ADDIS ABABA UNIVERSITY

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The Influence of Digital Technology in Improving Supply Chain Efficiency: In the Case of Ethiopian Airlines

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Logistics and Supply Chain Management

By

Yodit Teklemariam (GSD/7638/15)

Advisor: Zellalem Tadesse (PhD)

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DECLARATION

I, the undersigned declare that this thesis titled “The Influence of Digital Technology in Improving Supply Chain Efficiency at Ethiopian Airlines” is my original work and never been presented to any other university or institution before for similar purpose. All the materials and resources used for thesis are properly acknowledged.

Name: Yodit Teklemariam

Signature: _____

Date: -_____

CERTIFICATION

This is to certify that thesis titled “The Influence of Digital Technology in Improving Supply Chain Efficiency at Ethiopian Airlines” submitted by Yodit Teklemariam is done under my supervision and it is an original work which was never been presented to any other university or institution for similar purpose.

_____

Zellalem Tadesse (PhD)
Research Advisor

APPROVED BY BOARD OF EXAMINERS

Advisor	Signature	Date
Internal Examiner	Signature	Date
External Examiner	Signature	Date

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LIST OF ABBREVIATIONS AND ACRONYMS

ACRONYMS	DEFINITION
SC	Supply Chain
DT	Digital Technology
AI	Artificial Intelligence
IoT	Internet Of Things
BDA	Big Data Analytics
RFID	Radio Frequency Identification
MRO	Maintenance, Repair and Overhaul
RFID	Radio Frequency Identification
TCT	Transaction Cost Theory
RBV	Resource Based View
DCT	Dynamic Capability Theory
ERP	Enterprise Resource Planning

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ABSTRACT

The object of this study is to examine the influence of digital technology in improving supply chain efficiency in Ethiopian Airlines procurement and supply chain division. Four dimensions of digital components such as integration, visibility, automation, and communication were examined with respect to major supply chain performance indicators like cost reduction, operational efficiency, cycle time reduction and customer satisfaction. An explanatory research design with mixed research approach is used, utilizing survey questioner to collect the quantitative data and semi structured interviews for the qualitative data, to have a comprehensive analysis of the subject under study. Out of the distributed 199 survey questioners, 188 were responded, which is 94.47% response rate and acceptable to conduct the study. The descriptive statistics indicate that there is a strong agreement regarding the effectiveness of digital tools in improving supply chain efficiency. Furthermore, the inferential statistics, both the correlation and regression analysis prove there is a statistically significant and positive relationship between all the four digital dimensions and supply chain efficiency, with automation and visibility identified as the most influential variables. The study concluded that implementing digital technology strategically can significantly improve supply chain outcomes and improve overall supply chain efficiency.

Keywords: Supply chain efficiency, digital technology, integration, visibility, automation, and communication.

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CHAPTER ONE

1. INTRODUCTION

Under this chapter, the study background, the statement of the problem, the objective, research questions, scope, and limitation, were presented.

1.1. Background of the Study

Digital technologies are becoming a main priority for organizations for developing a supply chain that is resilient and sustainable to be competitive in an actively changing operating environment (Ning & Yao, 2023). Digital technologies have changed several industries, including the aviation industry and in recent years, the integration of digital tools and practices for process streamlining are significantly transforming the operational efficiency of various industries worldwide. With the improvement of technologies like artificial intelligence (AI), blockchain, the Internet of Things (IoT), and advanced analytics, businesses are rethinking their supply chain process to remain competitive, improve their efficiency, and increase resilience (Supply chain conference 2024). Digital supply chain is the development of information systems and the adoption of innovative technologies strengthening the integration and agility of the supply chain and thus improving customer service and sustainability performance of the organization (Ageron et al., 2020).

In the current globalized world, digitization is not an option, rather a main priority for all businesses across all industries (Agrawal & Narain, 2018). The aviation industry also recognized the importance of adopting advanced technologies to remain competitive in such an increasingly global market. According to SITA's 2023 Air Transport IT insight report, airlines are adjusting themselves for digital advancement and increased IT spending year on year since 2020, reaching an estimated 34.5 billion USD in 2023, with 99% of airlines predicting an increase in IT and technology spending in 2023. To maintain competitive advantage, especially for industries operating in actively changing and highly connected operating environments like the aviation industry, supply chain efficiency is a critical area. Efficient supply chain management is essential to gain competitive power providing enhanced customer satisfaction, cost reduction, resource optimization, increased market share, and overall profitability (Negi, 2021). An efficient supply chain will save cost and improve customer satisfaction by minimizing waste, reducing delays, and by ensuring that resources

are utilized optimally as possible (Achebe et al., 2021). Efficient supply chain management is crucial for survival and success in a continuously changing world (Croznik & Trkman, 2012).

Traditionally, supply chain operations were dependent on manual processes and tasks characterized by redundant paperwork, unintegrated processes, have less supply chain visibility, limited information sharing and communication among stockholders. According to different studies, implementing digital technologies in a supply chain process will address the inefficiencies and issues observed with the traditional supply chain process by automating supply chain processes, enabling integration, enhancing visibility and communication throughout the supply chain process. Digitalization of supply chain and using technologies such as blockchain, IoT, machine learning increase and enhance the ability to optimize planning, sourcing, and procurement (Billiard et al.,2022).Digitalization of supply chain process enables seamless, integrated, transparent, and efficient processes. It enables companies to address the new requirements of the customers, the challenges on the supply side as well as the remaining expectations in efficiency improvement (Alicki et al., 2016). With growing competition and a fast-changing global business environment, airlines must improve and adapt their supply chain processes to stay competitive in the market.

In Ethiopia, the government is taking different initiatives to implement digital transformation in different sectors including the transportation sector. In recent years, digitalization is gaining great attention in the country and as part of this strategy, the government issued a digital strategy called Digital Ethiopia 2025 which is a strategic framework aiming to leverage digital technologies and leading the country economy into a digitally empowered and knowledge-based economy. According to International Trade Administration, digital economy overview, the government of Ethiopia has developed digital portals, for e-trade, e-procurement, e-service, a city portal, and ease-of-doing-business portals to assist in the country's development.

In the Ethiopian transportation sector, Ethiopian airlines is the only air transport provider that has been connecting the country to different parts of the world by providing cargo as well as passenger transportation. Ethiopian Airlines group is a fully state-owned airline and has been operating as the country's flag carrier since its establishment in 1945. As one of Africa's leading airlines, Ethiopian Airlines Group has fully digitalized all its business processes like aircraft maintenance and Flight Operations, Commercial Operations, Finance, HRM,

Customer Services, Procurement and supply Chain Management, Online learning, management approvals and authorizations by removing paper from the entire system as of September 28, 2017(Ethiopian airlines website). The airline also has been adopting innovative digital solutions to enhance its supply chain operations. The airline has a centralized procurement and supply chain division that gives support to the entire airline operation including its partner airline. The airlines' procurement and supply chain operation are highly influenced and challenged by the global business environment, given that most of its source of supply is the international market due to the unique nature of its operation and limited local capability as the country is not industrialized. According to world back Ethiopia profiles the country is depended on agriculture and 70% the workforce is still in this sector (World Bank. n.d.). Therefore, using digital tools and systems in the supply chain process is not only to streamline end-to-end supply chain activities of the airline but also to have valuable data and information for strategic decision-making. Therefore, continuously assessing the influence of digital technologies in improving supply chain efficiency of the airline is important as it will offer industry tailored insight for the airline stockholders and can guide informed decisions about adopting innovative technologies for overall supply chain efficiency and competitiveness.

1.2. Background of the Organization

Ethiopian Airlines, which is fully owned by Ethiopian government has come along 79 years of successful journey since its establishment in 1945. Throughout the years, the airline has become a leader in the industry in technology, leadership, network expansion and aviation mentoring. Ethiopian is now the leading Aviation Group in Africa. Currently, the airline serves 141 international passenger and cargo destinations, including 66 African cities, with daily and multiple flights with a minimum layover in Addis (Ethiopian website, 2024).

Ethiopian has central procurement division lead by two directors; one reporting to the Group Chief Executive Officer (GCFO) and handles all non-aircraft related or commercial purchase requirements of the airline including equity partners and the other one directly reporting to MD MRO and responsible to fulfill all the airlines aircraft related purchase. The Procurement and supply chain division includes different departments such as Strategic sourcing, tactical purchase sections, warranty, and contract management section, receiving, inventory audit, warehouse and surplus administration and logistics section.

1.3. Statement of the Problem

Supply chain efficiency is a key component of competitive advantage and operational excellence for businesses across industries in the fast-paced and interconnected global market; accordingly, an efficient supply chain reduces delays and ensures that resources are utilized optimally, ultimately leading to cost savings and improved customer satisfaction(Achebe et al., 2021). In the airline industry, supply chain efficiency is a critical aspect in the overall success of the industry, given the time sensitivity of the nature of the operation. Zakir et al. (2023) states that supply chain efficiency is very essential for reducing operational costs in the aviation sector.

However, the industry is being very much challenged to efficiently manage its supply chain because of the complexity of operation and different limitations. The global airline industry operates in service industry complexities within a highly turbulent environment and in contrast to other industries, the aviation sector undergoes rapid change due to different factors (Iwabuchi et al., 2013). Various challenges such as the aftermath of the COVID-19 pandemic, ongoing supply chain disruptions, staff shortages, the decline in business travel, geopolitical instability, and climate change policies are among the significant challenges the aviation industry is currently facing (Parachi, 2022). The International Air Transport Association (IATA) has also highlighted that supply chain challenges are resulting in higher operating costs and affecting growth, and these issues will continue to impact airlines performance negatively into 2025(IATA Press Release No: 59, 2024).

Different literature suggested that using digital tools and systems will provide a possible solution for the challenges by improving visibility in the supply chain operation, automating the whole supply chain process, enabling overall process integration as well as better communication among supply chain stakeholders. Digitalization enables standardization, simplification, and automation of processes, which also improves supply chain visibility and long-term competitive advantage for companies through enhancing access to information, reducing costs, and improving product quality as well as responsiveness and collaboration abilities (Agrawal & Narain, 2018). To improve supply chain operations, digital transformation is required through the adoption of technologies like IoT, AI, drones, and robotics(GEP, 2022).

Ethiopian Airlines is also facing similar challenges in its supply chain operations, and as observed and mentioned on internal activity reports of the sections as well as internal customer feedback, out-of-stock situations, unplanned orders, AOG orders, shipment delays, and lengthy bid process times are some of the reported challenges of the division. Accordingly, the airline has been implementing digital tools and systems to address those challenges and improve its supply chain process throughout the years. In Ethiopian Airlines procurement and supply chain division, most of the activities, like purchase requisition, supplier selection, spend management, purchase order processing, inventory management, planning, and shipment tracking, are done electronically. The airline uses systems such as SAP ERP, Maintenix, e-procurement, RFID, and a spend analysis system to better improve its process, enhance decision- making, enable better information sharing and create visibility in its procurement and supply chain process.

However, while digital technology benefits are mentioned and generally understood as a driver of supply chain efficiency, there is limited empirical evidence or study that specifically emphasizes the influence of digital technologies on supply chain efficiency improvement, specifically to the airline industry. Such studies are limited in academic literature. The available research also has been undertaken on broader topics such as general supply chain management and digital transformation in aviation. The study by (Queiroz et al., 2019) emphasized how supply chain capabilities can be enhanced through industry 4.0 technologies, and it proposes a framework to enable an understanding of the opportunities and challenges related to digitalization. A study by (Motaung & Safilo, 2023) on Benefits and barriers of digital procurement: Lessons from an airport company also discuss the advantages and limitations of digital procurement in the aviation industry. The study focuses on how digital procurement enhances efficiency in airport operations. Hence, the study supports the broader requirement for digital transformation in an airline specific supply chain. Another study by Mohaddessin et al., (2024) examines strategies of digital transformation that are changing the airline industry and how it affects operational efficiency, customer engagement, and the ability to adapt to new market.

