5. Use of periodic interdepartmental meeting among internal functions
6. Uses of cross functional teams for product design

2.7. Conceptual Framework

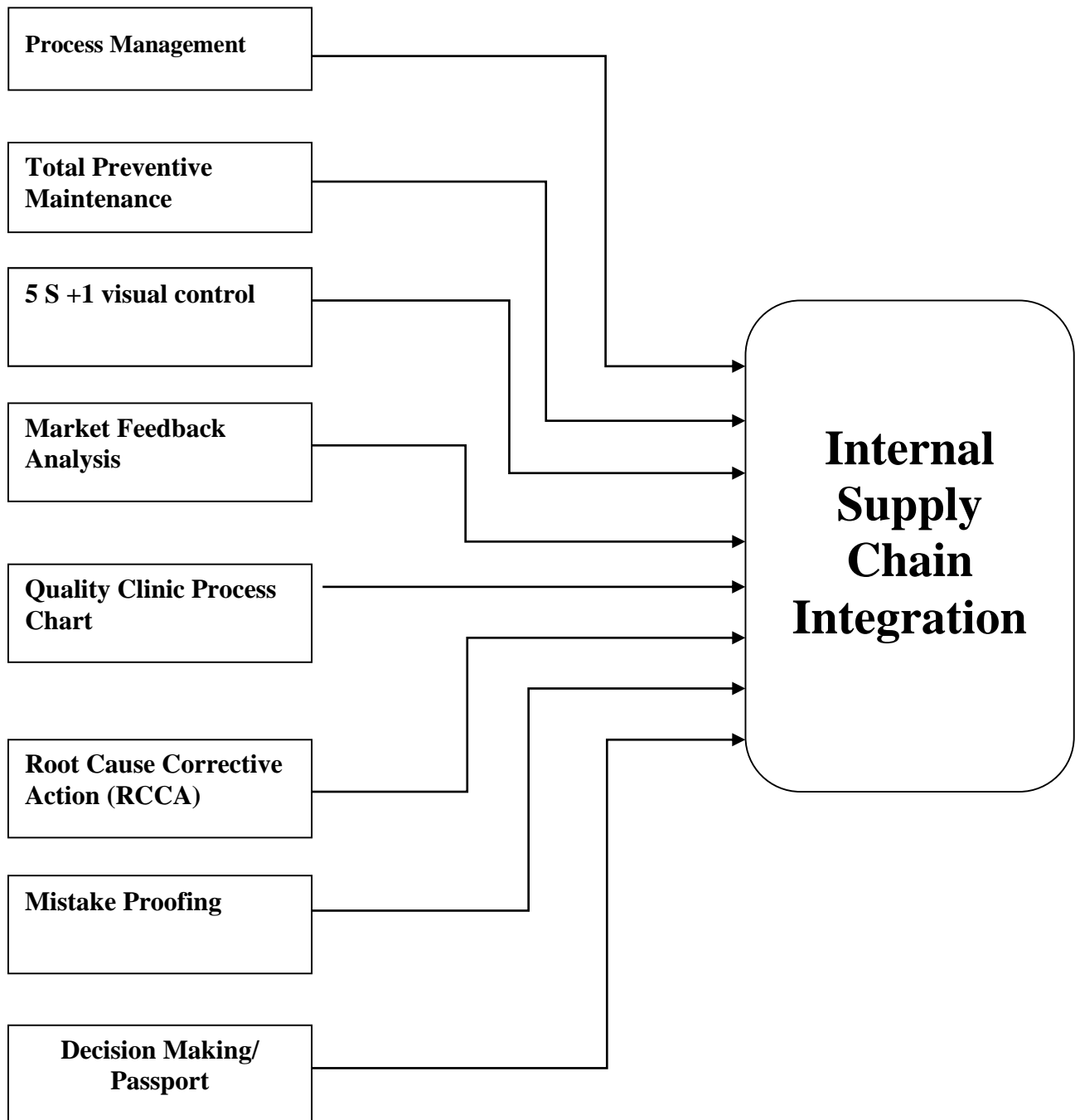
Conceptual frame work explains the main things to be studied, the key factors, or variables and the assumed relationship among them (Voughan 2008). Since almost no observations have been made in the literature about the relationship among operating systems and internal supply chain integration within the airline industry; specifically, ACE in the airlines industry, there was a notable absence of literature exploring the extent how ISCI will be influenced by operating system especially by ACE in the airline industries.

According to Roth (2010), the tools of ACE operating system may be brought in to play during Kaizen events. These are all methods that are written up in a variety of books, many of which base their origins on methods used by Toyota and other Japanese automotive manufacturers. Ito University, as well as numerous consultants and training organizations, provide courses that included the Kaizen methods. The Kaizen approach organizes people in to teams that use lean tools to collect data, conduct analysis, and carry out improvements. Even if Kaizen doesn't include in UTC's list of ACE tools, as a philosophy, it is part of ACE.

From detail review of ACE practice in UTC through ACE tools implementation and review on enablers of ISCI, ACE tools have a great influence on ISCI. Related studies conducted on lean and kaizen in Ethiopian on different manufacturing & service providing organizations focus on the operating system tools as an independent variables and organizational growth (Samuel, 2012), product, quality and profit improvement (Alebel, 2016) and operational effectiveness and efficiency (Getu, 2016) as dependent variable.

Therefore, this research had used the eights ACE operating tools as independent variable and internal supply chain integration 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. The framework depicts ISCI as influenced by variables including: the eight ACE operating tools.

Figure 2.1: Conceptual frame work of the study



Source: Own Literature review

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1. Research design and approach

The study mainly focused on the roles ACE operating system implementation on EAL's ISCI by taking EAL's operational Cells in to consideration. This study adopted quantitative research approach with a primary purpose of determining the roles of ACE implementation on internal SCI of the organization. The researcher preferred this technique because it has vital strengths like: it generates precise, numerical data from survey sizes. Furthermore, the findings are reliable and can be generalized and replicated to many populations (Maxwell and Delaney, 2004). The quantitative aspect of the research refers the generation of descriptive statistical analysis from the use of large-scale survey to be carried out from responses of participants using methods of questionnaires (Dawson, 2002 as cited by Getu, 2016).

Churchill (1999) explains research design as "the framework or plan for a study, used as a guide in collecting and analyzing data. It is the blueprint that is followed in completing a study. It resembles the architect's blueprint for a house". However, there is no single perfect design of conducting research. There are different classifications of research design reported in the literature. The most useful classification is based on the objectives of the research: Exploratory, Case Study, Descriptive, or Causal (Cooper and Schindler, 2008; Churchill, 1999).

Explanatory research design is used for this study. Under this stage, the study fulfills the objectives of explanatory research by getting an in-depth skill of ACE operating systems implementation as strategic operating system and investigating the role of ACE in the ISCI of EAL.

3.2. Population of the Study and Sampling Method

There are several alternative ways of taking a sample. The major alternative sampling plans may be grouped into probability techniques and non-probability techniques. The simple random is the best known probability sample, in which each member of the population has an equal probability of being selected. Probability sampling designs are used when the representativeness of the sample is of importance in the interest of wider generalizability. When time or other factors, rather than generalizability, become critical, non-probability sampling is generally used. As a result, probabilistic random sampling had been used.

The research considered a total population of 227 EAL's ACE Cells agents or department representative including all local ticket offices at Addis Ababa.

Therefore, the unit of analysis for this study was focused on company's department/ACE cells level. All EAL ACE cells (227 cells) which were located in Headquarter in Bole international airport are unit of analysis for this study. It is due to the fact that ACE implementation has an impact on the company's ISCI.

The researcher targeted these cells' Change agents as a unit of analysis for this study purpose. From the total population size, a sample size of 122 was taken. Thus, samples of 122 ACE Agents are selected using simple random sampling technique which is based in EAL Headquarter. Due to the fact that there is a total of "9" predictors in the survey (eight independent and one dependent predictors), the ideal minimum sample size for this study is calculate using the formula from (Green, 1991) which states that the minimum sample is based on $50+8(m)$ where m is the number of predictors to be studied

$$\text{Sample Size} = 50+8(m), \quad = 50+8(9) = 122 \text{ Where m is number of predictor.}$$

For interview purpose the researcher applied non-probable purposive sampling method and which occurs when target population are chosen by the judgment of the researcher. Researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money. Therefore, the Change and Performance Management Managers and Director (five in number, see App 1.) were selected for interview since their position is important in describing impact of ACE implementation on Company's internal SCI, results obtained and the challenges & constraints for ACE implementation, and productivity improvement in the company. They have detailed information about the current status of the ACE practices and its relevance. This helped the researcher to get more and significant information and cross checked data obtained from the questioners.

