THE ROLE OF SUPPLY CHAIN MANAGEMENT PRACTICESINOPERATIONAL PERFORMANCE OF MRO; THE CASE OF ETHIOPIAN AIRLINES

By

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DECLARATION

I, Misgana Tamyalew, declare that this paper is a result of my independent research work on the topic entitled “The role of supply chain management practices in the operational performance of MRO, The case of Ethiopian airlines” in partial fulfillment of the requirements for the Degree of Masters of Art in Logistics and Supply Chain Management at Addis Ababa University, School of commerce.This work has not been submitted for a degree to any other university. All the references are also duly acknowledged.

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Date**_____**

CONFIRMATION

This is to certify that Misgana Tamyalew has carried out this research work on the topic entitled “The role of supply chain management practices in the operational performance of MRO, The case of Ethiopian airlines’’ under my supervision. This work is original in nature and has not been presented for a degree in any university and it can be submitted for the partial fulfillment of the requirements for the award of the degree of Masters of Art in Logistics and Supply Chain Management.

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Dr. Tariku Jebena

Date _____

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ABSTRACT

Supply chain management (SCM) is one of the most important tools that companies use to develop their performances. The basic objective of this research was to study the role of SCM Practices inthe operational performance of the ET MRO. To study the role of supply chain management practices in theoperational performance, five key dimensions of SCM practices (Customer relationshipmanagement, supplier relationshipmanagement, internal integration, information sharing and information quality) were used as independent variables, while time and quality variables were used as an indicator of theoperational performance. A sample of 117 employees was taken from a target population of 516 employees. Aquestionnaire and interview were used as a research tool for the collection of data. Baseline data was found from some key informants and also from secondary data.Collected data were analyzed through SPSS version 23 by running frequencies, mean score and linear regression. Main findings of the study revealed that there is a high level of practical implementation of SCM practices specially on the important dimensions' customer relationship management and internal integration in the Ethiopian airlinesSCM and that they all have a significant and positive effect in the operational performance of the ET MRO, that is they improved the organization's performance in terms of lowering the TAT of aircrafts and components and that improving the maintenance quality. A combination of all the five practices studied had a stronger effect on MRO performance.

Keywords: Operational performance, Supply chain management, Supply chain management practices

Table of Content

List of Tables

Table **Page**

List of Figures

Figure **Page**

Acronyms and abbreviations

AMT: Aircraft Maintenance

ET: Ethiopian Airlines

MEL: Minimum Equipment List

MRO: Maintenance Repair and Overhaul

MRP: Material Requirement Planning

OEM: Original Equipment Manufacturer

RSPL: Recommended Spare Parts List

SCM: Supply Chain Management

SCM P: Procurement and Supply Chain Management Practice

TAT: Turnaround time of components

WFP: Waiting For Part

CHAPTER ONE

Introduction

The main topics of this introduction part are background of the study, statement of the problem, research questions, research objectives, significance of the study, scope of the study, definition of key terms, and organization of the study.

1.1. Background of the Study

The successful implementation of SCM practices provides opportunities to improve operational performance along the supply chain (Harrison and New, 2002). For example, Tan *et al.* (1998) empirically found that customer relations and purchasing practices impact the effectiveness of SCM strategy and lead to financial and market performance. Frohlich and Westbrook (2001) studied the impact of supplier and customer integration to company's performance. They identified five different integration strategies: inward-facing, periphery-facing, supplier-facing, customer-facing, and outward facing. These strategies represent the various degrees of integration with suppliers and customers. They found that companies with broader supply chain integration – with customers and suppliers showed the largest performance improvement. Vickery *et al.* (2003) found that the relationship between supply chain integration with financial performance was indirect and fully mediated by customer service performance. In addition, Li *et al.* (2006) studied the impact of SCM practices on organizational performance and competitive advantage. They found that SCM practices as a multidimensional concept cover upstream and downstream supply chain as well as internal supply chain. Li *et al* (2006) study showed significant impact of SCM practices to organizational performance and competitive advantage.

The aviation sector handles items, which are capital-intensive. The items also involve a huge number of components. A lot of these components are moving, creating challenges to track the inventory accurately. The value of the inventory items is in rotable parts. These issues make supply chain management all the more challenging for the aviation industry. The SCM system ensures not only optimized inventory, stock, streamlined procurement and improvised operations but also results in improved turnaround time from vendors, better warranty and contract

managements resulting in overall performance gains for aviation companies. The turnaround time for unplanned maintenance also improves significantly. The gaps between demand & supply can be closed leading to a lean inventory with automated replenishment (Kreyon,2015).

Ethiopian Airlines often referred to as simply Ethiopian or ET, is Ethiopia's flag carrier which is wholly owned by the country's government. Ethiopian was founded on 21 December 1945 and commenced operations on 8April1946, expanding to international flights in 1951. During the past seventy plus years, it has become one of the continent's leading carriers, unrivalled in Africa for efficiency and operational success, turning profits for almost all the years of its existence. (Ethiopian Fact Sheet, 2018).

Ethiopian Airlines has a dedicated section called Supply Chain Management (SCM) divisionwhich provides services to a companywide under a matrix organizational structure functionally under the Chief Financial Officer and administratively under the Managing director MRO Svcs. It's fully charged with the responsibility of maintaining and operating an effective and efficient supply chain. The supply chain section handles the entire goods requirement for the company. It sources for and purchase commercial stores items, aircraft spares, in-flight consumables, capital assets as well as items required for office use (Ethiopian Fact Sheet, 2018).

Some of the functions of this section include; developing, implementing and reviewing of the purchasing policy, procedures and strategy to ensure all purchases deliver best value, source goods & services that meet ET quality standards for smooth operation of the business, carry out periodic cost/benefit analysis on purchasing methods to ensure best options are used to achieve quality goods and services and value for money, ensure stake- holders adhere to laid down purchasing procedures and policy to improve current practices, which will in turn bring down costs. Others include, negotiate best price and terms of contracts with suppliers to achieve savings, maintain supplier contracts/agreements' records to ensure timely renewals/termination and supplier rationalization, development and performance rating to ensure timely deliveries and quality assurance including authorizing additions / deletion of new/existing suppliers.

Supply Chain management practices employed by the company include, planning, warehousing, purchasing, forecasting, strategic sourcing and contract administration, customer database management and materials logistics. In order to achieve effectiveness and efficiency, the supply

chain section has embarked on an aggressive performance evaluation for each supply chain activity.

1.2. Statement of the Problem

In recent years, the aviation industry has started facing unprecedented challenges in terms of reducing maintenance costs, maintain inventory levels, and delivering high levels of service. In this capital-intensive environment, service providers in the aviation industry are leveraging the use of effective supply chain management practice to forecast the customer requirements, analyze the demand patterns, and determine the accuracy of stocks. Moreover, with the surge in the maintenance costs, implementing effective supply chain management also helps the service providers to keep track of the maintenance in terms of the cost associated with components, time, and labor materials. The transportation and logistics industry heavily relies on the supply chain to effectively monitor and keep track of their current activities. A leading aviation industry client wants to leverage effective supply chain management solutions to optimize their operational efficiency and deliver better service to the customers (Infiniti Research, 2018).

The airline industries are increasingly focused towards reducing the maintenance costs, keeping a high level of inventory accuracy & deliver high levels of service. The sector handles items, which are capital-intensive and the items also involve a huge number of components. A lot of these components are moving, creating challenges to track the inventory accurately. These issues make supply chain management all the more challenging for the aviation industry (Kreyon, 2015).

Disruptions in an aviation company's supply chain can equate to millions of dollars in losses, so effective MRO in aviation requires the best practice of supply chain management with sophisticated coordination of suppliers, parts, inventory levels and logistics(Victoria,2017).

Today the Ethiopian airlines experiences different operational disruptions like flight cancellations, flight delays and extension of aircraft maintenance schedules, maintenance task deferrals(carryovers) and long turnaround times(TATs) of component maintenancesin the shops which may partly be contributed by the supply chain management practice of the company.

Referring to the six months' delay report from Sep2018 to Feb2019, there were a total delay of 178hrs on B787, 60hrs on B767, 56.57hrs on B737 and 28.23hrs on A350. From all these delay logs 23% of the delay on B787, 37% on B767, 29% on B737 and 28% on A350 were accounted to parts failure.

Based on the six months' record of waiting for parts from Sep2018 to Feb2019, 37 components in emergency shop, 155 in electric shop, 17 in instrument shop, 415 in IFE and radio shop, 23 in fuel shop, 31 in hydraulic shop. 37 in pneumatic shop, 9 in interior shop and 12 in harness shop were kept as unserviceable due to parts shortage to do the repairs.

Again based on the six months' part deferral or carryover report from Sep2018 and Feb2019, a total number 749 repair tasks on different fleets were deferred or pushed to another schedules till the required parts are availed to undertake the repairs.

From anecdotal information, there are number of challenges faced by supply chain management department which hampers it to provide full and quality service to the maintenance section. Among these problems the inventory management system, the inaccurate demand forecasting or material planning process and weak supplier relationship management can be listed. As the supply chain management practice may contribute for the operational performance and wellbeing of all airlines,a due attention has to be given to the problematic areas. In this regard, to undergo a research will be very important to assess the root causes of the problem and get the problem rectified.

The main purpose of this research study is to investigate the role of SCM practicesin operational performance of the maintenance, repair and overhaul (MRO). Moreover, the study recommends how to implement best supply chain management practice for the overall operational performance of the MRO.

1.3. Research questions

In order to achieve the aforementioned objectives, this study answered the following research questions:

1. How supply chain management is being practiced in the Ethiopian airlines MRO?
2. How do the SCM practices affect the operational performance of ET MRO?

1.4. Objectives of the study

1.4.1. General Objectives

The general objectives of this research was to assess the role of the supply chain management practices (SCM P) in the operational performance of the Ethiopian MRO (ET MRO).

1.4.2. Specific objectives of the study

The specific objectives of the study were the following:

1. To examine the current supply chain management practicesofETPSCM
2. To assess the effect of the SCM P in the operational performance of ET MRO

1.5. Significance of the study

This study provides helpful information to various stake holders and mainly the Ethiopian MRO will benefit from the study as a source of information and foundation for a better design of policies that can help to improve and control performance of the maintenance by putting the best supply chain management practice in to place.

The findings from the study may particularly be useful in providing additional knowledge to existing and future organizations to understand the supply chain management practice of Ethiopian airlines.

This study may also be beneficial to other operators since they would enhance the realization on the best supply chain management practices that are majorly employed or recommended. With a good supply chain practice, airline's management can lower operational expenses with timelier planning for procurement and improvement in services. The findings may also provide a useful reference document to stake holders in the supply chain management practice and academic institutions in their endeavors to formulate work plan to meet the operational requirement.

This study is also significant in terms of providing the necessary resource in light of the possibility of future research projects that might be proposed or carried out in the same area.

1.6. Scope of the Study

The scope of the study is limited to supply chain management practicesof Ethiopian Airlines(ET) in the maintenance, repair and overhaul(MRO) division. It has examined and gave specific emphasis on the effect of SCM P on the operational performance contributed by the MRO division only to the overall operation.The study does not consider operational disruptions caused by non-avoidable factors such as natural disaster, strike actions, crew logistics, civil unrest and other causes not related to mechanical and technical problems of the aircraft. The study focuses on the supply chain management practice which are directly associated with MRO with aircraft part or materials requirement.

The researcher consideredEthiopian MRO in the Ethiopian airlines located at bole international airport due to budget and time limitations.

1.7. Definition of key terms and concepts

1. **Customer**: In this thesis, the term customer is used to refer "The Maintenance Department"
2. **Internal integration**: In this thesis, the term internal integration is used to refer *"Integration within ET SCM and ET SCM with Maintenance"*
3. **Timeliness**: In this thesis, the term timeliness is used to refer *"To complete the maintenance of aircraft or component per the predetermined scheduled time"*
4. **Quality**: In this thesis, the term quality is used to refer *"The quality of the maintenance"*
5. **Turnaround time (TAT):** In this thesis, the term TAT is used to *refer "The total duration of time to return an aircraft or component from repair to service''*
6. **Deferred maintenance:** As per 14 CFR 91.213, "Inoperative instruments and equipment," which is largely about something called a minimum equipment list (MEL).
7. **MEL:** is defined in Advisory Circular 91-67 as a precise listing of instruments, equipment, and procedures that allows an aircraft to be operated under specific conditions with inoperative equipment.

1.8. Organization of the Study

The thesis report is organized into five chapters. Chapter oneis a general introduction to the problem and includes the objective of the research along with the significance and scope of the study. Chapter two deals with the review of related literatureconsisting of theoretical, empirical, conceptual frame work and identified literature gaps in the studieswith sufficient details. In chapter three the research approach, research design and sampling techniques employed are presented. Chapter four discuses about the data presentation, analysis and interpretation.Finally, chapter five presentedsummary of findings, conclusion and recommendations with proposed strategy.

CHAPTER TWO

Related Literature Review

2.1 Introduction

Under this part the researcher broadly discussesthe theoretical, empirical and identified literature gaps specific to concepts and ideas of supply chain management practice and operational performancewith the aim of understanding it's theoretical background according to different international scholars.

2.2 Review of Concepts and Theories

2.2.1 The concepts, nature and practices of SCM

The field of Supply Chain Management (SCM) was born to manage the flow of information, products and service across a network of customers, enterprises and supply chain partners (Russel and Taylor, 2009). And since its introduction as a concept in the 1980s, supply chain management has undergone significant changes and extensions. Many authors attribute the foundations of SCM to the historical evolution of the logistics. Analysis of SCM literature reveal that there are many views of supply chain management, but academic textbooks and researchers in the field of logistics and supply chain management typically adopt the Council of Supply Chain Management Professionals (CSCMP) definition, "Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities" (Mihai and Irina, 2013).

The concept of "supply chain" is well established in the literature and is generally referred to as the alignment of firms that bring products or services to market (Lambert *et.al*, 1998).The supply chain includes manufacturer, suppliers, transporters, warehouses, wholesalers, retailers, other intermediaries and even customers themselves. Any product traded on the consumer goods market, in its evolution from raw material to finished products, undergoes a series of successive transactions on the business to business market (Caescu and Dumitru, 2011). Chopra and Meindl (2007) believes that "a supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. Within each organization, such as a manufacturer, the supply chain

includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service". Chen and Paulraj (2004) stated that a typical supply chain is a network of materials, information, and services processing links with the characteristics of supply, transformation and demand. Supply chain management consists of all parties including manufacturer, Marketer, Supplier, transporter, warehouses, retailers and customers directly or indirectly involved in fulfillment of a customer requirement. The main objective of supply chain management is to improve the overall organizational performance and customer satisfaction by improving product or service delivery to consumer (Deepak, 2014).