In the case of Ethiopian Airlines, there are limited number of related studies. There is one related research specifically on e-procurement, impact on maintenance, repair, and overhaul (MRO) studied by (Ayalew, 2020). Although the above-mentioned digital solutions are adopted by the airline, it is not clearly understood how the digital technology implemented by

the airline is influencing the supply chain efficiency metrics such as cost reduction, cycle time, customer satisfaction, and overall operational efficiency.

Therefore, this research aims to examine the influence of digital technology in enhancing supply chain efficiency by analyzing the relationship between key digitalization components (integration, automation, visibility, and enhanced communication) and supply chain efficiency, and bridge the gap in the literature with practical applications for the airline's stakeholders.

1.4. Research Objective

1.4.1. General Objective

The General objective of the study is to assess how digital technology impact and improves supply chain efficiency of Ethiopian Airlines.

1.4.2. Specific Objective

1. To analyze the current level of digital technology practice within Ethiopian Airline's supply chain processes.
2. To assess the impact of integration enabled by digital technology on supply chain efficiency of Ethiopian Airlines.
3. To examine how process automation improves supply chain efficiency of Ethiopian Airlines.
4. To assess how visibility enhancement through digital tools improves supply chain efficiency
5. To analyze how enhanced communication promotes supply chain efficiency

1.5. Research Questions

1. How digital technology practices impact the supply chain efficiency of Ethiopian airlines supply chain process?
2. How does digital integration influence supply chain efficiency?

3. How does process automation improve supply chain efficiency?
4. How does visibility enhancement through digital tools contribute to the improvement of supply chain efficiency?
5. How does enhanced communication promote supply chain efficiency?

1.6. Significance of the Study

The findings from the study are expected to hold significant importance to several stakeholders, particularly for the airline. For the Airline and the aviation industry, the study can provide visible information regarding the influence of digital technology in improving supply chain efficiency and demonstrate how digital technology reduces operational cost, improve operational efficiency, reduce cycle time, and enhance customer satisfaction accordingly improve overall efficiency. The findings can be used as an input for strategic decision making and guide for future technological investments. The study can also serve as a benchmark by providing insights into successful implementation of digital technology and encourage others to invest in innovative digital tools. For Policy makers, the findings of the study can help as a guide in policy making with respect to digitalization of procurement and supply chain processes.

The research can also contribute to the existing principles and theories on supply chain efficiency, digital technology and provide theoretical insights and frameworks. It can pave the way for future studies in related areas and help in future research on similar topics.

1.7. Scop of the Study

This research focused on the digital technology employed by Ethiopian Airlines on its supply chain process, and how the implementation influence supply chain efficiency of the airline. Mainly the study is conducted taking Ethiopian Airlines Procurement and Supply chain division as a focus and assessed the influence of the implemented digital tools in improving the airlines supply chain with regards to cost reduction, improving operational efficiency, cycle time reduction and customer satisfaction. To conduct this study both explanatory and descriptive research design as well as both qualitative and quantitative analysis were implemented.

1.8. Definition of Termes

- **Supply Chain:** The network of individuals, businesses, and resources that work together to guarantee that a specific product is manufactured and supplied to the consumer in the most efficient manner and at the appropriate time is known as the supply chain, according to (Renko, 2011).
- **Efficiency**: An organization's ability to produce goods and services with minimal costs by minimizing waste and optimizing resource utilization Bag, S (2023 cited in Salamah et al., 2024).
- **Integration: - S**eamless connectivity and real-time data sharing between departments, suppliers, and partners through digital technologies such as ERP system IOT and cloud platforms (Büyüközkan & Göçer, 2018)
- **Visibility**: The ability to track and monitor goods and information throughout the supply chain, and accessibility of real-time data among supply chain stakeholders through implementing digital technologies (Jean, 2024).
- **Automation**: Using digital technologies to improve efficiency and streamline supply chain process (Claire Vanner, 2024) .
- **Digital Technology**: The use of devices, software, and systems that process, store, and transmit information in digital form rather than analog and include various tools and applications such as computers, smartphones, the internet, cloud computing, and software that enable electronic data processing Harahap et al. (2023 cited in Handayati et al., 2024).

1.9. Organization of the Study

The subject paper is organized under five chapters. The background of the study, background regarding the organization, the statement of problem, the study objectives, research questions, significance and the scope is covered under chapter one. On chapter two, both imperial and theoretical literature review of related material have been presented. Methodology of the research, and presentation as well as analysis of the data is discussed under chapter three and four, respectively. Finally, the discussion, conclusion, and recommendation about the study is presented under chapter five.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. Introduction

Under this chapter, different theories, empirical studies, existing literature from journal papers and other publications about the influence of digital technologies in supply chain efficiency, were discussed. Different expert opinions and findings of studies on related topics will be examined. The chapter will also include literature gaps and conceptual frameworks for the research.

2.1.1. Supply Chain Practice

Supply chain council defines supply chain management "as a process that encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and logistics activities"(Supply Chain Council, n.d.). It is the process of production, distribution and delivery of finished products or services to end customers and it involves a group or network of companies, a flow of information, and resources.

Roberta S. Russell & Bernard W. Taylor (2010) also states that the supply chain is an integrated group of business processes and activities such as source, making and delivering products with the same goal, providing customer satisfaction. Within the firm, the supply chain process involves various activities such as demand forecasting, procurement, inventory management, warehousing, and logistics activities. Supply chain management is the coordination of activities, within and among vertically linked firms, for the purpose of serving end customers at a profit. (Larson & Rogers (1998). The seamless integration of this interconnected process can enable firms to achieve better response time, cost reduction, and better operational efficiency.

Demand forecasting is the practice of predicting future customer demand for a product or service based on historical data, market analysis, and other relevant information. It involves estimating the quantity of a product or service that consumers will purchase in the future,

which enables a business to make informed decisions about inventory management, production planning, and resource allocation (Atwani et al., 2024).

Ethiopian Federal Government Procurement and Property Administration Proclamation defines procurement as a process of obtaining goods, works, consultancy or other services through purchasing, hiring, or obtaining by any other contractual means. It is a process of sourcing and buying goods and services from third parties. This process involves need identification, suppler sourcing/evaluation, negotiation, processing purchase order, delivery and receiving, payment processing and suppler relationship management.

Inventory management process refers to the activities of ordering, storing, using, and selling a company's inventory. This includes raw materials, components, and finished products, as well as the warehousing and processing of these items. Inventory management is responsible for planning and controlling inventory from the raw material stage to the customer. Since inventory either results from production or supports it, the two cannot be managed separately and, therefore, must be coordinated. Inventory must be considered at each of the planning levels and is thus part of production planning, master production scheduling, and material requirements planning. Production planning is concerned with overall inventory, master planning with end items, and material requirements planning with component parts and raw material (Arnold et al., 2008).

Warehousing is the process of keeping and storing goods and materials in a specified place until they are needed and used. Warehousing includes activities such as receiving goods, identifying, putting away, holding goods, picking, and dispatching (Arnold et al., 2008). The role of warehousing is to ensure that individual companies possessed sufficient stock not only to respond to anticipated customer requirements but also to act as a buffer guarding against the "bullwhip effect" produced by uncertainties in supply and demand characteristic of linear supply chains (Ross, 2004).

To cope with the rapidly changing business environment, currently the supply chain needs to be more agile, and efficient and technology is one of the enablers. Technology adoption, data utilization and ESG (Environmental, social governance) trends are already driving a rapidly evolving supply chain (Grant & Councils, 2024).

In the aviation industry the supply chain is changing continuously with the continuous development of the industry. The need for efficiency, cost reduction, and increased flexibility are the current trends that are driving the aviation supply chain management. One key trend is the adoption of digital technologies to streamline supply chain operations. From advanced analytics and artificial intelligence to blockchain and internet of things (IoT) devices, these technologies are revolutionizing the way supply chains are managed in the aviation industry. With the ability to track and analyze data in real-time, companies can optimize their operations, improve forecasting accuracy, and enhance overall supply chain performance (Jadoon, 2024).

2.1.2. Supply Chain Efficiency

As defined by Labs (2010, as cited in Negi, 2021) Supply chain efficiency is a measure of getting the desired quality product to the required place at the needed time with the possible least cost. Therefore, supply chain efficiency is very important for any organizations or businesses sustainable performance. In the supply chain process, many stakeholders are involved from both upstream as well as downstream process. Raw material producers, manufacturers, suppliers are found on the upstream side and from the downstream side all the stakeholders involved in supplying the required product to the final user. For a supply chain to be efficient, the coordinated and seamless flow of material, information, and money should be fulfilled at any stage of the supply chain process. Any disruption in this process will affect the supply chain efficiency.

Different studies identified that the basic supply chain efficiency indicators are cost reduction, on time delivery, and quality that can be obtained from west elimination, maximum resource utilization and reduced delays. The target of supply chain efficiency is to control the cost and quality of the product as well as the processes for achieving maximum quality and customer satisfaction (Negi, 2021). Supply chain efficiency intends to maximize the existing resources to deliver a product to the end-user without delay and increasing costs and ensure efficiency in process, enhance product quality, mitigate disruption, and drive business growth(GEP, 2022).

Supply chain efficiency is very critical for any business, as it directly impacts the businesses' ability to deliver a product in terms of cost, speed, and reliability. Negi (2021) clarified and

defined key measurements and variables for assessing efficiency. The article stated that lead time, quality, low cost, high customer service, resource utilization, profitability, minimum waste, flexibility, integration and value addition to the stakeholders are the significant supply chain efficiency indicators. Furthermore, it is suggested that the use of technology such as IOT usage, continuous information sharing, improved workforce for effective and efficient operation, cost, and quality control of the product as well as the processes, resource optimization and coordination between the supply chain partner can be taken as a measure to improve supply chain efficiency.

2.1.3. Digital Technologies in Supply Chain

In recent years, the adoption of digital technologies in supply chain management has received a lot of attention due to its effectiveness in improving performance, visibility, and decision-making processes. As Berman (2021) explained, 'Digital technologies include all types of electronic tools, devices and systems that process, transmit and store data in binary form and range from simple digital watches and televisions to cutting-edge robotics and artificial intelligence. By using different technological tools and systems, firms can digitalize their processes to improve how they operate and increase efficiency in their operation.

Digitization is the process of creating digital versions of analogue/physical things such as paper documents, microfilm images, photographs, sounds, and more (Arenkov et al., 2019). The current global business environment is very volatile and challenging, especially for Supply chain since supply chain involves the coordinated effort of different players from both downstream and upstream supply chain partners, cross border transactions and communications, and operates in a vast geopolitical environment. To adopt and sustain in such a challenging operating environment, using digital technologies and digitalization of supply chain holds a great importance, by enhancing communication and information exchange, enabling easy tracking, and traceability throughout the supply chain process. As stated by Agrawal & Narain (2018), digital supply chain technologies are powerful innovative technologies that can change the traditional way of doing various processes of supply chain like supply chain planning, task execution, interacting with all the participants of supply chain, achieving integration among the members of supply chain, and enabling new business models.

Compared to traditional supply chain, digital supply chain is networked, real-time and accurate, highly automated communication with broad use of EDI/B2B integration, portals and/or automated data capture, proactive & continuous collaboration, end-to-end & near real-time visibility, and enable decision making based on end-to-end, real-time information(OpenText, 2024). Digital transformation has revolutionized supply chain collaboration and integration, enabling data-driven decision-making and predictive analytics that optimize inventory management, demand forecasting, and resource allocation (Benatiya Andaloussi, 2024). Investing in and implementing emerging technologies will create a sustained competitive advantage for companies through enhancing access to information, reducing costs, improving products quality, as well as responsiveness, and collaboration abilities(Agrawal & Narain, 2018)

Different studies and literatures state that key digital technologies used in supply chain management such as blockchain, IoT, AI, and big data analytics among other innovations, have changed traditional supply chain management practices by making it possible to share and analyze data in real time.

Blockchain is one of the key supply chain technologies among the technologies that are now being implemented. Blockchain is an innovative, decentralized, and distributive "state-of-the-art" technology, which maintains confidentiality, integrity, and availability of all the transaction sand data(Dutta et al., 2020). Wang & Wang (2018),stated that, blockchain technology offers benefits such as improved tracking and traceability, efficiency gains through automation, and reduction of complexities. Accordingly, it has the potential to significantly change supply chain practices by enhancing transparency, efficiency, and security. Blockchain enhances supply chain transparency, traceability, and security, reducing risks associated with fraud and ensuring compliance with regulatory standards (Holloway, 2025).

