

**ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE
DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN
MANAGEMENT**



**The Role of Maintenance Repair Overhaul Supply Chain Management in an
operational and organizational performance:
The case of Ethiopian Airlines**

A thesis submitted to the graduate school of Addis Ababa University School of Commerce in partial fulfillment of the requirements for the masters of Logistics and supply chain management program

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DECLARATION

I, the undersigned, declare that, this study “**The Role of Maintenance repair overhaul Supply Chain Management in an operational and organizational Performance**”: (In the case of **Ethiopian airlines**) 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 ACRONYMS

MRO: - Maintenance Repair Overhaul

M & E: - Maintenance and Engineering

SCM: - Supply Chain Management

AOG: - Aircraft on Ground

EAL: - Ethiopian Air lines

SSP: - Strategic supplier partnership

LIQ: - Level of information quality

ILP: - Internal lean practice

MRSCM:-Maintenance repair overhaul relation with Supply chain management

LIS: - Level information sharing

OPP: - Operational performance

DDY: - Delivery dependability

TTM: - Time to market

ORP: - Organizational performance

TAT: - Turn around time

Abstract

Title: *The Role of Maintenance Repair Overhaul Supply Chain Management in an operational and organization performance: The case of Ethiopian Airlines.*

The aim of Supply chain management is to improve the overall organization performance and customer satisfaction by improving product or service delivery to consumer.

The specific objectives were to: establish the role of Strategic supplier partnership, the role of supply chain management Department in Maintenance repair overhaul , the role of Internal lean practice and role of level of information sharing & quality base on the operational and organizational performance of Ethiopian Airlines: A descriptive case study design was used. Statistical analysis was carried out using SPSS.

The purpose of this study is to identify relationship between the supply chain management practices with operational and organizational performance in an Ethiopian airline. The supply chain management practices are include Strategic supplier partnership, Levels of Information Sharing, Levels of Information Quality, Maintenance department integration and Internal lean practice required to the organizational performance, while the operational performance is one of the dependent variable associated with the supply chain management practice that affect the company performance. This study uses strains of supply management practices with reduced the company cost. Also the practices from that cross are then analyzed. The results of this analysis can be used to find which supply chain management practices correlate with specific properties like quality, price, delivery dependability, product time to market and overall the company performance.

Keywords: *Operational & Organizational Performance, Strategic supplier partnership, supply chain management practices.*

Chapter One

Introduction

1.1 Back ground of the study

A supply chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to customer. The activities involve the transformation of natural resources, raw materials, and components into a finished product that is delivered to the end customer. (Wikipedia,). And, supply chain management should address issues challenge must be succeeding by aviation industry in order to, optimize delivery performance while minimizing cost. Combined with this, supply chains need to respond to unplanned events while managing the increasingly complex obligations of the airline industry. Advancing aviation 2013 global MRO supply chain benchmarking study (www.pwc.com/us/airlines) recognized that while supply performance in other industries has had considerable focus on benchmarks for aviation service organizations, they didn't meet their expectations as they are less developed. And these in part reasons have their unique characteristics. Also Airline assets are moving, creating a unique service supply chain environment and much of the inventory value is in routable parts (units can be repair again & install it on aircrafts) as a large amount of unique part numbers, most of which have little to no usage.

The other MRO supply chain performance focuses on inventory part turnovers and supplier delivery performance do not consider its role on service levels to maintenance and engineering (M & E) and overall airline departure reliability. Serving as the aviation industries first comprehensive benchmarking study of its kind, this study measures MRO supply chain service levels to achieve airline departure reliability. This not only helps to understand performance levels but, it is also designed to identify the contributing factors that impact performance. In the Airlines industry, companies are increasing their focus on their supply chains to lower related maintenance costs while delivering higher service levels. In particular, MRO practitioners should look for better understanding related to performance gap that exists within their supply chains, and the opportunities that may results from improving their effectiveness. A practice assessment can provide better clarity regarding the maturity of current Ethiopian airlines supply chain practice and their correlation to performance. It is important to consider the gap of these operational results as a function of supply chain in organizational performance.

1.2 Statement of the problem

Aviation on time dispatch reliability increases based on aircraft part inventory, coordination & the integration of supply chain with other sections (sections like: line maintenance, base maintenance & component repair shops). Advancing aviation 2013 Global MRO supply chain benchmarking study, states that airline companies are increasing their focus on their supply chains to lower related maintenance costs while delivering higher service levels. Ethiopian airlines engaged in transportation of passengers and moving of cargo from place to place all over the world. In aviation industry customer satisfaction is a major performance measurement tool for the airlines. While minimizing costs, Procurement and Supply Chain Management department along with the maintenance divisions (MRO), plays a major role to keep the aircrafts on the sky, smoothly support the operation and the overhaul airline departure reliability. Poor performance of aircraft parts supply, inventory turns on routable parts & supplier delivery performance has a huge effect on the operational performance of the airlines. Furthermore, unavailability of a single item or component can cause grounding of an aircraft (AOG) which in turn leads the company to incur high purchase cost to get this part on rush/immediate base, to reschedule the flight & ultimately customer dissatisfaction and bitter complaints which finally will turn out to bankruptcy. Over the years, the supply chain function has remained passive in regard to the acquisition of high value goods & service with coordination & collaboration from source up to end of customers. This also, attributes a lot for extended lead time and high costs for purchasing of goods (Different supply chain airline articles). This continuing problem has caused a decline of supply chain performance of enormous company's. So, this study aimed at examining this phenomenon & establishes the role of supply chain management practice on airline maintenance repair overhaul in operational and organizational performance of Ethiopian airlines.

1.3 Research Questions

1. How does supply chain management practices influence the MRO (as one of revenue generation divisions in EAL) performance of Ethiopian airlines operations?
2. What are the current supply chain management practices in MRO of Ethiopian Airlines?
3. Is Level of information sharing (IS) and other variables that affect MRO supply chain performance on Ethiopian Airlines?

1.4 Objectives of the study

General Objective

The general objective of this study is to assess the opportunities and challenges of MRO supply chain management practice on performance in Ethiopian Airlines

The specific objectives

1. To determine how far supply chain management practice will have an effect on the MRO performance of Ethiopian airlines.
2. To determine the current supply chain management practices so as to improve the performance of MRO in Ethiopian airlines.
3. To determine the specific effect of supply chain management practice on operational performance of MRO in Ethiopian airlines.

1.5 Significance of the Study

1. The finding of the study will specifically help Ethiopian airlines to revisit their supply chain activity in MRO if they are to improve it.
2. The study will also act as a basis for further research to other researchers in field of supply chain in MRO area.

1.6. Delimitation and scope of the study

Ethiopian Airlines undertakes supply chain under two independent sections namely aircraft related (MRO) and non-aircraft related supply chain. Due to time constraint and present researcher work experience this study will focus on aircraft (MRO) related supply chain and excludes supply chain related with non –aircraft related.

1.7. Scope of the study

The proportion of the research will cover the conceptual scope, location scope and the time scope.

Geographical scope: The research will be carried out in Ethiopian airlines specifically at MRO procurement and supply chain division.

Time scope: Main study is to be covered a period of five months which is from January, 2017 to May, 2017.

1.8. Organization of the study

Generally the paper is organized into five chapters. The first chapter presents background which continued statement of the problem and continued with the research questions, objective of the study, significance of the study, scope of the study and organization of the paper. The second chapter deals with the literature review which shows a review of related topics for the research and conceptual framework of the study with operational definition. The third chapter is research methodology which includes; research design, source population, study population, sample design, data collection instrument and administration, data management, data processing procedures and ethical consideration. The fourth chapter handles data analysis, result and discussion. The fifth chapter wind ups the paper by summarizing the major findings, giving conclusion and recommendations, by listing limitation of the study and by giving suggestion for further study.

Chapter Two

Review of related Literature

2.1 Defining General supply chains

The blind men and the elephant: The realities addressed by supply chains reflect phenomena arising from the changing nature of the international economy during the latter half of the 20th century. As such, the same phenomenon is documented and researched from multiple fields, resulting in a Plethora of terms fundamentally pointing to the same reality. However, these terms embody perspectives from their respective fields to characterize this new reality. We review a sample of the most common terms encountered when discussing this phenomenon. The list is by no means exhaustive, but should provide cursory overviews for the majority of terms encountered in the literature. They include supply chains, value chains, filière, global commodity chains, and global production networks.

Supply chains: Supply chains emerged when issues related to materials flow were first introduced. Since the 1990s, however, the term showed an exponential rise in popularity, along with its corresponding concept of supply chain management, introduced by consultants in the 1980s (Arshinder and Deshmukh 2008; Chen and Paulraj 2004). Among its many origins, Chen and Paulraj (2004) point to five, in particular, when explaining this trend:

- (1) The quality revolution;
- (2) Notions of materials management and integrated logistics;
- (3) A growing interest in industrial markets and networks;
- (4) The notion of increased focus; and
- (5) Influential industry-specific studies.

The term “supply chain”, in contrast to “value chain”, has remained a relatively unified term in use with few nomenclatural variations. However, it has been confusingly associated with multiple definitions in its usage. Common among these definitions is the existence of an input-output structure covering a range of value-adding activities (Gereffi et al. 2001). The use of the term “supply” also carries a more specific denotation than “value”, and Sturgeon (2001) thus suggests that supply chains be confined to the set of activities that are driven by a lead firm (or firms), while value chain refers to a greater set of activities.

Value chains: The concept of the value chain provides a key starting point in understanding the dynamics of industrial organization, international trade, and regional development. Use of the term “value chains” has been documented as far back as the 1960s in the context of development paths for mineral-exporting economies. In the 1980s, however, the term rose to popularity, particularly in the business literature, due to the works of Michael Porter (1980, 1985, and 1990). Porter proposed two elements now found in modern value chain analysis: the value chain and the value stream. The value chain referred to the intra-firm activities involved in transforming inputs into outputs, and included not only the physical transformation processes, but also the support functions involved. These include research and development, procurement, human resources management, and many of the tasks that may now be regarded as higher value adding activities. His value system resembles the modern value chain in extending the framework of activities to inter-firm linkages (Kaplinsky and Morris 2002; Gereffi et al. 2001; Hess and Yeung 2006). While these conceptualisations provide limited utility in the analysis of socioeconomic dynamics and development, they provided many of the theoretical foundations for the value chain today (Henderson et al. 2002). The concept also translated into economic geography, beginning with the works of Peter Dicken (1986), who integrated value chains into a territorial context, and was followed by a large body of works on transnational corporations and regional development (Hess and Yeung 2006). Furthering the concept was popular work by Womack and Jones (1996) on the value streams in the context of lean production. The proposed value streams were equivalent to the modern value chain, and added yet another term to the increasingly confusing nomenclature on value chains. Global commodity chains add yet another contributing “chain” based concept, which in turn was built from the legacy of world-systems theory. Many of these multiple concepts, terms, and their respective practitioners came together at a conference in 2000 in Bellagio, Italy to communicate and unify their research under the value chain umbrella (Bair 2005). Since then, the value chain field has seen significant advancement from the works of Gary Gereffi, Timothy Sturgeon, Raphael Kaplinsky, John Humphrey, and Hubert Schmitz in the areas of industrial organization and economic sociology (Kaplinsky 2000, 2004). With the consolidation of value chain efforts, the definition of value chains found in the literature has been very consistent over the past decade. A value chain is defined as the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky and

Morris 2002; Gereffi et al. 2001; Kaplinsky 2000, 2004). Furthermore, when these value chains span enterprises in more than one country, they are termed “global value chains” (Kaplinsky 2000).

Global production networks: Henderson et al. (2002) define global production networks as “the globally organized nexus of interconnected functions and operations by firms and non-firm institutions through which goods and services are produced and distributed”. The concept has many predecessors, ranging from value chains, supply chains, global commodity chains, clusters, and actor-network theory. The most recent and relevant of these is Gereffi’s concept of the global commodity chain. The “Manchester School” of researchers, including Neil Coe, Peter Dicken, Jeffrey Henderson, Martin Hess, Khalid Nadvi, and Henry Wai-chungYeung, among others, have done much work to advance the concept. Together, they have expanded upon the global commodity chain framework by moving beyond a governance focus and by altering the nomenclature of the “commodity chain” to the “production network”, to be more inclusive. Also significant is the work by Dieter Ernst done on global production networks, developed simultaneously but independently. Ernst conceptualised GPNs as an organizational innovation that “combine(s) concentrated dispersion of the value chain across firm and national boundaries, with a parallel process of integration of hierarchical layers of network participants” (Ernst and Kim 2001:1).

Global commodity chains: Global commodity chains (GCCs) are defined as “sets of inter-organizational networks clustered around one commodity or product, linking households, enterprises, and states to one another within the world-economy. These networks are situationally specific, socially constructed and locally integrated, underscoring the socialembeddedness of economic organization” (Henderson et al. 2002; Gereffi 1994). GCCs are distinct from the early value chain concept in their explicit international dimension and focus on governance structure within the chain. Governance in GCCs is characterized as either producer-driven or buyer-driven, and acknowledges the significant influence that lead firms exert on the structure and operations of the rest of the chain (Gereffi et al. 2001; Kaplinsky and Morris 2002). The GCC concept was developed in the mid-1990s by Gary Gereffi and Miguel Korzeniewicz, along with Dieter Ernst, John Humphrey, and Hubert Schmitz, among others. The concept was heavily influenced by Wallerstein’s world-system framework and the structuralist and dependency paradigms of the 1970s and 1980s. GCCs are an attempt to render these paradigms operational in order to understand modern forms of industrial organization. In taking a global network approach, GCCs include a comprehensive range of organisations and elements significant to economic and social development. By rising above state-

centric analysis to recognize the significance of inter firm networks and corporate power, GCCs have enabled analysis that reveals previously unrecognized restrictions on firm development and, by correlation, economic and social development. The studies have provided insights into a wide range of issues, including upgrading, market expansion, and trade patterns, as well as industries, such as footwear, garments, electronics, horticulture, and tourism. Furthermore, the analysis produces prescriptive results that hold value for policy formulation (Henderson et al. 2002; Hess and Yeung 2006; Gereffi, Humphrey, and Sturgeon 2005). The GCC concept does encounter some criticism, particularly from global production network research, which attempts to build on the GCC concept. First is the high level of aggregation found in GCCs, both in geography, which is split between core and periphery, and governance, which is split into buyer-driven and producer-driven chains. In addition, the latter split is acknowledged to be representative of some empirical realities, but is not necessarily universally applicable. Secondly, the emphasis on the role of inter-firm governance is seen to come at the expense of overlooking the significance of institutions and other external governance factors in GCCs. Thirdly, GCCs do not take into account path dependencies and firm ownership in their analysis. Finally, the perspective carried forth in GCCs attribute firm trajectories largely as a result of the exogenous network environment, and gives little credit to independent, endogenous firm efforts (Hess and Yeung 2006; Henderson et al. 2002).