3.3. Sources of Data and Collection Techniques

The study used both primary and secondary data collection methods to achieve its objective. For a primary data, questionnaire and interview were used. According to (Krishnaswami and Ranganatham, 2007), the researcher chosen this method because it is less expensive, permits anonymity and may result in more responses that are honest. Therefore, the data were collected from sample populations in the EAL headquarter by preparing and distributing structured questionnaires which are developed from literatures. The questionnaires had been pre-tested to check its appropriateness for gathering all the required information. Furthermore, to questioners, structured interview was used as a primary data. Since interviews are particularly useful for getting the story behind a participant's experiences and pursue in-depth information around the

topic. It also allows greater control over the interview situation (e.g. sequencing of questions) while providing opportunities for making clarifications and collecting supplementary information (Collis and Hussey, 2009). This helped the researcher to triangulate the information that obtains from questionnaires. In addition to primary data, variety of secondary data including information contained from organization web-pages, reports and individual ACE Cells portal page, documentation and reports from change management was used as a secondary data for this study.

3.4. Method of data analysis

The quantitative data which were gathered through structured questionnaire was processed using SPSS (statistical package for social sciences) version 23 to get descriptive statistics results to calculate percentages and to produce tables and bar graphs. The relationship between the dependent variable, ISCI, and the independent variables, the eight ACE operating tools were expressed as a linear combination of the independent variables plus an error term. Following Greene (2003), the multiple linear regression model is specified as:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \varepsilon$$

Where: Y= ISCI, β_0 = Constant term, X1= Process management X2=Total productive maintenance, X3= 5S+1 and visual control, X4=Market Feedback Analysis, X5= Quality clinic process chart, X6= Root Cause Corrective Analysis, X7=Mistake proofing, X8=Decision making tool. The β are coefficients of independent variables, Xs are the independent variables and ε is a vector of errors of prediction. The errors are assumed to be normally distributed with an expected value of zero and a common variance.

The results findings were presented in frequency tables and percentages were used to summarize the demographic information of respondents. In order to put numerically found result of the study in understandable way the study further used descriptive statistic method of data and result summarization or presentation. Descriptive statistics; Mean, Standard deviation, Correlation and Multiple regressions of the respondents' scores on all the dimensions were assessed in order to assess the role of ACE operating tools on ISCI. By applying these statistical tools, the study has pointed up the roles of ACE operating system on ISCI.

3.5. Measurement of Variables

The identified variables to this particular study followed the conventional variable fashion (i.e., dependent and independent variable). Therefore, the dependent variable or variable to be

measured using different antecedents or dimensions is company's internal SCI. Whereas, the independent variable or the measuring variables are the eight ACE operating tools. To investigate the relationship between the independent variables and the dependent variables the study used Pearson correlation coefficient.

All items of questionnaires regarding to ACE tools were developed from the procedures to certify cells in the four achievement levels. The researcher measured the variables using the 5 point Likert scale (1=strongly disagree to 5= strongly agree) to identify the overall level of respondents' agreement using subjective approach of measuring ACE implementation and its role on ISCI. Since there is no clear and valid source regarding to data collection in any related literature conducted in ACE implementation, the researcher obligated to use literatures conducted in related field of research area (other than ACE). Operating systems like Kaizen (Albel, 2016) used 5 point Likert scale in his case study on achievement and challenges of Kaizen. Due to the fact on unavailability of standard questionnaires, that could rate the roles of ACE implementation ISCI, the researcher prepared questionnaires by referring different related studies, and to increase validity of the instrument the questionnaires were pre tested on some of the respondents that have adequate knowledge on the subject area. Using the expert's view and suggestions, the final questionnaires were prepared and distributed to the respondents. The internal consistency of the instrument was also tested via reliability analysis. Cronbach's coefficient alpha is an internal consistency estimator where the values exceed 0.60 (Hair, 1995 as cited George and Mallery, 2003). Therefore, this rule was the guiding line to measure the internal consistency of data collection instrument deployed in this study.

3.6. Ethical Consideration

Considering the relevance of ethics in research work, the researcher considered ethical issues as much as possible. To this effect, the researcher requested the official letter from Addis Ababa University School of Commerce to let EAL and selected respondents know that the researcher is a graduating student of 2018 academic year. Once the approved letter is transferred to EAL, the purpose of the study had been properly explained to all participants. The issue of confidentiality also explained in advance to each participant and the questionnaires are supposed to be answered anonymously. The analysis was done collectively based on participants under study population.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1. Introduction

It is recalled that the general objective of this research is to assess the roles of ACE implementation on EAL's ISCI. Therefore, the overall effort was to attain this objective, and answer questions formulated in chapter one, along the lines of scientifically valid research procedure.

The results findings were presented in frequency tables and percentages were used to summarize the demographic information of respondents. In order to put numerically found result of the study in understandable way the study further used descriptive statistic method of data and result summarization or presentation. Descriptive statistics; Mean, Standard deviation, Correlation and Multiple regressions of the respondents' scores on all the dimensions were assessed in order to assess the role of ACE operating tools on ISCI.

This chapter analyses the findings and results from the data collected. The results are divided into five major subsections that include; reliability test, Demographic Information of Respondents, level of ISCI and ACE implementation, correlation among variables, and multiple linear regressions.

4.2. Reliability Test

The study was conducted through the instrumentalism of different data gathering tools (i.e., questionnaire and interview). Questionnaires were distributed to participants via email and in person. To deal with non-return rate, 30 additional questioners were distributed. From the total of 152 questionnaires distributed to the designated respondents 138 were collected. From the remaining 12 questionnaires; 8 were not returned at all, and 4 were not correctly filled. Therefore, the overall response rate was 92%.

Moreover, in order to evaluate the internal consistency of the item used in the data collection tool, Cronbach's Alpha is used. According to George and Mallery (2003), Chronbach's Alpha is an indicator of degree of internal consistency of scales. The higher the coefficient the higher degree of consistency denotes; >0.9-Excellent, >0.8-Good, >0.7-Acceptable, >0.6-Questionable, >0.5-Poor, <0.5-Unacceptable. Therefore, as shown in the table 4.1 below, the result of the reliability test revealed that the items in the questionnaire exhibited Chronbach's Alpha rate more than enough to be called consistent or acceptable.

As clearly shown in Appendix 3 which was obtained from actual data collection, all the scales used to measure the dimensions of this particular study scored calculated alpha values that range from the lowest value of 0.838 to the highest value of 0.943 which is consistent or acceptable.

4.3. Demographic Information of Respondents

The study utilized respondents who were key staff (ACE agents) who have the lion share in implementing ACE operating tools in respective cells/departments. The background information on Age, gender, experience in EAL, qualifications of the respondents and ACE Gold level were looked into.

To deal with non-return rate additional 30 questionnaires were distributed. Among these additional questionnaires to the target population, 16 were collected and the remaining 14 were non-returned. Therefore, a total of 138 questionnaires were collected.

Table 4.1, Frequency and Percentage of Background Variables

Background variable	Group	Frequency	Percent
Age	18-25	44	31.9
	26-35	79	57.2
	36-45	8	5.8
	> 45	7	5.1
	Total	138	100.0
Gender	Male	106	76.8
	Female	32	23.2
	Total	138	100.0
Educational level	Diploma	13	9.4
	Degree	110	79.7
	MA/MSC and above	15	10.9
Service year	1-5	71	51.4
	6-10	43	31.2
	11-15	15	10.9
	>15	9	6.5
	Total	138	100.0
ACE level	Bronze	3	2.2
	Silver	19	13.8
	Gold	116	84.1
	Total	138	100.0

Source: Survey Finding, 2018

Table 4.1 shows frequency and percentage of background variables of participants participated

in this study. A total of 138 participants involved in this study of which more than third-fourth (76.8%) were male and the remaining 23.2% were female. This implies that the company gives less attention for females to participate in ACE implementation and ACE leadership. More than half of the total participants (57.2%) were in the age range of 26-35 years old. 31.9% of participants were in the age range of 18-25 years old while minorities of participants, 5.8% and 5.1%, were in the age range of 36-45 and greater than 45 years old respectively. Regarding educational level of participants, the majority (79.7%), were having educational qualification of Bachelor Degree whereas the remaining minorities, 10.9% and 9.4%, were having educational level of MA/MSc and above and diploma respectively. This implies the respondents can easily understand the questionnaire and reply appropriate answer.