The airline industry also can benefit from implementing blockchain as blockchain enables tracking of products throughout the supply chain, can reduce errors, prevent fraud, and it can also enhance trust. According to Dutta et al., (2020), aviation industry can incorporate digitization and securitization by integrating RFID technology with their Supply chain which will assist in tracking ports and implement process improvement. RFID technology integrated

with blockchain and IoT further increases security and ensures transparent and immutable data management of RFIDs.

Another key supply chain digital technologies that can enhance supply chain performance is Internet of Things (IOT). As defined by Ben-Daya et al., (2019), the Internet of Things is a network of digitally connected physical objects that sense, monitor, and interact both inside and between businesses and their supply chain allowing agility, visibility, tracking, and sharing, which helps with timely supply chain planning, control, and coordination.

Different sources categories the IOT used in supply chain into different layers. De Vass et al., (2021), explained the IOT categorizing with 4 layers: a sensing layer, a network layer, a service layer, and an interface layer. Phase & Mhetre (2023), categorize the IOT into two layers i.e., the infrastructure layer which consists of the physical entities of the management system such Sensors, Sensor nods, Gateways, mobile device, proxy server and cloud; and the second layer is application layer which consists of the working and information flow of the entire system.

As can be understood from different literatures, IOT can improve and enhance supply chain operations and can bring efficiency throughout the supply chain process. IoT improves supply chain visibility, predictive maintenance, and operational efficiency through continuous monitoring and data insights (Holloway, 2025). IOT can be applied in the supply chain process to enable warehouse management, fleet management, real time trucking and controlling, and inventory planning/forecasting. IoT in supply chains can greatly enhance the ability to track goods, collect data, communicate with partners, and gain better business insights and these enhancements can result in more efficient and transparent supply chain processes (De Vass et al., 2021)

Artificial intelligence (AI) is another technology that is being used in current supply chain processes. As defined by Schutzer (1990, cited by Toorajipour et al., 2021), AI is the capability of machines to communicate with, and imitate the capabilities of, humans. Key discoveries show that effective usage of AI can enable the supply chain to become much more resilient and flexible. Toorajipour et al., (2021) stated that AI can transform supply chain management through smart automation and analytical tools. AI technologies support demand forecasting, inventory optimization, and personalized marketing strategies, improving

customer engagement and satisfaction (Holloway, 2025). AI can significantly help with designing supply chain networks, choosing suppliers, managing inventory, planning demand, and handling green supply chain issues. These improvements can lead to a more efficient and decentralized supply chain (Sharma et al., 2022).

Big data analytics (BDA) is also becoming a vital tool in supply chain and has been defined by many in different contexts. In the context of SCM, BDA is defined as 'the ability of organizations to collect and organize SC data from heterogeneous systems distributed across organizational boundaries, analyze it either batch-wise or real-time or near real-time and visualize it intuitively to create proactive SC system and support decision making Arunachalam, Kumar, and Kawalek (2018 as cited in Maheshwari et al., 2020).

2.1.4. Digital Technology Dimensions in Supply Chain Efficiency

Digital technologies play a major role and become essential in our day-to-day life, especially in today's competitive supply chain environment. The adoption of IoT, AI, blockchain, and advanced analytics has shown to substantially transform supply chain management (SCM) practices by enabling greater visibility and transparency across the supply chain, real-time data collection and tracking, data analysis, facilitate proactive management of inventory, reduces lead times, and facilitate decision-making, thereby enhancing operational efficiency and enhances overall supply chain responsiveness (Holloway, 2025).

2.1.4.1. Integration

Digital integration is an integration of different systems, platforms, software, and devices of an organization to enable seamless data exchange and information sharing. An integrated system will reduce lead times by improving coordination between procurement and logistics process (Gunasekaran & Ngai, 2004)

Digital technologies enable supply chain process integration, resulting in improved efficiency in terms of cost reduction, operational efficacy, reducing cycle time and improved customer satisfaction. IT systems facilitate supply chain process integration, resulting in better demand planning, streamlined operations, and enhanced financial processes (Rai et al., 2006)). Such integrations enable organizations to share information within the supply chain and achieve

operational excellence. Digital integration improves purchasing and supply chain processes by reducing manual work and leading to cost saving (Hallikas et al., 2019).

Using Internet of Things, artificial intelligence, and cloud computing is essential for achieving the benefits of supply chain integration led to business process synchronizing, automation, flexibility, and efficient data analysis and management, thereby, enhancing firms' profitability and competitiveness (Najat & Alaa Eddine. E. M, 2024).Overall, digital technologies enable effective supply chain integration, leading to cost reduction, improved operational efficiency, reduced cycle times, and enhanced customer satisfaction.

2.1.4.2. Visibility

The main role of digital technologies is to make the supply chain clearer and more visible. Digital tools such as the Internet of Things (IoT) and tracking systems such as RFID and GPS help to track and monitor items and materials as they travel through the supply chain in real time. Such tools also can be used to manage inventory and in demand forecasting. Hoshimov et al. (2021), stated that using digital technologies, such as Cloud Computing, Internet of Things (IoT), and Big Data Analytics, significantly improve supply chain performance with respect to inventory management, cost reduction, and order fulfillment ratios compared to traditional method.

Enhanced visibility in the supply chain process because of digital technology implementation enables organizations to quickly identify and address disruptions, which leads to minimizing delays and improving overall supply chain agility. The availability of accurate data enables a more accurate analysis which supports decision making and provides higher flexibility (Yang et al., 2021). Increased visibility and agility provided by technologies have a considerable role in providing flexible, agile, robust, and sustainable SC (Ghadge et al., 2020). Using predictive analytics in a supply chain will improve demand forecasting accuracy and enable identification of potential disruptions resulting in substantial cost savings and enhanced supply chain responsiveness (Ibiyemi & Olutimehin, 2024). Enhanced visibility through digital technology can improve supply chain efficiency, reduce operational costs, and increase customer satisfaction.

2.1.4.3. Process Automation

Automating repetitive manual tasks and process streamlining is one of the critical roles of digital technologies. As it leads to decreasing lead time, and improvement in operational efficiency, automation positively affects supply chain efficiency and accordingly, organizations need to utilize advanced technology to make their operation cost effective and lean (Atieh et al., 2025).

Automated tools will streamline different supply chain processes by reducing manual interventions, minimizing human errors, and enabling accurate demand forecasting. Digital integration and automation of information flows in supply chains enhance process speed, resulting in cost savings by reducing manual work (Hallikas et al., 2019).These technologies improve operations, enhance productivity, and significantly lower operational costs.(Agrawal & Narin R, 2018) stated that investing in and implementing emerging technologies will create a sustained competitive advantage for companies through enhancing access to information, reducing costs, improving products quality, as well as responsiveness, and collaboration abilities. Growing information sharing and synchronization of operations between SC partners help to decrease total costs and increase the efficiency and agility. These advancements contribute to cost reduction, improved operational efficiency, reduced cycle times, and increased customer satisfaction in supply chain management, demonstrating the transformative impact of process automation on overall supply chain performance.

2.1.4.4. Enhanced Communication

Using digital technologies allows effective and fast communication between supply chain players which improves supply chain collaboration**.** Digital supply chain supports a shift from traditional, supply chain into a more collaborative supply chain that continuously enhances operations based on timely information sharing across the operation (OpenText, 2024). As stated by Benatiya Andaloussi (2024), organizations can collaborate and connect seamlessly with their suppliers, manufacturers, distributors, and customers to improve communication, relationships, and facilitate the sharing of critical information and resources by using digital systems and technologies. The improved transparency and collaboration along the SC network also led to increased trust and stronger relationships between SC members (Ghadge et al., 2020).

Adopting digital tools and communication technology is changing procurement and supply chain functions impacting supply chain efficiency paraments. According to different studies, companies that use digital communication technology make their supply chain more adaptable and agile as it will allow them to react quickly to changes. By saving time and improving service quality, the application of digital technology improves the companies of the organizations (Ghate et al., 2024)

Customer satisfaction is one of the improvements obtained by communication technologies by enabling transparency, accurate demand forecasting, and timely order fulfillment (Amukanga & Otuya, 2021). The implementation of digital tools in procurement and supply chain management process will result in on-time data exchange, process automation, and streamlined decision making, thereby leading to significant cost saving and improved responsiveness(Ghate et al., 2024).

2.1.5. Performance Measurement of Supply Chain Efficiency

Different studies outlined that the use of technologies can improve supply chain efficiency by enabling real-time data and information sharing, transparency, and efficiency in overall supply chain process. Technologies such as Cloud Computing (CC), Big Data Analytics (BDA), and the Internet of Things (IoT) could help SCs to have real-time data and information (Hoshimov et al., 2021). Alicke et al., (2018) stated the application of the Internet of Things, the use of advanced robotics, and the application of advanced analytics of big data in supply chain management can improve performance and customer satisfaction significantly.

Moving toward digitalization in SC is becoming connected to integrated technological mechanisms for information sharing among SC partners (Harju et al., 2020). Using artificial intelligence for big data analysis helps companies make better decisions, manage their supply chains more effectively, and work more efficiently (Smerichevska et al., 2024). By using AI, companies are changing their methods to be more proactive(Smerichevska et al., 2024). Overall, using digital technology in supply chain processes affects procurement cycle time, reduces costs, and brings better operational efficiency.

Cost Reduction in a supply chain is a major benefit of using digital technology. The visibility and real-time data availability enables better inventory management and accuracy in forecasting, as a result optimum inventory can be maintained which will minimize inventory holding cost. Digitization can take supply chains to the next level and drive major cost reductions, which will result in higher annual revenues (Dadsena et al., 2024).

Operational efficiency is another benefit of using digital tools in supply chains. Digital technology automates processes and repetitive tasks, which improves efficiency by reducing mistakes and errors that can happen with manual processes. The availability of real time data and visibility allowed by digitalization also help to reduce errors in demand forecasting. Furthermore, digitalization facilitates on time and smooth communication and collaboration. Jadoon (2024) stated that implementing advanced analytics and real-time data tracking can improve forecasting accuracy, optimize inventory levels, and identify potential bottlenecks in the supply chain.

Cycle time is one of the advantages of using digital tools in supply chains. Digital technology helps different groups work together and communicate better, leading to smoother operations and shorter wait times (Jadoon, 2024). Digital tools and systems allow supply chains to automate routine tasks, simplify their processes, and improve quick and easy communication with suppliers. This leads to a shorter procurement cycle as orders can be handled and approved faster and more efficiently.

Customer satisfaction is another advantage of using digital tools in supply chains. Digital technology helps different groups work together and communicate better, leading to smoother operations and shorter wait times (Jadoon, 2024). Digital tools and systems allow supply chains to automate routine tasks, simplify their processes, and improve quick and easy communication with supplier’s internal supply chain stakeholders. This leads to a shorter cycle as orders can be handled and approved faster and enhances better response to requests.

2.2. Theoretical Literature Review

2.2.1. Resource Based Theory (RBT)

Developed by Jay Barney (1991), resource-based theory states that a firm's resources and distinctive capabilities contribute to its competitive advantage and the theory focuses on the unique resource of the firm will be source of competitive advantage. Digital transformation has significant role in enhancing supply chain capabilities, which in turn positively influence sustainable competitive performance (Ning & Yao, 2023).

On their systematic literature review on the application of the Resource-Based View (RBV) theory in supply chain management, Komakech et al., (2024), revealed that emerging trends like integrating advanced technologies like Blockchain, Artificial Intelligence and the Internet of Things are identified as strategic resources that redefine competitive landscapes by enhancing transparency, and responsiveness within supply chains. By analyzing data from surveys of supply chain and logistics experts from various industries, Wu et al. (2006) in their study found that IT-enhanced supply chain abilities are unique to each company and hard for others to copy. These skills can boost the value of a company's IT resources.

2.2.2. Transaction Cost Theory (TCT)

Transaction cost theory focuses on finding the best way to minimize costs, considering specific external factors that affect how transactions work, Coase (1937 as cited by Schmidt & Wagner, 2019).