Filière: Filière, meaning “thread” in French, is a concept very similar to value chains that originates from the French literature. The concept analyses production as the flow of goods and services across a system of agents (Kaplinsky and Morris 2002; Henderson et al. 2002). The concept was first developed by French scholars in the 1960s and 1970s to understand the economic processes within production and distribution, and to map commodity flows across agents and activities. Early studies focused on the structure of French agriculture, and were applied to agricultural policy and then industrial policy in the 1980s. More recent work integrates an element of political economy in its considerations of public institutions. (Kaplinsky and Morris 2002; Gereffi et al. 2001).

Kaplinsky and Morris (2002) and Henderson et al. (2002) identify some differences in the filière concept, in that the time and international dimensions are lacking, being focused on static domestic scenarios, with its emphasis on the role of large firms and state institutions (if this infers a critique based on the lack of SME coverage, much the same could be said about SCM, too).

The firm perspective: Among the many descriptions referring to the interconnected nature of firms today, we choose to proceed with “supply chains” for two reasons: (1) it best represents the firm’s perspective in the complex system dynamics of the international economy, and (2) it is the term of choice for the majority of business-relevant research, such as management science and operations research. In their seminal paper, Mentzer et al. (2001) merges preceding definitions of a supply chain to produce the following: “a supply chain is defined as a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.” For the purposes of this chapter, this is also the definition we adopt moving forward.

Conceptualizing supply chains: In studying the supply chain, one constantly encounters the methodological challenge of defining boundaries among the many interconnections of a network. Mentzer’s definition is purposefully open-ended in allowing as many actors as may exist in between the focal firm and the ultimate source/consumer. Whereas early conceptions of the supply chain focused on the flow of goods from supplier to manufacturer, distributor, and end user, supply chains are now recognized as covering the dirt to dirt source of earliest supply to end consumption (Cooper, Lambert, and Pagh 1997). Furthermore, Mentzer et al. (2001) point out that “any one organization can be part of numerous supply chains. Wal-Mart, for example, can be part of the supply chain for candy, for clothing, for hardware, and for many other products. This multiple supply chain phenomenon begins to explain the network nature that many supply chains possess. For example, AT&T might find Motorola to be a customer in one supply chain, a partner in another, a supplier in a third, and a competitor in still a fourth supply chain.” In order to handle such complexities, some basic typologies of supply chains have been proposed. These typologies classify supply chains according to either organizational or functional scope. The organizational scope of supply chains begins by classifying according to degrees of separation from the focal firm (Figure 2.1). A “direct supply chain” encapsulates the focal firm and its immediate suppliers and customers. An “ultimate supply chain” includes all the organizations involved upstream and downstream relative to the focal firm until the ultimate supplier(s) and ultimate consumer(s) is reached. Anything in between the direct supply chain and ultimate supply chain in scope can be referred to as an “extended supply chain” (Mentzer et al. 2001).

Figure 2.1. Classify of the organizational scope of supply chains

FIGURE 1a - DIRECT SUPPLY CHAIN



FIGURE 1b - EXTENDED SUPPLY CHAIN

Suppliers supplier ----Supplier---- organization--- customer----customer's customer

FIGURE 1c - ULTIMATE SUPPLY CHAIN

Third party logistics supplier

Ultimate supplier ---supplier--- organization—customer----ultimate customer

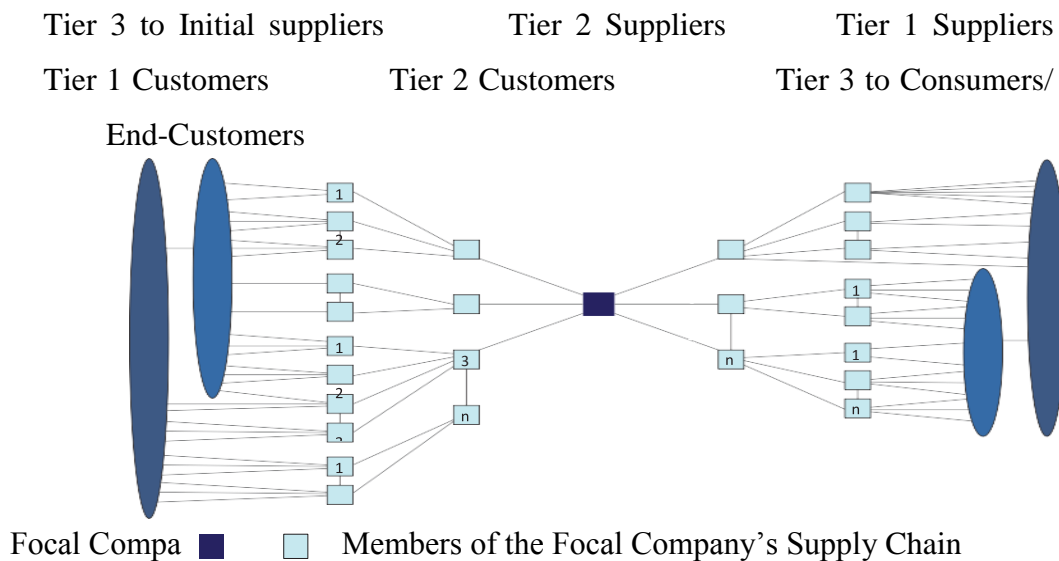
Financial provider

Market research firm

Source: Mentzer et al. (2001)

The nature of the organization is also classified as either primary or supporting. Primary organizations directly add value to the specific output to be consumed. Supporting organizations add value indirectly by supporting the primary organizations. In addition, organizations can be grouped according to the number of degrees of separation from the focal firm, such as the “Tier 1” and “Tier 2”

Figure 2.2: Organizational tiers based on degrees of separation in the supply chain



The number of tiers describes the horizontal structure of the supply chain, which may be long or short. The vertical structure of the supply chain refers to the number of organizations within each tier. These allow some orientation of the organization within the supply chain, such as in describing the

horizontal position of the focal firm relative to the ultimate supplier or customer (Lambert and Cooper 2000). The supply chain also has a functional scope. This covers the business processes that span the supply chain, and can cover functions as varied as marketing, product development, customer service and operations (Arshinder and Deshmukh 2008; Cooper, Lambert, and Pagh 1997). Whereas no standard template of business functions is found, the processes undertaken can be classified as one of four types: a managed process link, a monitored process link, a not-managed process link, or a non-member process link.

A managed link is critical to the focal firm, whereas a monitored link may only require auditing or little intervention. Not-managed links are not critical enough to require attention and/or are trusted by the focal firm to independently deliver. Finally, non-member process links are with organizations in other supply chains that still influence the performance of the supply in question, such as when a supplier works with the focal firm's competitor (Lambert and Cooper 2000).

2.2 Supply chain management

Birth of the idea: The origins of supply chain management are not exactly known, but there is general reference to its introduction by consultants in the early 1980s. In the decades since, it has received considerable attention, initially starting within the business community. From the early 1990s, academic research started following supply chains and tried to establish some theoretical structure (Cooper, Lambert, and Pagh 1997; Lambert and Cooper 2000; Croom, Romano, and Giannakis 2000). SCM's antecedents Part of the reason the start of supply chain management is difficult to pin down is because of its many antecedents. These include channels research in the 1960s on managing inter-organizational operations, systems integration research in the 1960s, and information sharing in the 1980s. Forrester is commonly cited for introducing key ideas on industrial dynamics, physical distribution, and transportation in the late 1950s and early 1960s (Mentzer et al. 2001; Croom, Romano, and Giannakis 2000; Cooper, Lambert, and Pagh 1997). In fact, Mentzer et al. (2001) start their paper with the following citation from 1958 that very much foreshadows supply chain management today: "Management is on the verge of a major breakthrough in understanding how industrial company success depends on the interactions between the flows of information, materials, money, manpower, and capital equipment. The way these five flow systems interlock to amplify one another and to cause change and fluctuation will form the basis for anticipating the effects of decisions, policies, organizational forms, and investment choices." (Forrester 1958, p. 37).

Drivers: This variety of antecedents and approaches is not surprising, however, as the 1960s and onwards witnessed significant shifts in industrial organization in the international economy. Many fields were documenting the phenomenon that we now refer to as supply chains. Before examining the variety of fields, however, we look at the drivers of this structural shift. The introduction of Manufacturing Resource Planning in the 1970s drove a transition from the economies of scale and mass production philosophy to the superior just-in-time (JIT) and flexible specialization production philosophy. JIT is a demanding philosophy to implement, however, with rigorous requirements on speed, minimal inventory, and consistency. Furthermore, international labor arbitrage through global sourcing enabled lower costs but introduced firms to a new world of operational challenges. Faced with the challenge of coordinating an increasingly complex influx and outflow of materials, firms began to realize the importance of buyer-supplier relationships. Concurrently, intense global competition in the 1980s expanded the new competitive requirements in cost to time and quality, as well. This necessitated improved downstream coordination with suppliers and distributors, and spurred research efforts in integrated transportation and logistics management. Combined, these factors gave rise to the popularity of supply chain management and its establishment as an academic discipline (Mentzer et al.2001; Tan 2001).

Plurality of disciplines and terms: Efforts to research the rising supply chain phenomenon came from a plethora of firm- oriented disciplines. In an effort to categorise these, we distinguish between function- oriented and organization-oriented disciplines. Amongst the function-oriented disciplines are purchasing and supply literature, logistics and transportation, and marketing. In the organization-oriented disciplines, we find industrial organization, transaction cost economics, institutional sociology, and systems dynamics, among others (Croom, Romano, and Giannakis 2000; Tan 2001; Melo, Nickel, and Saldanha-da-Gama 2009).

As a result, a wide variety of terms relating to the supply chain concept have also arisen over the past few decades. These include network sourcing, supply pipeline management, demand chain management, value chain management, and value stream management. They can be found in discussions amongst academics, consultants, or business management. (Croom, Romano, and Giannakis 2000). Of these, the purchasing/supply and logistics/transportation literature were the most prevalent with business, and out of the many terms, supply chain management rose in recognition

Consolidation: The rise of supply chain management by the late 1980s and its embodiment of so many concepts resulted in a problem of definitions in the 1990s. Literature from this period laments that the term is used so often that the meaning is lost (Tan et al. 1998a; New 1997; La Londe and Masters 1994; Tan 2001; Davis 1993; Ross 1998; Mentzer et al. 2001). Moreover, SCM was only increasing as a concept of real relevance and as a popular topic (Cooper, Lambert, and Pagh 1997; LaLonde 1997; Mentzer et al. 2001). The late 1990s gave rise to the recognition that clear definitions and conceptual frameworks on SCM were needed (Saunders 1995, 1998; New 1995; Cooper, Lambert, and Pagh 1997; Babbar and Prasad 1998; Croom, Romano, and Giannakis 2000). This period saw much consolidation and maturation of SCM as a theoretical construct. For example, whereas the Council of Logistics Management viewed SCM as a type of inter-firm logistics in 1986, they revised their definition in 1998 to declare logistics management as a subset of SCM. Other fields, such as operations research, may have started their investigations of the supply chain phenomenon independently, but then merged their efforts into SCM afterwards (Lambert and Cooper 2000; Melo, Nickel, and Saldanha-da-Gama 2009). This consolidation culminated by the late 1990s and early 2000s with the seminal works of Cooper, Lambert, Mentzer, and their associates (Cooper, Lambert, and Pagh 1997; Lambert, Cooper, and Pagh 1998; Lambert and Cooper 2000; Mentzer et al. 2001).

The supply chain management framework: SCM as a management framework is now at a stage where the definitions, subject, purpose, and perspective are largely unified. These common grounds emerged from the multidisciplinary sources of SCM, and researchers have leveraged these commonalities to consolidate the plurality of frameworks on SCM. However, there is still variance when it comes to the operational concepts and, correspondingly, the operational implementation of SCM. We review some of the most widely cited unifying frameworks of SCM. Stadtler (2005) and Mentzer et al. (2001) both present definitions of SCM that integrate the many found in their respective literature reviews: “Supply chain management (SCM) is the task of integrating organizational units along a SC and coordinating materials, information and financial flows in order to fulfill (ultimate) customer demands with the aim of improving competitiveness of the SC as a whole.” (Stadtler 2005). “...supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.”