As far as the service year of participants is concerned, almost half of the total participants, 51.4%, were having 1-5 years of service in their organization. 31.2% of participants were having 6-10 years of service; 10.9% were having 11-15 years of service and 6.5% were more than 15 years of service in their organization. This implies that EAL lacks experienced ACE agents. The more experienced ACE agents, the more fruitful he/she can be in leading one cell as per the ACE protocol. As per collected data most of the ACE agents have less than 5-year experience. The researcher believes the effective implementation of ACE will be highly impacted by the experience of the ACE agents. According to Thomas (2004), The ACE operating system tends to select and utilize agents that comes diverse educational and experiential backgrounds. Since they are responsible to facilitate the ACE activities in order to ensure the success of ACE in their cells and selected to act as experts in guiding the organization in their learning and use of the operating system tools, they have to be more experienced. Finally, participants' section ACE achievement level was asked. More than three-fourth of participants (84.1%) reported that their cells ACE achievement level was "Gold" level. The remaining minorities, 13.8% and 2.2%, reported that their ACE achievement level was "Silver" and "Bronze" level respectively. Although the respondent ACE cells rate 84 % of them are certified ACE Gold level, there is almost no available concrete evidence that can proof these ACE cells can deserve ACE Gold achievement level on their respective ACE Portal page. This implies that respondents have adequate information about ACE implementation in EAL. Besides to this, this can be taken as a good indicator that the EAL's ISCI is supported by ACE implementation since ACE Gold level demand to have a synergy among different cells.

4.4. Level of ISCI and ACE Implementation

Table 4.2: Descriptive Statistics of ACE and ISCI

Variable	N	Minimum	Maximum	Mean	Std. Deviation
ISCI	138	8.00	28.00	21.5942	4.74863
ACE	138	36.00	100.00	74.6159	13.68644

Source: Survey Finding, 2018

Table 4.2 shows that the calculated mean, minimum, maximum score and standard deviation of ISCI. The calculated mean score of ISCI was 21.59 with a standard deviation of 4.75 and the hypothetical mean score of ISCI was 18. This means in 6 items of a 5-point Likert scale the possible score ranges from 6 ($6 \times 1 = 6$) to 20 ($6 \times 5 = 20$) and the hypothetical mean score becomes 18 ($6 \times 3 = 18$). The calculated mean score was greater than the hypothetical mean score. One sample t-test result showed that there was a statistically significant mean score difference between the hypothetical mean/test value and calculated mean, $t = 8.89$, $df = 137$, $p < 0.01$. The level of ISCI was rated high or above average by the respondents.

The above table also shows the calculated mean, minimum, maximum score and standard deviation of ACE. The calculated mean of ACE was 74.62 with standard deviations of 13.69 and the hypothetical mean score of ACE was 60. In other words, in 20 items of a 5-point Likert scale the possible score ranges from 20 ($20 \times 1 = 20$) to 100 ($20 \times 5 = 100$) and the hypothetical mean score becomes 60 ($20 \times 3 = 60$). The calculated mean score of ACE (74.62) was greater than the hypothetical mean score (60). One sample t-test result showed that there was a statistically significant mean score difference between the hypothetical mean/test value and calculated mean, $t = 12.55$, $df = 137$, $p < 0.001$. The level of participants' ACE implementation practice was high or above average as perceived by the respondents.

4.5. Level of ACE training

Even if EAL's change management supply training on ACE, it isn't on the satisfactory level. According to the data (Appendix 4) almost all the items on general ACE implementation questioner (part 1) score calculated mean of 4 (mathematically rounded) but only item number 4 and 6, scored 3 (mathematically rounded). The level of participants training quality is on average as perceived by the respondents. Therefore, the training quality have to increase to all employees.

4.6. Correlation: Relationship among Variables

Table 4.3: Correlation Statistics of ACE Operating Tools and ISCI

	ACEI	PM	TPM	SS	MFA	QCPC	RCCA	MISPRO	DC	ISCI
ACEI	1	.866**	.710**	.667**	.682**	.604**	.328**	.439**	.431**	.007
PM		1	.798**	.775**	.726**	.648**	.470**	.519**	.634**	.119
TPM			1	.710**	.644**	.583**	.523**	.503**	.451**	.181*
SS				1	.673**	.622**	.470**	.408**	.465**	.151
MFA					1	.830**	.575**	.505**	.487**	.070
QCPC						1	.569**	.416**	.535**	.053
RCCA							1	.699**	.491**	.393**
MISPRO								1	.560**	.221**
DM									1	.216*
ISCI										1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Source: Survey Finding, 2018

Correlation analysis estimates the extent of the relationship between any pair of variables (Reimann, Filzmoser, Garrett, & Dutter, 2008). The correlation coefficient is a measure of this relationship and depends on the variability of each of the two variables. Because of covariance, correlation coefficient can take a number with + or – sign (Reimann et.al, 2008). One of the widely used methods to calculate a correlation coefficient is the Pearson product moment correlation. This method results in a number between –1 and +1 that expresses how closely the two variables are related, ±1 shows a perfect 1:1 relationship (positive or negative) and 0 indicates that no systematic relationship exists between the two variables (Reimann et.al, 2008). In relation to the magnitude of correlation coefficient, Cohen (1988) stated that a correlation coefficient from 0.10 to 0.29 can be considered as small or weak, from 0.30 to 0.49 medium and from 0.50 to 1 large or strong.

Table 4.3 shows correlation between ACE Operating Tools and ISCI. As can be seen in table ISCI had statistically positive significant relationship with some ACE Operating Tools like RCCA, MISPRO, TPM and DM. This implies that as one variable increase, the other variable also increases and vice-versa. There was medium correlation between RCCA and ISCI, $r = 0.393$, $p < 0.01$. The correlation between MISPRO and ISCI was weak, $r = 0.221$, $p < 0.01$. The correlation between DM and ISCI was weak, $r = 0.216$, $p < 0.05$. Similarly, the correlation between TPM and ISCI was weak, $r = 0.181$, $p < 0.05$. However, the correlation between ISCI

and the remaining ACE Operating Tools like PM, SS, MFA and QCPC were not statistically significant.

Table 4.3 also shows the correlation among ACE Operating Tools. The result indicated that the correlation among all ACE Operating tools were positive and statistically significant. The first strong correlation was between MFA and QCPC, $r = 0.830$, $p < 0.01$. The second strong correlation was between PM and TPM, $r = 0.798$, $p < 0.01$. The third strong correlation was between PM and SS, $r = 0.775$, $p < 0.01$. However, the correlation between MISPRO and SS was moderate and it was relatively the least strong correlation among dimensions of ACE, $r = 0.775$, $p < 0.01$. This shows the eight operating tools have strong relationship among each other.

4.7. Multiple Linear Regressions: Tests of assumptions for Multicollinearity, Outliers, normality, linearity, homoscedasticity, independence of residuals

Multicollinearity

In order to identify whether some of the independent variables have very high correlations with other independent variables, using collinearity diagnostics, multicollinearity estimate was performed. Robert (2006), if collinearity is discovered then one can either remove one of the variables or create a new variable that combine the previous two that were highly inter correlated because when the predictor variables are highly correlated, they share essentially the same information and together, they may explain a great deal of the dependent variable, but may not individually contribute significantly to the model. Thus, the impact of multicollinearity is to reduce any individual independent variable's predictive power by the extent to which it is associated with the other independent variables.

The variables (DM, TPM, RCCA, QCPC, MISPRO, SS, PM) have shown significant relationship with each other among this operating system, the relationship between MFA and QCPC, had the highest correlation coefficient which was greater than 0.80. The correlation coefficient of rest was not too high (see table 4.4). To avoid the multicollinearity effect, the predictor variable MFA was removed from the model due to the fact that it's highest correlation coefficient. In such a way, the assumption of multicollinearity was not violated.