The examination of definitions, key and derived concepts resulted in the identification of four major criteria: management activities; logistics activities, objective and components (Mihai and Irina, 2013). Here is a summary presented with the definition of SCM related to each criterion.

Table 2.2 The four major criteria of Supply Chain Management concept, Source: Mihai and Irina, (2013)

Criteria	Concepts	Definition
1. Management activities	*Key Concepts*: planning, organizing, implementing, motivating, controlling *Derived Concepts:* goods, services, efficiency	SCM consist in planning organizing, implementing, motivating and controlling efficiently of all the activities involved in movement of goods and services from the first supplier to the ultimate customer.
2. Logistics activities	*Key Concepts*: transportation, processing, storage *Derived Concepts*: raw materials, work-in-process inventory, finished goods	SCM includes transportation, processing and storage of raw materials, work-in-process inventory and finished goods from initial extraction stage to the final customer.
3. Objectives	*Key Concepts*: value, customer requirements, trust, competitive advantage, relationships *Derived Concepts:* sustainable, long term	SCM include a number of value-added processes designed to satisfy customer requirements, to establish a long term relationships, to build the trust among the supply chain partners and to achieve a sustainable competitive advantage.
4. Components	*Key Concepts*: suppliers, manufacturers, warehouses, stores *Derived Concepts:* products, services	SCM encompasses suppliers, manufacturers, warehouses, stores and other intermediaries that are involved in the movement of products and services from point-of-origin to point-of-consumption.

The practice of SCM refers to complete set of actions which are done in organizations towards improving the effectiveness in the internal supply chain. The modern evaluation of the SCM practices that comprises of partnership with the supplier, process of outsourcing, compression of cycle time, continuousness of process flow and sharing of technology and information by using purchasing the quality and relations with the customer SCM practices are defined as a set of activities undertaken in an organization to promote effective management of its supply chain (Tan et al., 1998). Supply base management refers to how firms utilize their suppliers processes, technology and capabilities to enhance supply chain performance and competitive advantage and how the manufacturing, logistics , materials , distribution and transportation functions are coordinated within organizations (Lee, 1992). Also Mentzer (2001) state that SCM in practice includes the involved companies planning and strategy for coordination of their supply chain, including collaboration between functions internally as well as across company. SCM practices are defined also as approaches applied in managing integration and coordination of supply, demand and relationships in order to satisfy consumers in effective and profitable manners. A recent study found that firms often use supplier evaluation or performance measurement to identify specific supplier deficiencies and to develop plans to address them. Such efforts may involve the measurement of supplier's delivery, quality, and cost performance, site visits, certification of supplier's products and processes, and the setting of performance goals (Krause & Scannell, 2002).

The six aspect of the SCM practices are, integration of SC, sharing of information, characteristics of supply chain management of client services, physical proximity also the capabilities of just in time (J.I.T), relationship in long-standing communication, cross functional team and participation of vendor for the purpose of measuring the relationship of supplier and buyer strategic supplier partnership with the supplier (Chen & Antony, 2004). It is explained as the long-term based association between company and the supplier. The purpose is achieving the long term based benefits in the way of achieving the organizational benefits (Stuart, 1997). It provides the organizations with the supplier and they help the organization in the process of planning and solving any problem. It enables the organization to work effectively and efficiently with the key supplier who are ready to bear the responsibility about the winner or failure of the product and the services. The supplier involvement to designing process of the product and services could be cost efficient (Tan et.al ,2002). Customer relationship involves about the managing, the complaints of

the customers and fast solutions to their problems. This helps the organization for maintaining the long term and good relationship with the customers. The present study, therefore, proposes SCM practices as a multi-dimensional concept. A more detailed discussion of these dimensions is provided below.

2.2.1.1 Customers Relationship Management

Customer relationship comprises the entire array of practices that are employed for the purpose of managing customer complaints, building long-term relationships with customers, and improving customer satisfaction (Claycomb *et.al*,1999).Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements, and strive to exceed customer expectations. Customer relationship management (CRM) is an important component of SCM (Gharakhani *et.al*, 2012). A firm's customer relationship practices can generate the organizational success in supply chain management practices efforts as well as its performance. Customer relationship management can be seen as the consistent organizational activity under usage of integrated selling, marketing and service strategy. That is, trying to define the real need of the customer, by the enterprise integrating various process and technology, in asking internal product and service improvement, in order to dawn effort of enhancing customer satisfaction and loyalty (Ruben & Lauri, 1999). Noble (1997) and Tan *et al*. (1998) consider customer relationship management as an important component of SCM practices. As pointed out by Day (2000), committed relationships are the most sustainable advantage because of their inherent barriers to competition. The growth of mass customization and personalized service is leading to an era in which relationship management with customers is becoming crucial for corporate survival (Wines,1996). Good relationships with supply chain members, including customers, are needed for successful implementation of SCM programs(Moberg, 2002). Close customer relationship allows an organization to differentiate its product from competitors, sustain customer loyalty, and dramatically extend the value it provides to its customers (Magretta, 1998).

2.2.1.2 SuppliersRelationship Management

Supplier's partnership represents the long-term relationship between the organization and suppliers. It is designed to leverage the strategic and operational capabilities of individual participating organizations to help them achieve significant ongoing benefits (Stuart, 1997). A strategic partnership emphasizes direct, long-term association and encourages mutual planning and problem solving efforts (Gunasekaran, 2001). Such strategic partnerships are entered into to promote shared benefits among the parties and ongoing participation in one or more key strategic areas such as technology, products, and markets (Yoshino,1997). Strategic partnerships with suppliers enable organizations to work more effectively with a few important suppliers who are willing to share responsibility for the success of the products. Suppliers participating early in the product-design process can offer more cost effective design choices, help select the best components and technologies, and help in design assessment(Tan,2002).Strategically aligned organizations can work closely together and eliminate wasteful time and effort (Balsmeier,1996). An effective supplier partnership can be a critical component of a leading edge supply chain (Noble,1997).

2.2.1.3 Internal integration

Internal integration is the extent to which business functions work cooperatively and interact through cross-functional process integration to resolve conflicts and achieve mutual goals (Danese *et al*., 2013; Pagell, 2004).

The link between external and internal integration has been frequently debated in SCI literature. There seem to be various views on the relationship. One group of authors argue that when internal integration is preceded by external integration it has a positive effect on business performance of individual firms within a supply chain in terms of enhanced product/service offerings, growth and profitability (Min andMentzer, 2004; Croxton *et al*., 2001; Stevens, 1989). Yet other authors mean that, although internal integration is essential for external integration, external integration can represent an incentive to pursue internal integration. In other words, the external integration demonstrated by interaction with suppliers and customers can stimulate internal integration (Halldórsson *et al*., 2008; Rodrigues *et al*., 2004). On the other hand, Richey *et al*. (2010) suggest focusing simultaneously on external and internal integration as they are interlinked. This view

corresponds to Stank *et al*. (2001) in that the best practice firms work simultaneously with external and internal integration.

Richey *et al*., (2010) discuss implementation barriers such as unidirectional information flow, functional goals incongruence, and lacking customer orientation. Moreover, to integrate without having a clear focus can negatively impact performance (Springinklee and Wallenburg, 2012). It can be argued that the deficiencies in either of the integration types can influence negatively both individual firm performance as well as the overall performance of a supply chain. Therefore, Ralston *et al*. (2015) emphasize that organizations may need to reconsider why and how they integrate externally and internally.

The basis of integration can therefore be characterized by cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes. The extent of integration can begin with product design, and incorporate all steps leading to the ultimate sale of the item transportation and distribution, modern materials handling, some authors also include all activities throughout the useful life of the product including service, reverse logistics and recycling (Ballou, 2000).

2.2.1.4 InformationQuality

Quality of information sharing includes such aspects as the accuracy, timeliness, adequacy, and credibility of information exchanged (Monczka, 1998). While information sharing is important, the significance of its impact on SCM depends on what information is shared, when and how it is shared, and with whom (Chizzo,1998). Literature is replete with example of the dysfunctional effects of inaccurate/delayed information, as information moves along the supply chain (Lee,1997). Divergent interests and opportunistic behavior of supply chain partners, and informational asymmetries across supply chain affect the quality of information(Feldmann,2003). It has been suggested that organizations will deliberately distort information that can potentially reach not only their competitors, but also their own suppliers and customers (Mason,1997). It appears that there is a builtin reluctance within organizations to give away more than minimal information (Berry, 1994). Since information disclosure is perceived as a loss of power. Given these predispositions, ensuring the quality of the shared information becomes a critical aspect of

effective SCM. Organizations need to view their information as a strategic asset and ensure that it flows with minimum delay and distortion (Feldmann,2003).

2.2.1.5 Information sharing

Information sharing is the ability of the firm in sharing knowledge with supply chain partners in an effective and efficient approach. Effective information sharing is considered as one of the most important abilities of supply chain process. Information sharing is one of the most important tools for achieving an integrated and coordinated supply chain Information should be inter-operable, which means that one system can talk to another (Lee, 2002). Zailani & Rajagopal (2005) add that the technological wave of internet and e-commerce provides a new opportunity to create a "smart" integrated supply chain.

Sridharan & Simatupang (2002) defined information sharing as the access to private data between business partners thus enabling them to monitor the progress of products and orders as they pass through various processes in the supply chain. They identified some of element that comprise information sharing, consisting data acquisition, processing, storage, presentation, retrieval, and broadcasting of demand and forecast data, inventory status and location, order status, cost related data, and performance status, internet, intranet, and extranet can be distinguished based on characteristics including access, users, and information. The internet is a public network accessed by general users. However, due to inconsistent format and diversified content, information available on the internet is fragmented. By comparison, the intranet, via internet technologies, is a private network set up within an organization; information is proprietary and only available for members within the organization.

Information sharing has two aspects: quantity and quality. Both aspects are important for the practices of SCM and have been treated as independent constructs in the past SCM studies (Monczka, 1998).Level (quantity aspect) of information sharing refers to the extent to which critical and proprietary information is communicated to one's supply chain partner (Monczka, 1998). Shared information can vary from strategic to tactical in nature and from information about logistics activities to general market and customer information (Mentzer,2000). Many researchers have suggested that the key to the seamless supply chain is making available undistorted and up-to-date marketing data at every node within the supply chain (Balsmeier,1996). By taking the data

available and sharing it with other parties within the supply chain, information can be used as a source of competitive advantage (Jones,1998). Lalonde (1998) considers sharing of information as one of five building blocks that characterize a solid supply chain relationship. According to Stein and Sweat (1998) supply chain partners who exchange information regularly are able to work as a single entity. Together, they can understand the needs of the end customer better and hence can respond to market change quicker. Moreover, Tompkins and Ang (1999) consider the effective use of relevant and timely information by all functional elements within the supply chain as a key competitive and distinguishing factor.

Many authors studied supply chain management practice and there are various elements and dimensions used to measure the supply chain practice, for more exploration some of them are listed on the following table.

Table 2.3 Dimensions of SCM practices, Source: Tompkins and Ang (1999)

No	Author	Dimensions
1	Chin *et al*	information sharing, customer relationship, strategic supplier partnership, material flow management and corporate culture.
2	Inda *et al*	Strategic supplier partnership , customer relationship , information sharing
3	Chowa *et al*	There are four elements (suppliers and customer mgt , information sharing , speed of communication, supply chain features)
4	Min & Mentzer	There are seven elements of supply chain practice such as agreed vision and goals, information sharing, risk and award sharing, cooperation, process integration, long-term relationship and a greed supply chain leadership.
5	Tan, Lyman and Wisner	Six elements of supply chain practice (using factor analysis) supply chain integration , information sharing, supply chain characteristics, customer service management , geographical proximity and JIT capability
6	Alvarado & Kotzab	Using inter-organizational system in supply chain practice such as EDI , and elimination of excess stock levels by postponing customization toward the end of the supply chain
7	Tan , Kannan and Handfield	Supply chain practice includes purchasing quality , and customer relations
8	Donlon	Supply chain practice includes supplier partnership , outsourcing cycle time compression , continuous process flow and information sharing

2.2.2. The Concepts, Nature and Practices of Supply Chain Management in Aviation Industry

The aviation industry is one of the most robust markets in the world's economy. It's an industry that has undergone remarkable resilience facing many familiar and persistent ecological and socio impacts. The aviation industry is renowned for its ongoing battle with cost reductions, volatile demand, quality constraints, and the ability to maintain excellent service levels for a variety of consumer groups (strategyand.pwc.com, 2015). Given today's streamlined economies it is becoming more apparent to pay close attention to budget and resources. Due to this, the aviation industry has followed the trend of globalization and consolidation much like other industries. This is achieved by alliances and partnerships between airlines allowing to extend networks, customer reach, and consolidate resources (Britton, 2011).

By itssheer nature, the aviation, aerospaceand defense supply chain isextremely complex, especially from an aftermarket standpoint. Most aircraft have a short production cycle but have a very long service cycle; sometimes as long as 30 years. This creates a service supply chain with significant requirements for maintenance, repair and overhaul and spare parts. Most parts are expensive; demand/ failure of parts and the failure location are extremely hard to predict; and customer service is absolutely critical. Many people have experienced delays when anaircraft cannot take off due to an aircraft component requiring replacement or overhaul . In addition, at every step of the supply chain there are requirements for traceability and compliance (Hader,2011). In several instances a repairable component removed from a particular aircraft may require reinstallation on the same aircraft after repairs. To manage all these complexities, a well thought supply chain strategy is required along with good process discipline and systems that support the strategy and processes.To ensure customer satisfaction is important for organizations to continuously improve aviation safety and reliability of its components that meet regulatory requirements. The globalization of the aviation industry and the diversity of regional and national requirements have complicated the achievement of this goal. Organizations to meet the challenge of quality assurance and integration of components purchased from suppliers around the world and at all levels within the supply chain. Aircraft suppliers and processors are supplying components for multiple customers meet the challenge of ever-changing quality requirements. Hence the need for compiling a uniform standard, which aims at

integrating the requirements for quality management system for aerospace industry and establish a common requirement for organizations at all levels of the supply chain throughout the world and led to an improvement in quality, safety and cost reduction through the elimination of specific quality requirements individual organizations (Hader,2011).