(Mentzer et al. 2001). These definitions and their predecessors view the target subject of SCM as the supply chain, consisting of two subcomponents: (1) the organizations that make up the structure of the supply chain, and (2) the processes that make up the flows across the supply chain. The purpose of SCM is to increase competitiveness of the supply chain through improved customer service. The perspective is unequivocally network-based, attaching significance not only to the firm's "nodes" that compose sectors of the international economy, but also to the relationships between those nodes. As Burgess, Singh and Koroglu (2006) note, the operational concepts in SCM tend to be classified into general categories or constructs

Figure 2.3. Strategic Sourcing/Procurement

Source: Integrated MRO Supply Management - Genesis Solutions (By Thomas Terfehr)

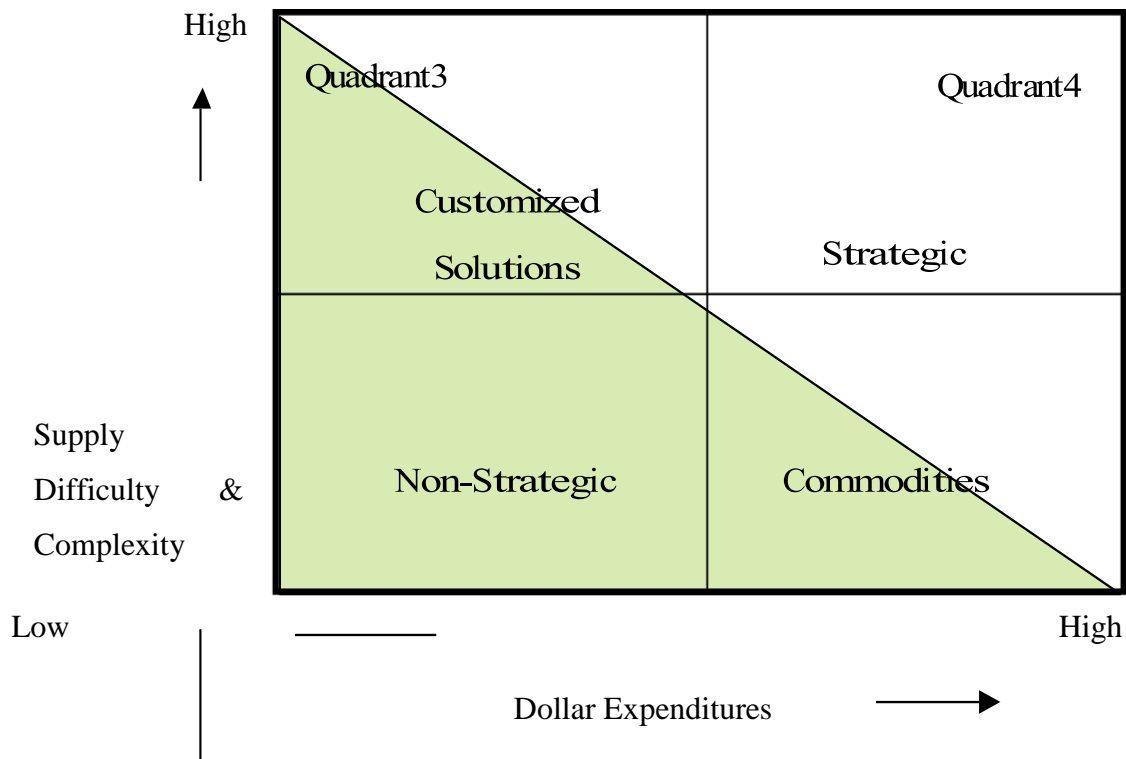
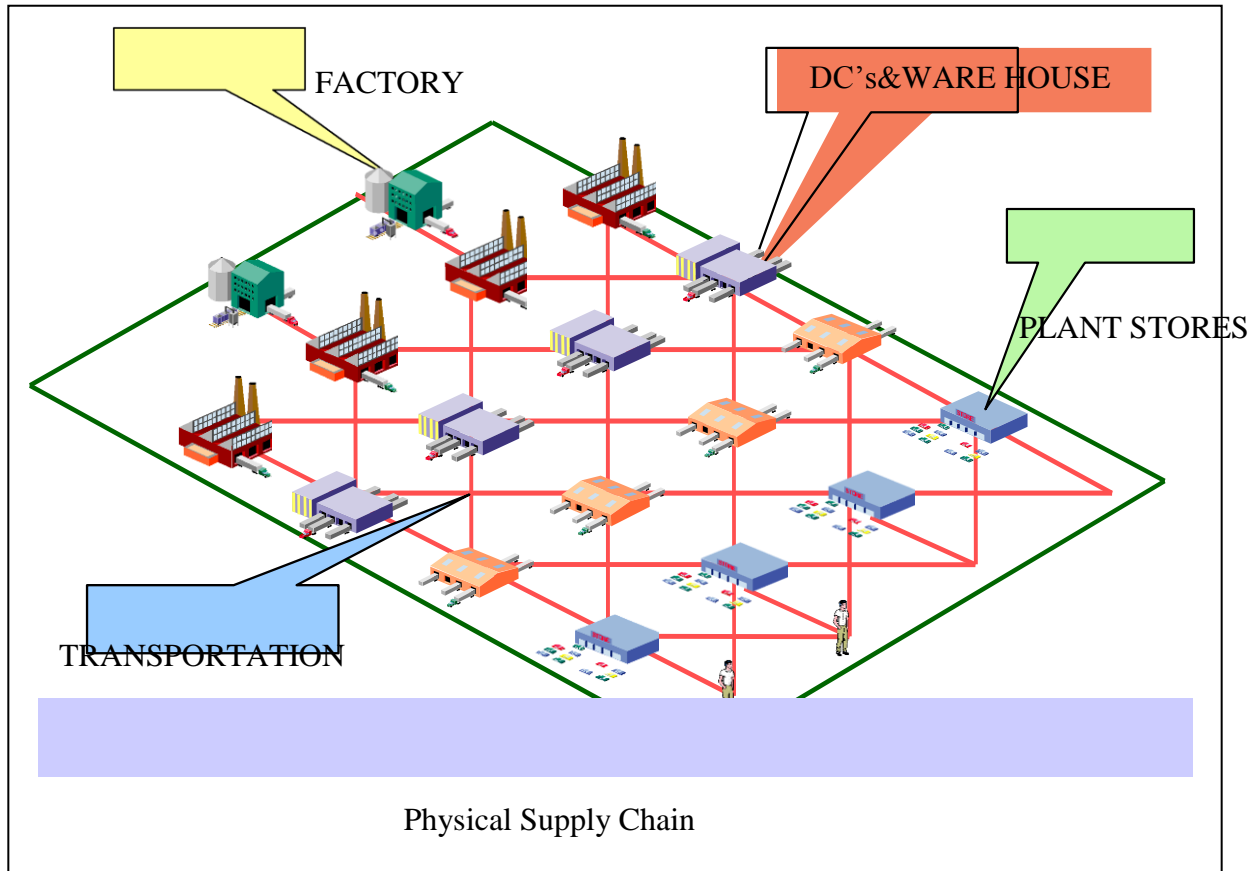


Figure 2.4. Physical Supply Chain



Source: Integrated MRO Supply Management - Genesis Solutions (By Thomas Terfehr) .

2.3. Maintenance, Repair and Overhaul in an Airline Industry

2.3.1. Maintenance, Repair and Overhaul Fundamentals

Maintenance, Repair and Overhaul (MRO) may be defined as "all actions that have the objective of retaining or restoring an item in or to a state in which it can perform its required function. The actions include the combination of all technical and corresponding administrative, managerial, and supervision actions". Kinisson states that maintenance can be described as the process of ensuring that a system continually performs its intended functions at its original level of reliability and safety. Viles et al. emphasize the goal of maintenance is not only to reduce repair time but also to improve product reliability, as well as to capture relevant information for analysis. "Maintaining complex systems such as aircraft fleets, rail systems, and production facilities can often exceed the cost of research, development, and production". "The aircraft fleet maintenance plays the most important role to guarantee the safety and reliability of the fleet in commercial airlines and military air forces". "Maintenance plays an important role in keeping product availability, reliability and quality at an appropriate level. It also addresses the product safety requirements". The importance of MRO can be judged by the fact that it typically constitutes 12-15 per cent of an airline's operating cost, with annual expenditures estimated to be US \$50 billion in 2013 and employment of 480,000 people in the world. Phillips et al. explain that the record aircraft production following strong sales in 2006 and 2007, given the typical 18,000-cycle or 8–10 years between overhauls, has created an unprecedented demand for landing gear overhauls on both long and short-haul aircraft. McFadden and Worrells state that the worldwide MROs have grown in response to continuous and increasing demand into a viable segment of the aviation industry. Finally, CIM Data highlights that the profitability of the industry is not from the sale of aircraft, but from maintenance for an anticipated thirty-plus year lifespan. The MRO in the aerospace market is a complex process that has strict and precise requirements to guarantee the safety of passengers and aircrew. Phillips et al. corroborate that maintenance forms an essential part of aircraft airworthiness criteria; its main objective is to ensure a fully serviced, operational and safe aircraft. Proper maintenance is an essential contributor to the high levels of safety experienced today; in contrast, improper maintenance can have tragic effects. Pipame explains that to maintain and repair their equipment, airlines take into account the manufacturers' instructions and standards of international organizations to improve the quality and safety of flight. "A number of entrepreneurial operators and support providers have adopted a new group of postproduction support strategies. Although there has been a considerable amount of improvement in the quality and reliability of components and systems, as well as in materials and procedures, over the 100-year life of aviation, they still have not reached total perfection. Aviation equipment, no matter how good or how reliable, still needs attention from time to time". Marais et al. emphasize that increasing the level of investigation surrounding

aviation incidents is recommended for improved safety. Marais et al. also agree with many of the FAA (Federal Aviation Administration) incident reports which simply state that a particular component failed and more detailed investigations would reveal the root causes of component failures and would, as suspected, identify inadequate maintenance to be an important factor. Regarding in-house airline maintenance capabilities, Carpenter and Henderson explain that commercial airlines can establish MRO services in their own fleets and operate as profit centers; however, it is not uncommon for airline operators to spin-off these MROs and act as a separate, corporate activity. "Third Party Independents perform similar functions as In-house MROs but are not affiliated to an airline operator. Independents often provide these services at a lower price. Therefore, independents market themselves as the value proposition over the OEMs and In-house MROs". Analyzing the operation side, Kinnisson explains that aircraft maintenance can be divided into scheduled and unscheduled maintenance. Scheduled maintenance is a preventive action to ensure that a product functions properly at pre-set intervals. Unscheduled maintenance is not planned or programmed, but it is required when an item has failed or broken down. Kinnisson and authors clarify that scheduled maintenance includes routine and detailed inspections called transit, 48 h, ,,,A''', ,,,B''', ,,,C''', and ,,,D''', checks, subdivided in line and base categories, as detailed in Table 1. According to Yoon, maintenance can be carried out either on or off the aircraft. When off-aircraft maintenance is performed, the equipment and components are removed from the aircraft and replaced with serviceable units. The removed units are then modified into materials for replacement and routed to the repair facility. The pace may be slower than on- aircraft maintenance, but its short turnaround for maintenance (meaning time to repair), is important and sometimes necessary. The Aviation Safety Bureau describes different types of aircraft repair:

(1) Aircraft Structural Repairs: structural repairs are made to aircraft that have sustained damage to the structure (i.e., external skin, stringers, formers, bulkheads, etc.). There are several ways an aircraft structure can be damaged. It is usually caused by ground service equipment, maintenance stands, bird strikes, or lightning strikes.

(2) Component repairs: component repairs range from simple part replacements to an entire overhaul. If a component fails to operate properly, it is removed from the aircraft and replaced by one that operates properly. The removed component is then repaired. Miroux explains that MRO management has become more complex due to business growth, specialization and diversity: cheap vs. expensive, none or slow movers vs. high movers, repairable vs. consumable, critical vs. non critical, standard vs. specific, and supplier lead times. The complexity of MRO management, which requires in-depth and specialized expertise to handle inventory management, forecasting, supply management, return and repair flows etc., forces companies to rethink their MRO strategies. Karadžić et al. state that due to the high intensive

workforce industry , attracting and maintaining technically proficient workers is one of the many challenges. To obtain cost savings and improve reliability, airlines are outsourcing partial or full MRO management to third party companies. This situation will be more deeply analyzed in MRO Business Models.

2.3.2. Particularities of the Aeronautical Industry

The supply chain in the aeronautical industry is very complex. Each component of an aircraft must be certified by the airworthiness authorities, which define strict requirements to guarantee safety. Due to the high level of requirements to qualify a supplier, there is a very limited number of companies authorized to provide parts and services in the aeronautical industry. This predicament leads to limited options when selecting a supplier for a new aircraft program and results in a lack of leverage to negotiate commercial conditions. Additionally, the same system suppliers operate in different sub tiers, so they become suppliers of their competitors, which may negatively impact the relationship between them and, ultimately, the final customer. Figure can reflects the above scenario, showing production and spare parts and the MRO services flow in the aeronautical industry. Essentially, there are four stakeholders: sub tier suppliers/ suppliers, aircraft OEMs, customers and MRO repair shops. The business model recently applied by aircraft OEMs provides for key suppliers working as system integrators. This means that instead of having hundreds of suppliers to address, aircraft OEMs have approximately 50 system suppliers. They can produce or purchase from multiple suppliers and be responsible for delivering an integrated system. Raju et al. corroborate that the modern day military and commercial aircraft systems are an integration of a large number of sub-systems and components.

Table 1: Detailed Scheduled Maintenance Source: Kinnisson [2] and authors.

Maintenance	Check	When(an average)	Description	Examples
Line	Transit, daily or 48h	After each stop or when aircraft is on ground more than 4 hours	Normally includes a visual inspection of the aircraft to look for obvious damage and deterioration.	Check fluid levels and emergency equipment, inspect wheels and brakes.
	A	500 FH or 2 months	Accomplished at a designated maintenance station and includes the opening of access panels to check and service certain items. Some limited special tooling, servicing, and test equipment is required.	General external visual inspection of aircraft structure for evidence of damage, deformation, corrosion, missing parts; crew oxygen system pressure check; operationally check emergency lights; lubricate nose gear retract actuator; check parking brake accumulator pressure; perform Built-in Test Equipment (BITE) test of Flap/Slat Electronics Unit.
	B	1100 FH or	This is a slightly more detailed check of components and systems. Special equipment and tests may be required. It does not involve detailed disassembly or removal of components.	
Base	C	Every 4000 FH or 20 months	This is an extensive check of individual systems and components for serviceability and function. It requires a thorough visual inspection of specified areas, components and systems as well as operational or functional checks. It is a high-level check that involves extensive tooling, test equipment, and special skill levels. 'C' checks remove the airplane from the revenue schedule for 3 to 5 days. The 'C' check	Visually check flight compartment escape ropes for condition and security; check operation of DC bus tie control unit; visually check the condition of entry door seals; operationally check flap asymmetry system; pressure decay check APU fuel line shroud; inspect engine inlet TAI ducting for cracks.
	D / HMV	25000 FH or 6 years	This can also be referred to as the structural check. It includes detailed visual and other non-destructive test inspections of the aircraft structure. It is an intense inspection of the structure for evidence of corrosion, structural deformation, cracking, and other signs of deterioration or distress and involves extensive disassembly to gain access for inspection. Special equipment and techniques are used. Structural checks are man-hour and calendar-time intensive. The 'D' check includes the lower checks, i.e., 'A,' 'B,' 'C,' and daily checks. This check removes the airplane from service for 20 or more days.	Inspect stabilizer attach bolts; inspect floor beams; detailed inspection of wing box structure.