In addition, the assumption of multicollinearity can also be assessed using SPSS as part of multiple regression procedure. In the collinearity statistics section, Tolerance and VIF (Variance inflation factor), values are given. Tolerance is an indicator of how much of the variability of the specified independent is not explained by the other independent variables in the model and is

calculated using the formula $(1 - R^2)$ for each variable. If this value is small (less than 0.10) it indicates that the multiple correlation with other variables is high, suggesting the possibility of multicollinearity (Robert, (2006)). In the present study the tolerance value for each independent variable was not less than 0.10 therefore, this also suggests that the assumption of multicollinearity was not violated (see table 4.4). The other value given is the VIF (Variance inflation factor), which is just the inverse of the Tolerance value. VIF values above 10 would indicate multicollinearity. Again in the present study the VIF value was less than 10 for all independent variables (see table 4.4). This also indicates that the assumption of multicollinearity was not violated. Therefore, it is possible to agree that multicollinearity is not a serious problem as long as this particular test result is concerned for this specific study.

Table 4.4, Collinearity Statistics Test of Independent Variables

Collinearity Statistics	
Tolerance	VIF
.203	4.933
.307	3.252
.350	2.854
.449	2.227
.394	2.539
.418	2.391
.479	2.090

Source: Own Survey Result, 2018

Homoscedasticity ("Homogeneity of variance" assumption or homoscedasticity)

It states that the variances of the same variable, selected from independent samples, will be equal. In regression analysis, this assumption states that the variances of the Y s, for each X , will be equal. The standard suggestion for examining the assumption of homoscedasticity in regression analysis is to plot the predicted Y values against the residual values. Heteroscedasticity is indicated when these values spread or fan out from left to right or right to left. The scatterplot shows that the points are concentrated around 0 which shows that no violation of homoscedasticity (see Appendix 5).

Outliers, normality, linearity, independence of residuals

These assumptions can be checked by inspecting the Normal Probability Plot (P-P) of the Regression Standardized Residual and the Scatterplot shown as part of the analysis. If points lie in a reasonably straight diagonal line from bottom left to top right in the Normal P-P plot, no major deviation from normality can be suggested. In the present study, we can easily inspect

from the Normal P-P plot that points line in a reasonably straight diagonal line from bottom left to top right for all dependent variables (see Appendix 5). This suggests that the assumption of normality was not violated. In the Scatterplot of the standardized residuals, the residuals were roughly rectangular with most of the scores concentrated in the center, along the line 0. This also suggests no violation of the assumption of independence of residuals. Outliers can also be detected from the Scatter plot. From this Scatter plot we can find that there were no major outliers.

In summary, as we can understand from the above paragraphs, all the essential assumptions, such as multicollinearity, Outliers, normality, linearity, homoscedasticity, independence of residuals for computing regression analysis were not violated for using linear regression.

Table 4.5, Goodness of Fit – ANOVA Result

Model		Sum of Squares	Df	Mean Square	F	Sig.
Regression		716.957	7	102.422	5.613	.000 ^b
Residual	2372.318	130	18.249			
Total	3089.275	137				

a. Dependent Variable: ISCI

b. Predictors: (Constant), DM TPM, RCCA, QCPC, MISPRO, SS, PM

Source: Own Survey Result, 2018

The goodness of fit results of linear multiple regressions with Internal Supply Chain Integration (ISCI) as the dependent variable and independent variables (DM, TPM, RCCA, QCPC, MISPRO, SS, PM) as predictors is reported in table 4.5. The model reveals a statistically significant relationship between **ISCI** and predictor variables, $F(7,130) = 5.61, p < 0.01$. In other word, the model was significant.

4.8. The Influence of ACE Operating Tools on the Internal Supply Chain Integration

As shown in table 4.6 the value of adjusted R square is 0.232. This value tells how much of the variance in the dependent variable Internal Supply Chain Integration (ISCI) is explained by the model/ACE Operating Tools (DM, TPM, RCCA, QCPC, MISPRO, SS, PM). In other words, multiplying R Square value with 100, the model explains 23.2% of the variance in the dependent variable/ISCI. This implies ACE’s impact on ISCI in EAL is about 23.2%, which is below the minimum expected R square. Therefore, the magnitude of ACE operation tools influence on

Ethiopian Airlines internal supply chain integration is very low as perceived by the respondents.

Table 4.6, The Influence of ACE Operating Tools on the Internal Supply Chain Integration

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.482 ^a	.232	.191	4.27184

a. Predictors: (Constant), DM, TPM, RCCA, QCPC, MISPRO, SS, PM

b. Dependent Variable: ISCI

Source: Own Survey Result, 2018

4.9. Regression coefficients of predictor variables in predicting the dependent variable

In order to assess dimensions of ACE in determining the ISCI of EAL, multiple linear regression analysis was computed. The table 4.7 shows that, among the predictor variables, variables like QCPC, RCCA and DM made a statistically significant prediction/influence in predicting the dependent variable, Internal Supply Chain Integration (ISCI).

Table 4.7, Regression coefficients of predictor variables in predicting the dependent variable

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	16.410	2.046		8.021	.000
PM	-.065	.088	-.126	-.740	.460
TPM	.126	.144	.121	.874	.384
SS	.156	.220	.092	.707	.481
QCPC	-.610	.197	.355	-3.092	.002
RCCA	1.116	.239	.572	4.668	.000
MISPRO	-.478	.312	-.182	-1.531	.128
DM	.334	.177	.210	1.892	.041

a. Dependent Variable: ISCI

Source: Own Survey Result, 2018

To evaluate the contribution or influence of each independent variable to the dependent variable, one can see the Beta value. In the table 4.7 above, the Beta value for predictor variable, RCCA, was 0.572 which implies that this predictor variable made the first strong positive and statistically significant influence in explaining or predicting the dependent variable/ISCI when

the variance explained by all other variables in the model is controlled for. In addition, QCPC made a statistically significant positive prediction to the dependent variable with Beta value of 0.355. This implies that QCPC made the second strong influence in predicting the criterion variable, ISCI. Furthermore, DM made the third strong positive influence/contribution in predicting the dependent variable, with Beta value of 0.210. However, the remaining predictor variables (TPM, MISPRO, SS, PM) didn't make any statistically significant contribution/influence in determining the dependent variable, $p > 0.05$.

In general, the study explored the relationship between Internal Supply Chain Integration and ACE operating tools with the expectation that there is statistically significant relationship between ISCI and ACE Operating Tools. Correlation results of this study indicated that the relationship between internal supply chain integration and ACE Operating Tools were statistically significant ($p < 0.05$).

Regression result also indicated that the model (DM, TPM, RCCA, QCPC, MISPRO, SS, PM) explained 23.2% of the variance in the dependent variable/ISCI. In addition, only three predictor variables (QCPC, RCCA and DM) made statistically significant prediction in predicting the dependent variable, internal supply chain integration practices. Therefore, the specified model which was:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \varepsilon$$

is modified as:

$$ISCI = 16.41 + 0.572 RCCA + 0.355QCPC + 0.210DM + 2.046$$

4.10. General findings from secondary data collection methods

While checking on secondary data collection methods, the researcher had noticed as there is inconsistency in implementing this continuous change operating system. All cells are not implementing all ACE tools per ACE protocol this have been proofed while checking all cells' internal ACE portal pages. There are few transactions/activities on a few ACE tools. Frequently used tools on all ACE portal page is QCPC and MFA a good example for these finding is that currently EAL change management evaluate Gold Sustainability every month and cells are categorized Green, Yellow and Red based on their status and release a news on Ethiopian weekly (electronic newspaper) for the past six months. There are still yellow and red categorized ACE Gold Cells. Per the report companywide ACE performance showed that using ACE as an operating system has diminished through time. It is becoming a challenge to achieve next level

of ACE movement, i.e. designing a new companywide Value Stream Mapping. According to ACE protocol (2005), when a department has certified for ACE Gold, it means that, it has listed, mapped, measured, improved, and streamlined all of its process. All business and manufacturing processes have become efficient, automated (where possible) and mistake proofing. This finding is also proofed in the interview session with EAL's change management executives. All most all mention inconsistence in implementing ACE as a major problem.