Schmidt & Wagner (2019), concluded on their study on Blockchain and supply chain relations: A transaction cost theory perspective, blockchain reduces transaction costs as it can reduce search and information cost and allows transparent and valid transactions. According to Zhu (2024), on his study on the application of transaction cost theory in SCM, using supplier evaluation models to assess suppliers based on transaction costs helps companies make better choices. Therefore, using different digital technologies in a supply chain can reduce transaction costs by improving coordination and reducing inefficiencies.

2.2.3. Systems Theory

System theory is developed by Bertalanffy (1968), and introduces the concept of open systems, emphasizing the interconnectedness of components within a system. This theory views organization as interconnected components working for a common goal. This theory explains how interconnected elements of a supply chain work cohesively, enabling end-to-end visibility considering the supply chain as a system of interconnected subsystem (Christopher, 2016). System theory provides a comprehensive approach to supply chain collaboration and digitization by considering the interconnectedness of network agents Clauss & Schumann, 2020). The application of general systems theory as a valuable framework for understanding and managing supply chains adaptability, resource allocation, and regular evaluations to sustain supply chain effectiveness (Caddy & Helou, 2007).

Systems theory principles in supply chains will contribute to better design, implementation, and management of these complex systems(Helou & Caddy, 2006). Therefore, applying this theory provides a valuable perspective for addressing the challenges and opportunities presented by digital technology implementation in supply chains for end-to-end process integration and leverage technologies to have efficient supply chain process.

2.2.4. Dynamic Capabilities Theory (DCT)

Dynamic capabilities theory is developed by Teece et al. (1997) and it focuses on organization's ability to adapt and succeed in highly changing environments. According to, (Masteika & Čepinskis, 2015) companies that possess strong dynamic capabilities are in a better position to manage supply chain complexities and uncertainties. This theoretical framework provides valuable insights into how firms can leverage digital technologies and collaborative practices to enhance supply chain performance.

Yuan & Pan (2023) on their study highlights the importance of dynamic capabilities in leveraging digital technologies to improve supply chain performance, adapt to environmental pressures, and enhance overall efficiency in an increasingly digitalized business landscape. Therefore, dynamic capability theory provides a valuable insight into how organizations can stay agile and competitive in rapidly evolving markets by implementing innovative digital technologies in their supply chain operation.

2.3. Empirical Literature Review

Empirical study related to digital technology implementation and supply chain efficiency specific to the airline industry is limited. However, the following studies were selected to analyze the impact of digital technologies on supply chain efficiency.

Kamarudeen & Sundarakani (2019), conducted a study on Business and Supply Chain Strategy of Flying Above the Dessert: A Case Study of Emirates Airlines. The study investigates the Business and the Supply Chain Strategy of Emirates Airlines. One of the recommendations for the airline to overcome the financial issue as well as to stay competitive on the market was to use digital tools like Block-chain Technology and automated IT systems to reduce supply chain related costs.

Radell & Schannon (2018), pinpointed that digital procurement solutions not only significantly enhance efficiency, but it goes beyond and plays a strategic role in shaping a company's digital strategy. Further justifies this statement highlighting research conducted by Procurement Leaders which shows that a fully automated procurement function could save the Global 5000 up to $86 billion annually. For companies with a spending base of $1billion to $3 billion, that implies $12 million in annual procurement headcount savings. Those that spend $3 billion or more would save an average of $27 million on headcount. A case study which is done by Procurement Leaders, (2022) on Pan African Health Organization Digital Endeavors to Increase Procurement spend and efficiency, also shows that implementation of digital technologies significantly increase efficiency, cost saving due to more efficient use of resource, and improves collaboration by enabling real-time sharing for information.

As per IATA (2024), the progress report on Sustainability, Digitalization and Safety in Air Cargo' and the report highlighted the importance of seamless sharing of digital information and shipment trucking. Furthermore, it emphasizes how adopting digital technologies will reduce manual processes and improve operational efficiency.

Digitalization of operations and supply chains: Insights from survey and case studies', outlined that digitalization of operation such as using 3D technologies could result reduction of transportation requirement and carbon emissions. The study indicated that airlines such as Air

New Zealand, Emirates and Etihad able to reduce Leadtime and inventory costs by using additive manufacturing Friedrich, Lange, & Elbert (2022, cited in Baycik & Gowda (2024).

2.4. Conceptual Framework

This section shows the conceptual and theoretical framework. Based on the reviewed literature, the independent as well as dependent variable is identified. The independent variables are integration, visibility, process automation and enhanced communication. The dependent variable is the supply chain efficiency, that can be expressed in terms of cost reduction, operational efficiency, cycle time and customer satisfaction.

Conceptual Framework

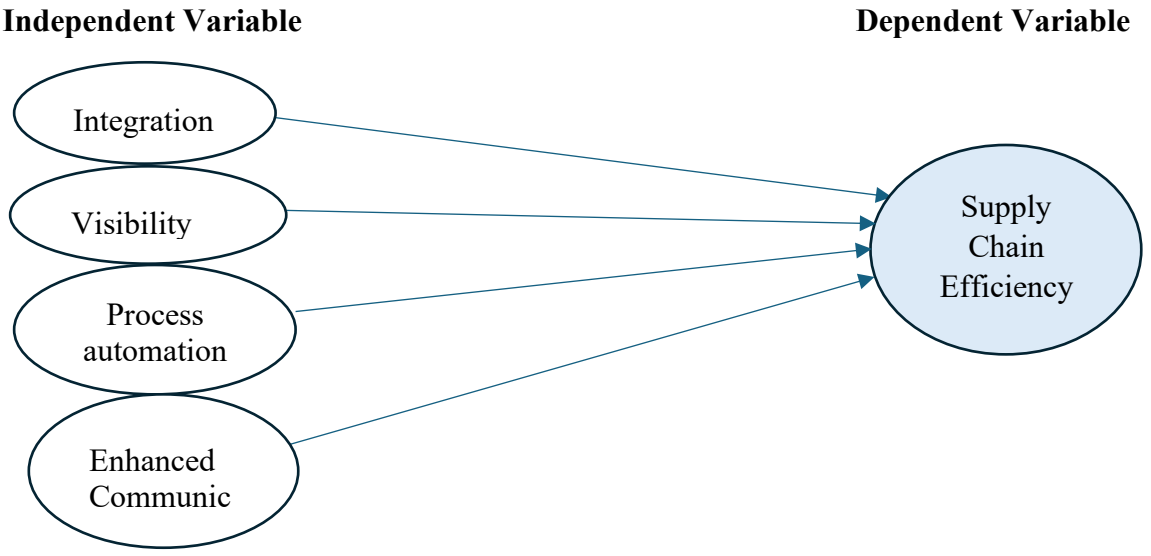

Figure 2.1:Conceptual Farmwork

Source: Adopted from (Patnayakun, 2002), and (Perano et al., 2023) with modification

2.5. Research Hypothesis

Main Hypothesis ($\mathbf{H_0}$ and $\mathbf{H_1}$)

H_0 (Null Hypothesis): There is no significant relationship between digital technology implementation and supply chain efficiency in Ethiopian airlines.

H_1 (Alternative Hypothesis): There is a significant relationship between digital technology implementation and supply chain efficiency in Ethiopian airlines.

The specific Hypothesis are as follows:

H1a: There is a significant positive relationship between integration and supply chain efficiency in the airline.
H1b: There is a significant positive relationship between visibility and supply chain efficiency in the airline.
H1c: There is a significant positive relationship between automation and supply chain efficiency in the airline.
H1d: There is a significant positive relationship between communication and supply chain efficiency in the airline.

2.6. Literature Gap

Even though there are several studies which was conducted in relation to procurement and supply chain management in the case of Ethiopian Airlines, only one related research specifically on e-procurement, impact on maintenance, repair, and overhaul (MRO) studied by (Ayalew, 2020) was found. However, similar study was not found regarding the influence of digital technology in supply chain efficiency improvement on the company case. Furthermore, limited empirical study is available that shows the relationship between digital technology implementation and supply chain efficiency improvement in the airline industry.

The available studies also lack comprehensive view of how multiple technologies are integrated and their combined effect on supply chain efficiency, rather studies examine effect of the individual technologies. Therefore, this study is focused on assessing how the adoption of digital technologies will influence the overall supply chain efficiency of Ethiopian Airlines with regards to cycle time reduction, operational efficiency, cost reduction and customer satisfaction.

CHAPTER THREE

3. METHODOLOGY OF THE STUDY

This chapter discusses the research design and method of the study used on this research paper. The chapter covers the research design, population and sample of the study, data collection methods and analysis, data presentation methods, reliability, and validity tests implemented on the research.

3.1. Research Philosophy

The research philosophy that guides this study is pragmatism. This philosophy focuses on the use of mixed methods. Both qualitative and quantitative methods of data collection and analysis were used throughout the study to have a comprehensive understanding of the subject study.

3.2. Research Approach

According to Creswell, (2014), the three major approaches that are used in research are quantitative, qualitative, and mixed methods. Quantitative approach is used for testing objective theories by testing the relationship among variables that can be measured so that numbered data can be analyzed using statistical procedures. On the other side qualitative approach are used for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. Qualitative research basically evaluates the attitudes, feelings, and motivations of respondents; its conclusions are not derived from quantitative analysis, while quantitative research employs mathematical analysis (Kothari, 2004). The approach that is becoming in use recently is a mixed method, which is a combination of the two approaches.

In mixed approach, a combination of quantitative and qualitative data collection and analysis method will be used to better understand the subject under study(Leavy & Patricia, 2017). Therefore, the research approach used in this study is a mixed approach and the data was collected and analyzed using both qualitative and quantitative technique to have a thorough understanding of digital technology's influence in improving supply chain efficiency of Ethiopian Airlines.

3.3. Research Design

Research design is the roadmap for fulfilling research objectives and answering research questions. According to (Saunders et al., 2003) Research design is the overall road map that the researchers choose to combine different techniques reasonably and logically. Research designs are plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. It involves the intersection of philosophical assumptions, strategies of inquiry, and specific methods (Creswell, 2014). When examining cause-and-effect connections, the research can be explanatory in nature, elucidating the factors that lead to specific results (Yin, 1994). This study used explanatory and descriptive design to justify the relationship between independent and dependent variables.

3.4. Population and Sampling Design

3.4.1. Target Population

According to (Mugenda & Mugenda, 2003) , the target population is any specific group of individuals or objects with similar physical characteristics that the researcher is planning to examine. The study focused on the examining the influence of digital technology in improving supply chain efficiency of Ethiopian Airlines. Therefore, the target population is all employees who are working under supply chain division of Ethiopian airlines since they are directly involved on the overall supply chain process and have the expertise on this regard. The selected target population also has a better position to provide accurate and valid information as they have exposure to the digital technologies adopted in the division.

3.4.2. Sample Size Determination

The Taro Yamane's (1967) sampling formula was used to determine the sample size for the study at 5% acceptable error.

n = N / [1+N (e) ^2]

Where: n = sample size

N = population size (the universe)

e = level of precision /sampling error (usually .10, .05 and .01 acceptable error)

^ = raised to the power of

Accordingly, from the total of 277 population the researcher approached 201 respondents.

Table 3:1: Sample Size Determination

Target population category	Population	Sample
P&SCM Director Aircraft	1	1
P&SCM Director Non-Aircraft	1	1
Non-Management and management staff under aircraft supply chain division	188	128
Non-Management and management staff under non-aircraft supply chain division	87	71
Total	277	201

Source: Ethiopian HR Employee Record (2024)

3.4.3. Sampling Techniques

The sampling technique implemented was both probability random sampling and non-probability sampling procedure. When each member of the population has a known, non-zero probability of being selected, probability of sampling is applied (Zikmund, 2010). Non-probability sampling, on the other hand, will be applied when there is no known or predefined chance for certain members of the population to be chosen as survey participants (Sekaran, 2003). Therefore, the study employed both probability of random sampling for non-management employees, team leaders, and managers, and non-probability sampling procedure for the Directors.

In this study, simple random sampling from probability sampling design was used specifically by using the random number table for the prepared questioner but nonprobability sampling design specifically purposive sampling was applied for the semi-structured interview questions.