Traditional supply chains in the aerospace and defense industry are evolving at an accelerated pace. Variability is becoming a critical business driver across all of its market segments. In addition, due to the push for increased cost effectiveness, industry players are globalizing their supply chains and working with partners from all over the world. Today's A&D supply chains are characterized by the need to manufacture increasingly complex equipment and systems, ongoing pressure to reduce costs, extended product life cycles, requirements for optimized asset utilization, turn-key support services, and ongoing requirements from regulatory and safety agencies.To meet the many challenges that emerged as a result of these new industry dynamics aerospace and defense companies have increasingly relied on automation and technology enhancements designed to work on removing business "silos," improving collaboration and fueling gains in productivity. In addition, companies have embarked on initiatives focused on reducing costs through improving procurement processes (Jorge *et.al*, 2009).

Increasing competition, cost pressures (rising energy costs, high commodity prices, etc.) and the impact of the global financial and economic crisis are some of the issues that aerospace industry is facing (Bublitz, 2013). To combat these challenges, the manufacturers and suppliers are using the advantages deriving from the globalization of the aerospace supply chain. On the other hand, globalization affected the aerospace industry with a variety of pressures, such as time compressing aircraft programs, reducing costs, increasing productivity and global competitiveness (Advani, 2013). Major aircraft manufacturers have become extremely selective in choosing suppliers. Suppliers are in the position to assume greater responsibilities in the supply chain to meet the relevant requirements and specificities, to be selected as a partner. In their turn, suppliers are facing problems within the value chain, the experience to manage these complex programs being rather limited. Another problem faced by the aviation industry refers to the existence of a fairly long time between planning and actual availability of the new capacities (Bernardini *et al*, 2013). The procurement of the critical raw materials takes quite a long time (such as carbon fiber), these materials being also quite expensive (these materials are highly subject to shortages and price

increases). The suppliers hold usually only limited quantities of these materials to effectively manage their financial resources. Regarding the workforce, the novelty used in materials and processes for the development programs of the new generation aircraft could lead to production problems related to the quality and reliability of some of the materials provided. A major obstacle is the size of the industry, but, the policy coherence with other aspects of procurement, such as the overall strengthening of the supply chain is also important. Although it is enjoying an aura of advanced technological and strategic value, the total turnover of the aerospace industry is a fraction of the automobile industry (Advani, 2013)

At this moment the supply chain of the aviation industry is not entirely prepared for the dual challenge of providing a larger volume of more sophisticated aircrafts. In fact, there is a real risk increasing supply chain disruptions. Some providers still have a limited expertise and capabilities (technology) engineering and support modest implementation of several programs. While the customer-supplier relationship in the aerospace industry still goes through a process of clarification, the management of suppliers along the supply chain remains a major challenge for the aerospace industry (Advani, 2013).

2.2.3. The Concepts and Nature Organizational, Operational performances

Organizational performance refers to how well an organization achieves its market-oriented goals as well as its financial goals (Yamin, 1999). The short-term objectives of SCM are primarily to increase productivity and reduce inventory and cycle time, while long-term objectives are to increase market share and profits for all members of the supply chain (Tan,1998). Financial metrics have served as a tool for comparing organizations and evaluating an organization's behavior over time (Holmberg,2000). Any organizational initiative, including supply chain management, should ultimately lead to enhanced organizational performance. A number of prior studies have measured organizational performance using both financial and market criteria, including return on investment (ROI), market share, profit margin on sales, the growth of ROI, the growth of sales, the growth of market share, and overall competitive position (Vickery,1999).

Operational performance refers to the measurable aspects of the outcomes of an organization's processes, such as reliability, production cycle time, and inventory turns. Operational

performance in turn affects business performance measures such as market share and customer satisfaction (Voss *et.al*, 1997).

Performance measurement systems weredeveloped as a means of monitoring and maintaining organizational control, which is the process of ensuring that an organization aims at strategies that lead to the achievement of its overall goals and objectives. Performance measures, the key tools for performance measurement systems, play a vital role in every organization as they are often viewed as forward-looking indicators that assist management to predict a company's economic performance and many times reveal the need for possible changes in operations (Nanni *et.al*, 1990)

The choice of performance measure is one of the most critical challenges facing organizations (Ittner & Larcker, 1998). Poorly chosen performance measures routinely create the wrong signals for managers, leading to poor decisions and undesirable results. There are enormous hidden costs in misused performance measures. Shareholders pay the bill each day in the form of overinvestment and acquisitions that do not pay off etc. It is not that management is poor. Simply, it is the wrongly chosen performance measures, which in turn push management to take improper decisions (Ferguson & Leistikow, 1998).

According to Damlin (2003) the operational performances are a direct result of relationships within the supply chain allowing for processes to be simplified. Thus, supplier relationships stimulate better understanding of activities, enhanced exchange of information and resources, and reduced operational down-times or product errors.

2.2.3.1 Operational Performance indicators

In order to get and keep competitive advantage over other market players in the same industry the manufacturing organizations and service providers must produce the quality products and services at lower cost with rapidly increasing variety. These are the few among many valuable objectives of the organizations. In order to get confirmations regarding the fulfilling of their objectives and goals organizations have to keep check over their performance (Ghalayini and Noble 1997). Simply the performance management is done by the organizations in order to confirm that either they are going in right direction or not. For measuring, managing and comparing the performance

the organizations are required to know about the performance indicators. The performance indicators can be defined as the physical values which are used to measure, compare and manage the overall organizational performance (Gosselin 2005). The performance indicators may include the quality (De Toni and Tonchia 2001; Gosselin 2005; Heckl and Moormann 2010; Badri *et al*. 1994; Neely and Platts 2005), cost (De Toni and Tonchia 2001; Neely and Platts 2005; White 1996), financial (Parmenter 2009; White 1996), flexibility (De Toni and Tonchia 2001; and White 1996), delivery reliability (Heckl and Moormann 2010; White 1996), employees' satisfaction (Leong et al. 1990; Mapes and Szwejczewski 1997; Parmenter 2009), customer satisfaction (Ittner 1998 and Neely and Platts 2005; Parmenter 2009), safety (Flin and O'connor 2000; Mearns *et al*. 2003; Parmenter 2009), environment/community (Neely and Platts 2005; Parmenter 2009; White 1996), and learning and growth (Parmenter 2009; Sadler-Smith and Chaston 2001; Utterback 1975).

The performance measures are used to evaluate and control the overall business operations. They are also used to measure and compare the performance of different organizations in the industry, plants, departments, teams and individuals (Ghalayini and Noble 1996; Mapes and Szwejczewski 1997; Parmenter 2009). Let's see all in more detail.

1. **Time**: De Toni and Tonchia (2001) have identified the manufacturing lead time, delivery lead time, due date performance, frequency of delivery and rate of production introductions as the measures of time performance in their article. Neely and Platts (2005) have identified time to market, distribution lead times, delivery reliability (to clients), supply lead times, supplier delivery reliability, manufacturing lead time, standard run time, actual run time, wait time, setup time, move time, inventory turnover, order carrying out time and mean(flexibility) as the measures of time indicator. White (1996) has used lead time, cycle time, time from customer's recognition of need to delivery, order processing time, response time, percentage on-time for rush jobs, paperwork throughput time, material throughput time, distance travelled, decision cycle time, time lost waiting for decisions, percentage first competitors to market, breakeven time, time from idea to market, average time between innovation, number of changes in projects and engineering time as the strategy related measures of time.

2.**Quality**: Quality is the key to success of every organization. Now a days the customers are demanding quality products and the organizations that are able to produce quality products at

lower cost win the game. The quality is checked mainly at three levels input, output and throughput or process quality. Most of the organizations focus on quality because they have made promises to their customers about quality of their services and products (Heckl and Moormann 2010; Badri *et al*., 1994). White (1996) has discussed eight dimensions of quality which are: features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. In between these dimensions, conformance has the empirical evidence with quality. Gosselin (2005) has discussed customer satisfaction, input quality, output quality, cost quality and number of customer complaints as the measures of quality. De Toni and Tonchia (2001) have discussed machine reliability, reworks, quality system costs, customer satisfaction, returned goods, input and output quality, product reliability, and machine reliability as the quality measures. According to Neely and Platts (2005) performance, features, reliability, conformance, technical durability, serviceability, aesthetics, perceived quality, humanity, and value are the measures of quality

3. Flexibility Flexibility is defined as the ability of the organizations to perform multiple tasks at given level of resources like, labour, machine etc (Zhang *et al*. 2003). Neely and Platts (2005) has discussed material quality, output quality, new product, modified products, deliverability, volume mix and resource mix are the most valid measures of flexibility. De Toni and Tonchia (2001) have identified volume flexibility, mix flexibility, product modification flexibility, process modification flexibility and expansion flexibility as the measures of flexibility performance. White (1996) has identified perceived flexibility, flexibility relative to competitors, process flexibility relative to competitors, perceived relative product flexibility, plant response time to product mix changes, product cycle time, set-up time, time to replace tools, change tool, assemble or move fixture, percentage increase in average number of set-ups per day, perceived relative volume flexibility, ability to perform multiple tasks efficiently, percentage programmable equipment, percentage of slack time for equipment, labour, percentage products using pull system, disruption caused by breakdowns and vendor lead time as the strategy related measures of flexibility performance of the manufacturing organizations.

4. Safety In recent years there has been a realization that the reliability of complex work systems in achieving organizational goals safely depends on work structures as well as technical arrangements (Mearns *et al*., 2003). Parmenter (2009) has identified in his book that the level of risk and safety perceived, accident rate, level of employees' cooperation, safety attitude of

managers and employees, level of employees' physical risk on work place and the level of safety information as the key measures of safety.

5.Financial Performance: Historically financial measures are the best measures to evaluate the company's performance, such as the physical values of sales and profits or percentage return on equity and assets. Because external groups of stockholders are strongly concerned with these sort of performance measures and they put pressure on companies to use financial measures for their internal performance measurement (White, 1996). Many researchers and organizations use different measures for evaluating and measuring their financial performance. Also Parameter (2009 suggested cost of goods sold / sales, scrap cost as %age of total sales, A/c Receivable turnover, cash flows, days in inventory, days sales in receivables, net income, sales, number of profitable customers, return on equity, sales by product, sales growth rate, return on assets and return on capital employed as the measures of the financial performance of the organizations.

6. Cost: The external stakeholders have more concern with the cost based measures of the performance, so that is why the organizations use cost accounting system which include measures of efficiency and effectiveness, represent an effort to relate internal performance measures to external ones (White, 1996). Neely and Platts (2005) has identified the manufacturing cost, value added cost, selling price, running cost and services cost as the measures of the cost performance. White (1996) has identified cost relative to competitors, perceived relative cost performance, manufacturing costs, capital productivity, labour productivity, machine productivity, total factor productivity, total product cost as a function of lead time, direct labour cost, indirect labour cost, percentage improvement in labour, relative labour cost, labour productivity, labour efficiency, material cost, inventory cost, scrap cost, repairing cost, cost of quality, design cost, relative R&D cost, distribution cost, overhead and transactions per product as strategy related measures of cost. De Toni and Tonchia (2001) have identified the material cost, labour cost, machinery energy cost, machinery material consumption cost, inventory cost, machine saturation, total productivity, working capital productivity, value added productivity and value added productivity/employee costs as the measures of cost performance of the organizations.

7. Employees satisfaction: The employees' satisfaction is the key to success for every organization. If the employees are satisfied then there will be satisfied customers and overall organizational performance will boost up (Leong *et al*., 1990; Mapes and Szwejczewski 1997). Parmenter (2009) was of the view that analysis of absenteeism, %age of staff working flexible hours, turnover rate, new recruits which are employee's referrals, employees' satisfaction per survey, employees' complaints resolution effectiveness, empowerment index and length of service of staff who has left are the measures to check the employees satisfaction in any organization.

8. Learning and growth: Leaning and growth provides the organizations with competitive advantage over their competitors. It happened because the learning organizations keep training their employees with the new technological advancements (Sadler-Smith and Chaston 2001). Parmenter (2009) mentioned in his book that the %age of managers having IT literacy, %age of employees having required education, employees terminated for performance this year, employees certified for skilled job function or position, investment for training, number of internal promotions, managers who have performance management training, number of new staff, times in training (days/year) and number of research paper generated are measures by which the organizations can check their performance in terms of learning and growth. The more the leaning organizations involve in innovativeness the more they develop new product development projects (Utterback 1975; Sadler-Smith and Chaston 2001).

9. Customer satisfaction: The higher customer satisfaction improves financial performance by increasing the loyalty of existing customers, reducing price elasticity, lowering marketing costs through positive word-of-mouth advertising, reducing transaction costs, and enhancing organization reputation (Ittner *et.al*., 2005). According to Parmenter (2009) stock outs, revenue gained from top customers in a week, number of complaints, customer loyalty index, customer lost, new customers, number of customer referrals, market share in term of customers, on time delivery, product quality, number of quality service guarantee issued and order frequency are the measures of the customer satisfaction.

10. Delivery reliability: White (1996) has proposed the perceived relative reliability, reliability relative to competitors, percentage on-time delivery, due date adherence, percentage increase in portion of delivery promises met. Percentage of orders with incorrect amount, schedule attainment, average delay, percentage reduction in lead time per product line, percentage

improvements in output, percentage reduction in purchasing lead time and percentage reduction in average service turnaround per warranty claim as the measures of the delivery reliability. There is little discrepancy between researchers about the measures of delivery reliability.

2.2.4. The concepts and nature of aviation operational performances

Operational performance refers to aspects of an organizations process which can be quantified. It includes variables such production or service reliability and defect rates, cycle time, on time delivery, cost of quality and scrap reduction, productivity, and inventory management. Operational performance (or operational reliability) in the aviation or airline context is about running an airline like a well-oiled machine. It's about on-time performance and completion rates (Voss *et al*., (2012). It's ensuring that continuous improvements and efficiencies are always in motion. A smoothly run airline enhances customer perception, satisfaction, and loyalty. Naturally, fewer operational hiccups means better cost efficiency and overall financials (Eugene,2018).