CHAPTER FIVE: SUMMARY AND RECOMMENDATION

This chapter presents the summary of major findings, conclusions and some recommendations appropriate for better implementation of ACE as an operating system to maximize its role in Internal Supply Chain Integration.

5.1. Summary of findings

According to the data analysis in the previous section and secondary data on ACE Portal page and reports, summary of the findings is presented as follows.

1. As shown on table 4.6, ACE Operating Tools have an influence on ISCI. It counts about 23.2% with the present ACE implementation culture.
2. This study had also identified that three major ACE operating tools have significantly affect ISCI of EAL. ISCI had statistically positive significant relationship with dimensions of ACE like Root Cause Corrective Action (RCCA), Mistake Proofing (MISPRO), and Decision making (DC). (See table 4.3 shows correlation between ACE Operating Tools and ISCI)
3. This study had also identified the level of ISCI of EAL (see table 4.2). The calculated mean score was greater than the hypothetical mean score. One sample t-test result showed that there was a statistically significant mean score difference between the hypothetical mean/test value and calculated mean, $t = 8.89$, $df = 137$, $p < 0.01$. This implies that the level of ISCI was high or above average.
4. According to table 4.4 the correlation among ACE Operating Tools, all tools were positive and statistically significant. The first strong correlation was between MFA and QCPC, $r = 0.830$, $p < 0.01$. The second strong correlation was between PM and TPM, $r = 0.798$, $p < 0.01$. The third strong correlation was between PM and SS, $r = 0.775$, $p < 0.01$. However, the correlation between MISPRO and SS was moderate and it was relatively the least strong correlation among dimensions of ACE, $r = 0.775$, $p < 0.01$.
5. According to the data (Appendix 4) almost all the items on general ACE implementation questionnaire (part 1) score calculated mean of 4 (mathematically rounded) but only item number 4 and 6, scored 3, (mathematically rounded). These items of questionnaires were emphasized on ACE training. This implies training quality have to increase to all employees.
6. Although the respondent ACE cells rate 84 % of them are certified ACE Gold level, there is almost no available concrete evidence that can proof these ACE cells can deserve ACE Gold

achievement level on their respective ACE Portal page. A good evidence for these finding is that, the ACE protocol recommended cell have to utilize all ACE tools properly with no deviation (100%). But some tools are not well utilized by all cells if this is the case EAL ACE level award isn't implemented properly. According to David (2008) the ACE operating system, is resulted from the integration of all ACE operating tools broadly based comprehensive process that involved all levels of employees in quality and productivity improvement activities.

7. According to table 4.1 that shows service year of participants, almost half of the total participants, 51.4%, were having 1-5 years of service in their organization. This implies that EAL lacks experienced ACE agents. According to David (2008) and Thomas (2004), The ACE operating system tends to select and utilize agents that comes diverse educational and experiential backgrounds. Since they are responsible to facilitate the ACE activities in order to ensure the success of ACE in their cells and selected to act as experts in guiding the organization in their learning and use of the operating system tools, they have to be more experienced. Having less experienced ACE agent will lead not to implement ACE on the grass root level (Cell level) which will have direct impact on company's internal supply chain integration.
8. There is inconsistency in implementing this continuous change operating system. All cells are not implementing all ACE tools per ACE protocol this have been proofed while checking all cells' internal ACE portal pages. There are few transactions/activities on a few ACE tools. Frequently used tools on all ACE portal page is QCPC and MFA. This finding is also proofed in the interview session with EAL's change management executives. All most all mention inconsistence in implementing ACE as a major problem.

5.2. Conclusion

This research was mainly conducted to examine the roles of ACE implementation as an operating tool on the company's (i.e, Ethiopian Airlines) internal supply chain integration, along with assessment on the level of ACE influence on internal Supply Chain integration, identification of significant dimension of ACE affecting ISCI and the relationship among eight ACE tools. Therefore, based on the findings of the study, the following conclusions were made:

1. ACE has influence on EAL's ISCI. But the level of influence is very weak.

2. ISCI had statistically positive significant relationship mainly with three ACE Operating Tools like Root Cause Corrective Action (RCCA), Mistake Proofing (MISPRO), and Decision Making (DM) even if it is weak relationship. This reveals that as far as the perception of the respondents are concerned EAL's ACE implementation added values to the company's ISCI.
3. EAL's internal supply chain integration level is moderately high.
4. All of the eight ACE operating tools have a strong and positive relationship among each other.
5. Level of training on ACE operating system is weak.

Generally, the value of the results of the study signified a better understanding on the roles of ACE operating tools on the company's internal supply chain integration.

5.3. Recommendations

Based on the findings and major conclusions drawn above, the researcher has forwarded the following recommendations.

1. The company has to work more on Root Cause Corrective Action (RCCA), Mistake Proofing (MISPRO), and Decision making/passport (DM) since these ACE tools have a strong correlation with internal Supply Chain Integration. So as EAL can improve well enough in its internal supply chain integration.
2. Each cell must ensure that all activities of the cells are conducted using the ACE tools in identifying, resolving and preventing their problem as per company's ACE protocols by involving all employees. This will lead the organization to increase the level of its ISCI. As David (2008), suggested the ACE operating system, is resulted from the integration of all ACE operating tools broadly based comprehensive process that involved all levels of employees in quality and productivity improvement activities. The company should also work more on sustaining ACE activities and achievements. This effort requires a combination of committed management, proper and continuous training, and a culture that makes sustaining improvement a habitual behavior from the shop floor to management.
3. Training and education have to be given by appropriate professionals who are having sufficient skills on the subject matter. Recurrent course subject matter and training across the departments have to be provided so as to employees can keep on sustaining ACE

operating tools. Furthermore, rewards are needed to encourage employees properly maintain and continuously improve operating procedures and the workplace environment. UTC has been awarded over 1,300 patents only in 2017 for their new products and ACE have a lion share on this new product achievement. (UTC website).

4. The company has to foster a culture of this continuous improvement. Each and every cell have to use ACE operating system to achieve the highest levels of performance in every aspect they do, from developing new products, to finding better ways to serve their customers. Some scholar like David (2008), suggested that UTC have harvested a lot by implementing and leaving ACE culture for every single product all over the world.
5. The company has to work aggressively on appointing ACE agents based on their experiences. As David (2008) and Thomas (2004) suggested people who are selected as to act as ACE Agents, are expected in guiding the organization in their learning and use of the operating system tools. Thomas further added that ACE operating system tends to select and utilize ACE agents that come from diverse educational and experiential background. Most ACE Agents are selected from their immediate work groups and have backgrounds that are representative of their peers. These types of selection have a tendency and capability to be far more successful, especially in the long term.
6. The company has to proof that this operating system is fruitful enough to be adopted in Ethiopia so that other civil service organizations, manufacturing companies and other local company can implement easily. Therefore, EAL should work to maximize standardization on every ACE operating tool since it is a base for continuous improvements. Standardization requires diligence in every section, improving work culture of employees and strong follow up to make sure works are done according to specified standards of the ACE operating tools.
7. Further studies are needed on similar subject area. When we observe the nature these operating tool, it seems there is high impact on ISCI. What the data shows is somehow unrealistic or insignificant. The R square value indicates only 23.2% that ACE operating tools influence ISCI of EAL. In statistics R value less than 25% tends to be insignificant.

5.4. Limitation and Suggestions for Future Studies

There are limitations to this study that should be considered when interpreting the study results. These limitations are left for future research. This study did not include other benefit/roles of ACE operating tools implementation like company's performance, external supply chain integration, employee's satisfaction, financial benefit etc.

Since the research solely conducted on the mentioned company and didn't refer any other organization. Therefore, the findings of this research cannot be generalized for other organization over the world which implements ACE. Detail information and related literature required for this study was not available for the researcher for the reason of confidentiality and property right issues on mainly ACE. Furthermore, the followings are some of other limitations of the research:

- A. Part of the research was depended on respondents' perception towards the roles of ACE on EAL's ISCI.
- B. Since the researcher was a staff of EAL, where the research is conducted, there is a fear of biasness on the final findings.
- C. Lack of empirical research in same field of area.