With regards to production parts, the process is fairly simple. The aircraft OEM places a purchasing order with the system supplier, respecting the lead-time and other commercial agreements. The part is delivered and the process is closed. The process is more complex when it pertains to spare parts. The customer can place a purchasing order to numerous players – aircraft OEM, repair shops and even directly to the system suppliers. In addition, the customer can request MRO services, especially heavy maintenance, from repair shops, system suppliers, and more recently from aircraft OEMs. This study focuses on customers and MRO repair shops to provide more detailed information. Future papers will address additional stakeholders and provide a broader review of information.

2.3.3. Commercial Aviation Industry

The commercial aviation industry is composed of airline companies that offer passenger and cargo transportation services. Approximately 230 major airlines operate throughout the world and are registered with the International Air Transport Association (IATA). Boeing explains that the industry continuously adapts to various market forces. Key market forces that role the airline industry are fuel prices, economic growth and development, environmental regulations, infrastructure, market liberalization, airplane capabilities, other modes of transport, business models, and emerging markets. Each of these forces can have both positive and negative impacts on the industry. Fuel has become the largest component of an airline's cost structure. This has driven manufacturers to produce more fuel-efficient airplanes and has forced airlines to pursue cost reductions and revenue enhancements in other areas to maintain profitability, even with higher fuel costs. Boeing also clarifies that commercial aviation has weathered many downturns in the past. However, recovery has followed quickly as the industry reliably returned to its long-term growth rate of approximately 5 percent per year. Despite uncertainties, 2012 passenger traffic rose 5.3 percent from 2011 levels. Boeing expects this trend to continue over the next 20 years, with world passenger traffic growing 5.0 percent annually. Air cargo traffic has been fluctuating after a high period in 2010. Air cargo decreased by 1.5 percent in 2012. The expansion of emerging-market economies will, however, foster a growing need for fast, efficient transportation of goods. Today, the fleet size in operation is approximately 20,000 aircraft and it is expected that this number will double over the next 20 years. An increase in the demand of fleet size and passenger/cargo directly roles the MRO demand.

Business Aviation Industry: Worldwide demand for business jets is highly correlated with wealth creation, which, in turn, is largely driven by economic growth. Since the introduction of the business jet,

in 1965, the business aircraft market has been highly cyclical. The crisis in the financial markets at the end of 2008 precipitated a sharp downturn in business aviation and new business aircraft orders. Bombardier estimates that more than 800 orders across all manufacturers were cancelled in the Light to Large categories in 2009. Bombardier predicts 24,000 business jet deliveries valued at \$650 billion in a 20-year delivery forecast. Bombardier also anticipates 9,800 deliveries worth \$269 billion from 2013 to 2022, and 14,200 deliveries worth \$381 billion from 2023 to 2032, which consequently contribute to an increase in MRO demand.

Military Aviation Industry: Political decisions determine when and how the military, as a whole, will be employed and this employment has a direct role on the MRO industry. Traditionally, North America and Europe accounted for approximately 80% of global defense spending. However, the global economic downturn, the US economic crisis, and the European debt crisis are expected to negatively impact defense spending and lead to defense budget cuts. As a consequence, the allocation for military aircraft is not expected to grow significantly during the forecast period due to financial constraints faced by most of the leading defense spenders. In 2008, the global military aircraft inventory exceeded 39,000 aircraft with maintenance on these aircraft costing governments \$60.7 billion. The U.S. accounted for half of this, spending an estimated \$31 billion on military MRO in 2008. The next largest individual country was Japan, which spent an estimated \$2.5 billion during this period. Canada has maintained a fleet of CF-18 in service since 1982. Extensive maintenance was conducted to extend the aircraft life span, repair any structural damage and modernize the entire system. Because spare parts will be increasingly rare and expensive, the systems will become more obsolete, and the CF-18 will be less compatible with other fleets. Canada is analyzing the purchase of F-35 to replace the fighter aircraft.

Maintenance Repair Shops: Most major aircraft maintenance and repair work is provided by repair shops, which carry out MRO operations for the aircraft operators. According to Pipame, 80% of MRO repair shops are small and medium enterprises. "Heavy airframe maintenance, which is especially labor intensive, offers an opportunity to reduce costs by off-shoring into lower wage countries such as Eastern Europe and Asia". According to Aviation Week and Space Technology (AW&ST), the market is actually dominated by Asian companies and the majority of the top 10 MRO global leading players are indeed in this geographic area, as demonstrated in reference book Table stated Singapore Technologies Aerospace is the largest airframe maintenance company in the world, having accumulated 11.5 million maintenance man-hours in 2012, followed by Haerco Group, from Hong Kong, which had 7.4 million maintenance man-hours. Lufthansa Technik, the largest airframe maintenance company in

years past, has lost market share and is now in fifth place. MRO providers are expanding their geographical reach and capabilities in a bid to become regional and global full service providers. The number of MRO businesses in emerging countries is increasing due to low labor costs and joint ventures between system suppliers and aircraft manufacturers. Some examples are Pratt & Whitney and China Eastern, General Electric and Singapore Technologies Aerospace, Boeing and Shanghai Aviation Services Co., and Bombardier and Tianjin Airport.

2.4. Operational Definition

- . **Strategic supplier partnership:** It is the long term relationship between its supplier and the organization. The purpose of strategic supplier partnership is to leverage on the strategic and operational capabilities of individual participating organization in achieving significant ongoing benefit (Subba Rao et al. 2004). Empirical studies on SCM revealed that Strategic supplier's partnerships enable the organizations to work more effectively with a few important suppliers who are willing to share responsibility for the success of mutual objective. According to Balsmeier PW, Voisin W, 1996 strategically aligned organizations can work closely together and eliminate wasteful time and effort.
- . **Levels of Information Sharing (LIS):** The extent to which critical and proprietary information is communicated to one's supply chain partner here the supply chain partner includes Aircraft part producers, suppliers, MRO providers etc.
- . **Levels of Information Quality (LIQ):** Refers to the accuracy, timeliness, adequacy, and credibility of information exchanged in MRO supply chain.
- . **Internal lean practice (ILP):** means organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation in supply chain management process that has zero waste.
- . **Operational Performance:** Operational performance defined as how well the organization works on improving the company operations by measuring the parameter indicators like on cost reduction/price, quality, delivery dependability and time to market are able to compete against the competitors.
- . **Organization Performance:** Organizational performance defined as how well the organization works on improving the company financial condition and be able to compete again the competitor. (Cheng Choon Ho, 2011). Grace Kilonzo, 2012 has also defined organizational performance, from both financial and non-financial criteria, as the ability of an organization to fulfill its mission through sound

management, strong governance and a persistent rededication to achieving results. Proper SCM practice will bring the competitive advantage over the competitors' interims price, quality, and time to market, cost of production, etc. On the other hand, organizational performance is the overall achievement of intended objective. (Heizer and Render, 2011) According to Koh 2007 as cited by Lang Ling Yap & Cheng Ling Tan; higher sales, higher accuracy in costing, and improved coordination between departments, improved coordination with suppliers, and improved coordination with customers can be a measure organizational performance. Some other measures that are related to organizational financial performance may include return on investment, market share, and profit margin on sales, growth of return on investment, growth of sales, and growth of market share to measure organizational performance.

2.5. Conceptual Frame work

The frame work developed in this research proposes that SCM practices will have an effect on organizational performance both directly and indirectly through competitive advantage. Gilley et al. (2004) stated that the vast majority of the research on SCM has focused on the understanding of SCM determinants and the decision-making process, especially in manufacturing firms. Little attention has been paid to the SCM results in the service sector (Espino-Rodriguez and Padron-Robaina, 2004). A few observations have been made in the literature about the implications and outcomes of SCM within different industries. However, these observations often tend to focus on the scope and nature of SCM and the type of business model adopted by an airline. There is a notable absence of literature exploring the extent and type of SCM, and the specific motives and factors behind SCM decisions in the airline industry. A holistic view of the determinants of SCM in MRO for the airlines, i.e. external and internal factors and motives, is deemed necessary. Moreover, SCM practices and their implications within the airline industry have not been studied in detail. Taneja (2004) has highlighted that restructuring supply chains has been a poorly examined research field. Although it is generally believed that SCM has become an attractive option for many industries, current SCM practices in the airline industry have not been thoroughly understood. Finally, the implications of SCM in aviation performance have not been confirmed. Conflicting viewpoints and the scarcity of studies examining this relationship can be identified in the review of literature on SCM.

The present study seeks to fill in the research gaps by examining the role of MRO SCM within Ethiopian airlines. In particular, the study aims to identify the determinants of SCM and examine current SCM practices within Ethiopian airline. The independent variables of the study are supplier Forecasting/Procurement, sourcing, different MRO sections, and warehousing /storage and inventory management while the dependent variable is operational & organizational performance (i.e. Ethiopian Airlines).

Independent Variable

Dependent Variable

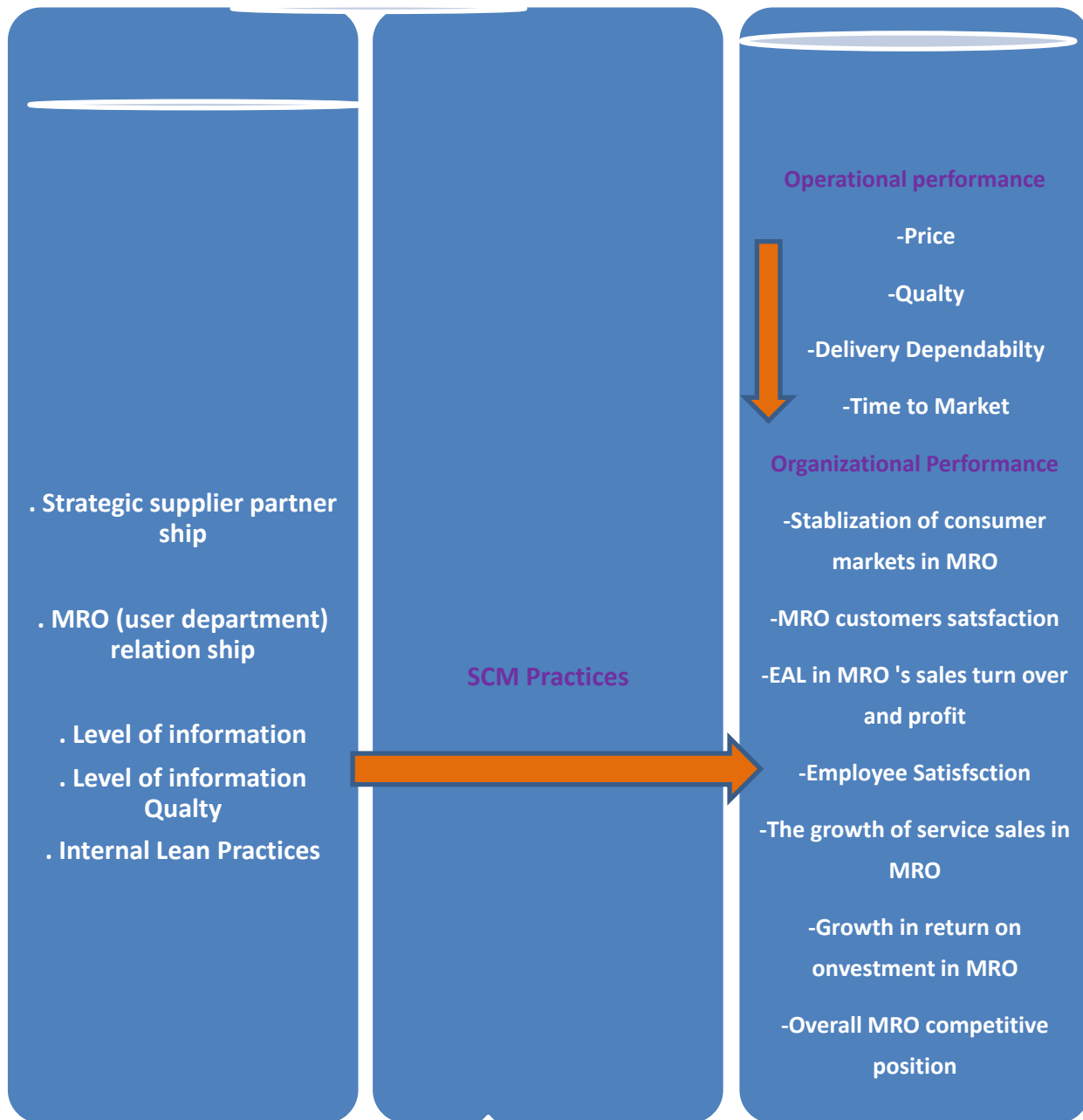


Figure 2.5 .The Conceptual Frame work of the Study (adapted from Source: Mustefa, 2014; Suhong Li*etal.*, 2006; Proclamation No. 328/06).

Chapter Three

Research Methods

3.1. Study Setting

The Study was conducted in functional MRO on the below sections in EAL. According to Ethiopian airlines one time MRO operations have more than 3000 employees with five sections from procurement & Supply chain sections, Technical & Engineering, Tactical purchase, Finance and Inbound & outbound logistics which are owned by Ethiopian airlines; and among those more than 3000 Population size as per J Carvalho, Sample Size n Determination table, a sample size is determine to be small size of the total population. Thus, a sample of eighty (80) employees was selected using random sampling technique. The questionnaire was conducted for the selected sample size. And in addition to those 5 Sections we have also other sections does not involve directly for all MRO rather they give service for selected target groups. In the other Airlines the sections service is given for the airlines but not the entire MRO therefore the researcher were exclude those other sections from this research.