2.2.4.1 Performance Indicators for MROs in the aviation

Maintenance of aircraft and associated tools, testers and ground support equipment (TTGE) costs over half the total cost of the operations. Therefore, it is essential to implement maintenance performance system to measure the value created by maintenance process. Maintenance managers must know that what is being done is what is needed by the business process; and if the maintenance output is not contributing/ creating any value for the business, it needs to be restructured. This brings the focus on doing the right things keeping in view the organizational goal. The restructuring if required, would be governed by operational as well as customer rules and objectives. Every flight (sortie) of an aircraft is cost intensive. Every flying hour logged reduces the residual life of the aircraft and components. The downtime of an aircraft amounts to loss of business and reduced operational preparedness. A sound maintenance, repair and overhaul (MRO) policy is the key to limited downtime and increased efficiency. Maintenance (M), repair (R) and overhaul (O) are three different processes and use of same performance indicators may not be feasible. Therefore, different approaches are to be adopted to measure the performance of M, R, and O. The issues that need to be considered for each of the three processes are listed below: Maintenance: Maintenance is preventive in nature. Activities are carried out as per

servicing schedules at stipulated periodicities. At times, based on condition monitoring data, predictive maintenance is also carried out. After the scheduled maintenance activities, it is expected that the system is serviceable and available till the time between the next scheduled maintenance of similar type. If the system fails before the next scheduled maintenance, then the reason for the failure; whether it is random in nature or due to maintenance inadequacies need to be established. Statistical analysis of the failure rates and the reason(s) for the failure would assist the decision maker to review the maintenance periodicities and/ or adopt reliability improvement measures (Raju *et.al,* 2012).

Maintenance performance indicators (MPIs) are utilized to evaluate the effectiveness of maintenance carried out. An indicator is a single measure or a product of several measures (metrics). A performance indicator is a measure capable of generating a quantified value to indicate the level of performance, taking into account single or multiple aspects. maintenance performance indicators could be used for monitoring the performance of employees, customer satisfaction, overall equipment effectiveness (OEE), financial reports, productivity, reliability, availability, and maintainability (RAM), etc. When designing MPIs, it is important to relate them to both the process inputs and the process outputs. If this is carried out properly, then MPIs can provide or identify areas for benchmarking, measure personnel performance and assist decision making towards enhancing maintenance efficiency and overall business objectives. Various MPIs are used in civil aviation and are well documented in civil aviation publications and reference books. In military aviation, operational preparedness and reliability of the aircraft contribute directly towards the mission effectiveness (Raju *et.al,* 2012). Here are lists of performance indicators of maintenance in aviation with a brief details.

2.2.4.1.1 Operational Availability Index or Serviceability Index

Operational availability index or serviceability index is the percentage of the ratio between sum of number of days each aircraft is serviceable to the sum of number of days each aircraft should have been serviceable. It is advantageous to use this index over the actual net serviceability as this index would indicate true operational availability; it can be used as a measure of the maintenance efficiency of the squadron (Raju *et.al*, 2012).

2.2.4.1.2 Aircraft Uptime

Aircraft uptime is the measure of availability of individual aircraft. The total up time achieved with the available resources and within the constraints would be a measure of the maintenance efficiency.

2.2.4.1.3 Time Index

Time index is the ratio between the difference of the desired inspection time (rectification time) and extra time to the desired inspection time (rectification time).

2.2.4.1.4 Index for Breakdowns Caused by Poor Preventive Maintenance

The index for breakdowns caused by poor preventive maintenance is the ratio between the difference of the total number of breakdowns and number of breakdowns that should have been prevented to total number of breakdowns

Failure of mechanical components is considered to follow normal distribution. Therefore, the probability of premature failure of well-maintained mechanical components is very less; except under conditions of undetected material failure.

2.2.4.1.5 Work Accomplishment Index

Work accomplishment index is the ratio between the difference of the total number of work packages for the task and the number of work packages not carried out to the total number of work packages for the task. The endeavor of the maintenance managers should be to minimize the number of WPs not carried out.

2.2.4.1.6 As Good as New Index

Maintenance cannot restore as good as new status. When the measured physical and performance parameters meet the ones stipulated by the designer of a new system, the system is considered to be in as good as new state. The as good as new index is developed by analyzing the work records on each component/ system. The work records meeting new (manufacturing) standard indicates as

good as new status of the system and the system is expected to perform like a new one till the next maintenance cycle.

2.2.4.1.7 Efficiency of Fault Diagnosis

It is proposed to measure the efficiency of fault diagnosis by comparing the value of time taken to pin-point and rectify the snag from the average time taken for rectifying same or similar snags in the past. As it is desired to minimize this time, a signal to noise ratio analysis for smaller the better care-about is carried out and the improvement is ascertained.

2.2.4.1.8 Environmental Condition Index

It is proposed to measure the adequacy of environmental conditions by comparing the prevailing conditions with the standard stipulated comfort conditions.

2.3 Review of Empirical Studies

Makena (2014) on his study of Impact of Supply Chain Management Practices on Organizational Performance: A Case Study of Haco Industries Limited (Kenya) observed that all the supply chain management practices studied had a positive effect on the organization's performance. To improve organization performance, the supply chain management focuses on operational time, cost, response, customer service and profitability or margins. However, it was noted that some of the respondents were not well versed with some of the practices like customer relationship management and hence had missing values. It was noted that some respondents disagreed with implementation of training and this is a very crucial practice as it will improve the individual's performance and morale which will translate into improved organization performance. From the commonly advocated SCM practices which includes information sharing, customer relations, strategic partnerships and the author added training as a determinant factor of the organization's performance in terms of its operational and business parameters. The limitations sought from this study was it failed to include the impact of the other important dimensions of SCMP which are internal integration and information quality. In addition, it didn't mention about the methodology used for the study.

Ivan and Lucia (2013) studied on selected aspects of the supply chain management in the aerospace industry. The authors inform on selected definitions in this topic, levels of supply chain and its maturity. The authors are focusing on introducing of the explanation of main specifics of SCM in aerospace industry and subsequently inform on the role and mission of selected international organizations involved in aerospace SCM and quality issues, namely The Aerospace and Defense Industries Association of Europe (ASD), International Aerospace Quality Group (IAQG) and European Aerospace Quality Group (EAQG). The information on quality management system in the framework of aerospace industry and SCM are also introduced. The part of the paper is dealing with information systems useful in the SCM the Digital Product Chain and Enterprise Resource Planning and issue concerning the success factors for SCM in the aerospace industry. It alsoemphasizes some aspects and factors regarding the aerospace SCM and the key challenges in the area of SCM in the aerospace industry.

The study lacks comprehensiveness as it didn't incorporate the major dimensions of SCM identified by Tan (2002) and Lee (1997), customer relationship management, supplier relationship management, internal integration, information quality and information sharing. In addition, the research didn't reveal the sampling technique and procedure employed in the case study.

Aradhana(2016) on his study of'Impact of CRM, SRM, Information Sharing and Goal Congruence on Retail-SCM' reviewed the various Supply Chain Management Practices (SCMPs), adopted by firms and how these can impact the performance of the organization and thus be a source of competitive advantage to the firm. Additionally, the SCMPs, which are particularly relevant for the retail sector, were identified and a conceptual retail supply chain model was proposed for further validation. The literature tried to fill the gap or shortcoming of previous studies on SCM relates to their overall importance on general forms of SCM that are applicable across different types of manufacturing organizations. To address this limitation, the study focused retail firms. However, the study didn't address the impact of the two important dimensions of the SCM P 'Internal Integration' and 'Information Quality' as identified by Tan (2002) and Lee (1997).

In general, even though there are a lot published documents relating supply chain management studies and practices in the many different industries, however, very little such documents are found for the aviation industry. The current findings explore the relationship between well-

knownconcepts and practices of supply chain management, types of inventory, logistics, transportation relating to aircraft industry, zooming in from macro to micro level processes. It indicates that aviation industry is very specialized and customized industry, with relationship to supply chain stages, logistics, transportation, manufacturing processes and the overall SCM P.

2.4 Conceptual Framework of the Study

This paper, through a structured and systematic review of literature, provides insights into the definition of SCM, the various SCMPs adopted by various researchers and the research methodology adopted by different researchers. The study enables to succinctly describe the relevant SCMPs applicable to the aviation MRO sector. The paper also proposes a conceptual model which is finally tested using multivariate data analysis.

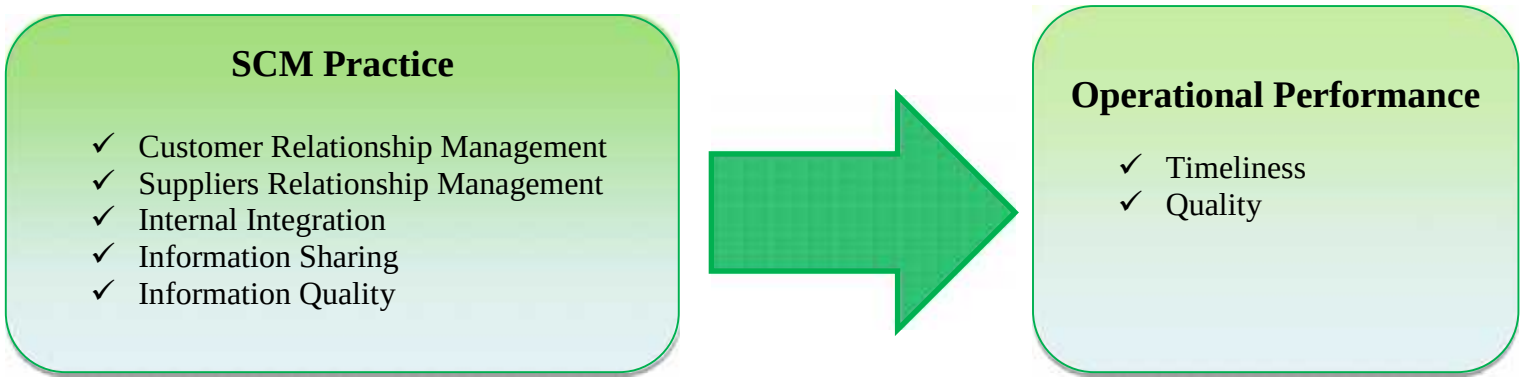
The main strategic goal of Ethiopian MRO is to provide full airframe MRO services to all aircraft models operated by Ethiopian and other operators in terms a bestturnaround time and quality maintenance. ET MRO maintains control to assure quality product or delivering dependable flying machine to its customers. It establishes procedure and control methods necessary for timeliness of maintenance activities to keep the turnaround time duration of Ethiopian MRO better than industry standards andestablishes safety and quality as a core value in ET MRO through giving due attention and immediate action to conditions that may affect safety and quality. It implements procedures which will benefit Ethiopian airlines by giving timely servicesand safeguarding Ethiopian customer's safety and property by providing quality services in compliance with conditions and restrictions of the Approved Maintenance Organization(AMO)certificate(ET organizational Manual, 2017).

Fig. 2.1 presents the SCM framework developed in this study by the researcher. The framework proposes that SCM practices have an impact on the operational performance of the ET MRO. SCM practice is conceptualized as a five-dimensional construct. The five dimensions are supplier relationship management, customer relationship management, level of information sharing, quality of information sharing, and internal integration (Tan *et.al*, 1998). On the other side, Operational performance has several metrics developed by different authors as specified on the literature portion in detail. Though these KPIs can be of great interest, they are not included in this study due to the concerns regarding the length of the study, to relate to the objective of the

studyand align with the strategic goal of the Ethiopian MRO. Hence, the researcher took only the two important operational metrics for the aviation MRO which are 'Time' and 'Quality' as a dependent variable.Therefore, based on the theoretical and empirical literature support, the expected relationships among SCM practices, and operational performance is discussed, and relationship between dependent and independent variables is developed. The framework is depicted by conducting extensive literature review and also an interview with the concerned management members to first assess the relevance of the model in the ET MRO context and to add if something is (are) missing.

Figure 2.1 Conceptual frame work model

(Source: adopted from Veera (2012) & modified by the researcher)



CHAPTER THREE

Methodologies of the Study

Under this chapter, the methodology that is used to achieve the objective of the study is discussed. First, the description of the study area is presented. Next, the research approach, research design is discussed. Then, unit of analysis, population of the study, sampling techniques, sample size, data collection instrument and data collection procedure are discussed. Finally, data analysis and presentation method is presented along with reliability and validity test of the research.

3.1 Description of the study Area

The study is conducted in the Ethiopian Airlines headquarter, MRO division. It is located in the Addis Ababa city, Bole International Airport. The research area focused on two departments, the procurement and supply chain management and the maintenance. Both research areas are located within the same division, ET MRO.

3.2 Research Approach

The study employed a mixed approach of quantitative and qualitative to have a detailed understanding and quality output. Regarding the main benefit of this approach, Creswell and Clark (2007), stated that the use of quantitative and qualitative approaches in combination may provide a better understanding of research problems and complex phenomena than either approach alone. Research problems that are best suited to mixed methods designs are those in which multiple perspectives of the research problem will provide a more detailed understanding than could be gleaned from a single perspective (Andrew *et.al*, 2010). The increase in mixed methods research justifies the question of determining the perceived value of mixed methods research compared with a purely quantitative or purely qualitative study. It is important to understand the perceived value of combining two distinct methodologies, especially given the added resources, time, and expertise required to conduct a mixed methods study.

In this research, Ethiopian Airlines, is considered as a case company to study the role of SCM on operational performance of the MRO. For the purpose of quantitative analysis, this study employed survey which is conducted through a questionnaire. The questionnaire items are partly

adopted from (Veera, 2012). Then, the questionnaire is enhanced by conducting interview and analyzing the feedbacks of the SCM and maintenance expertsto match the aviation sector and meet the objective of the study. Qualitative approach is also conducted through document analysis to explore the effect of the SCM on the operational performance of the MRO. The qualitative document analysis is used as a secondary source of data to gain more information and support the findings reached by questionnaire survey.