3.5. Sources Of the Data

The study used primary data, and the data was collected through questionnaires and semi-structured interviews questions.

3.6. Procedure Of Data Collection

The data gathering tools for the primary data were both questionnaire and semi-structured interviews. A semi-structured interview was conducted with two (2) directors under procurement and supply chain management to get a better understanding about the benefits and the challenges of digital technology implementation. Therefore, among the total sample size of 201, two (2) respondents were interviewed, and questioners were administered for the remaining 199 respondents. The data collected from the questionnaire were used to assess the level of technology practices of Ethiopian airline supply chain division, and the influence of the implemented system on improving supply chain efficiency of the airline.

3.7. Data Analysis and Presentation

To answer the research questions and analyze the collected data, the study applied both descriptive and Inferential Statistic. Descriptive Statistic such as mean, percentages, frequency, and standard deviation is used to summarize the data. Inferential statistics such as regression analysis, correlation, ANOVA, and different tests were conducted to examine the relationship between independent and dependent variables. To process the statistical data, SPSS (Statistical Package for Social Sciences) software was used.

3.8. Reliability and Validity Test

3.8.1. Validity Test

Validity is the degree to which an instrument measures what it is supposed to measure. It is the extent to which differences found with a measuring instrument reflect true differences among those being tested (C.R Kothari, 2004). Validity can be established in different ways such as content validity, construct validity, face validity and criterion validity. Therefore, this

study addressed the content validity of the instruments, through careful review of the literature and by getting feedback from experts on the subject area.

3.8.2. Reliability Test

Reliability analysis is the internal consistency of the instruments (Leavy & Patricia, n.d.). The measure is considered reliable if it can produce the same result when re-examined. Cronbach's alpha is the most common measure of the reliability of internal consistency and this study used Cronbach alpha to test the reliability of instruments with coefficient ranges of a minimum alpha value of 0.70, to prove the internal consistency and reliability. Accordingly, pilot test was administered prior to distributing the survey to the participants. Further, the responses were tested with Cronbach alpha with the help of SPSS.

Table 3.2 below shows the result obtained from Cronbach alpha test and as it can be referred, the alpha value is greater than 0.70, which is the minimum alpha value to prove the internal consistency and reliability of the instruments.

Table 3:2: Reliability Test Result

Variable	Cronbach Alpha	Number of items
DT Implementation	.869	10
Integration	.703	4
Visibility	.783	4
Automation	.748	4
Enhanced Communication	.812	4
Cost Reduction	.730	4
Operational Efficiency	.813	4
Cycle time	.718	4
Customer Satisfaction	.703	4

Source: Survey data 2025

3.9. Ethical Consideration

The study was undertaken by addressing ethical considerations strictly adhering to ethical guidelines throughout the research process, ensuring confidentiality, and anonymity for the participants. The data was gathered with the full permission of the company and the willingness of the participants.

CHAPTER FOUR

4. DATA ANALYSIS, RESULT AND DISCUSSION

This chapter includes the data presentation, analysis and discussion based on the data obtained from the survey questionnaire and semi-structured interview questions from procurement and supply chain division of Ethiopian Airlines.

4.1. Response Rate

One hundred ninety-nine (199) questionnaires were distributed to the respondents in the case company Ethiopian Airlines procurement and supply chain employees. Out of the distributed questioners one hundred eighty-eight (188) were filled and returned. Therefore, the study managed to have a response rate of 94.47% which is sufficient response for the study.

4.2. Demographic Characteristics of the Respondent

This part of the study discusses the demographic characteristics of the respondents. This includes age, gender, work experience and education level of the respondent.

Table 4:1: Age of the respondents

Age	**Frequency**	**Percent**
From 21-29	39	20.7
From 30-39	100	53.2
From 40-49	43	22.9
From 50-59	5	2.7
60 or above	1	.5
Total	**188**	**100**

Source: Survey data 2025

The above table shows that 20.7% of the respondents were from 21 to 29 years, 53.2% of the respondents were from 30 to 39 years, 22.9 % of the respondents were from 40 to 49 years, 2.7% of the respondents were from 50 to 59 years and the remaining 0.5% of the respondents

were from 60 or above years. The result indicates that most of the respondents' ages fall 39 and below years old, which is a relatively good age range for easy technology implementation.

Table 4:2 Gender of the respondents

Gender	**Frequency**	**Percent**
Male	124	66.0
Female	64	34.0
Total	**188**	**100**

Source: Survey data 2025

As indicated on the above table, 66% of the respondents are male on the other hand 34% of the respondents were female. The result indicates that most of the respondents were male.

Table 4:3: Work experience of the respondent

Experience	**Frequency**	**Percent**
Less than or equal to 5 years	16	8.5
Between 6 to 10 years	36	19.1
Between 11 to 15 years	69	36.7
Between 16 to 19 years	39	20.7
20 and above year	28	14.9
Total	**188**	**100**

Source: Survey data 2025

The work experience distribution of the respondents on the above table shows 8.5% of the respondents have less than or equal to five years of experience, 19.1% of them were between six and ten years, 36.7 % have between eleven and fifteen years, 20.7 % have between sixteen and nineteen years and the rest 14.9% have an experience of twenty years or more. The data indicates most of the respondents stayed with the company for more than 6 years. Therefore, it implies that most of the respondents were senior staff and very experienced, and they could easily understand the survey questioner and they were able to provide reliable responses for the survey.

Table 4:4: Education level of the respondents

Education Level	Frequency	Percent
Master	68	36.2
Bachelors	112	59.6
Diploma	8	4.3
Total	**188**	**100**

Source: Survey data 2025

As indicated on table 6 above, 36.2% of the respondents were holders of a master's degree, 59.6% of them have a bachelor's degree and the remining 4.3% were diploma holders. This data shows the respondents have a good academic background to enable them to understand the questionaries and provide valid responses.

4.3. Descriptive Analysis

A descriptive data analysis was done to determine the level of digital technology practices at Ethiopian Airlines procurement and supply chain process and its influence on supply chain efficiency. Accordingly, to collect the primary data from the respondents, a 5point Likert scale survey questioner was implemented. The participants were asked to indicate their agreement using a scale from 1 up to 5 where; 1 represents strong disagreement, 2 disagreement, 3 neutral, 4 agree and 5 strongly agree. Accordingly, the scale assumptions stated on the table below were used to interpret the computed mean scores.

Table 4:5: Likert scale interpretation

Likert Scale Description	Scale	Scale Interval
Strongly Disagree	1	1.00-1.80
Disagree	2	1.81-2.60
Neutral	3	2.61-3.40
Agree	4	3.41-4.20
Strongly Agree	5	4.21-5.00

Source: (Nyutu et al., 2021)

4.3.1. Digital Technology Practices in Supply Chain Process

The digital technology practices in procurement and supply chain process are analyzed and the result is tabulated below.

Table 4:6: Digital technology practices

Statement	N	Mean	Std. Deviation
The organization uses technology to systematically process and review it's spent pattern	188	4.50	.625
Sourcing activity is assisted with technological tools	188	4.42	.584
RFP floating and supplier communication is done using digital technology	188	4.56	.549
Supplier evaluation process is supported with IT system	188	4.30	.766
Demand forecasting is done using technological tool	188	4.61	.689
The purchase order process is supported with IT system	188	4.74	.497
Inventory monitoring and tracking is supported by technological system	188	4.46	.640
There is an end-to-end integrated procurement system	188	3.95	.783
There is a shared system or platform to store and access procurement and supply chain related information's	188	4.30	.766
There is a system that suppliers can access to get information and status of the projects they are taking part in	188	3.76	.956
Valid N (listwise)	188		
Overall mean		4.36	

Source: Survey data 2025

The result on the descriptive statistics indicates that respondents generally agree and to strongly agree that various procurement and supply chain processes of the organization are supported by technological tools and systems. As indicated on the table above, the

organization uses technology to systematically review and track its spent pattern and the mean value 4.50 with a standard deviation 0.625 indicates strong agreement among respondents. Similarly, the sourcing activity with a mean value of 4.42 and standard deviation of 0.584 indicates the usage of technology in supplier selection and negotiation process. The use of technology for RFP flotation and communication with suppliers, demand forecasting and inventory monitoring also score high mean value of 4.61, 4.56, 4.46 and this indicates there is an effective digital technology usage in place in those activities. On the other hand, support for supplier evaluation through IT system and the existence of shared platform for storing and accessing procurement and supply chain information had a mean value of 4.30, and standard deviation of 0.766, reflects good adoption and availability of central data, but with some variation among the respondents implying inconsistent user experience.

Relatively the lowest score was found regarding the presence of an end-to-end integrated procurement system and supplier access to the system, with a mean value of 3.95, 3.76 and a standard deviation of 0.783, 0.956, respectively. While this indicates a generally positive perception, to the presence of an integrated system and the availability of a system that suppliers can access to get information, the variation among the response indicates that full integration is not yet consistently achieved, and the variation regarding the supplier access to information also indicates likewise.

Generally, the descriptive data analysis indicates that the organization effectively implemented digital tools in most of its supply chain functions, particularly in purchasing, forecasting, sourcing, and spending management. On the other hand, the relatively lower score and higher deviation on the area such as supplier access to information and availability of end-to-end integrated system is a potential area for improvement.

To support the descriptive statistics from the survey data, semi structured interviews were conducted with the procurement directors. The responses revealed key points that aligned with the quantitative findings that were obtained from the survey. The interviewees consistently confirmed the widespread use of digital tools across the main procurement functions, such as the purchase order process, which are fully automated so that the requests go through the system, get approved digitally, and are sent to suppliers, which is very efficient and reduces paperwork. They also confirmed using system to track and analyze the company's spending to identify saving opportunities and manage the budget more effectively and rely on ERP

system for forecasting based on historical data and real-time inventory levels. Furthermore, it is confirmed that most of the communication with suppliers is through email integration or procurement portals, which are faster and keep everything documented. However, in areas such as end-to-end integration and availability of systems for suppliers to access information, the interviewee said that there is a system in place, but it is not fully utilized and integrated. In some areas the integration is smooth but in other areas there are standalone systems, and they rely on manual intervention. As an example, the e-procurement system and workflow approval are not automatically integrated with SAP ERP system, and it requires intervention. Similarly, the supplier portal is underutilized, especially with local suppliers. These insights also align with the statistical variation observed in this area.

4.3.2. The Influence of Digital Technology in Supply Chain efficiency

This section discusses the influence of digital technologies on supply chain efficiency by taking key digital technology factors such as integration, visibility, automation, and communication as independent variables. Respondents were requested to indicate their extent of agreement applying the 5point Likert scale of measurement. The table below shows the overall result based on the mean and standard deviation of individual variables.

Table 4:7: Integration

Statement	N	Mean	Std. Deviation
Integration enabled by digital technology has reduced operational costs by minimizing redundancies	188	4.34	.595
Integration by digital technology enables operational efficiency by aligning activities across departments, ensuring efficient use of resources	188	4.28	.610
Integration by digital technology enables faster responses to supply chain disruptions and further shortening cycle times	188	4.32	.659
Integration enables quick response to customer needs, and improves customer satisfaction	188	4.29	.633
Valid N (listwise)	188		
Overall mean		4.3075	

Source: Survey data 2025

The descriptive statistics indicate that there is a very high level of agreement among respondents regarding the benefits of digital integration in operational and overall supply chain efficiency. The average mean score of 4.3075 indicates that digital integration highly influences supply chain efficiency. The first statement was regarding whether integration enabled by digital technology will reduce operation costs by minimizing redundancies. The mean value of 4.34 signifies that the respondents are highly agreeing that integration will reduce operation costs. The other question the respondents asked was to express their agreement level whether the integration by digital technology enables operational efficiency by aligning activities across departments and ensuring efficient use of resources. Accordingly, the respondents expressed their strong agreement that integration improves cross departmental efficiency with a mean value of 4.28. Also, the majority of the respondents agree that integration supports faster response to disruptions and improves customer responsiveness and satisfaction with a mean score of 4.32 and 4.29, respectively.