3.2. Research Approach

The two basic approaches in social sciences research are qualitative and quantitative orientation. However, the literature suggests a growing interest in a mixed method approach (triangulation) following on from the argument that 'one is used to strengthen the other. Often, combining qualitative and quantitative methods, also known as the triangulation of methods, can capture a more holistic, complete and contextual view of a phenomenon (lick, 1979). This study combines published statistical data reports, secondary data, to be used as the selected quantitative method, and an exploratory case study and semi-structured interviews to be used as the selected qualitative method.

3.3. Research Design

Churchill (1999, p. 98) 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, Descriptive,

or Causal (Cooper and Schindler, 2008; Churchill, 1999). This study evolves through Descriptive, and Causal types of research design. Under these stages, the study fulfills the objectives of both the descriptive research and the causal research by getting an in-depth knowledge of SCM determinants and SCM in MRO current practices within Ethiopian airline and investigating the implications of these variables in the performance of Ethiopian.

3.4. Study & source population

The research considered a total population of 80 employees as a unit of analysis for this study purpose during the study period. But sections which are found in those none MRO sections in EAL were excluded from the study. Because of in Ethiopian airlines there are two procurement sections which are aircraft related and the non-aircraft related. So that, this research mostly focused on only the aircraft related supply chain process.

3.5. Sample Design and Procedure

The research was selected data by using a random sample technique from representative 80 employees among 5 sections. Was taken, based on Jcarvalho “Archival applocation of mathematical sampling techniques”,(1984),sample size determination table shown below, from management members, Professional employees, semi-skilled, store personnel’s & technical department employees.

Table 3.1 J Carvalho, Sample Size Determination table

No.	Population size	Small	Medium	Large
1.	51-90	5	13	20
2.	91-150	8	20	32
3.	151-280	13	32	50
4.	281-500	20	50	80
5.	501-1,200	32	80	125
6.	1,201-3,200	50	125	200
7.	3,201-10,000	80	200	315
8.	10,001-35,000	125	315	500
9.	35,001-150,000	200	500	800

Source: -The national archive revised October 2005

Based on the above sample size determination table the sample size determined systematically from

the following department.

Table 3.2. Sampling Table

No	Target Population	Target population on the departments			Sample size each stratum
		Male	Female	Total	
1.	Procurement & supply chain	50	40	90	36
2.	Logistics & warehouse	61	14	75	18
3.	Finance & Strategic sourcing	31	22	53	14
4.	Engineering, Technical section	18	2	20	7
5.	Line,Base,&Engine maintenance.	9	3	12	5
Total		169	81	250	80

Source:-EAL's April 2017 HR & sample size

3.6. Questionnaire sections

The questionnaires are adapted from Mustefa (2014), suhongLiaetal. (2006) and from EAL document .And structured questionnaires were used to collect the data from the selected group of MRO under study using appropriate information tools. The use of questionnaire was chosen because it would enable the researcher to reach a number of respondents with in a limited period of time and it is convenient ensure the privacy of respondents. Close ended questionnaire was having been designed to cover more ground with in a limited time frame, particularly for those respondents who would have severe time constraints. Generally, the questionnaire has three sections:-

Section one: Addressed the demographic information of the Airlines industry.it includes the type of business respondent's educational level and his/or her background, work experience, current position, and the familiarity of SCM practice with close ended questions.

Section Two: this part focused on the core points under investigation that addresses the extent to SCM practices (the independent variables) and operational performance (achievement of intended objective) (the dependent variables) with the MRO airline business company under study.

Section three: Evaluated the company's performance in depth. it is to be noted that although the questionnaire used in this study is expected to be self-administered, there were frequent interaction to ensure data quality.

3.7. Instrument and Measures

A set of supply chain measurement practices that are applicable for airline business companies are available on the literature. These SCM practices include close partnership with suppliers, close partnership with customers, just in time supply, E-procurement, outsourcing, subcontracting, proper logistics and transport management, strategic planning, technical section relation with SCM, supply chain bench marking, few suppliers, many suppliers, and holding safety stock. Airline MRO Business Company is established with different objective from other MRO airline companies and for the purpose of measurement we were control some variables. As we explained above dependent variables were the performance indicators, tested against the in dependent variables (supply chain management practices). The relationship between practice components (Independent variables) and performance indicators (dependent variables) are identified by multiple linear regressions. Dependent variables are performance indicators of the MRO company in line with the intended objective.

3.8. Reliability and Validity test

3.8.1. Assessment of Intra-rater reliability

According to Anders Jonsson and Gunilla Svingby, 2007, reliability analysis is concerned with the internal consistency of the research instrument .Most of the studies investigating intra-rater reliability by using Cronbach's alpha to estimate raters' consistency, and the majority report on alpha values above .70, which, according to Glasswell, and Harland cited on Anders Jonsson and Gunilla Sving by 2007, is generally considered sufficient. as multiple items in all constructs were used, the internal consistency /reliabilities of SCM practices, operational performance ,and organizational performance were assessed and the following table show the summary of reliabilities of all constructs .and as we can see in the following table the internal consistency of the research instrument for further analysis.

Table3.3. Cronbach’s alpha reliability test

No.	Variables	Reliability	No. Variables
1.	Supply chain management practices	.936	37
2.	Operational performance	.857	16
3.	Organizational performance	.858	7

Source: Questionnaire 2017

3.8.2 Analysis of Validity

Compel, 1960 identified the most commonly used methods for demonstrating validity are referred to as content –related, criterion related, & construct-related validity. Validity refers to the test or measurement strategy measures and how well it does so. This study addressed content validity through their view of literature and adapting instruments use in this research. It refers to the relevance of the instruments or measurement strategy to the construct being measured (Fitzpatrick, 1983).on the other hand (Groth- Marnat, 2003) define content validity the extent to which the test or measurement strategy measures theoretical construct or trait.

3.9. Unit of Analysis

The collected data would be organized, classified, coded and encoded into a computer. The variety of information collected from questionnaires was tallied and tabulated. Then, it was analyzed using SPSS software to calculate percentages and to produce tables and bar graphs. In this research Pearson coefficient of correlation test is used to investigate the association between SCM practice and overall performance of the organization .further more Test for dependent samples were carried out to determine whether the SCM practice have got higher performance after the proper implementation of the SCM practice than before adopting the system. After analyzing the data the findings was summarized and appropriate conclusion drawn with possible recommendations.

Chapter Four

Data Analysis and Discussions

4.1. Data Sample Information

As we have explained in the earlier chapter, this research has attempted to examine the application of standard supply chain management practices and its role on the performance of Ethiopian Airlines MRO. Based on the specified research methodology the primary data was collected from the target population of EAL MRO. According EAL MRO HR 2015/16 annual report, the company used to undertake MRO aviation business by employing more than 3000 Skilled and semi-skilled workers .But their involvement on the SCM practice varies from one department to the other. Even with the core process of MRO the involvement of worker in SCM practices varies according to their hierarchical position. the researcher believes the data was valid if it would be collected from the employees of the company, those working on the core process and having direct relationship with supply chain management practices if the company. The following table shows the total employee of EAL MRO unit. The strata (the target population (department)) identified based on the intensity of involvement on the SCM practices.

Table 4.1 Total employee of EAL MRO at Addis Ababa facility

No.	Terms of employment	Male	Female	Total
1.	Permanent	2,828	422	3,250
2.	Temporary	627	268	895
Total		3,455	690	4,145

Source:-EAL MRO 2015/16 HR data

But much of the employees are supportive staff and their direct involvements on the SCM practices of the Company are limited, so, the target population was not be the entire employee of the company. Accordingly the target populations for this study was from procurement, logistics & warehouse, strategic sourcing, maintenance & Engineering and some extent finance department employees. In order to have the better picture about the SCM practices of the company the questionnaire distributed to procurement, logistics, warehouse, strategic sourcing , maintenance & Engineering department those have direct participation on the SCM practices of the company. i.e. the

study considered only the employees at the core business processes and the information collected from them is believed sufficient enough to conduct the analysis. the sample size determined based on Jcarvalho ,sample size Determination table as we mentioned in the methodology part. A total 80 questionnaire were distributed in EAL MRO unit & inputs got from managers, team leaders, procurement officers & other employees. out of which 74 were returned. Therefore, 74 questionnaires served as data for analysis to present the findings and draw conclusions.

Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
male	43	58.1	58.1	58.1
Valid female	31	41.9	41.9	100.0
Total	74	100.0	100.0	

Table 4.2: Respondent Gender

From Table 4.2, we can see that from the total 74 respondents at aviation MRO 58% or 43 of them are Males the remaining 42% or 31 of respondents were Females at MRO SCM office. This implies the gender distribution of the officials in those facilities is balanced.

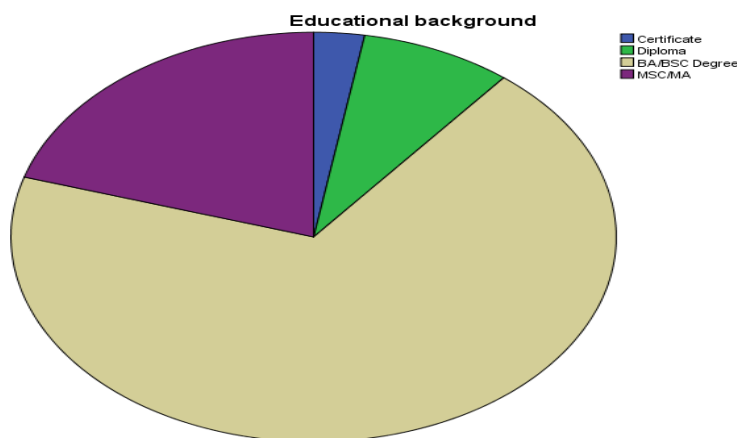


Figure 2.6. Respondents Education Status

From Figure 2.6, we can see that from a total 74 respondents at MRO SCM level 51 of them or 69% of them have 1st degrees (BA/BSc Degree) and or 15 of them 20% of the respondent have 2nd Degree (MSc/MA Degree), and the remaining respondents or 11% of them are

Diploma & below Diploma holders. This indicates most of MRO SCM officials in EAL are middle level professionals, this suggests our respondents give relevant and accurate information needed for the study of supply chain management practices on performance of MRO in EAL.

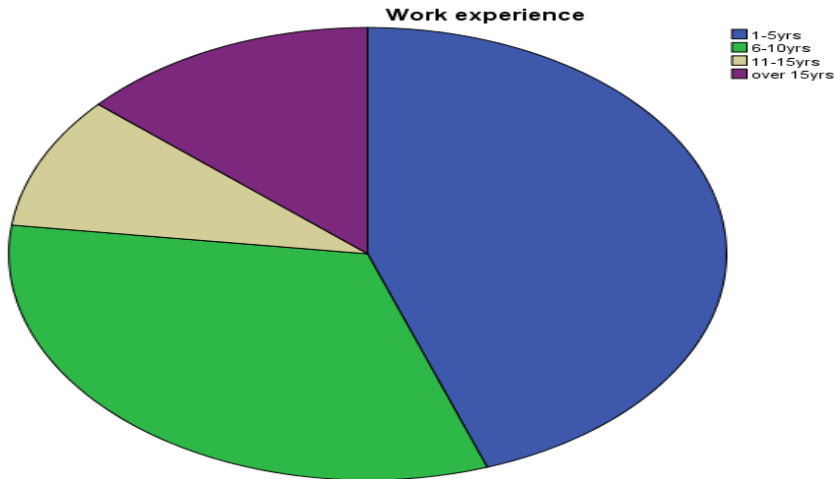


Figure 2.7. Work Experience

From Figure 2.7, we can see that from a total 74 respondents at MRO level 33 of them or 45% of them fall at a work experience bracket 1-5 years and 24 respondent or 32% of them fall at a work experience bracket 6-10 years and 7 or 10% of them fall at a work experience bracket 11-15years and the remaining of them fall at a work experience bracket more than 15 years. This implies most of those respondents are young professionals and they are more cooperative and easily understand the questionnaire which is required to complete by them and they give information that the respondents were well up-to-date with the supply chain procedures at the MRO level and therefore they gave the correct and accurate information the researcher needed for the study.

4.2. Supply Chain Management Practice, Operational & Organizational Performance of MRO in EAL

4.2.1. Supply Chain Management Practice of MRO in EAL

SCM Practice at MRO in EAL

	Mean	Std. Deviation	N
Strategic supplier partnership	3.5270	.50268	74
MRO relation with SCM	3.6622	.55584	74
Level of information sharing	3.5000	.64638	74
Internal lean practice	3.5676	.52554	74
Level of information quality	3.4865	.52975	74

Table 4.3: Supply Chain Management Practice of MRO in EAL

From table 4.3, the researcher sought to establish the supply chain management practices that have been put in Place at MRO in EAL, the respondents were instructed to respond to the statements on a 5 point Likert scale and indicate the extent they agree with the statements that is: 5-Strongly agree, 4-Agree, 3-Nutral, 2-Disagree, 1-Strongly disagree. A mean (M) score of 0-1.5 inclusive means that the respondents strongly disagreed, between 1.50 to 2.50 inclusive means they disagreed, 2.50 to 3.50 inclusive means the respondents were neutral, 3.50-4.50 inclusive means they agreed, and a mean above 4.50 means the respondents strongly agreed. Based on the findings on Table 4.3, the supply chain management practices that have been put in place by those of MRO in EAL: Strategic supplier partnership (M=3.5270, SD=.50268), MRO relation with SCM (M=3.6622; SD=.55584), Internal lean practice (M=3.5676; SD=.52554). These Supply chain management practices had mean scores greater the 3.50 and therefore the respondents agreed with the practice of those list of SCM practices in their facilities. However, the respondents are neutral in the supply chain management practice called Level of information sharing (IS) with (M=3.5000; SD=.64638),

and Level of information quality (M=3.4865; SD=.52975) in their facilities since they fall in between 2.50 to 3.50.