3.3 Research Design

The research used both descriptive and explanatory research design in order to give a more in-depth insight about what the current supply chain management practice seems like in the ET SCM. Descriptive studies are aimed at finding out "what is," so observational and survey methods are frequently used to collect descriptive data (Borg & Gall, 1989). Studies of this type might describe the current state of multimedia usage in schools or patterns of activity resulting from group work at the computer. In addition, descriptive research is unique in the number of variables employed. Like other types of research, descriptive research can include multiple variables for analysis, yet unlike other methods, it requires only one variable (Borg & Gall, 1989). For example, a descriptive study might employ methods of analyzing correlations between multiple variables by using tests such as Pearson's Product Moment correlation, regression, or multiple regression analysis. Good examples of this are the Knupfer and Hayes (1994) study about the effects of the Channel one broadcast on knowledge of current events, Manaev's (1991) study about mass media effectiveness, McKenna's (1993) study of the relationship between attributes of a radio program and it’s appeal to listeners, Orey and Nelson's (1994) examination of learner interactions with hypermedia environments, and Shapiro's (1991) study of memory and decision processes. The other research design employed is explanatory researchdesign, in order to explain how the SCM practice affects the operational performance of the ET MRO by explaining and predicting relationships between variables mentioned on the conceptual framework. When the focus is on cause-effect relationships, the study can be explanatory explaining which causes produce which effects (Yin, 1994). Our concern in casual analysis is how one variable affects, or is responsible for changes in another variable. The stricter interpretation of causation is that some external factor produces a change in the dependent variable. Explanatory research which is grounded in theory is created to answer why and how questions. We are more interested in understanding, explaining, predicting and controlling relationships between variables than we are

in detecting causes. Explanatory studies go beyond description and attempts to explain the reasons for the phenomenon that the descriptive study only observed (Yin, 1994).

3.4 Unit of Analysis

Ethiopian Airlines has around 16,000 permanent employees including staffs working in different countries (out stations). This study has taken employees at the head quarter MRO division and focuses only on the SCM and maintenance employees as unit of analysis not only for a reason of manageability but also for the following reasons. Basically,all outstation offices are being managed and controlled centrally from head quarter and majority of the material management and maintenance tasks takes place at head quarter MRO.

3.5 Population of the study

The target population of the study is composed of SCM (both management and non-management) and maintenance (only management) employees based at the head quarter. Due to the nature of their work, the SCM employees have the expertise and exposure about the SCM practice and which makes them the right informants of the research. However, non-management maintenance employees lack the required expertise, exposure and experience to be an informant of this particular study and are difficult to approach them due to the nature of their jobs which involves more of physical movements. Based on this, management members of the maintenance units are considered since their expertise permits them to clearly understand and give feedback on the SCM practice. Accordingly, 231employees from PSCM (both management and non-management) and 285 employees from maintenance (only management) are considered as valid target population of the study. Hence, the target population of the study embraces 516 employeesfrom SCM non-management & management and maintenance management employees (N=516).

3.6 Sampling Design

Depending on the nature of a population and the information desired through sampling from it, there are many ways in which the sample may be drawn (Schreuder *et al.*, 1993).Purposive sampling is an informant selection tool which is widely used. However, the use of the method is not adequately explained in most studies. The purposive sampling technique, also called judgment sampling, is the deliberate choice of an informant due to the qualities the informant possesses. It is a nonrandom technique that does not need underlying theories or a set number of informants. Simply put, the researcher decides what needs to be known and sets out to find people who can

and are willing to provide the information by virtue of knowledge or experience (Bernard 2002, Lewis & Sheppard 2006).

In this study the researcher used both probability and non-probability sampling. First the population was selected through purposive sampling in which the target population is selected and divided in to characteristics of importance of their working division as SCM (both management and non-management) & maintenance (management only).Then after a simple random sampling was applied to get a representative sample from each target population. Applying the sampling formula shown below (Bryman,2003) with confidence level of 95% and 8% confidence interval in order to incorporate all the characteristics of the affected participants under study and again to reduce bias and ultimately improve the precision level of the output of the study.

$$n0 = \frac{Z^2pq}{e^2} = \frac{(1.96)^2 0.5X0.5}{(0.08)^2} = \frac{0.9604}{0.0064} = 151$$

$$n = \frac{n0}{1 + \frac{(n0-1)}{N}}$$

$$n = \frac{151}{1+(151-1)/516} = \mathbf{117}$$

Where,

N = Target Population

n0 = Sample size

n = Calculated/Actual sample size

e = the desired level of precision, (taken confidence level = 90% where by α = 0.1)

P = is estimated proportion of an attribute in the population

(taken as 0.5 and q = 1-P = 0.5; for conservative estimate)

Z = normal curve that cuts an area α (the value read from statistical table)

Hence based on the above formula the sample size was determined to be 117 from the whole target population and through random picking 54 were selected from SCM and 63 employees were taken from Maintenance.

Table 3.2 MRO population and sample size: (Source: MRO HR and own survey)

MRO target population and sample size		
Specialty and Position	**Number of employees**	**Random sample size from each group**
PSCM (Management & Non Management)	231	54
Maintenance (Management)	285	63
Total	516	117

3.7 Sources of data

The secondary data was obtained from the ET MRO portal, reports and log books. And the primary data were collected through questionnaire and interview. The questionnaire was semi-structured; consisting of both open and close ended questions to help the researcher get specific information while non-structured helped the respondent to express his or her opinion. The questionnaire was piloted before the data collection. It was pretested in pilot survey using

fivehigher management staffs from both groups who are considered to be experts in their respective areas. The respondents were assured that the information obtained would be treated for research purpose and no other purpose (Kombo and Tromp, 2006).

3.8 Data Collection Procedures

Secondary Data: Secondary data wascollected from different company sources like portal, daily delay log book, deferred reports from aircraft material planning section, aircraft maintenance status report and post mortem report after scheduled maintenance.

Primary data:wasgathered through two major ways:

Semi-Structured Interview: Semi-structured interview was conducted with Aircraft Maintenance and SCM higher management staffs at their respective officesfor a total duration ranging between 30 to 60 minutes individually during off hours for its convenience and avoid interruptions.

Questionnaire Surveys: Questionnaires was distributed to the random respondents of both strata at their working offices. The drop-and- pick- later method was adopted for the study. This method was appropriate as it enabled the respondent to dedicate enough time to fill the questionnaire as per the allocated time of seven days.

3.9 Reliability and Validity Test

In order to ensure the quality of a research it was evaluated using its reliability and validity test. The reliability and validity of the study is further discussed below.

Reliability refers to whether an assessment instrument gives the same results each time it is used in the same setting with the same type of subjects. Reliability essentially means consistent or dependable results (Grad, 2011). The study used standard survey questionnaire which is developed by (Veera, 2012). In addition to the standard questionnaire, the researcher designed questionnaire items which were identified in during the review of literatures. Hence, pilot study was conducted prior to distributing the survey to the actual survey participants to ensure its reliability. The Cronbach's alpha coefficient .832 indicated that the survey questionnaire is reliable since it is greater than 0.7 which is the minimal alpha value.

Subsequently, the reliability test conducted again using the full scale data and the result .833 revealed the internal consistency and reliability of the survey instrument.

Table 3.2 Reliability test result for pilot study

Construct	Variables	Cronbach's Alpha	N of Items
SCM	Customer Relationship Management	.841	8
	Supplier Relationship Management	.877	10
	Internal Integration	.794	5
	Information Quality	.892	5
	Information Sharing	.714	7
Operational Performance	Operational Performance	.832	20

Validity refers to how well the assessment tool actually measures the underlying outcome of interest. For outcome measures such as surveys or tests, validity refers to the accuracy of measurement (Grad, 2011). According to Carmines & Zeller (1979) Content and Construct validity tests are conducted to check the overall validity of a study. Content indicates the extent to which items adequately measure or represent the content of the property or trait that the researcher wishes to measure. And construct validity indicates the extent to which a measurement method accurately represents a construct. Accordingly, the SCM and maintenance experts reviewed the variables and the contents to assess content validity, in relation to the area or field under study. As a result, the study revealed that out of 98% of the variables found to be relevant to determine the role of SCM practice on operational performance.

3.10 Method of Data Analysis

The quantitative data is collected from the identified areas of data sources, edited, organized, and analyzed using SPSS version 23 based on appropriate statistical methods and tools. Descriptive statistics methods such as frequency distribution, mean calculation, cross tabulation and graphical representations are used to summarize the collected data. Next, reliability analysis has been conducted using Cronbach's Alpha test to measure the reliability and internal consistency of the survey. Based on the above test, the survey data is found to be appropriate for conducting multivariate linear regression analysis.

3.11 Ethical Consideration

To ensure ethicality of the research, prior to distribution of the questionnaire, the respondents werebriefed about the purpose of the study and the respondents will be informed that the data obtained from them will be kept confidentially and is only used for research synonyms. And then consent of the respondents will be asked based on their willingness to collect data. The purpose of the research will be clearly communicated to the respondents, interviewees and the company's data owners so that they can provide accurate information.

CHAPTER FOUR

Data Presentation, Analysis and Discussion

In this chapter, the captured data from the qualitative and quantitative research is presented, analyzed, described and interpreted in a systematic manner as the next step of the research process. The documentation and analysis process aimed to present data in an understandable and interpretable form in order to identify trends and relations in accordance with the research aims. The research results were presented as a combination of both quantitativeand qualitative data.The quantitative data was obtained from questionnaire and analyzed through SPSS 23. The analysis of the qualitative data was collected through interview. Furthermore, it is important to remain mindful of the fact that the data from the qualitative and quantitative sections are connected, in that the results of qualitative data contributed to the development of the quantitative questionnaire to study the current SCM P of ET and the role of the ET SCMP in the operational performance of the ET MRO.The comprehensive, connected data concludes with interpretation and discussions.

4.1 Reliability Test

Reliability comes to the forefront when variables developed from summated scales are used as predictor components in objective models. Internal consistency reliability is a way to gauge how well a test or survey is actually measuring what you want it to measure. The Cronbach's alpha is the most widely used method for estimating internal consistency reliability (Cronbach, 1951). Cronbach's alpha is an index of reliability associated with the variation accounted for by the true score of the underlying construct (Hatcher, 1994). Alpha coefficient ranges in value from 0 to 1 and may be used to describe the reliability of factors. The higher the score, the more reliable the generated scale is. Nunnaly (1978) has indicated 0.7 to be an acceptable reliability coefficient but lower thresholds are sometimes used in the literature. As can be seen from SPSS generated data for this study on Table 4.1, the calculated coefficients Cronbach’s alpha was greater than 0.7 for all variables, which asserts the variables are internally consistent.

Table 4.1 Reliability Statistics (Source: Own Survey, 2019)

Construct	Variables	Cronbach's Alpha	N of Items
SCM	Customer Relationship Management	.742	8
	Supplier Relationship Management	.831	10
	Internal Integration	.714	5
	Information Quality	.907	5
	Information Sharing	.761	7
Operational Performance	Operational Performance	.833	20

4.2Demographic characteristics of the survey respondents

This part presents the profile or the demographic characteristics of the survey respondents who were identified as an eligible informantby the sample taken and completed an individual questionnaire. The demographic data of the respondents considered were gender, department, current position, highest formal education attended and years of work experience in ET.

Table 4.2 Demographic data of the respondents (Source: Own survey, 2019)

	Gender of Respondents			Department of Respondents				Position of Respondents			Education of Respondents			Experience of Respondents				
	M	F	Total	SCM	MAINT.	MRO MGT	Total	MGT	Non MGT	Total	Degree	Masters	Total	<5 yrs	5-10	11-15	16-20	T
Frequency	98	19	117	54	61	2	117	81	36	117	82	35	117	11	80	23	3	117
Percent	83.8	16.2	100	46.2	52.1	1.7	100.0	69.2	30.8	100	70.1	29.9	100	9.4	68.4	19.7	2.6	100.0
Valid Percent	83.8	16.2	100	46.2	52.1	1.7	100.0	69.2	30.8	100	70.1	29.9	100	9.4	68.4	19.7	2.6	100
Cumulative Percent	83.8	16.2		46.2	98.3		100	69.2		100	70.1		100	9.4	77.8	97.4		100

As it is indicated on table 4.2, out of the 117 respondents 98(83.8%) of them are male and the remaining 19 (16.2%) are female. This implies that the ET MRO is more of dominated by male employees. The reason for the inclusion of this information in this study was to give an overall insight of the gender distribution in the ET MRO and to confirm that the study involved both genders.

Coming to the distribution of respondents by their department to which they are working to, the target population from each department was first determined based on the respondent's expertise through purposive sampling, which is from PSCM and Maintenance. Afterwards a simple random sampling was used to determine the sample size from the population chosen proportional to the respective group size. Based on that, 54(46.2%) belong to the SCM and the balance 61(52.1%) were from maintenance. As a matter of chance the frequency of the informants is almost evenly distributed to each group which may prove the quality of the information collected in terms of any possible biases.

The data pertaining to the distribution of the respondents with respect to their current job position is also depicted in table 4.2.Another selection criterion of the target population other than their expertise was their position. Accordingly, both management and non-management employees were taken from PSCM and only management employees were considered from the maintenance side. Then after a random selection was made from the determined sample size. Based on this, the majority, which is 69.2%,were found to be from the management while the remaining 30.8% were from non-management group. This implies that due to a better exposure to over watch all the activities and incoming problems of their respective section as well as across sections, management members can provide reliable and relevant information to the study.

Education plays an important role in the progress of an individual's mind and companies. The educational status of the respondents, as it can be observed from the table 4.2 shows that, out of the 117 respondents 82(70.1%) of the respondents have university degree and the remaining 35(29.9%) hold masters degree. This shows that allof the respondents were well educated, hence they are capable of conceptualizing and they are able to respond to the questionnaires without difficulties.

Longer the work experience, higher the welfare of human resource development. There is a positive association between work experience and job expertise. Service year explains how well an employee performs on the assigned area. In view of this, work experience related demographic data of the respondents is captured in the survey questionnaire which is depicted in table 4.2. Accordingly,68.4% of the respondents have worked from 5 to 10 years, 19.7% of them worked from 11 to 15 years, the 9.4% worked less than 5 years and the remaining employees, 2.6% of the employees worked between 16 to 20 years. This indicates that the majority of the informants are well experienced as well as productive and it also implies that this quantitative survey incorporates employees with different levels of experiences to confirm the representation of the sample to investigatethe current practice of SCM in the ET SCM and the role of ET SCM P on the operational performance of the ET MRO.