Furthermore, the interview responses from procurement directors reflected similar outcomes. They said that implementing digital procurement tools has significantly reduced redundancy and enables them to avoid duplicating efforts across departments as they are able to use a single platform. Furthermore, digital integration enables real-time visibility, and they are now able to make fast and joint decision making with shared data.

Table 4:8: Visibility

Statement	N	Mean	Std. Deviation
Visibility in the organizations supply chain process results cost reduction by enabling better inventory forecasting	188	4.63	.566
Improved visibility enables quicker decision making enhances operational efficiency	188	4.26	.820
Real-time tracking and visibility have reduced delays and shortened supply chain cycle times	188	4.47	.615
Enhanced visibility into supply chain processes has improved customer trust and satisfaction	188	4.48	.666
Valid N (listwise)	188		
Overall mean		4.46	

Source: Survey data 2025

As can be seen on the above table, the responses reveals that a very high level of agreement on the positive impact of the supply chain visibility on various operational outcomes. The overall mean value is 4.46, indicating that visibility is both present and effective on Ethiopian Airlines procurement and supply chain process.

The mean value of 4.63, 4.26, 4.47, and 4.48 also indicates that visibility supports cost reduction via better inventory forecasting and real-time tracking, enhances decision-making and operational efficiency, shortens cycle time, and improves customer trust and satisfaction. The findings from the interview also show that real-time data has allowed the company to eliminate guesswork and have a more accurate inventory and resulting in a reduction in holding costs.

Table 4:9:Automation

Statement	N	Mean	Std. Deviation
Process automation has reduced repetitive manual tasks, leading to cost reduction in supply chain operations	188	4.2	.863
Automation enhances overall operational efficiency by streamlining process and automating reddened manual tasks	188	4.55	.680
Automating the supply chain process improves cycle time by reducing manual intervention and enabling fast supply chain workflow	188	4.56	.687
Automation in supply chain processes ensures timely deliveries, improving customer satisfaction	188	4.59	.676
Valid N (listwise)	188		
Overall mean		4.475	

Source: Survey data 2025

As can be referred in the above descriptive analysis, the finding shows that a strong agreement among respondents regarding the positive impact of automation in supply chain operations. The respondents agree that process automation has significantly reduced repetitive manual tasks leading to cost reduction, as indicated by a mean value of 4.20. Furthermore, the mean score of 4.55 shows that automating the supply chain process can enhance overall operational efficiency by streamlining processes and eliminating repetitive activities. In addition, automating the supply chain process reduces manual intervention and reduces cycle times, the respondents strongly agree with this statemen with the mean score of 4.56. Respondents

further emphasized that automation is evidenced to ensure timely deliveries thereby improving customer satisfaction, as evidenced by a mean value of 4.59.

The interview with the procurement directors also provided support to the survey findings, the response indicates how automation changes procurement and supply chain operations. The directors stated that the organization's ERP system serves as the backbone for automation, streamlining the end-to-end process from purchase requisition to payment process. One of the interviewee states that "using ERP has significantly reduces manual data entry and approval bottlenecks and every step of the process is traceable as well." Another interviewee indicated that the Maintenx system allows automation of work order scheduling and tracking resulting in better planning thereby a reduction of emergency procurement requests.

Overall, the average mean value of 4.75 and the response from the interviewee indicates automation is effectively implemented across the supply chain process thereby resulting in a substantial performance benefit in cost, time, efficiency, and service delivery.

Table 4:10: Communication

Statement	N	Mean	Std. Deviation
Improved communication has contributed to cost reduction by minimizing delays and rework	188	4.37	.859
Better communication will enhance overall operational efficiency by reducing misunderstandings and errors in the supply chain process	188	4.56	.539
Real-time communication has enabled faster resolution of supply chain disruptions	188	4.46	.673
Enhanced communication will increase customer satisfaction by ensuring transparency and responsiveness	188	4.52	.666
Valid N (listwise)	188		
Overall mean		4.477	

Source: Survey data 2025

As indicated on the above, the analysis result indicates a strong agreement among the respondents regarding the influence of communication in improving supply chain efficiency. The overall mean value of 4.477 indicates a strong agreement that improved communication influences positively the various parameters of supply chain efficiency. Regarding the relationship between cost reduction and improved communication, the respondents are in complete agreement that effective communication saves costs by reducing delays and rework with a mean rating of 4.37. Furthermore, a mean rating of 4.56 indicates that effective communication can improve operating efficiency through reducing misunderstanding and error in the supply chain process. The respondent further agreed that real-time communication enables quick response to supply chain disruptions, with a mean score of 4.46. Similarly, the mean score of 4.52 indicates that enhanced communication can increase customer satisfaction by improving transparency and responsiveness. Furthermore, the interview responses from procurement directors reflected similar outcomes. They said that digital communication platforms increase the ability of the supply chain to collaborate effectively and to quickly respond to needs. Tools such as Microsoft teams, Skype for business and the e-procurement platform improve internal as well as external communications.

Table 4:11: Summary of Supply Chain Efficiency Parameters

Performance indicators	Mean	Std. Deviation
Cost reduction	4.291	0.355
Operational efficiency	4.398	0.420
Cyle time	4.462	0.405
Customer satisfaction	4.469	0.412
Overall Mean for Supply Chain Efficiency	4.405	0.398

Source: Survey data 2025

As can be seen on the above table, all the supply chain parameters such as cost reduction, operational efficiency, cycle time and customer satisfaction are above 4 indicating the respondent's agreement to the positive influence of digital technology. The mean value of 4.29, indicates that the implementation of integrated digital technology throughout the Ethiopian Airlines procurement and supply chain operation has leads to significant cost reduction. Automating the supply chain process, using real-time trucking, and communicating systems enables the airline to have more cost-effective supply chain by reducing repetitive

manual task, better inventory management and reducing delay on the overall process, then leading to streamlined overall supply chain process. Using digital technology also improved overall operational efficiency of the airline and the mean value of 4.39, implies that having an integrated and automated process, enhanced visibility, and better communication enables streamlined end to end supply chain process resulting in overall operational efficiency. Similarly, the mean value of 4.46 and 4.47 implies that the airline can reduce cycle time and enhance customer satisfaction by implementing digital technologies in its supply chain process.

The overall mean of 4.405 on the above descriptive analysis shows that the strong level of agreement of the respondents regarding the benefit of digital technology in their supply chain process and as a result the organization can reduce costs, improve operational efficiency, reduce cycle time, and improve customer satisfaction within its supply chain operation.

The procurement directors responded during the interview that using ERP system and spend analysis system enables them to have better visibility into their supply chain operation, accordingly, allows them to make more strategi decision. Furthermore, stressed that the system helps them to track expenditure more precisely and enables them to negotiate better terms with suppliers. They also highlighted that using technology for inventory monitoring and forecasting improves their ability to plan in advance and respond quickly to disruptions and to better manage their customers' requirements. Overall, the response shows the implementation of digital tools and systems in their SC operation help them to reduce their cost, better serve their customers, and improve their supply chain process.

4.4. Inferential Statistics

The study examines the influence of four key digital technology factors such as integration, visibility, automation, and communication on supply chain efficiency using Pearson correlation analysis, regression analysis and ANOVA test. Hence, in this section the results of the examination are presented.

4.4.1. Correlation

The results of the person correlation analysis for each independent variable and supply chain efficiency are shown in the table below.

Table 4:12:Correlation

Correlations						
		Integration	Visibility	Automation	Communication	Supply Chain Efficiency
Integration	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	188				
Visibility	Pearson Correlation	.551**	1			
	Sig. (2-tailed)	.000				
	N	188	188			
Automation	Pearson Correlation	.473**	.653**	1		
	Sig. (2-tailed)	.000	.000			
	N	188	188	188		
Communication	Pearson Correlation	.302**	.566**	.481**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	188	188	188	188	
Supply Chain Efficiency	Pearson Correlation	.558**	.736**	.712**	.583**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	188	188	188	188	188
**. Correlation is significant at the 0.01 level (2-tailed).						

Source: SPSS result

The Pearson correlation result indicates that all the four supply chain dimensions have a positive and significant relationship with supply chain efficiency. As can be referred on the attached table, visibility has the strongest positive correlation with supply chain efficiency with a coefficient of .736 indicating that improved visibility through digital systems is closely related with enhanced operational performance in the airline supply chain process. The next strongly and positively correlated variable is automation with *r* value of .712 and this indicates that the use of automated technologies contributes significantly to improving cycle time by reducing manual work, process efficiency and reliability in the supply chain process.

The other two variables, communication and integration, show a moderately strong positive correlation with supply chain efficiency, with r value of .583 and .558, respectively. This finding demonstrates that effective digital communication tools facilitate better communication and fast decision-making processes. Similarly, integrating and aliening the systems and information flow across the division will have a significant impact in promoting operational efficiency.

Furthermore, a positive and significant correlation is observed among the independent variables. This result indicates that implementation of digital technology in Ethiopian Airlines supply chain is interrelated. Visibility and automation have a strong correlation with a coefficient value of .653, indicating that when improvement is done to increase visibility in the supply chain process, it is also likely to enhance process automation. Visibility is also positively correlated with communication with *r* value .566 and this implies that transparency and information accessibility in the supply chain process can enhance communication and facilitate fast response. The relationship between automation and communication with coefficient value .481 also shows that automated systems can facilitate communication through alert and information updating. Integration is also moderately related to visibility and automation with coefficient value of .551 and .473 indicating that when system is integrated across functions, it is likely to improve process automation. On the other hand, the *r* value of .302 implies that there is a weak relationship between integration and communication, and this indicates that although integration can support communication but there may be other influencing factors.

4.4.2. Regression Analysis

To assess the impact of each independent variable on supply chain efficiency, multiple linear regression analysis was conducted by using SPSS. The results from the analysis and from different tests are depicted below.

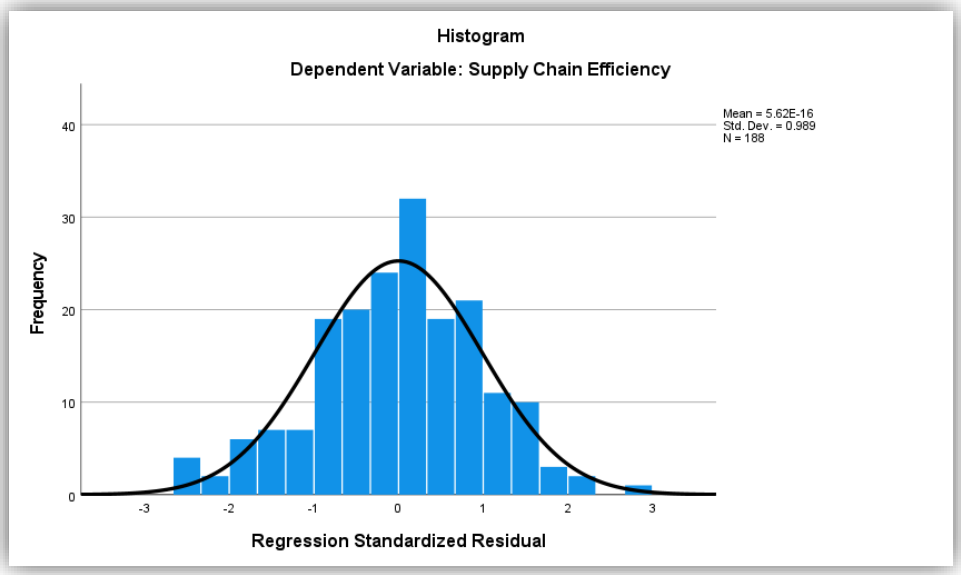

Figure 4.1: Histogram

The above histogram is generated to check the assumption of regression analysis which is the normality of the residuals. As can be seen on the diagram, the graph resembles a bell shape which indicates a normal curve, and that the data meets the assumption. The mean value of the standardized residual (5.62E-16) is very close to zero and the standard deviation (0.989) is close to one which implies the residual are properly standardized. Overall, the result shows the model is valid and appropriate to evaluate the supply chain efficiency.

Furthermore, to check the residuals are distributed normally, the below P-P plot chart is generated.