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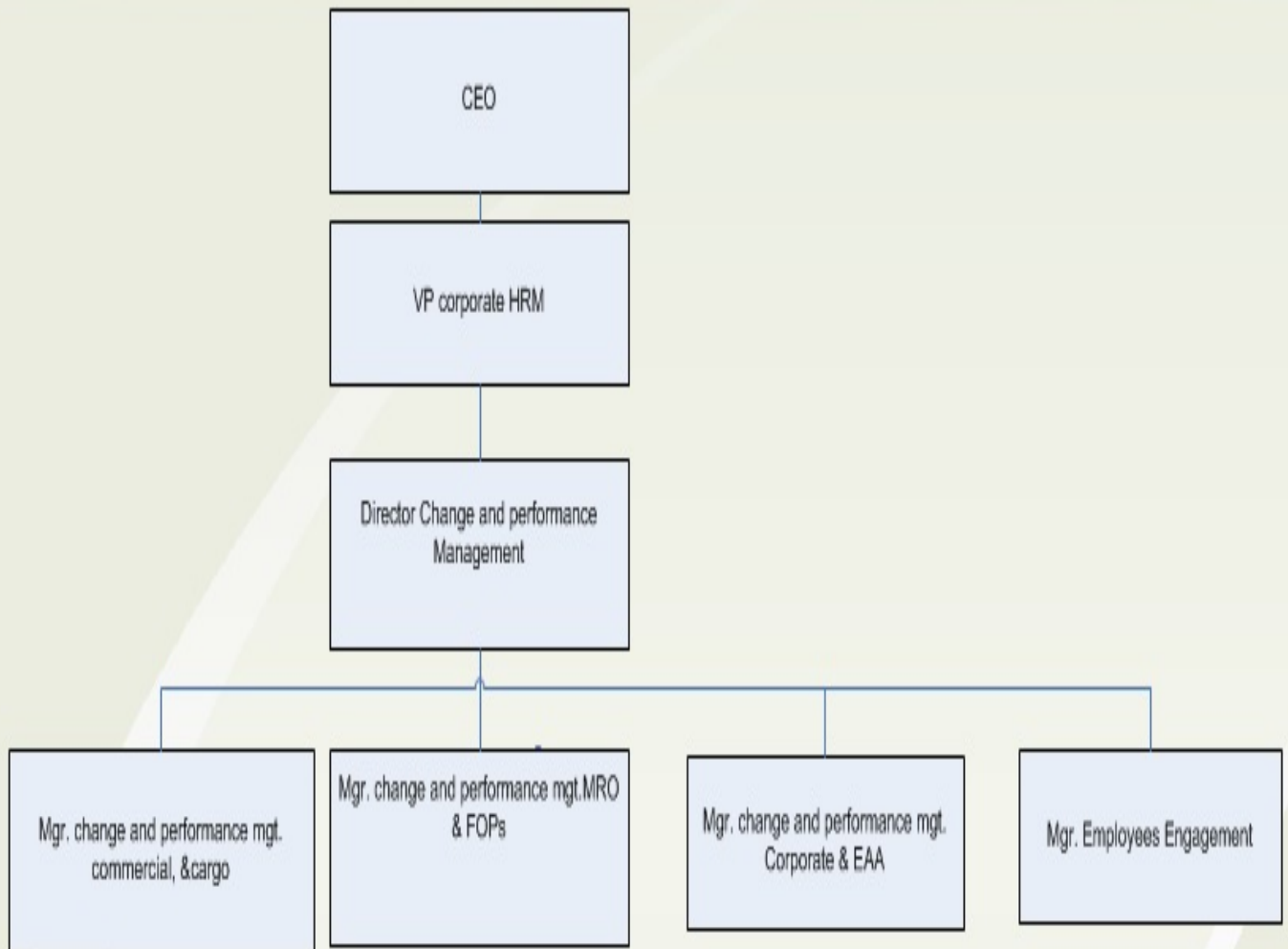
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Appendix 1: EAL ACE Management Structure

Change & performance Management structure



Appendix 2: ACE tools measurement per achievement level

ACE tools	Qualifying	Bronze	Silver
Process Management	<ul style="list-style-type: none"> -Key processes or parts families identified and prioritized. -Process Metrics defined, baselines and targets are set for all key processes with process owner 	<ul style="list-style-type: none"> - Map and document key process. -Complete improvements on processes selected at qualifying -Develop process improvement for silver level -Cross- functional process improvement opportunities identified and being worked with customers and suppliers. 	<ul style="list-style-type: none"> - Achieve business process improvement targets for all key processes. - Benchmarking exercise completed best in class practices identified and action plan to incorporate best practices is initiated. - Result demonstrated on cross functional process improvement
Passport Process	<ul style="list-style-type: none"> -Demonstrate use of passport process where applicable 	<ul style="list-style-type: none"> - Identify opportunities for use of passport concepts to key business decision making processes. 	<ul style="list-style-type: none"> - Demonstrate use of passport concept to key business decision making process.
Standard work	<ul style="list-style-type: none"> - Work instructions are available and up to date. - Waste elimination opportunity identified. - Standard work analysis initiated on the impact/maturity matrix. 	<ul style="list-style-type: none"> -Documentation of improved processes is up to date. - Validate the full implementation of waste elimination activities identified at qualification level. - Identify new waste elimination opportunities. 	<ul style="list-style-type: none"> - All key process are documented. - complete the waste elimination opportunities identified at Bronze level. -Identify, analyze and implement new opportunities of waste elimination.
5 S + 1	<ul style="list-style-type: none"> -Area defined and process for 5S+1 assessment and improvement implemented 	<ul style="list-style-type: none"> - Achieve significant improvement toward work place and work flow organization, visual control 	<ul style="list-style-type: none"> -Visual, efficient work place fully implemented and sustained.

	<ul style="list-style-type: none"> - Information on EH&S hazards is known and posted as well as the prevention and control methods for each work station. The evacuation plan are posted close to the main exit - Opportunities for improving work place organization, visual controls and EH & S should be identified. 	<p>and EH& S.</p> <ul style="list-style-type: none"> -Norms established & applied for folder organization and sort exercises applied to material, paper and electronic files. -Implementation of Kanban system for support products. 	<ul style="list-style-type: none"> - All EH & S hazards are controlled -Initiate new opportunity for improving workplace.
Total Productive Maintenance (TPM)	<ul style="list-style-type: none"> -Equipment assessment - Preventive maintenance schedule, develop method to collect and track down time history. - Equipment safeguarding evaluation according to safety norm. 	<ul style="list-style-type: none"> - Equipment Safeguarding has completed in accordance with equipment safety norm. 	<ul style="list-style-type: none"> -Maintaining Equipment safety per the company safety procedure.
Market Feedback Analysis (MFA)	<ul style="list-style-type: none"> -Customer identified and their expectation defined. - Method established to capture data 	<ul style="list-style-type: none"> - MFA methodology is in place for key processes, and is used to target improvement activities towards Silver. - Measurable improvements on key customer deliverables - Communicate the improvement opportunities identified by the customers of the cell at ACE meeting. 	<ul style="list-style-type: none"> - Improvement efforts continue to achieve customer satisfaction. (Score of 5.0 or higher). -Robust data-driven process for handling customer issues. - Every defective products returned must be accompanied by a customer feedback sheet.
Quality Clinic	<ul style="list-style-type: none"> -Data collection process is defined. 	<ul style="list-style-type: none"> - QCPC data collection activity is alive and well in 	<ul style="list-style-type: none"> - Attain turn backs resolution ratio of 80%.

Process Chart (QCPC)	- Selected process must include source of turn backs relating to EH&S	the cell.- Attain turn back resolution ratio of 50%Identify & resolve recurrent turn backs with RCCA & mistake proofing tools.	- Demonstrate level of maturity of quality clinic. - QCPC data collection activities sustained.
Root Cause Corrective Action (RCCA)	-Training on RCCA for at least 25% of cell employees.	-Action process is used to resolve complex and/or recurrent problems. -RCCA form completed or in progress. - The eight RCCA steps are registered in system for any returned order.	-Continue he uses of RCCA to attain business objectives. - Use of RCCA tool in all pertinent situations.
Mistake Proofing (MP)	-Training on MP for at least 25% of cell employees	- Demonstrate an adequate use of mistake proofing tools. -improving mistake proofing tools for recurrent turn backs	-Implement and document mistake proofing devices. - mistake proofing solutions are applied to recurrent turn backs and every escape of the cell and integrated to the customer feedback sheet.