4.3Descriptive statistics on Aggregated Variables

All questions under the independent variables supply chain management practices which are customer relationship management, supplier relationship management, internal integration, information quality and information sharing are all grouped under the respective construct to analyze the aggregated role on the individual dimensions. Similarly, all questions under the dependent variable, operational performance were also categorized as operational performance dimension. The following table shows the grouped responses result for each variable.

Table 4.3 Aggregated mean value of all variables: (Source: Own survey, 2019)

Constructs	Mean	Std. Deviation
Customer Relationship Management	4.17	.235
Supplier Relationship Management	2.98	.128
Internal Integration	4.16	.234
Information Quality	3.65	.235
Information Sharing	3.40	.175
Operational Performance	3.50	.130

Based on the result of the analysis, customer relationship management (M=4.17) has the highest mean value followed by internal integration (M=4.16), information quality(M=3.65) ,information

sharing (M=3.40) and supplier relationship management has the least mean value 2.98. The operational performance has a mean value of 3.50.

4.4The ET SCM practice -Construct Level

This section explains the current practice of Ethiopian procurement and supply chain management. It provides detail findings of the survey with respect to each variable identified on the conceptual framework. In all cases the mean scores and standard deviations are presented. The mean score tells us the current practice of the ET SCM in terms of each constructs. The standard deviation describes the variability of the response from the mean score. The lower variability implies the concentrated response by the majority toward the mean score. That is, the majority of the respondents are in an agreement of the mean score. The constructs (independent variables) that are analyzed here are: Customer Relationship management,Suppliers Relationship Management, Internal Integration, Information Sharing and Information Quality.

4.4.1 Customer Relationship Management

The first section of the survey questionnaire was to assess the customer relationship management of ET SCM. The respondents reply to this construct is depicted on table 4.4.

Table 4.4ET SCM P: Customer relationship management (Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Sense of fair play with customers	4.09	.669
2	Level of Interaction with customers	4.06	.620
3	Quality/Service feedback follow-up	4.58	.633
4	Measurement and evaluation of customer satisfaction	4.24	.448
5	Determination of customer expectations	2.81	.706
6	Facilitation of assistance	4.09	.384
7	Evaluation of formal and informal complaints	4.77	.443
8	Periodical evaluation of relationships with customers	4.21	.446

According to Gharakhani (2012), Customer relationship management (CRM) is an important component of SCM and a firm's customer relationship practices can generate the organizational success in supply chain management practices efforts as well as its performance. As it is analyzed on the table 4.4, service feedback follow ups and evaluation of formal and informal complaints have got highest mean score 4.58 and 4.77 respectively, while determination of customer expectations scores the least 2.81. Customer relationship comprises the entire array of practices that are employed for the purpose of managing customer complaints, building long-term relationships with customers, and improving customer satisfaction (Claycomb *et.al*, 1999). Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements, and strive to exceed customer expectations (Gharakhani et.al, 2012). Coming to the ET SCM practice, the study revealed that the feedback collection and evaluation of customer compliments practice is good but it fails to determine customer expectations. The information collected through interview with the maintenance managers is also in support of this result.They said, the ET SCM serves them well in collection of feedbacks and fixing observed problems as quickly as possible, however the section has a drawback of meeting their expectation as required like in the cases of providing or availing materials or spares which are required for maintenance. They added the material planning section in particular has to work hard to avail spares and avoid parts shortage and stock outs which results in the extensionTATs of the aircraft and component maintenances.

4.4.2 Supplier Relationship Management

Considering supplier relationship management, the current practice of ETSCM with its suppliers was assessed. Supplier's partnership represents the long-term relationship between the organization and suppliers. It is designed to leverage the strategic and operational capabilities of individual participating organizations to help them achieve significant ongoing benefits (Stuart, 1997). The result of the survey questionnaire of ET SCM practice ofthis important variable is summarized and presented here under in table 4.5.

Table 4.2ET SCM P: Supplier relationship management (Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Reliance on few dependable suppliers	2.20	.440
2	Reliance on high quality dependable suppliers	2.26	.532
3	Consideration of quality as a selection criterion	4.23	.443
4	Establishment of long term relationship with suppliers	2.70	.606
5	Level of help to suppliers for product improvement	1.82	.610
6	Continuous improvement	2.73	.448
7	Inclusion of suppliers in planning and goal setting	2.12	.528
8	Involvement of suppliers in product development	2.82	.407
9	Certification of suppliers for quality	4.84	.370
10	Joint problems solution with supplies	4.14	.434

A strategic partnership emphasizes direct, long-term association and encourages mutual planning and problem solving efforts (Gunasekaran, 2001). Such strategic partnerships are entered into to promote shared benefits among the parties and ongoing participation in one or more key strategic areas such as technology, products, and markets (Yoshino,1997). However as per the finding of the survey the establishment of long term relationship with suppliers in the ET SCM is very low(2.70). Yoshino (1997) added that strategic partnerships with suppliers enable organizations to work more effectively with a few important suppliers who are willing to share responsibility for the success of the products. Again the study shown that there's a low level of reliance on few dependable and high quality suppliers as it is depicted with the mean value of 2.20 and 2.26 respectively in the ET SCM. The inclusion of suppliers in planning and goal setting is 2.12 and the involvement of suppliers in product development is 2.82, which indicates the ET SCM suppliers have a minimal involvement in the ET SCM goal setting and product development. In line with this Tan (2002) said, Suppliers participating early in the product-design process can offer more cost effective design choices, help select the best components and technologies, and help in design assessment.

Regarding this construct, the information collected through interview with the ET SCM management shows, the problem arises mainly from the poor performance of the strategic sourcing section. The majority of the informants agreedthat the section doesn't strive up to the required level to maintain a competitive edge through building long term partnership and forming strategic alliance with fewer dependable and high quality suppliers by narrowing down the vendor bid list. There is also some sort of reservation in the case of full sharing of information and plans with vendors to keep the confidentiality of information.

On the other hand, the ET SCM is seen to be very effective in the sub variables, consideration of quality as a selection criterion(M=4.23), certification of supplier's quality(M=4.84) and the practice of solving problems jointly with suppliers (4.14) as per the result of the study.

4.4.3 Internal Integration

Internal integration is the extent to which business functions work cooperatively and interact through cross-functional process integration to resolve conflicts and achieve mutual goals (Danese *et.al*, 2013; Pagell, 2004). In relation to this variable, the mean and standard deviation result of the data gathered through the survey questionnaire shows that the ET SCM has a well-integrated practice with internal SCM stake holders in all parameters as indicated on table 4.6 above except on the item 3, which tells about the pull production system, the mean value 4.97 denotes a negative performance, in which as the mean value rises it is indicating ET SCM produces only what has been ordered by customers and is reactive to meet customer requirements.

However, though the study signifies a positive result this construct seeks a great attention in its continuous implementation and on the understanding of the very purpose for integration. In line to this, Richey *et.al*, (2010) discuss there are implementation barriers such as unidirectional information flow, functional goals incongruence, and lacking customer orientation. Moreover, to integrate without having a clear focus can negatively impact performance (Springinklee and Wallenburg, 2012). It can be argued that the deficiencies in either of the integration types can influence negatively both individual firm performance as well as the overall performance of a supply chain. Therefore, Ralston *et.al* (2015) emphasize that organizations may need to reconsider why and how they integrate externally and internally.

Table 4.3ET SCM P: Internal Integration(Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Reduction of time wastage in operation	4.23	.443
2	Continuous quality improvement	4.20	.478
3	Pull production system	4.97	.414
4	Pushes suppliers for shorter lead times	4.74	.709
5	Streamlined order process	4.69	.499

4.4.4 Information Quality

Quality of information sharing includes such aspects as the accuracy, timeliness, adequacy, and credibility of information exchanged (Monczka, 1998).As per the survey result the information quality of ET SCM is summarized here under in table 4.7. The study revealed that there is an information high quality of information with respect to timeliness and adequacy with respective mean value of 4.24 and 4.05, whereas, the accuracy of the information is found to be poor (M=2.74). In line to this Chizzo (1998) said, while information sharing is important, the significance of its impact on SCM depends on what information is shared, when and how it is shared, and with whom.

Table 4.4ET SCM P: Information Quality(Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Timeliness of Information exchange	4.24	.429
2	Accuracy of Information exchange	2.74	.498
3	Completeness of Information exchange	3.36	.499
4	Adequacy of Information exchange	4.05	.570
5	Reliability of Information exchange	3.92	.528

In relation to the completeness and reliability of the information exchange, more than half of the respondents replied that there is a complete and reliable information exchange practice in the ET SCM. The mean value of this sub-variable is 3.36 and 3.92 respectively as can be seen in table 4.7 above.

4.4.5 Information Sharing

Information sharing is the ability of the firm in sharing knowledge with supply chain partners in an effective and efficient approach. Effective information sharing is considered as one of the most important abilities of supply chain process. Information sharing is one of the most important tools for achieving an integrated and coordinated supply chain (Lee, 2002).

Table 4.5ET SCM P: Information Sharing(Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Proprietary information sharing to partners	2.11	.584
2	Information about changing needs to partners	3.29	.475
3	Information about changing needs from partners	3.73	.448
4	Information of issues affecting its business	4.32	.467
5	Sharing of business knowledge from partners	3.25	.434
6	Exchange of information for business planning	3.10	.515
7	Important information exchange	4.04	.532

Level of information sharing refers to the extent to which critical and proprietary information is communicated to one's supply chain partner (Monczka, 1998). According to this study the extent of sharing proprietary information is very low in ET SCM(M=2.11).But scholars assert that it will be more beneficial be to share relevant information. By taking the data available and sharing it with other parties within the supply chain, information can be used as a source of competitive

advantage (Jones,1998).Tompkins and Ang (1999) consider the effective use of relevant and timely information by all functional elements within the supply chain as a key competitive and distinguishing factor. Moreover, Lalonde (1998) considers sharing of information as one of five building blocks that characterize a solid supply chain relationship.

As tothe overall sharing information culture, the study revealed that there is a good culture of information exchange in which the mean score of the sub variables are found to be above average except for the practice of sharing proprietary information with a lower mean value. Even the practice of sharing Informationlike issues affecting its business M=4.32 and important information exchange M=4.04 scored high which must be appreciated.

4.5. The operational performance of ET MRO - Construct Level

Operational performance refers to the measurable aspects of the outcomes of anorganization's processes, such as reliability, production cycle time, and inventory turns. Operational performance in turn affects business performance measures such as market share and customer satisfaction (Voss *et.al*, 1999).

Maintenance performance indicators (MPIs) are utilized to evaluate the effectiveness of maintenance carried out. An indicator is a single measure or a product of several measures (metrics). A performance indicator is a measure capable of generating a quantified value to indicate the level of performance, taking into account single or multiple aspects. maintenance performance indicators could be used for monitoring the performance of employees, customer satisfaction, overall equipment effectiveness (OEE), financial reports, productivity, reliability, availability, and maintainability (RAM), etc. When designing MPIs, it is important to relate them to both the process inputs and the process outputs. If this is carried out properly, then MPIs can provide or identify areas for benchmarking, measure personnel performance and assist decision making towards enhancing maintenance efficiency and overall business objectives. Below are the survey results for both dependent variables time and quality.

4.5.1. Time

As presented in Table 4.9, the data collected for the assessment of the operational performance with respect to timeliness of ET MRO proves the existence of the research problem raised at the beginning of the study. Based on the survey result, the TATs of aircrafts and components with a mean score value of 282 and 1.99 respectively are found to be extended and longer than the scheduled allocated time. The average respondents agreed that the ET MRO provides with adequate ground times (except for line maintenance), skilled manpower, all the necessary trainings and has got a good practice of managing projects. Furthermore, the study result showed that the maintenance personnel exert an extra effort to meet scheduled maintenance time.

However, the availability of spares and tools and the warehouse services scored the least mean value 1.82 and 1.86 respectively. This shows that the ET SCM is not giving the required service with respect to availing spares, tools and delivery of requested materials to the ET MRO which was also asserted by the interview made with the management members of the maintenance team.Since this is one of the reasons for the extension of maintenance period, the ET PSCM need to work hard towards improving the service level and meet customer demand in these problematic areas.

Table 4.6Operational Performance: Time(Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Meet scheduled TAT of aircrafts	2.82	.610
2	Meet scheduled TAT of components	1.99	.701
3	Adequacy of ground times for schedule maintenance	3.52	.738
4	Adequacy of ground times for line maintenance	2.26	.672
5	Skill of maintenance personnel	4.61	.587
6	Provision of training and facilities	4.41	.528
7	Manpower allocation	4.21	.637
8	Management of projects	3.35	.479
9	Extra effort of maintenance personnel	4.25	.472
10	Adequacy of scheduled TAT	4.04	.578
11	Availability of Spares and tools	1.82	.624
12	Warehouse service	1.86	.571

4.5.2 Quality

The quality of maintenance is one of the critical indicators that determines the operational performance.According to Neely and Platts (2005) performance, features, reliability, conformance, technical durability, serviceability, aesthetics, perceived quality, humanity, and value are the measures of quality. Activities related to aircraft maintenance are carried out as per servicing schedules at stipulated periodicities. At times, based on condition monitoring data, predictive maintenance is also carried out. After the scheduled maintenance activities, it is expected that the system is serviceable and available till the time between the next scheduled maintenance of similar type. If the system fails before the next scheduled maintenance, then the reason for the failure; whether it is random in nature or due to maintenance inadequacies need to be established. Statistical analysis of the failure rates and the reason(s) for the failure would assist the decision maker to review the maintenance periodicities and/ or adopt reliability improvement measures (Raju *et.al*, 2012).

Table 4.7Operational Performance: Quality (Source: Own survey, 2019)

Item	Statement	Mean	Std. Deviation
1	Standard of quality assurance	4.71	.456
2	consideration of human factors	4.31	.499
3	Deferral of tasks	4.68	.470
4	Quality of preceding maintenance	3.33	.557
5	Poor performance of aircraft	4.55	.594
6	Availability & ease of manuals	4.39	.491
7	Availability of spares and ground support equipment	1.83	.686
8	Spares quality issues	3.20	.630

As per the collected information for the selected samples the quality variable as a whole has more or less a good mean value except for item 3 and 7. Item 3 or the sub variable which denotes the existenceof deferral of tasks is very high 4.68 is which has got a negative indication to the quality of the maintenance. As per 14 CFR 91.213, Deferred maintenance means to postpone the maintenance of a specific task to the next schedule due to some holdups related to technical issues or spares shortage. This allows the aircraft to fly with inoperative instruments and equipment.