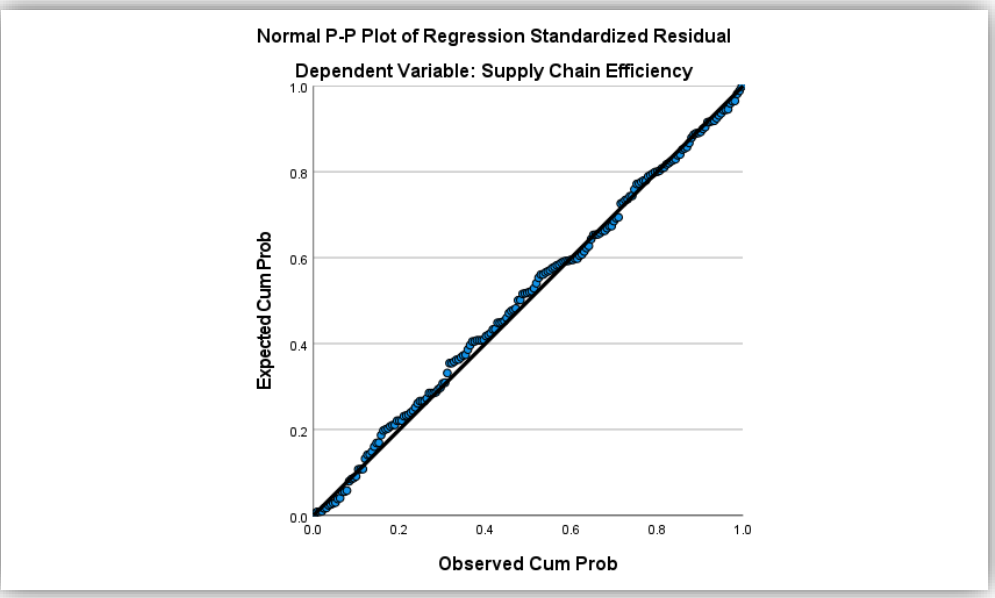

Figure 4.2: P- P Plot

The conception of the above chart is that the more the points lay alongside the line the residuals are normally distributed. Accordingly, the above chart shows that the points fall closely to the diagonal line justifying distribution of the residuals are normal and the model meets the assumption of normality.

Table 4:13: Summary of the Model

Summary of the Model					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.822[a]	.676	.669	.18664	1.107
a. Predictors: (Constant), Communication, Integration, Automation, Visibility					
b. Dependent Variable: Supply Chain Efficiency					

Source: SPSS result

The correlation coefficient R= .822 specifies that there is a strong positive relationship among the independent variables such as integration, visibility, automation and communication and supply chain efficiency. As stipulated in the above table, R^2 = .676 and adjusted R^2 = .669 clearly indicates that the independent variable under review explains 67.6% of the variation in the airline supply chain efficiency. The remining 32.4% are influenced by other factors not

included in the analysis. Furthermore, the standard error of estimate = .18664 implies the average distance of the observed values from the regression line is low value. Overall, the analysis demonstrates that the model is strong and reliable in predicting digital technology dimensions significantly and positively influence supply chain efficiency in the context of Ethiopian Airlines.

Table 4:14: ANOVA test

ANOVA						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	13.309	4	3.327	95.510	.000[b]
	Residual	6.375	183	.035		
	Total	19.684	187			
a. Dependent Variable: Supply Chain Efficiency						
b. Predictors: (Constant), Communication, Integration, Automation, Visibility						

Source: SPSS result

The ANOVA test results (F=95.510) and P< 0.001, show that the regression model or the independent variables, such as integrity, visibility, automation, and communication explain a significant portion of the variance in supply chain efficiency. Furthermore, the Regression Sum of Squares of 13.309, indicating the variation explained by the model, and the Residual Sum of Squares of 6.375, the unexplained variation. Overall, regression model is demonstrated to be statistically significant model as per the outcome of ANOVA test.

Table 4:15: Coefficient Table

Coefficients								
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.659	.147		11.290	.000		
	Integration	.099	.030	.168	3.268	.001	.673	1.486
	Visibility	.204	.041	.317	4.941	.000	.429	2.332
	Automation	.189	.033	.333	5.795	.000	.536	1.865
	Communication	.123	.033	.192	3.701	.000	.656	1.523
a. Dependent Variable: Supply Chain Efficiency								

Source: SPSS result

Each independent variables contribution to supply chain efficiency is listed on the above table. The unstandardized beta coefficient shows that the expected change in supply chain efficiency resulting from a unit change in each independent variable, given the rest of the variable is constant. Therefore, based on figures of unstandardized coefficients, a one-unit change in integration will contribute to a .099 improvement in supply chain efficiency assuming the other variables remain constant. Similarly, a one-unit change in visibility, automation, and communication will lead to a .204, .189, and .123 increase in supply chain efficiency.

Referring to the outcome of the analysis, all the four predictor variables are found statically significant ($P < 0.01$), indicating that each variable has an influence on supply chain efficiency. With beta value ($\beta = .333$) automation has the strongest effect, indicating that the improvement in this area contributes significantly to enhance supply chain efficiency. It's corresponding P value 0.000 also signifies that Automating the overall supply chain process will have a significant positive impact on supply chain efficiency by enabling cost reduction, enhancing overall operational efficiency, reducing cycle time, and enhancing responsiveness. Hence, the null hypothesis H_0c is rejected. The next influential factor is visibility with ($\beta = .317$) emphasizing the importance of real-time trucking and transparency in supply chain operations. The P value 0.000 indicates that creating visibility and transparency on the end-to-end supply chain process has a significant and positive influence on supply chain efficiency, therefore, the null hypothesis H_0b is rejected. Communication and integration with

beta value (β = .192) and (β = .168) are also key influencing factors for supply chain efficiency but their effect is slightly lower. The P value of 0.00 and 0.01 also indicates that implementing digital communication tools and integrated systems has a positive influence on supply chain efficiency. Accordingly, the null hypothesis H_0d and H_0a is rejected. The collinearity statistics also demonstrate that the independent variables do not show excessive correlation as the variance inflation factor (VIF) value for all the predictor variables are below 10 and the tolerance rate above 0.2.

Finaly, the regression model is present as follows:

Dependent variable: Y = Supply chain efficiency
Independent variable: X1=Integration, X2=Visibility, X3= Automation, X4= Communication

$$Y=1.659+0.099X1 +0.204X2 +0.189X3+0.123X4$$

4.5. Findings

Per the result, major procurement activities such as purchase order processing, RFP flotation, demand forecasting and spend analysis are successfully digitalized. The highest rated item was the purchase order process being supported by the IT system (M=4.74), implying that this process is automated. This is closely followed by demand forecasting (M=4.61) and RFP floatation & communication with suppliers (M=4.56). Moreover, the mean value of 4.5 and 4.46 shows that the organization performs spend analysis and inventory forecasting using digital tools and this implies that systematic and data supported decision making is part of the procurement and supply chain process. On the other hand, end-to-end digital integration of procurement functions and supplier access systems or platform received a relatively lower mean score of 3.95 and 3.76 and this shows there is a gap in this area indicating a room for improvements. Moreover, based on the response from the interview it is noted that even if most of the systems are integrated, there are still some standalone systems which are not automatically integrated and require manual intervention. Overall, the result of the mean value 4.405 shows that improvements were noted on cost reduction, operational efficiency, cycle time reduction and customer satisfaction implying that digital technology practices have significant influence on the supply chain efficiency of Ethiopian airlines.

The result denotes that digital integration has a significant influence on supply chain efficiency of the airline. The finding implies that integration has the potential to reduce operation costs by reducing redundancies (M= 4.34) and enable efficient use of resources (M = 4.28). It also improves responsiveness towards supply chain disruption (M= 4.32) and enhances customer satisfaction (M=4.29). Such integration supports fast decision making, smooth coordination across the supply chain, and better delivery contributing to enhanced operational performance and overall supply chain efficiency.

The result indicates that enhanced visibility through digital tools improved supply chain efficiency of the airline by providing actual insight into the process. It has enabled better inventory forecasting (M=4.63), reduced delays (M=4.47), and quicker decision making (4.26). It also supports transparency and customer trust (M=4.48). Having the access to accurate, and timely information, the airline can respond more effectively to changes in requirement and supply, reducing uncertainty and optimizing resource planning. Generally, digital visibility tools help to anticipate issues and prevent disruption by enabling better planning and contributing to cost reduction and operational efficiency in the overall supply chain process.

The finding also demonstrates that automation of procurement and supply chain activities play an important role in improving supply chain efficiency by eliminating repetitive manual tasks and streamlining processes. Automation has led to cost reduction(M=4.20) and enhance overall operational efficiency (M=4.55). It also improves cycle time through reduced manual intervention (M=4.56) and contributes to more timely delivery and thereby increases customer satisfaction (M=4.59). By automating routine and repetitive activities, in a purchase order process, inventory management, supplier evaluation and communication, Ethiopian airlines improved its supply chain efficiency. The highest mean value of 4.47 for automation shows that the level of agreement among participants is very high and that automation is well aligned across supply chain functions. This is also evidenced by the improvement in cost saving, decreased cycle time, enhanced operational efficiency and service delivery.

According to the finding, improved communication enabled by digital technology has positively influenced supply chain efficiency by reducing delays, misunderstanding and rework in the supply chain process. The study demonstrates that communication tools contributed to cost reduction (M=4.37) and improved operational efficiency (M=4.56). Real-

time communication also enables faster resolution of supply chain disruption (M=4.46) similarly enhancing transparency and responsiveness to customers (M=4.52). Such a seamless flow of information across the supply chain process enables faster coordination, clear communication, and improved delivery to customers. Accordingly, it improves supply chain efficiency.

The inferential analysis indicates that digital technology dimensions such as integration, visibility, automation, and communication have a positive influence on the supply chain efficiency and same is indicated with the result of the correlation coefficient R= .822 implying that there is a strong positive relationship between the independent variable and supply chain efficiency. The regression analysis result also demonstrates that all the four independent variables are found statically significant ($P < 0.01$), denoting that each variable has an influence on supply chain efficiency with beta value (β = .333, .317, .192 and .168).

TABLE 4:16:Summary of Finding and Hypothesis Testing Results

Research Objective	Hypothesis	Result summary	Finding
To assess the impact of **integration** on SC efficiency of Ethiopian Airlines.	H_1a- There is a significant positive relationship between integration & SC efficiency	Regression shows β= .168, P = 0.001. Persson correlation r=0.558, P < 0.01, express a moderate, significant positive relationship	Supported
To examine how process **visibility** improves SC efficiency of Ethiopian Airlines.	H_1b- There is a significant positive relationship between visibility & SC efficiency	Regression shows β= .317, P < 0.001. Persson correlation r=0.736, P < 0.01, express a strong significant influence on SC efficiency	Strongly supported
To assess how **automation** improves SC efficiency	H_1c- There is a significant positive relationship between automation & SC efficiency	Regression shows β= .333, P < 0.001. Persson correlation r=0.712, P < 0.01, a strongest predictor or influencing variable among the four variables.	Strongly Supported
To analyze how enhanced **communication** promotes SC efficiency	H_1d- There is a significant positive relationship between communication & SC efficiency	Regression shows β= .192, P < 0.001. Persson correlation r=0.583, P < 0.01, significant but contribute relatively lesser compared to the other variables.	Supported

CHAPTER FIVE

5. DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

5.1. Discussion

The general objective of the research was to assess the influence of digital technology in improving Ethiopian Airlines supply chain efficiency. The focus of the study was on the four key digital technology dimensions such as integration, visibility, automation, and communication. Based on the data collected from both survey questioners from 188 respondents and semi structured interviews of two supply chain directors, descriptive as well as inferential analysis was conducted to understand the digital technology implementation practice of Ethiopian Airlines and the extent to which each of the stated digital technology variables contributes to the improvement of supply chain efficiency.

The findings of this study align with the existing literatures, implying digital technology implementation such as digital integration, visibility tools, automation and communication platforms influence supply chain efficiency of the airline resulting a cost reduction, overall operational efficiency, cycle time reduction and enhancing customer satisfaction.