Source- (ACE Hand book 2005)

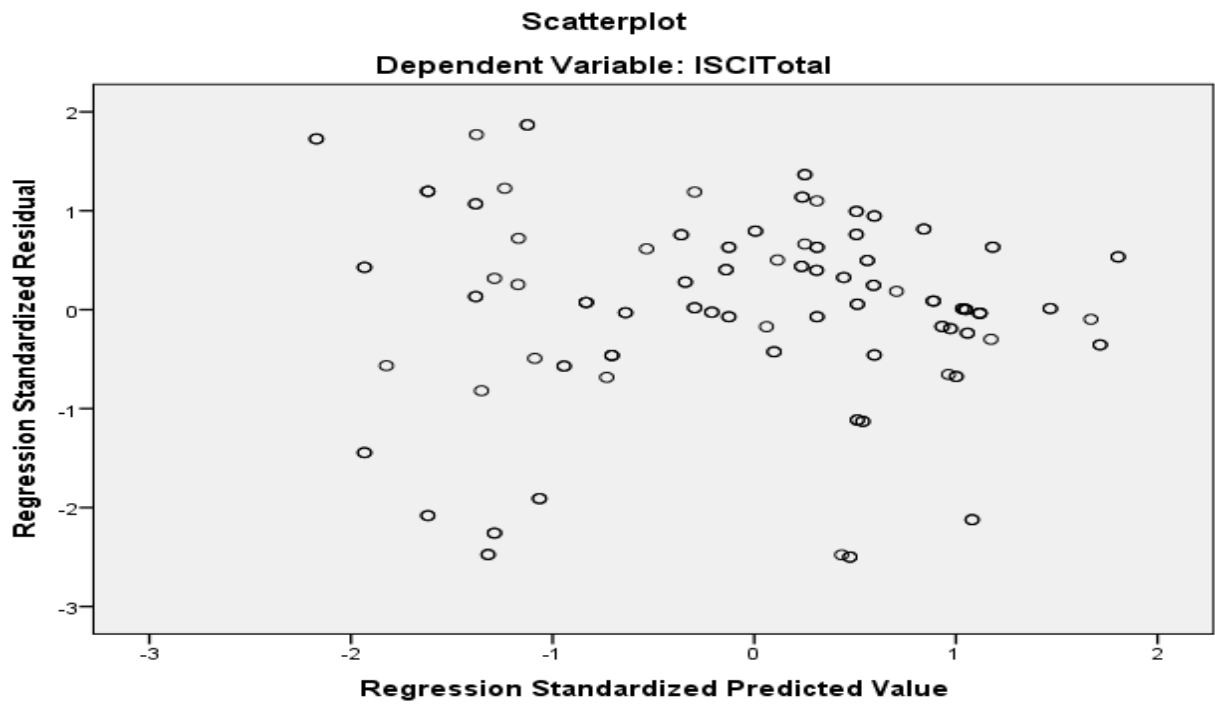
Appendix 3: reliability of the questionnaire dimensions

Dimension	Cronbach's Alpha	No. of Items
General ACE Implementation (ACEI)	.943	20
Process Management (PM)	.879	13
Total Productive Maintenance (TPM)	.885	6
5S+1 and Visual Control (SS)	.879	3
Market Feedback Analysis (MFA)	.903	3
Quality Clinic Process Chart (QCPC)	.933	3
Root Cause Corrective Action (RCCA)	.857	3
Mistake Proofing (MISPRO)	.838	2
Decision Making (DM)	.867	3
Internal Supply Chain Integration (ISCI)	.900	6

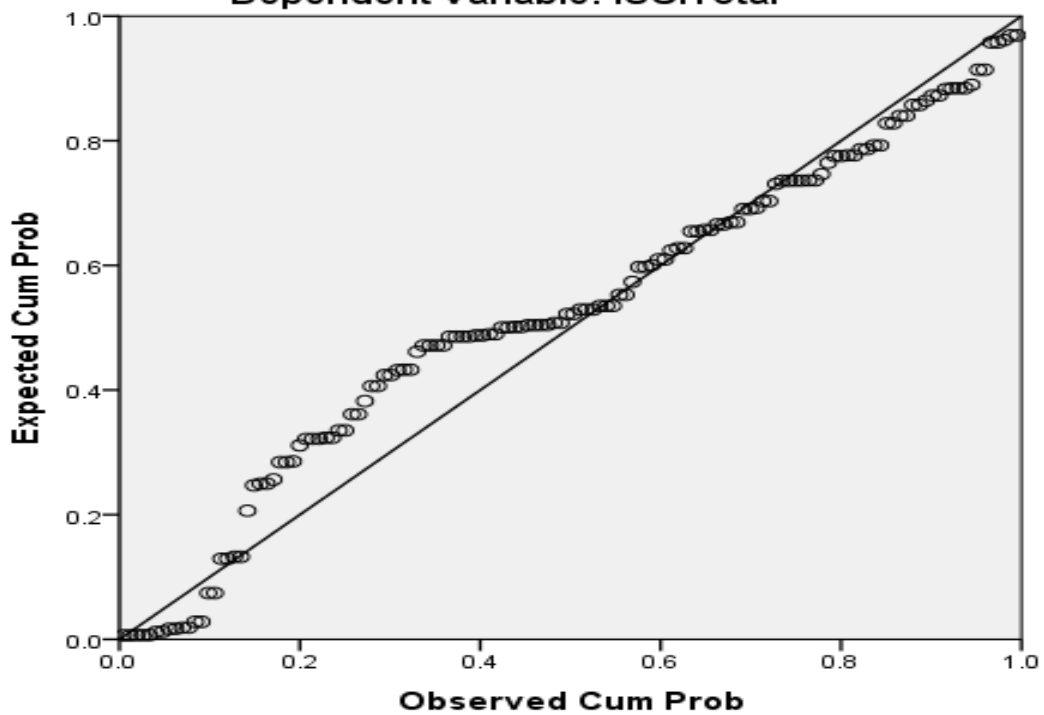
Appendix 4: Descriptive statistics on general ACE implementation practice in EAL

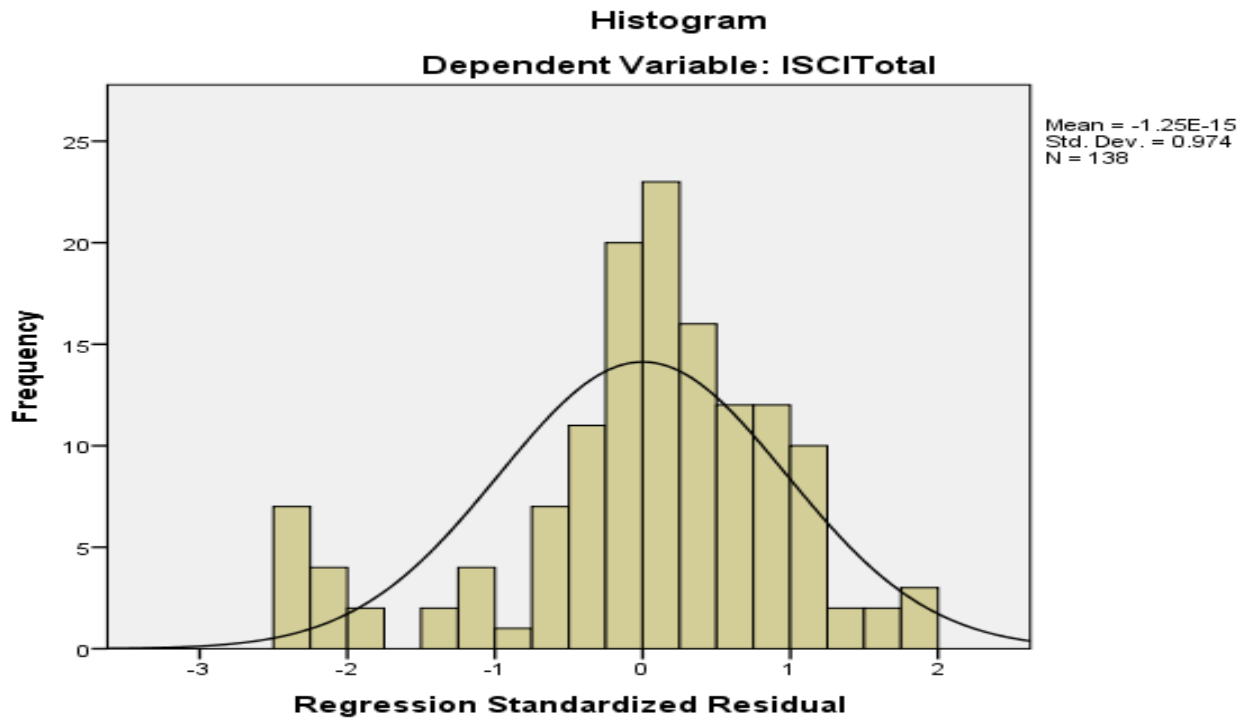
Descriptive Statistics			
	N	Mean	Std. Deviation
I1	138	3.8551	.86751
I2	138	3.6087	1.09033
I3	138	3.5870	1.02329
I4	138	3.5942	1.05773
I5	138	3.6377	1.07352
I6	138	3.2609	1.16082
I7	138	3.9058	.94280
I8	138	3.8406	.90615
I9	138	4.1957	.84455
I10	138	4.1594	.87334
I11	138	3.9348	.99051
I12	138	3.8188	.95318
I13	138	3.4855	1.04801
I14	138	3.7754	.93604
I15	138	3.6594	.94750
I16	138	3.7464	.82002
I17	138	3.6667	.98406
I18	138	3.6087	1.04940
I19	138	3.6449	1.00219
I20	138	3.6304	1.08120
Valid N (list wise)	138		