4.2.2. Operational Performance of MRO

Operational Performance of MRO in EAL

	N	Mean	Std. Deviation
Price	74	3.5811	.54914
Quality	74	3.6081	.69868
Delivery dependability	74	3.5270	.57868
Time to market	74	3.6892	.84279

Table 4.4: Operational Performance of MRO in EAL

The respondents were asked to respond to the statements on a 5 point Likert scale and indicate the extent they agree with the statements that is: 5-Strongly agree, 4-Agree, 3-Nutral, 2-Disagree,1-Strongly disagree. A mean (M) score of 0-1.5 inclusive means that the respondents strongly disagreed, between 1.50 to 2.50 inclusive means they disagreed, 2.50 to 3.50 inclusive means the respondents were neutral or not sure, 3.50-4.50 inclusive means they agreed, and a mean above 4.50 means the respondents strongly agreed. Based on the findings on Table 4.4, we found the respondents agree to those questions which measures the performance of MRO that is Price (M= 3.5811; SD= .54914), Quality (M= 3.6081; SD=.69868), and Delivery Dependability (M= 3.5270; SD= .57868), and time to market with (M= 3.6892, SD= .84279) their mean score is fall more than 3.50.

4.2.3. Supply Chain Related Organizational Performance

Organizational Performance of MRO in EAL

	N	Mean	Std. Deviation
Stabilization of consumer markets	74	3.76	1.018
Customer satisfaction	74	3.96	.898
Sales turnover and profit	74	3.81	1.002
Employee satisfaction	74	2.58	1.194
The growth of MRO service sale	74	3.57	1.195
MRO growth in return on investment	74	4.05	.964
Over all MRO competitive position	74	3.84	.861

Table 4.5: Supply Chain Related organizational Performance at EAL

For this study we take only seven SCM related Organizational Performances and those performance measures also asked for response by the statements with a 5 point Likert scale and indicate the extent they agree with the statements that is: 5-Strongly agree (significant increase), 4-Agree (increase), 3-Neutral (same as before), 2-Disagree (decrease) , 1-Strongly disagree (significant decrease). A mean (M) score of 0-1.5 inclusive means that the respondents strongly disagreed (significant decrease), between 1.50 to 2.50 inclusive means they disagreed (decrease) , 2.50 to 3.50 inclusive means the respondents were neutral (same as before), 3.50-4.50 inclusive means they agreed (increase), and a mean above 4.50 means the respondents strongly agreed (significant increase). Based on the findings on Table 4.5 we found that all of those Seven Supply Chain related organizational performance are answered in a range of 3.50 to 4.50 that is they all agree (increase) on the six SC related organizational performances that is for the question Our Stabilization of consumer markets. (M= 3.76; SD= 1.018), our Customer satisfaction (M= 3.96; SD= .898), our Sales turnover and profit (M= 3.81; SD= 1.002), The growth of MRO service sale (M=3.57; SD= 1.195), Our MRO growth in return on investment (M= 4.05; SD= .964) and Our Overall MRO competitive position (M= 3.84; SD= .861). However, the respondents are neutral (same as before) in Employee satisfaction (M= 2.58; SD= 1.194) their mean score is fall in between 2.50 to 3.50.

4.3. Correlation Analysis of MRO in EAL

4.3.1 Correlation between supply chain practices and operational performance

The researcher carried out a correlation analysis to test the relationship between the dependent and the independent variables. In this study our dependent variables are operational performance and supply chain related organizational performance and the independent variable is supply chain management practices which include Strategic supplier partnership, MRO relation with SCM, Level of information sharing (LIS), internal lean practice, and Levels of information quality (LIQ). The findings for this analysis are shown in the following

		SSP	MRSCM	LIS	LIQ	ILP	OPP
SSP	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	74					
MRSCM	Pearson Correlation	.401**	1				
	Sig. (2-tailed)	.000					
	N	74	74				
LIS	Pearson Correlation	.485**	.248*	1			
	Sig. (2-tailed)	.000	.033				
	N	74	74	74			
LIQ	Pearson Correlation	.464**	.287*	.040	1		
	Sig. (2-tailed)	.000	.013	.735			
	N	74	74	t	74		
ILP	Pearson Correlation	.304**	.384**	.081	.225	1	
	Sig. (2-tailed)	.008	.001	.495	.054		
	N	74	74	74	74	74	
OPP	Pearson Correlation	.623**	.396**	.160	.512**	.577**	1
	Sig. (2-tailed)	.000	.000	.172	.000	.000	
	N	74	74	74	74	74	74

Table 4.6. Correlation between supply chain practices and operational performance

Source: Questionnaire analysis, 2017

From the above Pearson correlation coefficient analysis table 4.6, we can see that strategic supplier partnership (SSP), Levels of information quality (LIQ) and internal lean practice (ILP), have positive and moderate linear relationship with the operational performance of EAL with the Pearson correlation coefficient value of ($r = 0.623$), ($r = 0.512$), and ($r = 0.577$) respectively. And it's statistical significant at less than 0.01. And MRO relation with SCM (MRSCM) have weak

positive linear relationship with operational performance with Pearson correlation coefficient value of ($r = 0.396$). And it's statistically significant less than 0.01. Therefore, the survey test result revealed that SCM practices and operational performance have positive linear relationship regardless of their magnitudes. Except, the Level of information sharing (LIS) has weak correlated with operational performance with correlation coefficient value of 0.160 at a significant value is greater than of 0.05.

4.3.2. Correlation between SCM practices and organizational performance

In this section we are going to analysis the correlation of supply chain management practices with the overall organization performance.

Table 4.7. Correlation between SCM practices and organizational performance

		SSP	MRSCM	LIS	LIO	ILP	ORP
SSP	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	74					
MRSCM	Pearson Correlation	.552**	1				
	Sig. (2-tailed)	.000					
	N	74	74				
LIS	Pearson Correlation	.295*	.452**	1			
	Sig. (2-tailed)	.010	.000				
	N	74	74	74			
LIQ	Pearson Correlation	.461**	.525**	.332**	1		
	Sig. (2-tailed)	.000	.000	.004			
	N	74	74	74	74		
ILP	Pearson Correlation	.476**	.502**	.296**	.411**	1	
	Sig. (2-tailed)	.000	.000	.010	.000		
	N	74	74	74	74	74	
ORP	Pearson Correlation	.414**	.428**	.415**	.425**	.424**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	74	74	74	74	74	74

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

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

Source: Survey, 2017.

As shown in above table, supply chain management practices are positively correlated with organizational performance. However, their associations with the performance vary from one practice to the other. According to the above Pearson correlation coefficient matrix table,

Strategic supplier partnership (SSP), MRO relation with SCM (MRSCM), level of information sharing (LIS), Levels of information quality (LIQ), and internal lean practice (ILP) are moderately correlated with organization performance with the correlation coefficient value of 0.414, 0.428, 0.415, 0.425 and 0.424 respectively. And the value is statistically significant, since its value is less than 0.01.

4.3.3. Correlation between Operational and organizational performance

As we have seen in the literature review, most scholars in the realm of supply chain management identified the disclosure for operational performance (competitiveness) as follows; I.e. cost reduction and price competitiveness, quality of product delivered, product delivery dependability, and time to market (organization’s capability in introducing new products faster than major competitors). In this section we are going to analyze the association of operational performance with the organization overall performance.

Table 4.8. Correlation between OPP and organization performance

		Price	Qualit	DDY	TTM	ORP
Price	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	74				
Quality	Pearson Correlation	.279	1			
	Sig. (2-tailed)	.01				
	N	74	74			
DDY	Pearson Correlation	.439*	.288	1		
	Sig. (2-tailed)	.00	.01			
	N	74	74	74		
TTM	Pearson Correlation	.334*	.228	.448**	1	
	Sig. (2-tailed)	.00	.05	.000		
	N	74	74	74	74	
ORP	Pearson Correlation	.237	.253	.565**	.514**	1
	Sig. (2-tailed)	.01	.01	.000	.000	
	N	74	74	74	74	74

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

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

As it is shown in the above Pearson correlation coefficient table 4.8, cost reduction /price competitiveness and quality of product delivered to customers have weak positive linear relationship with organizational performance with the correlation coefficient value of 0.237 and 0.253 Respectively. And significant value is less than 0.05. On the other hand, product delivery

dependability and the capability of the organization to deliver either the existing or new product to market faster than the industry average (time to market) have moderate positive linear relationship with organization performance with Pearson correlation coefficient value of 0.565 and 0.514 respectively. And significant value is less than 0.01.

4.3.4. Correlation between cumulative SCM practice, OPP and ORP

It is a linear relationship between the transformed average value of the five construct of SCM practices, operational performance and organization performance indicators.

Table 4.9. Correlation between Cumulative SCM practices, OPP and ORP

		supply chain management practice	operational performance	Organizational performance
supply chain management practice	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	74		
operational performance	Pearson Correlation	.678**	1	
	Sig. (2-tailed)	.000		
	N	74	74	
Organizational performance	Pearson Correlation	.578**	.564**	1
	Sig. (2-tailed)	.000	.000	
	N	74	74	74

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

Source: survey 2017

The cumulative linear relationship between supply chain management practices, operational/ competitive performance and over all organizational performance depicted in the in the above table 4.9. As we can see from the table above, supply chain management practices have relatively higher Pearson correlation coefficient with operational/ competitive performance with the correlation coefficient value of 0.678 as compared to the linear relationship between supply chain management practices with organizational performance which has correlation coefficient value of 0.578 at a significant value of less than 0.01. Similarly, operational / competitive performances have moderate linear relationship with organization performance with the value of 0.564 at significant level of less than 0.01.

4.4. Multiple regression analysis

4.4.1. Regression between SCM practices and OPP

Regression analysis is conducted to know by how much the independent variable explains the dependent variable. At this point the independent variables are supply chain management practices and the dependent variable is operational performance.

Table 4.10: Regression analysis model summary between SCM practices and OPP

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.779 ^a	.607	.578	.34335

- a. Predictors: (Constant), Internal lean practice of the enterprise, Level of information sharing with the customer, MRO relation with SCM, information quality, with strategic supplier partnership.

And according to the above regression analysis model summary table, SCM practices have strong positive linear relationship with operational performance with the r value of 0.779. And the adjusted R Square value depicted that, 58% of the total variability in operational performance is explained by supply chain management practices.

Table 4.11: Regression analysis ANOVA table between SCM practices and OPP

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	12.362	5	2.472	20.972	.000 ^b
Residual	8.017	68	.118		
Total	20.378	73			

- a. Dependent Variable: operational performance
 b. Predictors:(Constant), Internal lean practice, Level of information sharing, Level of information quality, MRO relation with SCM, Strategic supplier partnership

In the above ANOVA table F test and p value indicate the explanatory power of the independent variable. And obviously, the null hypothesis is that; the model has no explanatory power. Which means the entire coefficient on the independent variables is zero or none of the independent variables help to predict the dependent variable. But, as it is shown in the above ANOVA table p- value for both is 0.000 and which is less than 0.05 and it is statically significant.

So we conclude that there is very strong evidence to reject the null and accept the alternative. Since the p-value is statically significant we can say that there is supported relationship between supply chain management practices and operational performance (competitiveness).

Table 4.12: Regression coefficient /output/ between SCM practices and OPP

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients Beta	T	Sig.
	B	Std. Error			
1 (Constant)	.670	.405		2.157	.038
SSP	.464	.111	.441	4.194	.000
MRSCM	.031	.084	.033	.373	.710
LIS	.040	.074	.046	1.124	.265
LIQ	.213	.089	.214	2.392	.020
ILP	.393	.085	.391	4.638	.000

a. Dependent Variable: Operational performance

The above coefficient matrix table tells us about the relationship between independent variables (SCM practices) and dependent variables (operational performance). By default the null hypothesis for t test in the regression analysis is that the coefficient in the independent variables is zero or the independent variable does not help the dependent variable.

From the table 4.12 we can see that, the p value for strategic supplier partnership (SSP) Level of information quality (LIQ) and Internal lean practice (ILP) is less 0.05 and it is statistically significant and we have strong reason to reject the null hypothesis which says the coefficient is zero and accept the alternative. So we can say that strategic supplier partnership (SSP) Level of information quality (LIQ) and Internal lean practice (ILP) has significant contribution to the competitiveness of EAL. However, the p value for MRO relation with SCM (MRSCM), and level information sharing (LIS), are greater than 0.05 and it is statistically insignificant. Therefore, the above coefficient matrix table tell us, even if, the coefficient in the independent variable different from zero, since the p value for the above mentioned independent variables greater than 0.05, we have a reason to accept the null and reject the alternative hypothesis. And we can say that the contribution of MRO relation with SCM (MRSCM), and level information sharing (LIS) to the competitiveness of the organization is insignificant. The regression equation between supply chain management practices and operational performance can be written as follows:

$$OPP = 0.670 + 0.464SSP + 0.031MRSCM + 0.40LIS + 0.213LIQ + 0.393ILP + \epsilon$$

4.4.2. Regression between SCM practices and ORP

This regression analysis is conducted to know by how much the independent variable explains the dependent variable. At this point the independent variables are supply chain management practices and the dependent variable is organizational performance.

4.4.3. Multi Collinearity Tests

Multi collinearity refers to the situation in which independent /Predictor variables are highly correlated. When independent variables are multi collinear, there is “overlap” or sharing of predictive power .HO (2006)

Model	Collinearity Statistics	
	Tolerance	VIF
Strategic supplier partner ship	.523	1.911
MRO relation with SCM	.745	1.343
Level of information sharing	.708	1.413
Level of information quality	.723	1.383
Internal lean practice	.815	1.227

a. Dependent Variable: Organizational performance

Table 4.13. Multi collinearity test of independent Variables

Source: own survey result, 2017

The result in table 4.13, show that the collinearity between independent variables has no series problem since the value of tolerance for all independent variable is greater than 0.1 and all VIF is less than ten ($VIF < 10$). Thus, multi collinearity does not seem to be a problem for the variables.