The findings based on descriptive analysis show that there is a high level of digital technology implementation throughout Ethiopian Airlines procurement and supply chain process. This indicates the airlines procurement and supply chain process is characterized by streamlined processes, reduced manual work, faster processing time, and responsive. The results demonstrate that the airline has successfully digitalized major procurement activities. While activities such as purchase order processing, RFP flotation, demand forecasting and spend analysis are successfully implemented, integration with external suppliers is relatively lower indicating a need for further investment and onboarding of partners to encourage system utilization.

Based on descriptive statistics and interview response, the result shows that integration, visibility, automation, and communication have a significant influence on supply chain efficiency of Ethiopian airlines. The highest mean score of 4.75 for automation reveals that the level of agreement among participants is high implying automation is well aligned across

supply chain functions and significantly influence supply chain efficiency. This is also aligned with the conclusion by Atieh et al., (2025) that automation significantly and positively affects efficiency by reducing lead time and improving overall operation efficiency. The score M= 4.47 for communication indicates that real-time communication significantly improves coordination and enhances responsiveness of the supply chain operation. A visibility mean score of 4.46 and integration mean score of 4.3075 also indicates that there is a well implementation of visibility tools and systems are reasonably well integrated across the supply chain function.

The inferential statistics further demonstrate a strong relationship between the digital technology dimensions (integration, visibility, automation, and communication) and supply chain efficiency as indicated by its R value .822 and that the predictors strongly explain the supply chain efficiency. Furthermore, the result shows the independent variables have a positive and significant influence on supply chain efficiency with P value < 0.01. Among the digital technology predictors, automation with beta value (β = .333) holds the highest influence on supply chain efficiency, followed by visibility (β = .317). This result is also in line with the Resource Base View (RBV) theory which outlined that firms can be able to maintain competitive advantage of valuable, rare, and unique resources(Barney, 1991). Real-time visibility and automation, as core component of IT capability, are strategic assets that provide firms with more competitive advantages as they improve agility and information flow (Bharadwaj, 2000). Communication with beta value (β = .192) is the third most significant influencing variable followed by integration with beta value (β = .168) when ranked from the strongest to moderate influence. These findings are also aligned with Transaction Cost Theory (TCT) which states that efficiency is improved by reducing the cost of communication and coordination (Williamson, 1985). The significant influence of integration and communication shows how digital technologies streamline operation and reduce costs that are incurred due to repetitive manual processes.

Furthermore, the study is in line with Dynamic Capability theory (DCT) by demonstrating how digital technologies such as real-time visibility and automation tools enhance the airline responsiveness in continuously changing operating environments. The high correlation coefficient R= .822 also demonstrates the existence of a strong positive relationship between predictor variables and supply chain efficiency indicating that better supply chain efficiency can be obtained by implementing all the mentioned digital technology factors which also

aligned with System Theory.

Overall, the finding shows implementing digital tools and technologies in supply chain processes highly influence supply chain efficiency. Technologies such as integrated procurement platforms, real-time notifications and automated data exchange reduce delay and human error resulting cost reduction. These findings are in line with a study by Wu et al. (2006), who stated that investment in technology such as automation, and real-time tracking tools improve supply chain capability through lower transaction costs, lower information asymmetry, and improved coordination. Specifically, Wu et al. (2006), highlighted that IT-enabled tools address inefficiencies with manual or stand-alone processes, thereby encouraging cost effective and responsive supply chain.

5.2. Conclusion

In consideration of the findings, the study concludes that digital technology implementation significantly enhances supply chain efficiency of the Ethiopian airlines. The result indicates that the airline has implemented digital technology across its procurement and supply chain process. In addition, the use of an integrated system, visibility tool, process automation and communication positively impacted the overall efficiency of the airline supply chain in terms of cost reduction, improved operational performance, shorter cycle time and improved customer satisfaction.

The statistics from the regression model ($R = .822.$, $R^2 = .676$ and adjusted $R^2 = .669$) also prove there is a strong relationship between the digital technology dimensions such as integration, visibility, automation and communication and the stated supply chain efficiency parameters. Furthermore, the result shows that the most influencing factors among the technological dimensions are those technologies that reduce manual effort, increase data visibility, and facilitate real-time coordination. This indicates the collective application of these technologies will contribute meaningfully to supply chain efficiency. Therefore, it is concluded that more focus should be given on automation and visibility tools and similar work on building integrated systems as well as enhancing external collaboration with suppliers to maximize digital technology implementation outcomes.

Overall, the study concluded that the implementation of digital technology plays a significant role in improving cost efficiency, reducing cycle time, enhancing operational efficiency, and improving customer satisfaction.

5.3. Recommendation

The following recommendations are pinpointed for consideration with respect to the study's findings:

- Areas such as system integration and supplier access scored a relatively lower mean of 3.95 and 3.76 in the descriptive analysis, indicating that it is a focus area for improvement and a gap that should be addressed. Therefore, Ethiopian Airlines procurement and supply chain management division, together with the top management, should give due attention to ensure full utilization of the existing e-procurement system and the supplier portal through better digital onboarding and platform expansion.

- The airline prioritizes investment in high impact technologies such as visibility enhancing systems and automation supporting tools to get immediate operational gain since this is also a foundation for further broader digital development.

- The airline should adopt a holistic and integrated digital strategy to ensure investment is not for single technologies, rather on systems that can integrate and connect all the supply chain parts for maximum and comprehensive supply chain efficiency.

- Top management should take a strategic decision to invest more in leading-edge technology to ensure efficiency in its supply chain operation and remain competitive in a continuously changing digital environment. The company needs to spend more on innovative technologies such as AI, blockchain, machine learning, and predictive analytics as it can enable the company to move beyond automation and visibility to intelligent, adaptive supply chains.

5.4. Limitation

The potential limitation faced while conducting the subject study was the unavailability of secondary data from the case organization. There were some secondary data and records but in highly aggregated and generalized form and the data was also present in a raw form. Therefore, it was difficult to establish and articulate a particular finding related to the influence of digital technology implementation on supply chain efficiency parameters. This hinders the possibility of confirming and validating the primary data result with historical performance data.

5.5. Suggestion For Future Research

The study was emphasized on exploring how digital technology dimensions (integration, visibility, automation, and communication) influence supply chain efficiency focusing on the efficiency parameters of cost reduction, operational efficiency, deduced cycle time and customer satisfaction in Ethiopian Airlines. The research is also conducted focusing on the internal supply chain process of the case company. Therefore, future studies are recommended to be done incorporating additional dimensions of emerging digital technologies and other supply chain efficiency paraments that are not incorporated in this research. In addition, since this study solely focus of internal supply chain process of the case company, future research on this area is recommended to incorporate other external supply chain actors such as suppliers, transport companies and freight forwarders, as it can provide deeper analysis and compressive insight regarding digital technology implementation in procurement and supply chain process.

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ANNEX I: QUESTIONNAIRE

This questionnaire is divided into five sections. Section A will be used to obtain general information about the respondents, Section B will be used to obtain information on the digital technology implementation practice, Section C, about the influence of Digital Technology in Supply Chain efficiency, Section D, about supply chain efficiency and Section E is an interview question to obtain the overview of digital technology practice, and its impact in improving supply chain efficiency. For part A, B, C and D, please respond by placing a check mark (√) in the answer box that corresponds to your response.

Your assistance in completing this questionnaire will be highly appreciated.

Section A: Demographic Data

1. What is your age?
   i. From 18 to 20 ()
   ii. From 21 to 29 ()
   iii. From 30 to 39 ()
   iv. From 40 to 49 ()
   v. From 50 to 59 ()
   vi. 60 or older ()
2. What is your gender?
   i. Male ()
   ii. Female ()
3. How long have you been working in this organization?
   i. Less than or equal to 5 years ()
   ii. Between 6 to 10 years ()
   iii. Between 11 to 15 years ()
   iv. Between 16 to 19 years ()
   v. 20 and above year ()
4. What is your highest level of education?
   i. Masters ()
   ii. Bachelors ()
   iii. Diploma ()
   iv. Certificate ()
   v. Other, please specify. _____

Please rate the extent you agree or disagree regarding the digital technology implementation practices. Apply the 1-5 Likert scale, where 1– represent Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree and 5– Strongly agree.

Section B: Digital Technology implementation & practices

Digital Technology Implementation in Supply Chain Process.	**Scale**				
	1	**2**	**3**	**4**	**5**
The organization uses technology to systematically process and review its spent pattern.					
Sourcing activity is assisted with technological tools					
RFP floating and supplier communication is done using digital technology					
Supplier evaluation process is supported with IT system					
Demand forecasting is done using technological tool					
The purchase order process is supported with IT system					
Inventory monitoring and tracking is supported by technological system					
There is an end-to-end integrated procurement system					
There is a shared system or platform to store and access procurement and supply chain related information's					
There is a system that suppliers can access to get information and status of the projects they are taking part in.					

Section C: The Impact of Digital Technology on Supply Chain efficiency

A. Integration	Scale				
	1	2	3	4	5
Integration enabled by digital technology has reduced operational costs by minimizing redundancies					
Integration by digital technology enables operational efficiency by aligning activities across departments, ensuring efficient use of resources.					
Integration by digital technology enables faster responses to supply chain disruptions and further shortening cycle times.					
Integration enables quick response to customer needs, and improves customer satisfaction					

B. Visibility	Scale				
	1	2	3	4	5
Visibility in the organizations supply chain process results cost reduction by enabling better inventory forecasting					
Improved visibility enables quicker decision making enhances operational efficiency					
Real-time tracking and visibility have reduced delays and shortened supply chain cycle times.					
Enhanced visibility into supply chain processes has improved customer trust and satisfaction					
C. Automation	Scale				
	1	2	3	4	5
Process automation has reduced repetitive manual tasks, leading to cost reduction in supply chain operations.					
Automation enhances overall operational efficiency by streamlining process and automating reddened manual tasks					
Automating the supply chain process improves cycle time by reducing manual intervention and enabling fast supply chain workflow.					
Automation in supply chain processes ensures timely deliveries, improving customer satisfaction.					
D. Enhanced Communication	Scale				
	1	2	3	3	4
Improved communication has contributed to cost reduction by minimizing delays and rework.					
Better communication will enhance overall operational efficiency by reducing misunderstandings and errors in the supply chain process.					
Real-time communication has enabled faster resolution of supply chain disruptions					
Enhanced communication will increase customer satisfaction by ensuring transparency and responsiveness.					

Section D: Supply Chain efficiency Parameters

A. Cost Reduction	Scale				
	1	2	3	4	5
Digital technology has helped reduce operational costs.					
Automation in supply chain processes has led to cost savings.					
Integration of technology has minimized redundant processes, reducing costs.					
Real-time tracking and visibility have improved cost management, leading to savings.					
B. Operational Efficiency	Scale				
	1	2	3	4	5
Automation has improved operational efficiency by reducing manual intervention.					
Integration of digital tools has streamlined operations, enhancing efficiency.					
Real-time tracking and visibility have made our operations more efficient.					
Better communication has led to improved overall operational performance.					
C. Cycle Time	Scale				
	1	2	3	4	5
Automation has reduced cycle times by minimizing manual processes.					
Visibility of inventory and production has improved cycle times by reducing delays.					
Integration of digital technologies has sped up the supply chain processes.					
Better communication has helped reduce bottlenecks, shortening cycle times.					
D. Customer Satisfaction	Scale				
	1	2	3	3	4
Automation has ensured timely deliveries, improving customer satisfaction.					
Improved visibility has helped us meet customer expectations more effectively.					
Real-time communication has allowed us to address customer concerns promptly.					
Overall improvements in the supply chain have resulted in higher customer satisfaction.					

Section E: Interview Questions

1. Please mention your overall experience of the current digital technology implementation practice at the Airline Supply chain management.
2. What improvements have you observed due to the implementation of technology in your supply chain process?

ANNEX II: TIME SCHEDULE AND BUDGET

The time schedule and budget allocated to the study are presented below.

TIME SCHEDULE

S/No.	Activity	April	May, June	June
1	Data Collection			
2	Data computation, analysis, and interpretation of results.			
3	Finalize report			

BUDGET

S/No.	Services/resources	Expenses (in ETB)
1	Payment to printing, binding, and related services	6000.00
3	Miscellaneous expense.	2000.00
	Total expenses	8000.00