APPENDIX 5: Regression Model Test Result



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: ISCITotal





Appendix 6: Data Collection Instruments: Questionnaires

Addis Ababa University School of Commerce

Logistics and Supply Chain Management Unit

Survey Questionnaires on “*The Role of ACE Operating System Implementation on company’s Internal Supply Chain Integration*”

Dear Respondents,

This is a research on the topic “*The Role of ACE Operating System Implementation on company’s Internal Supply Chain Integration: Ethiopian Airlines in focus*”. The research is carried out in order to fulfill the requirement of Graduate Studies of Addis Ababa University for Master’s degree in Logistics and Supply Chain Integration. You have been selected as a respondent to this questionnaire because the researcher believes the information that you provide will be very useful in enabling the researcher to realize the objectives of the study. In answering the questions you may be requested to put tick (✓) mark inside the box that indicates your level of agreement for each statement regarding the roles of ACE operating system and internal supply chain integration.

I really appreciate the fact that you have taken to fill in this questionnaire. Thank you very much.

Objective

The objective of this questionnaire is to gather information from employees of EAL about the role of ACE Implementation on Company’s internal Supply chain integration.

The questioners have three parts. The first part general information about the respondent, the second part is about ACE implementation and ACE operating tools. The third part is about the relationship among departments in EAL and their Internal Supply Chain Integration.

In case if you have any inquiry, please contact on below

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Advisor Name: TarikuJebena(Phd)

Email: Tarikujebena@gmail.com

PART I- General Information

1. Age

- a) 18-25 b) 26-35 c) 36-45 d) Above 45

2. Sex

- a) Male b) Female

3. Educational level

- a) Up to grade 12 b) Certificate c) Diploma
 d) Degree e) > Degree

4. Years of service in Ethiopia Airlines:

- a) 1-5 b) 6-10 c) 11-15 d) above 16

5. Your Section ACE achievement level

- A. Qualifying B. Bronze C. Silver D. Gold

PART II, Technical questions: Please state your level of opinion for each given statement using the following scales:

1= strongly disagree 2=disagree 3= Neutral 4= Agree 5=strongly agree

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
A. Training, and general ACE implementation practice						
No	Criteria					
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	Employees became eager in learning new skills.					
9	All employees in your cell are assigned in ACE tools					
10	ACE changes your working culture and environment					
11	ACE is implemented in Ethiopian Airlines as an operating					

	system					
12	Teams celebrate your ACE cell achievements and expected success					
13	Human talents are fully used					
14	Costs are reduced to produce products, in comparing to previous cost and sales are increased.					
15	The company has made the key mind-shift from quality defect detection to active prevention.					
16	The defect rate has been reduced.					
17	Employees are now responsible for inspecting their own work and know exactly the standards they have to meet.					
18	Employee use ACE tools to solve any operational problem					
19	Efficient utilization of resources improved:- it is possible to produce services/products by using less inputs than before.					
20	Cells sustained in all ACE tools implementation as an operating system.					

B, ACE Tools

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
No	Process Management (PM)	1	2	3	4	5
1	All tools in process management elimination have addressed in your cells properly.					
2	Key processes identified and prioritized.					
3	Every process in your cells have been mapped properly					
4	Every process have reached matured level					
5	Cross functional meeting held appropriately to interface process between inter departmental/Cells					
6	Cells improve their process by benchmarking other internal departments					
7	Your section process interface with other department					
8	Your Cells 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	Inventory and work in progress for almost everything is the lowest in EAL					
13	Unnecessary motions are reduced					
B. Total Preventive Maintenance (TPM)						

14	Equipment Safeguarding has completed in accordance with equipment safety norm					
15	Your section Equipment Safety is controlled and maintained per their schedule.					
16	Your working environment is safe for your daily operation					
17	Change in technical efficiency: In EAL there is improvement in utilization of EAL equipment, tools etc.					
18	Equipment breakdown are virtually eliminated.					
19	Decrease number of accidents, injuries.					
C. 5 S +1 visual control (SS)						
20	Your ACE cell have visually, efficient work place and fully implemented					
21	5 S + 1 Audit executed monthly					
22	For all 5 S + 1 Audit turn backs corrective actions taken accordingly.					
23	Your cell's/department's internal supply chain function are located together to supply each other					
D. Market Feedback Analysis (MFA)						
24	Your sections improvement efforts continue to achieve customer satisfaction					
25	Customers are satisfied with your section's service/products					
26	Spend time discussing future customer needs.					
E. Quality Clinic Process (QCPC)						
27	Data collection activity is alive					
28	Attain turn back resolution ratio of 80%					
29	Demonstrate level of maturity of quality clinic					
F. Root Cause Corrective Action (RCCA)						
30	Recurrent problems/turn backs resolved using RCCA					
31	Solution's provided by RCCA is pertinent enough and last long					
32	The 8 RCCA steps are registered in system for any returned order.					
G. Mistake Proofing (MISPRO)						
33	Mistake proofing solutions are applied to recurrent turn backs					
34	Your cell implement and document mistake proofing devices					
H. Decision Making tools (DM)						
35	Your ACE cell use passport concept to key business decision making process properly					
36	Problems that needs management involvement escalate on time for higher management decisions					
37	Management staffs give high emphasize for effective ACE implementation.					

Part III- Your Company Internal Supply Chain Integration Practices

To what extent does Ethiopian Airlines use the following integration practice?

No	Dimensions of Internal Integration	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
1	Ethiopian Airlines has data integration among internal function					
2	Different departments in Ethiopian Airlines have effective data integration in among themselves.					
3	Integrative inventory management					
4	Real-time integration and connection among all internal functions from raw material management through production, shipping and sales					
5	The use of periodic interdepartmental meeting among internal functions					
6	The uses of cross functional teams for product design					

If you have any additional comments on ACE, please state on the space provided below.

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If you have any additional comments on internal supply chain integration, please state on the space provided below.

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Appendix 7. In-Depth Interview Questions

Interview questions for Change management Team and sample Change Agents.

1. Why do you think EAL prefer ACE from other known operating system like Kaizen, Six Sigma, etc.....?
2. Do you think ACE brought change in EAL? Is there structural change? What are some other changes?
3. What are the major challenges you faced in implementing ACE in EAL?
4. Do you think the challenges can be solved? If so how and what are the possible solutions to solve the problems?
5. How do rate ACE is implementation as it is designed by UTC?
6. Do you think ACE implementation improve the performance of the EAL in terms of quality, speed, and work flow process?
7. What are the best practices of EAL ACE implementation?
8. Do you think ACE can bring about a change in public institutions in General? If yes, how? If not why not?
9. Do you think ACE can influence on EAL's internal SCI and to what extent?
10. How do you rate EAL's internal SCI before and after ACE implementation?