Table 4.14: Regression analysis model summary between SCM practices and ORP

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.649a	.421	.680	.37187

a. Predictors: (Constant), Internal lean practice, Level of information sharing, Level of information quality, MRO relation with SCM, Strategic supplier partnership.

And according to the above regression analysis model summary table, SCM practices have moderate positive linear relationship with organizational performance with the r value of 0.649. And the adjusted R Square value depicted that, 68 % of the total variability in organizational performance is explained by supply chain management practices.

Table 4.15 Regression analysis ANOVA table between SCM practices and ORP

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.048	5	.410	1.764	.000 ^b
	Residual	15.790	68	.232		
	Total	17.838	73			

a. Dependent Variable: Organizational performance

b. Predictors: (Constant), Internal lean practice, Level of information sharing, Level of information quality, MRO relation with SCM, Strategic supplier partnership

In the above ANOVA table F test and p value indicate the explanatory power of the independent variable. And obviously, the null hypothesis is that; the model has no explanatory power. Which means the entire coefficient on the independent variables is zero or none of the independent variables help to predict the dependent variable.

But, as it is shown in the above ANOVA table p- value for both is 0.000 and which is less than 0.05 and it is statically significant. So we conclude that there is very strong evidence to reject the null and accept the alternative. Since the p-value is statically significant we can say that there is supported relationship between supply chain management practices and organizational performance (competitiveness).

Table 4.16: Regression coefficient /output/ between SCM practices and ORP

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
1 (Constant)	0.790	.569		6.133	.000
SSP	-.311	.155	-.317	-2.008	.049
MRSCM	.093	.118	.104	.789	.433
LIS	.063	.104	.082	.605	.547
LIQ	.309	.125	.331	2.466	.016
ILP	-.121	.119	-.129	-1.019	.312

a. Dependent Variable: Organizational performance

The above coefficient matrix table tells us about the relationship between independent variables (operational performance) and dependent variables (organizational performance). By default the null hypothesis t test in the regression analysis is that the coefficient in the independent variables is zero or the independent variable does not help the dependent variable.

From the above regression analysis table we can see that, the p value for Strategic supplier partnership (SSP) and Level of information quality (LIQ) is less 0.05 and it is statistically significant. So we have strong reason to reject the null hypothesis which says the coefficient is zero and accept the alternative. So we can say that Strategic supplier partnership (SSP) and Level of information quality (LIQ) has significant contribution to the competitiveness of EAL.

However, the p value for MRSCM, LIS and ILP are greater than 0.05 and it is statistically insignificant. As we can see in coefficient matrix table, even if, the coefficient in the independent variable different from zero, since the p value for the above mentioned independent variables greater than 0.05, we have a reason to accept the null and reject the alternative hypothesis.

The regression equation between supply chain management practices and organizational performance can be written as follows:

$$ORP = 0.79 - 0.311SSP + 0.093 MRSCM + 0.063 LIS + 0.309LIQ - 0.121ILP + \epsilon$$

4.4.4. Regression Analysis between operational and Organizational performance

In this sub topic the variability of organizational performance due the change operational performance indicators (Time to market, Quality of the product delivered, Price or cost, and product delivery dependability) is analyzed as follows.

Table 4.17: Regression analysis between operational performance indicators and ORP

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.525 ^a	.276	.380	.50443

a. Predictors: (Constant), Time to market, Price, Quality, Delivery dependability

The above model summary table 4.17 shows us the regression analysis between operational and organizational performance. From the table, we can see that operational performance has positive linear relationship with the correlation coefficient value of 0.525. And the adjusted R Square value also depicted that, 38% of the total variability in organizational performance is explained by operational performance.

Table 4.18: Regression analysis ANOVA table between OPP and ORP

ANOVA^a

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	21.281	4	5.07	8.276	.000 ^b
	Residual	27.557	69	.354		
	Total	36.838	73			

a. Dependent Variable: Organizational performance

b. Predictors: (Constant), Time to market, Price, Quality, Delivery dependability

As it is shown in the above ANOVA table p- value is 0.000 and which is less than 0.05 and it is statically significant. And, we can say that there is supported relationship between operational performance (competitiveness) and organizational performance.

Table 4.19: Regression coefficient /output/ between OPP and ORP

Coefficients^a

Model		Unstandardized		Standardized Coefficients Beta	T	Sig.
		B	Std.			
1	(Constant)	.831	.407		2.043	.036
	Price or cost	-.041	.105	-.040	-.393	.695
	Quality	.095	.085	.107	1.125	.263
	delivery dependability	.435	.106	.442	4.109	.000
	Time to market	.248	.082	.308	3.028	.002

a. Dependent Variable: Organizational performance

The above coefficient matrix table tells us about the relationship between independent variables (operational performance) and dependent variables (organizational performance). By default the null hypothesis t test in the regression analysis is that the coefficient in the independent variables is zero or the independent variable does not help the dependent variable.

From the above regression analysis table we can see that, the p value for product delivery dependability (PDD) and time to market (TTM) is less 0.05 and it is statistically significant. So we have strong reason to reject the null hypothesis which says the coefficient is zero and accept the alternative. So we can say that product delivery dependability (PDD) and time to market (TTM) has significant contribution to the competitiveness of EAL.

However, the p value for price and quality of the product delivered (QPD) are greater than 0.05 and it is statistically insignificant. As we can see in coefficient matrix table, even if, the coefficient in the independent variable different from zero, since the p value for the above Mentioned independent variables greater than 0.05, we have a reason to accept the null and reject the alternative hypothesis.

The regression equation between operational performance and organizational performance can be written as follows:

$$ORP = 0.831 - 0.041Price + 0.095Quality + 0.435DDY + 0.248TTM + \epsilon$$

To present the result descriptively, the average respondents were neutral about the supply chain management practice EAL Company with mean value of 3.52. However, the respondents have relatively higher mean value for operational performance with the mean value of 3.59. This implies that the company has relatively better operational performance /competitiveness/ with minimum supply chain management practice. As we have seen in the introduction part of this

research, EAL is endowed with immense the resources and it is natural to have competitive advantage over the competitor. In general the survey revealed that even if, EAL is not undertaking proper supply chain management practices, the company have better operational performance /competitiveness/ especially interims price and quality of the product delivered.

Chapter Five

Summary, Conclusion and Recommendations

5.1. Introduction

This study wanted to explore the role of SCM practices on performance of Maintenance repair overhaul SCM in EAL. The researcher give answer for the research questions, what are the current supply chain management practices in MRO? How supply chain management Practice influence the operational performance of those Maintenance repair overhaul in EAL?, and How SCM practices affect supply chain related organizational performance of those Maintenance repair overhaul facilities through operational. Therefore this chapter gives the summary, conclusions, recommendations and suggestions for further research based on the results in chapter four.

5.2. Summary of the Findings

The results of the study provide important insights on supply chain management practices on performance of MRO in EAL. and the summary of this research finding is as follows

- The supply chain management practices that have been put in place by those of MRO in EAL: Strategic supplier partnership (M=3.5270, SD=.50268), MRO relation with SCM (M=3.6622; SD=.55584), Internal lean practice (M=3.5676; SD=.52554). These Supply chain management practices had mean scores greater the 3.50 and therefore the respondents agreed with the practice of those list of SCM practices in their facilities. However, the respondents are neutral in the supply chain management practice called Level of information sharing (IS) with (M=3.5000; SD=.64638), and Level of information quality (M=3.4865; SD=.52975) in their facilities since they fall in between 2.50 to 3.50.
- The Operation performance of MRO that is Price (M= 3.5811; SD= .54914), Quality (M= 3.6081; SD=.69868), and Delivery Dependability (M= 3.5270; SD= .57868), and time to market with (M= 3.6892, SD= .84279) their mean score is fall more than 3.50.
- I found that all of those Seven Supply Chain related organizational performance are answered in a rage of 3.50 to 4.50 that is they all agree (increase) on the six SC related organizational performances that is for the question Our Stabilization of consumer markets. (M= 3.76; SD= 1.018), our Customer satisfaction (M= 3.96; SD= .898), our Sales turnover and profit (M= 3.81; SD= 1.002), The growth of MRO service sale (M=3.57; SD= 1.195), Our MRO growth in return on investment (M= 4.05; SD= .964) and Our Overall MRO competitive position (M= 3.84; SD= .861). However, the respondents are neutral (same as before) in Employee satisfaction (M= 2.58; SD= 1.194) their mean score is fall in

between 2.50 to 3.50.

- SCM practices and operational performance have positive linear relationship regardless of their magnitudes. Except, the Level of information sharing (LIS) has weak correlated with organizational performance with correlation coefficient value of 0.160 at a significant value are greater than of 0.05.

- Strategic supplier partnership (SSP), MRO relation with SCM (MRSCM), level of information sharing (LIS), Levels of information quality (LIQ), and internal lean practice (ILP) are moderately correlated with organization performance with the correlation coefficient value of 0.414, 0.428, 0.415, 0.425 and 0.424 respectively. And the value is statistically significant, since its value is less than 0.01.

- Pearson correlation coefficient table 4.12, cost reduction /price competitiveness and quality of product delivered to customers have weak positive linear relationship with organizational performance with the correlation coefficient value of 0.237 and 0.253 respectively. And significant value is less than 0.05. On the other hand, product delivery dependability and the capability of the organization to deliver either the existing or new product to market faster than the industry average (time to market) have moderate positive linear relationship with organization performance with Pearson correlation coefficient value of 0.565 and 0.514 respectively. And significant value is less than 0.01.

- supply chain management practices have relatively higher Pearson correlation coefficient with operational/ competitive performance with the correlation coefficient value of 0.678 as compared to the linear relationship between supply chain management practices with organizational performance which has correlation coefficient value of 0.578 at a significant value of less than 0.01. Similarly, operational/competitive performances have moderate linear relationship with organization performance with the value of 0.564 at significant level of less than 0.01.

- SCM practices have strong positive liner relationship with operational performance with the r value of 0.779. And the adjusted R Square value depicted that, 58% of the total variability in operational performance is explained by supply chain management practices.

-SCM practices have Strong positive liner relationship with organizational performance with the r value of 0.649. And the adjusted R Square value depicted that, 68 % of the total variability in organizational performance is explained by supply chain management practices

-operational performance has positive linear relationship with the correlation coefficient value of 0.525. And the adjusted R Square value also depicted that, 38% of the total variability in organizational performance is explained by operational performance.

5.3. Conclusion

From the research findings, SCM practices implemented in EAL MRO include internal lean practice, Level of information sharing, Level of information quality, MRO relation with SCM, Strategic supplier partnership. From the correlation analysis we made in this research some of SCM practice in those MRO in EAL has an role on both operational performance and SCM related organizational performances. From the regression analysis done in this research we can conclude that SCM practice in EAL MRO facility affect both operational and SCM related organizational performances.

5.4. Recommendations

Based on the study results, the researcher give the following recommendations; firstly, aviation MRO facilities need to focus on SCM practices in order to improve their performance since those practices have an influence on both operational performance and SCM related organizational performances. Secondly, MRO aviation companies can use the finding of this result as a base for revising supply chain management strategies since in the MRO facility the list of the SCM practices which are implemented are very small in their numbers. Thirdly, MRO supply chain department officials should get a chance to update them self in logistics and supply chain management practices since if those officials have the required knowledge about the supply chain management practices it is easier to implement the necessary supply chain management practices in their facilities.

5.5. Limitation of the Study and Direction for future studies

The major limitation of the study is that the data was collected from one MRO facility therefore, requires further research covering various MRO sectors and taking into consideration the specific conditions in the company. So, this research has been cared only in one MRO facility due to resource limitation to do. Moreover, this study used only one MRO facility; future studies should consider expanding their scope to include other aviation MRO facilities. And also, further studies related to the supply chain management practice on MRO facilities can be conducted especially comparative studies between Maintenance repair overhaul SCM sections can be done.

References

- Arshinder, Arun Kanda and S.G. Deshmukh. 2008. "Supply chain coordination: perspectives, empirical studies and research directions", International Journal of Production Economics, 115(2): 316-335.
- AW&ST. 2013. "The MRO global leading players". Aviation Week and Space Technology, MRO Edition, Aviation Week Ranks. April 2013.
- Burgess, Kevin, Prakash J. Singh, and Rana Koroglu. 2006. "Supply chain management: a structured literature review and implications for future research", International Journal of Operations & Production Management, 26(7): 703-729.
- Carpenter, R., & Henderson, A. "Keep Them Flying: Find your winning position in the MRO game. IBM Global Business Services: <http://www-304.ibm.com/jct03004c/easyaccess/fileserve?contentid=174266>
- Chen, Injazz J. and Antony Paulraj. 2004. "Towards a theory of supply chain management: the constructs and measurements", Journal of Operations Management, 22(2): 119–150.
- CIM data. 2002. "Product lifecycle management: Empowering the future of business". Ann Arbor, MI. <http://doc.mbalib.com/view/8cb8b763acd25742ed7e72ad9ac29d01.html>
- Cochran, W. G. 1963. *Sampling Techniques, 2nd Ed.* New York: John Wiley and Sons, Inc. Israel
- Cooper, Martha C., Douglas M. Lambert, and Janus D. Pagh. 1997. "Supply chain management: more than a new name for logistics", The International Journal of Logistics Management, 8(1): 1-14.
- Croom, Simon, Pietro Romano, and Mihalis Giannakis. 2000. "Supply chain management: an analytical framework for critical literature review", European Journal of Purchasing & Supply Management, 6(1): 67-83.
- Dicken, Peter. 1986. "Global Shift: Industrial Change in a Turbulent World", Harper and Row: London.
- EFNMS. 2013. "MRO Definition". European Federation of National Maintenance Society. <http://www.efnms.org/>
- Ernst, D. and Kim, L. 2001. "Global production networks, knowledge diffusion and local capability formation: a conceptual framework"; paper presented at the Nelson & Winter Conference, Aalborg,

12–15 June.

Forrester, Jay W. 1958. *“Industrial dynamics: a major breakthrough for decision makers”*, Harvard Business Review, 36(4): 37-66.