Consequently, the quality of the maintenance is affected. For this we can easily refer from the same table 4.10, item 7 availability of spares and ground support equipment, with a least mean vale 1.87, which is one of the restricting reasons not to accomplish scheduled tasks.

Hence, the ET SCM should take this as an improvement opportunity to fill the gap in order to improve the quality of the maintenance of ET MRO.

4.6The Role of Supply Chain Management in the operational performance of Ethiopian airlines MRO: Statistical Analysis

Linear regression is a statistical procedure for calculating the value of a dependent variable from an independent variable. It is a modeling technique where a dependent variable is predicted based on one or more independent variables. The concept of linear regression was first proposed by Sir Francis Galton in 1894. Linear regression is a statistical test applied to a data set to define and quantify the relation between the considered variables (Chang, 2004). The researcher conducted a multiple regression analysis so as to test the relationship among independent variables of SCM P (customer relationship management, supplier relationship management, internal integration, information quality and information sharing) and the dependent variable, operational performance of the ET MRO. This relationship is established by the model:

$$Y = B0 + B1*X1 + B2*X2 + B3*X3 + B4*X4 + B5*X5 + e$$

Where:

Y, the response variable;

X1, the first predictor variable;

X2, the second predictor variable;

B0, the Y-intercept;

B1, the first regression coefficient;

B2, the second regression coefficient

e, the residual error, which is an unmeasured variable.

4.6.1 Assumption Tests of the model

In multiple regression analysis there are many assumptions about the model, namely, multicollinearity, non-consistent variance (non-homogeneity), linearity, and autocorrelation. If one or more assumption is violated, then the model in hand is no more reliable and also is not acceptable in estimating the population parameters. Hence the researcher has tested the following pre regression assumptions before answering the research questions.

4.6.1.2 Assumption of Multicollinearity

By carrying out a correlation analysis before we fit the regression equations, we can see which, if any, of the explanatory variables are very highly correlated and avoid this problem (or at least this will indicate why estimates of regression coefficients may give values very different from those we might expect). A small tolerance value indicates that the variable under consideration is almost a perfect linear combination of the independent variables already in the equation and that it should not be added to the regression equation. A good regression model must not have a strong correlation among its independent variables or must not have a multi-collinearity problem and that the value of variance inflation factor (VIF) must have a value between 1 and 10 and the tolerance level should be more than 0.2 (SPSS Inc., 2017). As can be referred from table 4.12, the obtained VIF (the coefficient of collinearity statistics) value is between 1 to 10 and the tolerance level is more than 0.2. Therefore, it can be concluded that there is no multi-collinearity problem on this regression model.

Table 4.12 Multicollinearity Test

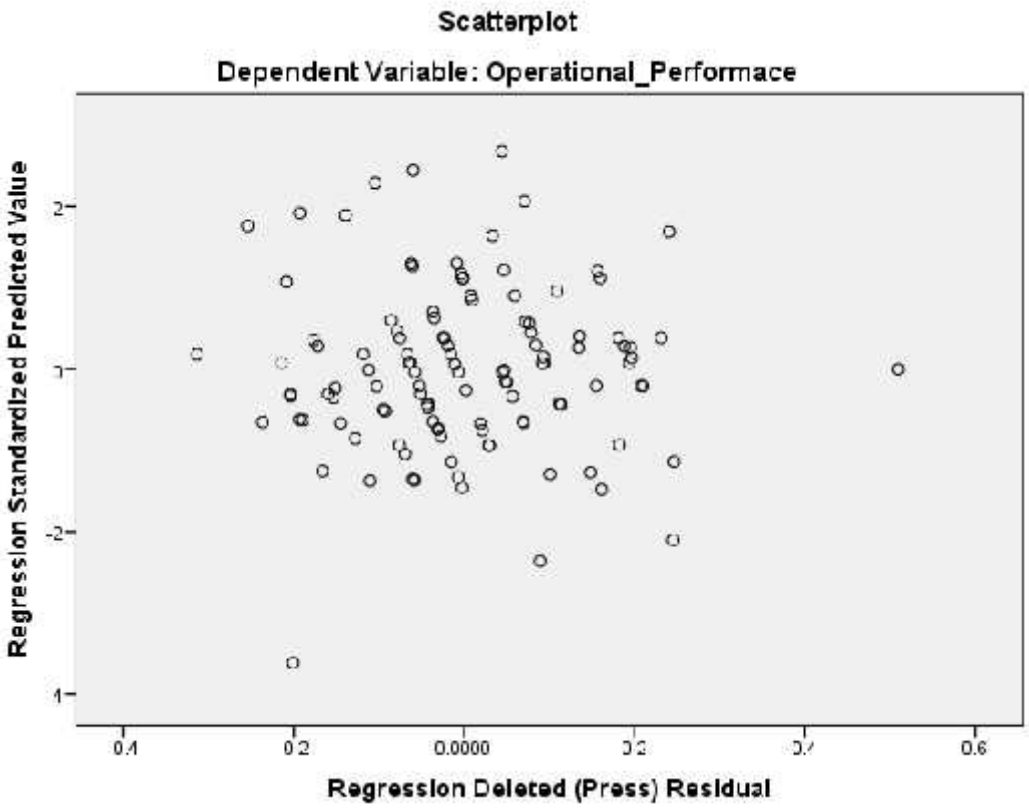
Model		Collinearity Statistics	
		Tolerance	VIF
1	Customer Relationship Management	.566	3.035
	Supplier Relationship Management	.373	2.027
	Internal Integration	.487	2.013
	Information Quality	.678	1.023
	Information Sharing	.382	3.018

a. Dependent Variable: Operational Performance

4.6.1.3. Assumption of Homoscedasticity

Homoscedasticity means that the variance of errorsisthe same across all levels of the IV. When the variance of errors differs at different values of the IV, heteroscedasticity is indicated. According to Berry and Feldman (1985) and Tabachnick and Fidell (1996)slight heteroscedasticity has little effect on significance tests; however, when heteroscedasticity is marked itcan lead to serious distortion of findings and seriously weaken the analysisthus increasing the possibility of a Type I error. This assumption can be checked by visual examination of a plot of the standardized residuals (the errors) by the regression standardized predicted value. Most modern statistical packages include this as an option.

Figure 4.1 Scatterplot based on Residual

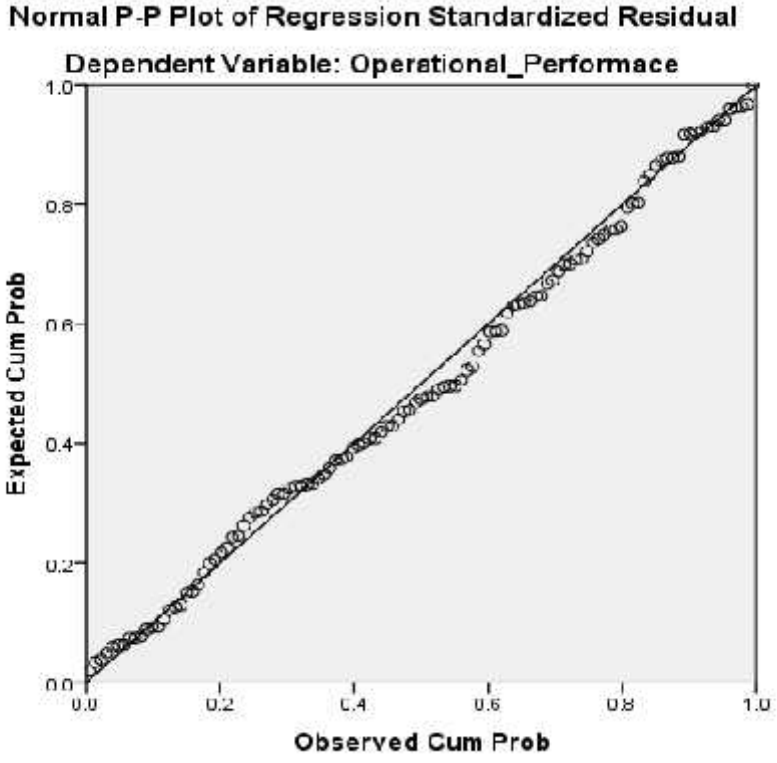


As can be seen in the scattered plot on figure 4.1 above, residuals are randomly scattered around 0 (the horizontal line) providing a relatively even distribution. Therefore, this study has no heteroscedasticity problem.

4.6.1.4. Assumption normally distribution of variables

Regression assumes that variables have normal distributions. Non-normally distributed variables or highly skewed or kurtotic variables, or variables with substantial outliers candistort relationships and significance tests. There are several pieces of information that are useful to the researcher in testing this assumption: visual inspection of data plots, skew, kurtosis, and P-P plots give researchers information about normality, and Kolmogorov-Smirnov tests provide inferential statistics on normality. Outliers can be identified either through visual inspection of histograms, frequency distributions, or by converting data to z-scores. Bivariate/multivariate data cleaning can also be important (Tabachnick& Fidell, p 139) in multiple regression. Most regression or multivariate statistics texts (e.g., Pedhazur, 1997; Tabachnick& Fidell, 2000) discuss the examination of standardized residuals, or indices of leverage. Analyses by Osborne (2001)showthatremoval of univariate and bivariate outliers can reduce the probability of Type I and Type II errors, and improve accuracy of estimates. Based on Figure 4.2 the residuals are normallydistributed because the plotted residuals are around the diagonal straight line.

Figure 4.2 P-P Plot of regression standardized residual



4.6.2 Results of the Regression Analysis

4.6.2.1Regression Analysis Model summary

R-squared is a goodness-of-fit measure for linear regression models. This statistic indicates the percentage of the variance in the dependent variable that the independent variables explain collectively. R-squared measures the strength of the relationship between your model and the dependent variable on a convenient 0 – 100% scale (Buse,1973). And the importance of the adjusted R-squared (R2) in multiple regression is to measure how well a model explains the response variable from independent variables. Statistically, the larger the R2 is, the better explanatory power the model has(Torrie,1960).

Table 4.8 Statistical Relationship:Model summary (Source: Own Survey, 2019)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854[a]	.730	.716	.367

a. Predictors: (Constant), Information Sharing, Customer Relationship Management, Internal Integration, Information Quality, Supplier Relationship Management

Based on the statistical results of Table 4.13, the adjusted R Square of 0.716indicates, at least 71% of the variation in operational performance is explained by the model. In other words, 71% change in operational performance of the ET MRO is attributable to the effectiveness in the PSCM practice.

4.6.2.2Regression Analysis Anova

Analysis of variance (ANOVA) is an analysis tool used in statistics that splits an observed aggregate variability found inside a data set into two parts: systematic factors and random factors. The systematic factors have a statistical influence on the given data set, while the random factors do not. Analysts use the ANOVA test to determine the influence that independent variables have on the dependent variable in a regression study. It assesses the significance of one or more factors by comparing the response variable means at different factor levels.

On this survey, based on Table 4.14, the ANOVA test shows that the p-value is 0.000 which is less than 0.05 (0.000<0.05). This shows that the regression model is statistically significant and regression model has a significant impact on operational performance. Hence, we can conclude that the regression model results in significantly better prediction of operational performance and that the regression model in general predicts the operational performance significantly.

Table 4.14 Statistical Relationship:Anova (Source: Own Survey, 2019)

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	57.663	5	11.426	91.723	.000[b]
	Residual	15.238	117	.114		
	Total	72.901	122			

a. Dependent Variable: Operational Performance

b. Predictors: (Constant), Information Sharing, Customer Relationship Management, Internal Integration, Information Quality, Supplier Relationship Management

4.6.2.3 Coefficients of Regression Analysis

Regression coefficients represent the mean change in the response variable for one unit of change in the predictor variable while holding other predictors in the model constant. This statistical control that regression provides is important because it isolates the role of one variable from all of the others in the model. Table 4.11 shows the Coefficients when we explore each predictor's beta (i.e., standardized regression coefficient) and the level of significance of each independent variables of the PSCM P on the dependent variable, operational performance of the ET MRO.

Form the aforementioned equation, if X1 differed by one unit (and X2, X3, X4, X5 remain constant) Y (Operational performance of the ET MRO) will differ by B1 units, on average. Accordingly, on this study model if the customer relationship management increases by 1%, on average, the operational performance of the ET MRO will be increased by 0.357 %.Similarly, with a one percent increase in the supplier relationship management of the ET PSCM, we expect the operational performance of the ET MRO toincrease by 0.197% having the other variables constant. Similarly, holding or keeping the other variables constant, a one percent increase in internal integration will result in, 0.231%,information quality will bring an increase of 0.134% and information sharing will result in 0.239% increase in the operational performance of the ET MRO.

Table 4.15 Statistical Relationship:Coefficients (Source: Own Survey, 2019)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.693	.199		-3.548	.001
	Customer Relationship Management	.359	.058	.357	5.254	.000
	Supplier Relationship Management	.234	.093	.197	2.782	.009
	Internal Integration	.321	.091	.231	3.483	.001
	Information Quality	.141	.063	.134	2.692	.011
	Information Sharing	.324	.096	.239	3.647	.001

a. Dependent Variable: Operational Performance

In general, the survey result showed that there is a significant and positive relationship between independent variables of supply chain practices and the operational performance of the ET MRO. And the finding of this survey is consistent with the findings of the other empirical research findings on the area of the study.

CHAPTER FIVE

Summary, Conclusion and Recommendations

This chapter presents summary, conclusions and recommendations for practice and also future research based on the findings drawn from the study.

5.1 Summary of research findings

Supply Chain Management is being practiced in many organizations as a tool to leverage their overall performance. Organizations with high level of SCM practices have high levels of organizational performance. the first objective of the study was to examine the current supply management practice of the Ethiopian PSCM. Accordingly, the result shows that there a relatively better implantation of customer relationship management and Internal integration. However, there is a lower degree of implementation on the other three dimensions' information quality, information sharing and supplier relationship management which need some work for enhancement. Especially, the supplier relationship management needs close attention for improvement.

The second objective was to assess the effect of the SCM P in the operational performance of ET MRO. Based on the findings of the research the SCM P plays a vital role in the performance of the operational performance of the ET MRO, which is 73% of change in operational performance of the ET MRO is attributable to the effectiveness in the PSCM practice of all the five predictor variables customer relationship management, internal integration, supplier relationship management, information sharing and information quality as per their order of importance.