Gereffi, Gary, John Humphrey, and Timothy Sturgeon. 2005. *“The governance of global value chains”*, Review of International Political Economy, 12(1): 78-104.

Gereffi, Gary, John Humphrey, Raphael Kaplinsky, and Timothy J. Sturgeon. 2001. *“Introduction: globalization, value chains and development”*, IDS Bulletin, 32(3): 1-8.

Gereffi, Gary. 1994. *“The organization of buyer-driven global commodity chains: How U.S. retailers shape overseas production networks”*, in: G. Gereffi and M. Korzeniewicz (eds.) Commodity Chains and Global Capitalism. Westport: Greenwood Press. pp. 95-122.

Henderson, Jeffrey, Peter Dicken, Martin Hess, Neil Coe, and Henry Wai-chungYeung. 2002. *“Global production networks and the analysis of economic development”*, Review of International Political Economy, 9(3): 436-464.

Hess, Martin and Henry Wai-chungYeung. 2006. *“Whither global production networks in economic geography? Past, present and future”*, Environment and Planning A, 38(7): 1193-1204.

IATA. 2009. *“Overhauling Maintenance, Repair and Overhaul (MRO)”*. <http://www.iata.org/publications/airlines-international/december-2009/Pages/08.aspx> (accessed 10 February 2014)

Kaplinsky, Raphael and Mike Morris.2002. *“A handbook for value chain research”*, Institute of Development Studies.

Kaplinsky, Raphael. 2000. *“Globalisation and unequalisation: What can be learned from value chain analysis?”*, Journal of Development Studies, 37(2): 117-146.

Kaplinsky, Raphael. 2004. *“Spreading the gains from globalization: what can be learned from value-chain analysis?”*, Problems of Economic Transition, 47(2): 74-115.

Kinnison, H. A. 2012. *“Aviation Maintenance Management”*.McGraw-Hill, New York, NY.

Lambert, Douglas M. and Martha C. Cooper. 2000. *“Issues in supply chain management”*, Industrial Marketing Management, 29(1): 65-83.

Lambert, Douglas M., Martha C. Cooper, and Janus D. Pagh. 1998. "Supply chain management: implementation issues and research opportunities", *The International Journal of Logistics Management*, 9(2): 1-20.

Marais, K. and Robichaud, M. 2012. "Analysis of trends in aviation maintenance risk: An empirical approach, *Reliability Engineering and System Safety*". School of Aeronautics and Astronautics, Purdue University, West Lafayette, IN.(accessed 10 April 2014).

McFadden, M. and ScottWorrells, D. 2012. "Global Outsourcing of Aircraft Maintenance". *Journal of Aviation Technology and Engineering*.

Melo, M.T., S. Nickel, and F. Saldanha-da-Gama. 2009. "Facility location and supply chain management- a review", *European Journal of Operational Research*, 196(2): 401–412.

Mentzer, John T., William DeWitt, James S. Keebler, Soonhong Min, Nancy W. Nix, Carlo D. Smith, and Zach G. Zacharia. 2001. "Defining supply chain management", *Journal of Business Logistics*, 22(2): 1-25.

Phillips, P., Diston, D. and Starr, A. 2011. "Perspectives on the commercial development of landing gear health monitoring systems". *Transportation Research. Part C* (19): 1339–1352.

PIPAME. 2010. "Le pôle interministériel de prospective et d'anticipation des mutations économiques, Maintenance et Réparation Aéronautique". Base de connaissances et évolution, available at: http://www.dgcis.gouv.fr/files/files/directions_services/etudes-et-statistiques/etudes/aeronautique_maintenance/aeronautique_maintenance.pdf

Porter, Michael E. 1985. "Competitive Advantage: Creating and Sustaining Superior Performance", The Free Press: New York.

Porter, Michael E. 1980. "Competitive Strategy: Techniques for Analyzing Industries and Competitors", The Free Press: New York.

Porter, Michael E. 1990. "The Competitive Advantage of Nations", The Free Press: New York.

Randall, W. S., Pohlen, T. L. and Hanna J. B. 2010. "Evolving a Theory of Performance Based Logistics Using Insights from Service Dominant Logic". *Journal of Business Logistics*, Vol. 31 (2): 35–62.

Safaei, N., Banjevic, D. and Jardine, A. 2011. "Workforce-constrained maintenance scheduling

for military aircraft fleet: A case study". Published online: 17 May 2011, Springer Science Business Media, LLC.

Shafiee, M. and Chukova, S. 2013. "*Maintenance models in warranty: A literature review*". European Journal of Operational Research, Vol. 229: 561–572.

Stadtler, Hartmut. 2005. "*Supply chain management and advanced planning- basics, overview and challenges*", European Journal of Operations Research, 163(3): 575-588.

Sturgeon, Timothy J. 2001. "*How do we define value chains and production networks?*", IDS Bulletin, 32(3): 9-18.

Tan, KeahChoon. 2001. "*A framework of supply chain management literature*", European Journal of Purchasing & Supply Management, 7(1): 39-48.

Viles, E., Puente, D., Alvarez, M. J. and Alonso, F. 2007. "*Improving the corrective maintenance of an electronic system for trains*". Journal of Quality in Maintenance Engineering, Vol. 3, pp. 75–87.

Womack, J. P. and D. T. Jones. 1996. "*Lean Thinking: Banish Waste and Create Wealth in Your Corporation*", Simon & Schuster: New York.

**Addis Ababa University School of Commerce Masters of Art in Logistics and
Supply Chain Management**

**Questionnaire on “The Role of Maintenance repair overhaul Supply Chain
Management in an operational and organizational Performance”:**

The case of Ethiopian airlines

Dear Respondents,

This questionnaire is designed to explore the “**The Role of Maintenance repair overhaul Supply Chain Management in an operational and organizational Performance**”: **The case of Ethiopian airlines**. This study is conducted in partial fulfillment of the requirements for the Master’s degree in Logistics and Supply Chain Management at Addis Ababa University. Its main objective is to assess the role of supply chain management practices on performance of MRO in EAL. Your response is vital to the outcome of the study and you are requested to completely and objectively answer all questions. The research is going to be carried out based on your responses and other relevant data that could support it. It forms a major part of the research and the information will enable the researcher to critically analyze the supply chain management practices on performance of MRO in EAL. So, please answer all questions. Space is provided at the end of the questionnaire for you to add further explanations or comments. I would promise that all information you provide would be strictly confidential.

Please tick (✓) or provide your own answers where applicable.

Thank you in advance for your indispensable cooperation to spare invaluable time and energy to complete these questionnaires.

Name: Million Wondimu a student at AAU Commercial College

Email: millionwo18@gmail.com

Questionnaire No: _____

Date: _____

PART1. General Information and Demographic Background of Respondents in the Selected Samples of MRO sections in EAL.

1.1. Gender

Male

Female

1.2. Age Bracket

Less than 27 Years

28-39 Years

40-49 Year

50-59 Years

Over 59 Years

1.3. Educational Qualification

Certificate

Diploma

BA/BSC Degree

MSc/ MA

Other Specify _____

1.4. Your Position in the MRO sections in EAL

Team Leader

Manager

Procurement officer

Logistics officer

Material controller

Material Planner

Sourcing officer

Air Craft Technician

Engineer

Other Specify _____

1.5. How many years have you been employed in this MRO sections?

1-5 Years

6-10 Years

11-15 Years

Over 15 Years

Part II: Instruments for supply chain management practices, operational performance and organizational performance

SECTION 1: SUPPLY CHAIN MANAGEMENT PRACTICES

The following questions are about how EAL has been implementing supply chain management practices. Please circle the appropriate number to indicate the extent to which you agree or disagree with each the following statement based on your experience working in this company. The item scales are five-point Likert type scales with 1 = strongly disagree (SD), 2 = disagree (D), 3 = neutral (N), 4 = agree (A), 5 = strongly agree (SA)

No	Strategic supplier partnership	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	SCM department go straight to the OEM to purchase aircraft parts	1	2	3	4	5
2.	SCM department are very strong when they negotiate their price with vendors	1	2	3	4	5
3.	SCM department used to make sure that no other company is getting similar ender products at the same low price	1	2	3	4	5
4.	SCM department assessed, developed and selected suppliers systematically	1	2	3	4	5
5.	SCM department purchase aircraft parts from few dependable and high quality suppliers	1	2	3	4	5
6.	SCM department used to monitor the usage of applicable procurement laws and standards	1	2	3	4	5
7.	SCM department has procedures and/or a program in place to ensure information is disclosed in accordance with applicable laws and regulations (e.g. complying with insider trading rules, protection of intellectual property)	1	2	3	4	5
8.	SCM department has procedures and/or a program in place to ensure that fair business, advertising, and competition are upheld (complying with anti-trust and fair competition laws)	1	2	3	4	5
9.	SCM department used to regulation body (FAA & EASA) operation instruction for production of quality products.	1	2	3	4	5
10.	SCM department consider quality as number one criterion in selecting suppliers	1	2	3	4	5
11.	SCM department has a procedure for inspection, analysis of test result, to handle non-conforming products, to clarify measures and to approve decisions.	1	2	3	4	5
12.	SCM department strive to establish long term relationship with its suppliers	1	2	3	4	5
13.	SCM department provided information to the suppliers for improving their products quality.	1	2	3	4	5

	SD	D	N	A	SA
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14.	SCM department has continuous improvement programs that include its key suppliers	1	2	3	4	5
15.	SCM department include its key suppliers in its planning and goal setting activities	1	2	3	4	5
16.	SCM department verifies its suppliers about their liability their performance and product quality.	1	2	3	4	5
17.	SCM department regularly solve problems jointly with its suppliers	1	2	3	4	5

No	Maintenance , component & Technical department (Users) relationship	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	SCM department frequently interacts with customers to achieve reliability, responsiveness, and improve some basic standards	1	2	3	4	5
2.	SCM department has frequent follow-up with its users for quality/service feedback	1	2	3	4	5
3.	SCM department frequently measures and evaluates customer satisfaction	1	2	3	4	5
4.	SCM department regularly determine future user expectations	1	2	3	4	5
5.	SCM department frequently evaluates the formal and informal complaints of its users	1	2	3	4	5
6.	SCM department periodically evaluates the importance of its relationship with its users	1	2	3	4	5

No	Level of information sharing	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	SCM department and trading partners keep fully informed each other about events or changes that may affect every one of us.	1	2	3	4	5
2.	SCM department trading partners share business knowledge of core business processes with us.	1	2	3	4	5
3.	SCM department and its trading partners exchange information that helps establishment of business planning	1	2	3	4	5

No	Level of information quality(Between SCM department and user department)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Information exchange is timely	1	2	3	4	5
2.	Information exchange is accurate	1	2	3	4	5
3.	Information exchange is complete	1	2	3	4	5
4.	Information exchange is adequate	1	2	3	4	5
5.	Information exchange is reliable	1	2	3	4	5

No	Internal lean practices	strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	SCM department strives to reduce time wastage in operations	1	2	3	4	5
2.	SCM department has continuous quality improvement program	1	2	3	4	5
3.	SCM department supplies only what has been ordered by users	1	2	3	4	5
4.	SCM department pushes suppliers for shorter lead times (Shorter TAT)	1	2	3	4	5
5.	SCM department stream lines ordering, receiving and other paper work from its suppliers	1	2	3	4	5
6	We use minimum inventories of aircraft component spare units & parts for our day to day activities in our operation	1	2	3	4	5

Section two: operational performance

With regard to operational performance of MRO in EAL, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement. The item scales are five-point Likert type scales with 1=strongly disagree (SD), 2=disagree (D), 3=neutral (N), 4=agree (A), 5=strongly agree (SA)

No.	Price /cost	strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	EAL MRO is able to offer prices as low or lower than its	1	2	3	4	5
2.	EAL MRO capacity utilization is very good.	1	2	3	4	5
3.	EAL MRO Inventory turnover is high.	1	2	3	4	5
4.	EAL MRO run operation with less aviation industry cost.	1	2	3	4	5
5.	EAL MRO service price is that competitive than others	1	2	3	4	5

Quality: an organization is capable of offering product quality and performance that creates higher value for customers.

No.	Quality	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	EAL MRO are able compete based on quality.	1	2	3	4	5
2.	EAL MRO products are highly reliable based on repair occurrence.	1	2	3	4	5
3.	EAL MRO products are very durable.	1	2	3	4	5
4.	EAL MRO offer high quality service to our customer.	1	2	3	4	5

Delivery dependability: an organization is capable of providing on time the type and volume of product required by customer(s).

No.	Delivery Dependability	strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	EAL MRO delivers the kind of service needed.	1	2	3	4	5
2.	EAL MRO delivers customer order on time.	1	2	3	4	5
3.	EAL MRO provides dependable delivery.	1	2	3	4	5
4.	Time to solve customer complaints is short.	1	2	3	4	5
5.	Customer order processing time is short.	1	2	3	4	5

Time to market: an organization is capable of introducing new products faster than major competitors

No.	Time to market	strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	EAL MRO delivers service to market quickly.	1	2	3	4	5
2.	EAL MRO have time-to-market lower than industry average	1	2	3	4	5

Section Three: organizational performance

Regarding organizational performance, please circle appropriate number which best indicate Ethiopian airlines in Maintenance repair overhaul's overall performance. The item scales are five-point Likert scales with 1=significant decrease, 2=decrease, 3=same as before, 4=increase, 5=significant increase.

No.	Attainment of intended objective	significant decrease	decrease	Same as before	increase	significant increase
1.	Stabilization of consumer markets in MRO	1	2	3	4	5
2.	MRO Customers satisfaction	1	2	3	4	5
3.	EAL Air craft and Engine Maintenance repair overhaul Sales turnover and profit	1	2	3	4	5
4.	Employee satisfaction (minimization of employee turnover, investment development and training, wages and reward policies, career plans, organizational climate)	1	2	3	4	5
5.	The growth of service sales in MRO	1	2	3	4	5
6.	Growth in return on investment in MRO facility	1	2	3	4	5
7.	Overall MRO competitive position	1	2	3	4	5

If you have any other comments please state on the below blank space:-

Thank you!!!