Customer relationship management, supplier relationship management, internal integration, information sharing and information quality, customer relationship management and information sharing should be considered as crucial factors in improving the operational performance of the the ET MRO. The order of the factors examined based on the standardized coefficients values is: customer relationship management (B = 0.357), information sharing (B=0.239), internal integration (B = 0.231), supplier relationship management (B = 0.197), and information quality (B

= 0.134), which can be considered as per the order of their importance by the Et PSCM in order to improve the performance of the ET MRO.

Based on survey data obtained from the study respondents, the analysis provides an evidence that the SCM practices (customer relationship management, supplier relationship management, internal integration, information and information quality) positively impact the operational performance of the ET MRO. From the findings, it is clear that the customer relationship management (CRM) construct has the highest impact on the operational performance while information quality construct has the least impact on operational performance. overall the regression model was statistically significant with a p-value of 0.000 and the survey result showed that there is a significant and positive relationship between independent variables of supply chain practices and the operational performance of the ET MRO.

In general, this study offered the overall picture of the Ethiopian airlines supply chain management practice. Moreover, it showed the degree of the influence of the supply chain management practices put on the operational performance.

5.2 Conclusion

This paper provides an empirical justification for a framework that identifies five key dimensions of SCM practices and describes the relationship with operational performance and provides an insight the level of implementation of these practices in the ET SCM. The study supports conceptual and prescriptive statements in the literature regarding the impact of SCM practices on operational performance and prove importance of the SCM practices in improving operational performance. Accordingly, the five dimensions of the independent variables explain a significant and positive variance in the operational performance.

From the results achieved by data analysis one of the interesting finding is that the customer relationship management has the major influence on the operational performance. The managing of customers is considered one of the factors that affect the overall operational performance of the ET MRO and therefore ET SCM could help to improve the performance of the MRO and thus

may contribute significantly and positively to improve performance of the operation through effectiveness.

The information sharing practice of the ET SCM was the second important dimension according to the result of the study and the degree of influence on the operational performance of the ET MRO. ET SCM has an experience of sharing information like changing needs with partners, exchanging of information of important information and issues that affects its business. However, there is a limitation on sharing proprietary information with partners or suppliers.

Moreover, other results revealed that the internal integration is the third important dimension on the operational performance. Recent years have seen growth in the importance of internal integration within an organizational and with internal customers. Effective internal integration serves as a key factor to some companies to gain competitive advantage and improve their performance. However, the study showed that there is a lack of acting proactively towards the requirements of customers and meet their needs.

Regarding the information quality, there is a timely, complete, adequate and reliable information exchange in the ET SCM. However, there is a lack of accuracy on the exchanged information.

The study concludes that the supply chain management is a process that is continuous in the organization and therefore there is always need for managing all the dimensions of the the SCM practice so that it can lead to superior operational performance. As a whole, ET SCM has an effective SCMP and has an important implication for operational performance of the ET MRO. In the long term the success of the ET MRO is heavily dependent on its supply chain practices of the ET SCM.

5.3 Recommendations

Based on the findings of the study the following recommendations are drawn in order to improve the operational performance of the ET MRO.

- ET SCM should strengthen it's supply chain management practice by putting greater effort to the implementation of some key best practices of the important dimensions. This should be done by keeping all practices updated. Monitoring and further improvements for specific practices that showed a moderate extent of application should be done to ensure full adoption and appreciation of these practices. The ET SCM should therefore focus more on the implementation and improvements of the the most important variables of the SCM practices that are customer relationship management and information sharing to improve the performance of the ET MRO. The research suggests that the ET SCM should pay more attention to customer relationship management and information sharing, as they have the greatest impact on the operational performance, but internal integration, supplier relationship management and information quality are also effective factors for in the operational performance.
- The material planning section in particular has to work hard and closely interact with customers to avail spares and avoid parts shortage and stock outs which results in the extension of TATs of the aircraft and component maintenances through improving its forecasting mechanisms.
- On the supplier relationship management, the ET SCM should take the current poor practice as an improvement opportunity to fill the gap in order to improve timeliness and quality of the maintenance of ET MRO.
- The ET SCM particularly strategic sourcing section. should strive to maintain a completive edge in building a long term strategic alliance and partnership with suppliers, with fewer dependable and high quality suppliers for an improved delivery and performance.

- The researcher recommended that the ET SCM particularly the inventory and warehouse section must take a serious attention on the accuracy of the information exchanged specially on the inventory level or balance on hand information of spares.

5.4 Limitation and suggestion for future research

The researcher had an uphill task to convince the respondents to participate in the study as most of the respondents were management members who were busy and had no time to respond to the questionnaires. This challenge was overcome by explaining the objectives of the study to the respondents who took considerable time filling the questionnaires and collection for compilation of these research. The findings of this study and application thereof are limited to the ET MRO in the aviation sector. It is therefore important to note that the findings of this study can only be used for comparative purposes in other domains. Future research should, endeavor to future studies should consider to include additional metrics of operational performance other than timeand quality. Plus, expanding their scope to the overall performance of the airline as a whole. The researcher also recommends that other variables accounting for 27% of impact in the operational performance need to be identified and their impact analyzed as well.

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Appendix

Appendix A: Survey Questionnaire

Addis Ababa University school of Commerce

Logistics & Supply Chain Management unit

Survey questionnaires to be filled by selected respondents

Dear Respondent,

The purpose of this questionnaire is to collect data for the study designed to assess the role of supply chain management practice on operational performance. The study is conducted for partial fulfillment for the degree of Master of Arts in Logistics and Supply Chain Managementat Addis Ababa University School of Commerce Department of Logistics and Supply Chain Management.

You are kindly requested to fill each question objectively as your response is vital for the outcome of the study.

The survey may take between 10 and 15 minutes.I would like to thank you for your valuable time to complete the survey.Your response will be confidential and will be used only for the purpose of the study.

Answering Instructions:

Please answer all questions. Most of the questions can be answered simply by marking on the best answer. On some of the questions, space is provided to add further comment. Please note the below abbreviations: Please tick (√) the appropriate column to indicate the extent to which you agree or disagree with each statements. 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).

Part A: Demographic related Information (Please use X on the choice you make)

1. **Gender:** Male ☐ Female ☐

2. **Department:** PSCM ☐ Maintenance ☐ MRO Management ☐

3. **Current Position:** Management ☐ Non-Management ☐

4. **Highest formal education attended**

   Certificate ☐ Diploma ☐ Degree ☐ Masters ☐

   Other ☐

5. **Years of experience:**

   Less than 5 years ☐ 5-10 years ☐ 11-15 years ☐

   16-20 years ☐ Above 21 years ☐

Part B: Supply Chain Management practices

This part of the survey examines various aspects of supply chain management practices. The questions are about how ET PSCM has been implementing these supply chain management practices. Kindly indicate your level of agreement/disagreement on each practices.

Item	Statement	Alternatives				
		1(SD)	2(D)	N(3)	4(A)	5(SA)
I	**Customer Relationship Management**					
1	ET PSCM shares a sense of fair play with its customers					
2	ET PSCM frequently interacts with customers to set its reliability and responsiveness					
3	ET PSCM has frequent follow-up with its customers for quality/service feedback					
4	ET PSCM measures and evaluates customer satisfaction periodically					
5	ET PSCM frequently determines future customer expectations					
6	ET PSCM facilitates customers' ability to seek assistance from it					
7	ET PSCM frequently evaluates the formal and informal complaints of its customers					
8	ET PSCM periodically evaluates the importance of its relationship with its customers					
II	**Suppliers Relationship Management**					
9	ET PSCM rely on few dependable suppliers					
10	ET PSCM rely on high quality suppliers					
11	ET PSCM consider quality as number one criterion in selecting suppliers					
12	ET PSCM strive to establish long term relationship with its suppliers					
13	ET PSCM helps its suppliers to improve their product quality					

14	ET PSCM has continuous improvement programs that include its key suppliers					
15	ET PSCM include its key suppliers in its planning and goal setting activities					
16	ET PSCM actively involves its key suppliers in new product development processes					
17	ET PSCM certifies it's suppliers for quality					
18	ET PSCM regularly solve problems jointly with it's suppliers					
III	**Internal Integration**					
19	ET PSCM strives to reduce time wastage in operations					
20	ET PSCM has continuous quality improvement program					
21	ET PSCM produces only what has been ordered by customers (pull production system)					
22	ET PSCM pushes suppliers for shorter lead times					
23	ET PSCM streamlines ordering, receiving and other paper work from its suppliers					
IV	**Information Quality**					
24	Information exchange between ET PSCM and it's trading partners is timely					
25	Information exchange between ET PSCM and its trading partners is accurate					
26	Information exchange between ET PSCM and its trading partners is complete					
27	Information exchange between ET PSCM and its trading partners is adequate					
28	Information exchange between ET PSCM and its trading partners is reliable					

V	Information Sharing					
29	ET PSCM shares its business units' proprietary information with it's trading partners					
30	ET PSCM informs it's trading partners in advance of changing needs					
31	ET's trading partners informET PSCM in advance of changing needs					
32	ET PSCM's trading partners keep ET PSCM fully informed about issues that affect its business					
33	ET PSCM's trading partners share business knowledge of core business processes with ET PSCM					
34	ET PSCM and its trading partners exchange information that helps establishment of business planning					
35	ET PSCM and its trading partners keep each other informed about events or changes that may affect the other partners					

PART C: Operational performance indicators

Inline with the following items, please indicate your degree of agreement /disagreement refereeing to the operational performance of the ET MRO.

Item	Statement	1(SD)	2(D)	3(N)	4(A)	5(SA)
I	**Timeliness**					
1	In ET MRO aircrafts are released from maintenance per their scheduled TATs					
2	In ET MRO components are released from maintenance per their scheduled TATs					
3	In ET MRO allocated ground times for scheduled maintenance is adequate enough to accomplish planned task cards					
4	In ET MRO allocated ground times for line maintenance is adequate enough to accomplish unplanned task cards					
5	There are well trained and skilled maintenance personnel who can manage time effectively and accomplish tasks per given target date					
6	Trainings and required facilities and equipment are provided timely to the maintenance personnel					
7	There is proper manpower allocation and organization of shifts					
8	Projects and other maintenances are well managed and coordinated to meet target date/time					
9	Maintenance personnel usually exert extra effort and time to meet on time performance					

10	Aircraft and component maintenance TATs are well scheduled and are granted adequate time					
11	Spares and tools are readily available for scheduled and unscheduled maintenances					
12	The warehouse service is well coordinated and customer focused					
II	**Quality Dimension**					
1	All maintenance activities are made per the standard of quality assurance with respect to reliability, conformance, durability, serviceability and aesthetics.					
2	All aspect of human factors are taken into consideration up on assigning maintenance personnel on tasks					
3	Mantenance tasks are deferred to the next maintenance schedule if same couldn't be accomplished due to time, man power, tool or spares constraints					
4	Maintenance schedules are affected by the quality of the preceding maintenance activity					
5	There are customer complaints related to poor performance of aircraft interior equipment like seat and inflight entertainments					
6	Maintenance manuals are readily available and 'easy to use'					
7	There is a spares, ground support equipment and					

	tools constraint to accomplish scheduled task					
8	There is spares quality issue which can affect the maintenance quality					

PART E: Final Thoughts

1. How do you describe the role of supply chain management in improving MRO's on time performance?

_____
_____
_____

2. In your opinion, what actions should EAL PSCM take to minimize flight delay, extended maintenance TAT and reduce cost?

_____
_____
_____

Thank you!

Appendix B: Interview Questions for key informants

1. In your opinion, how do you evaluate the current performance of ET MRO against key competitors?

2. What do you think are the major causes for flight delay and extended maintenance TAT?

3. How does the ET PSCM affect the EAL MRO operational performance?

4. Whatmust the EAL procurement and supply chain management practice be like to improve operational performance for on time performance, reduced TAT and cost.

Thank You!

Appendix C: List of Supply Chain Management and Operational Performance activities coding

Code of Item	Item Description
CRM1	Sense of fair play with customers
CRM2	Level of interaction for reliability and responsiveness
CRM3	Quality/Service feedback follow-up
CRM4	Measurement and evaluation of customer satisfaction
CRM5	Determination of future customer expectations
CRM6	Facilitation of assistance
CRM7	Evaluation of formal and informal complaints
CRM8	Periodical evaluation of relationships
SRM1	Reliance on few dependable suppliers
SRM2	Reliance on high quality dependable suppliers
SRM3	Consideration of quality as a selection criterion
SRM4	Establishment of long term relationship with suppliers
SRM5	Level of help to suppliers for product improvement
SRM6	Continuous improvement
SRM7	Inclusion of suppliers in planning and goal setting
SRM8	Involvement of suppliers in product development
SRM9	Certification of suppliers for quality
SRM10	Joint problems solution with supplies
II1	Reduction of time wastage
II2	Continuous quality improvement
II3	Pull production system
II4	Pushes suppliers for shorter lead times
II5	Streamlined order process
IQ1	Timeliness of Information exchange
IQ2	Accuracy of Information exchange
IQ3	Completeness of Information exchange
IQ4	Adequacy of Information exchange
IQ5	Reliability of Information exchange
IS1	Proprietary information sharing to partners
IS2	Information about changing needs to partners
IS3	Information about changing needs from partners
IS4	Information of issues affecting its business

IS5	Sharing of business knowledge from partners
IS6	Exchange of information for business planning
IS7	Important information exchange
TM1	TAT of aircrafts
TM2	TAT of components
TM3	Adequacy of ground times for schedule maintenance
TM4	Adequacy of ground times for line maintenance
TM5	Skill of maintenance peroneal
TM6	Training and facilities
TM7	Manpower allocation
TM8	Management of projects
TM9	Extra effort of maintenance personnel
TM10	Adequacy of scheduled TAT
TM11	Availability of Spares and tools
TM12	Warehouse service
QL1	Standard of quality assurance
QL2	consideration of human factors
QL3	Deferral of tasks
QL4	Quality of preceding maintenance
QL5	Poor performance of aircraft
QL6	Availability & ease of manuals
QL7	Availability of spares and ground support equipment
QL8	Spares quality issues
DI1	Gender
DI2	Department
DI3	Position
DI4	Highest Education
DI5	Experience

Source: Developed by the researcher (2019)